Towards an Ecology of Knowledge for Sustainable Food System Education

by

William Cameron Valley

B.Sc., The University of British Columbia, 2002
B.Ed., The University of British Columbia, 2004

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

in

The Faculty of Graduate and Postdoctoral Studies

(Integrated Studies in Land and Food Systems)

THE UNIVERSITY OF BRITISH COLUMBIA

(Vancouver)

November, 2014

© William Cameron Valley, 2014
Abstract

This study investigates the Land, Food, and Community (LFC) series of core courses within the Faculty of Land and Food Systems at the University of British Columbia (Vancouver) as an example of a sustainable food system education (SFSE) program. SFSE programs are emerging across North America as an alternative approach to developing future professionals within the food system. SFSE programs share common curricular use of systems-based, inter- and trans-disciplinary, experiential learning approaches.

The study has two components. The first component focuses on the theoretical framework of the LFC series. The second component focuses on experiences of a sample of students enrolled in a second-year course in 2012. Using a qualitative case study methodology, I incorporate autoethnographic experiences, document analysis, semi-structured interviews, and analysis of written responses to a dual-position food security problem to address the following research objectives: identify and situate the LFC theoretical framework within a diversity of scholarly domains; determine the impact of specific pedagogical strategies in the second-year course on students’ epistemic and ontological cognitive development (EOCD); and, investigate the correspondence between EOCD and systems competencies in addressing food systems problems.

Results from the first component identify four key elements of the LFC theoretical framework: the ecology of knowledge, the community of learners, polycultures of the mind, and systems approaches. The elements are situated within Freirean critical constructivist learning theory, Bateson’s theory of ecological knowing, cognitive flexibility theory, and community-engaged scholarship. Results from the second component suggest that the pedagogical activities in the second-year course had an impact on participants’ EOCD by helping students understand the concepts of holism and pluralism as well as demonstrating the limitations of reductionism and the uncertainty of knowledge in ill-structured domains. Evidence suggests that systems thinking
competencies are not being adequately developed in the second-year course. The study found limited evidence of correspondence between EOCD and the ability to apply systems principles to address a food system issue. The study concludes with a discussion on characteristics of a signature pedagogy for SFSE programs and a proposed scaffolding of EOCD and the development of systems thinking competencies across the LFC series.
Preface

This dissertation is original, unpublished, independent work by the author. The data collection reported in Chapter 5 was covered by The University of British Columbia’s Behavioral Research Ethics Board Certificate number H12-00771.
# Table of Contents

Abstract ........................................................................................................... ii  
Preface ........................................................................................................... iv  
Table of Contents ............................................................................................ v  
List of Tables ................................................................................................... ix  
List of Figures .................................................................................................. x  
List of Abbreviations ....................................................................................... xi  
Acknowledgements .......................................................................................... xiii  
Dedication .......................................................................................................... xiv  

CHAPTER 1 Introduction .................................................................................... 1  
1.1 Rationale for Study ................................................................................... 1  
1.2 Study Focus ............................................................................................... 4  
1.3 Literature Review ...................................................................................... 7  
1.3.1. The Fractured Consensus of Global Food Security ......................... 7  
1.3.2. Worldviews and Modern Educational Systems .............................. 13  
1.3.3. Sustainable Food System Education .............................................. 15  
1.3.3.1 SFSE Theme: Systems Thinking ............................................... 17  
1.3.3.2 SFSE Theme: Inter- and Trans- Disciplinarity ......................... 19  
1.3.3.3 SFSE Theme: Experiential Learning ...................................... 20  
1.3.4. Epistemic and Ontological Cognitive Development ..................... 22  
1.3.4.1 Reflective Judgment Model ....................................................... 24  
1.3.4.2 Model of Epistemic and Ontological Cognitive Development ... 25  
1.3.5. Summary ........................................................................................... 27  
1.4 Research Objectives ............................................................................... 28  
1.5 Research Questions ............................................................................... 28  
1.6 Research Methodology .......................................................................... 29  
1.7 Dissertation Outline .............................................................................. 30  

CHAPTER 2 Case Description: the Land, Food and Community Series .......... 33  
2.1 Introduction ............................................................................................. 33  
2.2 Institutional Context ............................................................................... 35  
2.3 Land, Food and Community Series Courses ........................................ 35  
2.4 Goal of the LFC Series ......................................................................... 36  
2.5 Design of the Three Central LFC Courses .......................................... 37  
2.6 LFC Learning Outcomes and Competencies ....................................... 39  
2.7 Instructional Models ............................................................................. 41  
2.8 Instructional Strategies ......................................................................... 43  
2.9 Course Descriptions ............................................................................. 46  
2.9.1. Land, Food and Community I (LFS 250). .................................... 46  
2.9.2. Land, Food and Community II (LFS 350) .................................. 51  
2.9.3. Land, Food and Community III (LFS 450) .................................. 52  
2.10 Detailed Description of Units One and Two in LFS 250 .................... 54  
2.10.1. Unit One: The Ecology of Knowledge ...................................... 55  
2.10.2. Unit Two: The BC Dairy System ............................................... 60  
2.11 Summary .............................................................................................. 62  

CHAPTER 3 Methodology .............................................................................. 63
CHAPTER 5 Results: EOCD and Systems Thinking Competencies .................................. 128
5.1 Introduction .................................................................................................................. 128
5.2 Research Questions ....................................................................................................... 128
5.3 Participant Description and Demographics .................................................................... 129
5.4 Findings for Research Question 1 ................................................................................ 129
  5.4.1. Context .................................................................................................................. 130
  5.4.2. Methods Review ...................................................................................................... 130
  5.4.3. Findings and Analysis ............................................................................................. 131
    5.4.3.1 The Elephant and the Blind Men Diagram ......................................................... 131
    5.4.3.2 Flashlights in the Forest ...................................................................................... 136
    5.4.3.3 Zea Film ............................................................................................................... 140
    5.4.3.4 Barnga Game ........................................................................................................ 143
  5.4.4. Comparison of Four Pedagogical Activities ............................................................ 146
5.5 Research Question 2 ..................................................................................................... 148
  5.5.1. Context .................................................................................................................. 148
  5.5.2. Review of Methods ................................................................................................ 148
  5.5.3. Results .................................................................................................................... 149
    5.5.3.1 Analysis of Written Responses ............................................................................ 151
  5.5.4. Summary: Comparison of Data Sets ...................................................................... 151
5.6 Research Question 3 ..................................................................................................... 153
  5.6.1. Context .................................................................................................................. 153
  5.6.2. Review of Methods ................................................................................................ 153
    5.6.2.1 Determining Epistemic and Ontological Cognitive Positions ............................ 153
  5.6.3. Results .................................................................................................................... 155
  5.6.4. Comparison of Data Sets ....................................................................................... 159
5.7 Limitations and Challenges to Assessing Systems Thinking ....................................... 160

CHAPTER 6 Discussion and Conclusion ............................................................................. 162
6.1 Introduction ................................................................................................................... 162
6.2 Purpose of Research ..................................................................................................... 162
  6.2.1. Research Questions ............................................................................................... 163
6.3 Summary of Findings ................................................................................................... 163
6.4 Signature Pedagogy for Sustainable Food System Education ................................... 165
  6.4.1. SFSE Signature Pedagogy: Surface Structure ....................................................... 167
  6.4.2. SFSE Signature Pedagogy: Deep Structure ......................................................... 169
  6.4.3. SFSE Signature Pedagogy: Implicit Structure ....................................................... 171
  6.4.4. SFSE Signature Pedagogy: Summary .................................................................... 176
6.5 Effects of LFS 250 Pedagogical Activities on EOCD ............................................... 176
  6.5.1. Promoting Understanding and Application of Systems Principles:

vii
List of Tables

Table 2.1 LFC Series Course Descriptions .................................................................................. 36
Table 3.1 Personal Roles in LFC Series since 2006........................................................................ 77
Table 3.2 Dual Position Text Analysis and Rating Rubric............................................................... 83
Table 3.3 MEOCD Position from Dimension Response (adapted from Greene et al, 2010) .......... 84
Table 5.1 Comparison between Class and Sample Characteristics.............................................. 129
Table C 1. Code Framework with Code, Definition and Examples .............................................. 225
Table E 1. Participant use of Systems Concepts within Interview Definition ................................. 230
Table F 1. Rating Associated with Examples of Written Responses to Dual Position Problem ....... 239
List of Figures

Figure 2.1 LFC Series Learning Outcomes.................................................................................................................. 39
Figure 2.2 LFC Series Competencies .......................................................................................................................... 40
Figure 2.3 The Elephant and the Blind Men Diagram ........................................................................................................ 57
Figure 5.1 Use of Systems Concepts in Participants' Definition of Systems Principles .............................................151
Figure 5.2 Rating of Participants Understanding of Systems Approaches Compared to Written
            Responses to Food System Problem .................................................................................................................. 152
Figure 5.3 Distribution of Cognitive Positions in the Study Sample ............................................................................ 156
Figure 5.4 Distribution of Cognitive Positions Relative to Systems Thinking Ratings .............................................. 160
## List of Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BC</td>
<td>British Columbia</td>
</tr>
<tr>
<td>CBAR</td>
<td>Community-Based Action Research</td>
</tr>
<tr>
<td>CBEL</td>
<td>Community-Based Experiential Learning</td>
</tr>
<tr>
<td>CES</td>
<td>Community Engaged Scholarship</td>
</tr>
<tr>
<td>CLS</td>
<td>Critical Learning Systems</td>
</tr>
<tr>
<td>EDR</td>
<td>Educational Design Research</td>
</tr>
<tr>
<td>EOCD</td>
<td>Epistemic and Ontological Cognitive Development</td>
</tr>
<tr>
<td>EU SCAR</td>
<td>European Union Standing Committee on Agricultural Research</td>
</tr>
<tr>
<td>FAO</td>
<td>Food and Agriculture Organization</td>
</tr>
<tr>
<td>IAASTD</td>
<td>International Assessment of Agricultural Science and Technology for Development</td>
</tr>
<tr>
<td>JA</td>
<td>Justification by Authority</td>
</tr>
<tr>
<td>LFC</td>
<td>Land, Food and Community</td>
</tr>
<tr>
<td>LFS</td>
<td>Land and Food Systems</td>
</tr>
<tr>
<td>MEOCD</td>
<td>Model of Epistemic and Ontological Cognitive Development</td>
</tr>
<tr>
<td>NRC</td>
<td>National Research Council</td>
</tr>
<tr>
<td>PBL</td>
<td>Problem-Based Learning</td>
</tr>
<tr>
<td>PJ</td>
<td>Personal Justification</td>
</tr>
<tr>
<td>RJM</td>
<td>Reflective Judgment Model</td>
</tr>
<tr>
<td>SFSE</td>
<td>Sustainable Food System Education</td>
</tr>
<tr>
<td>SC</td>
<td>Simple and Certain</td>
</tr>
<tr>
<td>SSM</td>
<td>Soft Systems Methodology</td>
</tr>
<tr>
<td>TSL</td>
<td>Transformative Sustainability Learning</td>
</tr>
</tbody>
</table>
UBC  University of British Columbia
XJA  Opposing Justification by Authority
XPJ  Opposing Personal Justification
XSC  Opposing Simple and Certain
Acknowledgements

I am in great debt to my mentor and supervisor, Alejandro Rojas. His shoulders have been sturdy foundations from which I have seen incredible land and mindscapes. Thank you.

I have benefited immensely from having a patient and assiduous doctoral committee. Thank you Andrew Riseman for making me see (amongst other things) why 4 words is better than 7. I'm still at 6. And thank you Jolie Mayer-Smith for sharing your incredible understanding of educational theory and practice, and tireless editing. I feel fortunate to have been taken under your wing before you make the best of an active retirement!
To Violet, Hazel, and Stephanie
CHAPTER 1  Introduction

In this chapter, I share my research rationale, study focus, and context followed by a literature review that integrates food security analysis, sustainable food system education (SFSE), and cognitive psychology. I include my research objectives, questions, and methodology. I introduce my case study of the Land, Food, and Community (LFC) series of core courses in the Faculty of Land and Food Systems at the University of British Columbia (UBC) as a sustainable food system education program. I conclude by introducing the organization of the chapters of the dissertation.

1.1 Rationale for Study

My research emerges from concerns about the sustainability of the modern food system. A consensus\(^1\) is emerging that “something is wrong with our agriculture and food systems” (Pretty 2008, p. 457). As a corollary, something must also be wrong with food system education; it is the experts and professionals educated within our institutes of higher education that create the food system landscapes, technologies, policies, and practices that characterize our modern food system. If we wish to feed the estimated nine billion mouths in 2050 without exacerbating the detrimental effects of our current system, we need to develop alternative models of food system education.

Since the 1960s, our ability to increase agricultural yield through scientific and technological innovation has been remarkable. Even with the boom in world population over the past five decades, per capita food production has outpaced global population growth (Pretty, 2008). In 2012, the global food system produced 2800 calories per person per day, “enough to make us all chubby” (Moore Lappé, 2012, p. 221). Consumers in the global North have more

food choices available at historically low costs. This has been achieved through innovations in food processing and distribution, complemented by a retail industry that aims to maximize choice and minimize the time and effort needed to sustain oneself and one’s family (Lang & Heasman, 2004; Sage, 2012).

However, despite technological advances and significant resource allocation devoted to food production, processing, and distribution, roughly one in seven people globally do not obtain adequate amounts of protein and energy from their diet, and another one in seven suffer from micronutrient malnutrition (Godfray et al., 2010; Patel, 2012). And beyond the inability to alleviate global hunger, there are alarming ecological, social, and human health trends associated with our efforts to increase food output. Growing evidence suggests that the ecological services at the foundation of agricultural productivity are being undermined and diminished through improper soil conservation practices, over-reliance on synthetic inputs, inefficient use of water resources, contamination of air and water, and loss of biodiversity (Pretty, 2008; Foley et al., 2011; Sage, 2012; Holt-Giménez & Altieri, 2013). The social impacts associated with our ability to increase agricultural yield include the unraveling of the social fabric in rural communities, an increased reliance on migrant workers and landless farmers, and the distancing, disconnect, and food de-skilling occurring in our increasingly global urban population (Allen, 2008; Holt Giménez & Shattuck, 2011; Wittman, 2009; Sage, 2012). Human health has also been affected by an increased availability of, and demand for, refined cereal, dairy, and meat products. Degenerative, non-communicable diseases like obesity, type II diabetes, and cardiovascular diseases have been linked with an increased intake in hypercaloric food in developed and developing countries in epidemic proportions (Lang & Heasman, 2004; Magrone et al., 2013; Popkin, 1998; Pretty, 2008).

Amongst these complex issues associated with the sustainability of the modern food system is a backdrop of uncertainty mounting from climate change, market instability, and an over-
reliance on fossil fuels. Changing weather patterns and the increased incidence of extreme weather events are having, and will continue to have, a dramatic impact on our food system (Francis & Porter, 2011; Macdiarmid et al., 2012). Not only will primary production be impacted through events like droughts and floods, but so too will our supply chains that rely upon the integrity of regional transportation routes and electrical power systems, as Hurricanes Katrina and Sandy both recently revealed in the United States (Twilley, 2014). As seen in the food crisis of 2008, the commodification of staple cereal crops leads to dramatic increases in prices through market speculation and hoarding at times of need (Tscharntke et al., 2012). Confounding the problem are global development policies that promote a reduction in national food storage capacities and a reliance on global markets to provide sources of staple grains (Jarosz, 2011). The result is decreasing accessibility to basic foodstuffs for millions of the world’s vulnerable populations. And throughout the food system, our over-reliance on fossil fuels is staggering (Maye & Kirwan, 2013; Woods, Williams, Hughes, Black, & Murphy, 2010). The use of fossil fuels in farm machinery, synthetic fertilizers, distribution networks, refrigeration, and consumer transportation to and from markets has led one author to assert that we are actually eating fossil fuels (Pfeiffer, 2008). As the era of cheap energy diminishes, experiences suggest that the current global food system is not resilient to market price instability or resource scarcity, potentially leaving hundreds of millions of people vulnerable to food insecurity in the future (Homer-Dixon, 2007; Woods et al., 2010).

Recognizing this sustainability crisis, scholars, educators, and practitioners within institutes of higher education have begun to make transformational changes in food system education through the formation of non-traditional degree programs, specializations, and certificates (Bawden, Macadam, Packham, & Valentine, 1984; Francis et al., 2011; Galt, Parr, Kim, et al., 2013; Jacobsen et al., 2012; Jordan, Bawden, & Bergmann, 2008; Rojas, 2009). Agriculture and
food-related disciplines\(^2\) have traditionally adopted reductive, disciplinary-focused educational practices, leaving graduates ill-prepared for dealing with the complexity that will dominate 21\(^{st}\) century food systems (Bawden, 2005; Francis, Breland, Østergaard, Lieblein, & Morse, 2013; Ison, 1990; Rojas, 2009). Didactic pedagogies and reductive approaches commonly employed in traditional educational settings are limited in their ability to develop cognitive competencies and practical knowledge for addressing the uncertainty inherent in the modern food system (Freire, 1970; Kolb, 1984; Mezirow, 2000; Salner, 1986). New models of food system education are attempting to overcome this fragmentation of knowledge by adopting systems approaches, embracing interdisciplinary methods, implementing experiential learning pedagogies, and increasing engagement with community stakeholders beyond the walls of academia (Francis et al., 2011; Galt et al., 2013; Jacobsen et al., 2012; Jordan, Bawden, & Bergmann, 2008; Kay & Bawden, 1996; Rojas, 2009). The level of complexity, the uncertainty, and the transdisciplinary scope of the issues that will need to be addressed in the coming decades are different than those experienced in the preceding decades of the 20\(^{th}\) century (Bawden, 2010; Ison, 1990; NRC, 2009; Rojas, 2009). Therefore, if undergraduate agriculture and food-centred programs intend to address new realities of the 21\(^{st}\) century food system, a fundamental remaking of food system education is necessary (NRC, 2009).

1.2 Study Focus

Undergraduate agriculture and food system oriented programs are ideally situated to address the realities of the modern food system due to the fundamentally experiential and interdisciplinary nature of their content, and their historical role in community-engagement through extension and applied research (NRC, 2009). In order to facilitate greater adoption and support

\(^{2}\) “Food-related disciplines” refers to academic disciplines such as food sciences, nutritional sciences, and food and resource economics.
for models of sustainable food system education (SFSE), more examples of pedagogical transformations need to be made available for others to identify successful practices and overcome potential challenges that may arise in the different contexts that exist across the spectrum of higher education programs. Self and colleagues (2012) note that despite an increase in SFSE program offerings in the past 10 years, there is little published in peer-reviewed literature about approaches to designing programs and teaching sustainable food system education. Similarly, the NRC (2009) states that there is a need for those who have implemented change to report and act as models for those who are interested in attempting similar levels of transformation.

This study contributes to SFSE program knowledge through an analysis of the Land, Food, and Community (LFC) series of courses in the Faculty of Land and Food Systems at the University of British Columbia, in Vancouver, Canada. The objective of the LFC series is to develop systems thinkers capable of working collaboratively in multicultural, inter- and trans-disciplinary teams to create solutions for complex, multi-stakeholder issues related to food, health, and the environment (Rojas, 2009). Students enrolled in the series are required to apply their disciplinary knowledge of environmental, social, and economic sustainability to address community food security challenges. Students from all degree specializations within the faculty are required to participate in the LFC series, creating the opportunity for interdisciplinary collaboration amongst agroecology, soil, plant, animal, nutritional, and food science students. Three of the courses are directly connected to community-based action research projects through curricular activities, facilitating transdisciplinary collaboration amongst students and community stakeholders. Chapter Two of the dissertation provides a further description of the six courses that comprise the LFC

---

3 LFS Undergraduate Programs: Applied Biology (food and the environment, soil, plant and animal sciences), Food, Nutrition and Health (dietetics, food market analysis, food science, international nutrition, and nutritional sciences) and Global Resource Systems.
series, including in-depth descriptions of the three central courses (LFS 250, LFS 350, and LFS 450).

There are two components to this dissertation: the first component identifies and situates the theories and concepts of the LFB series in scholarly literature; the second component seeks to determine the impact of specific pedagogical activities in the central second-year course of the LFC series on student epistemic and ontologic cognitive development (EOCD), and to determine if correspondence exists between EOCD and systems thinking competencies in a sample of students (n=37) from 2012.

My research draws upon multiple scholarly fields: food security analysis, sustainable food system education, and cognitive psychology. In the following section, I integrate these domains by analyzing current global food security discourse, emphasizing the fundamental differences that exists between competing action frame perspectives (Elliott, 2012; Lang & Heasman, 2004; McIntyre, Herren, Wakhungu, & Watson, 2009; Mooney & Hunt, 2009; Tomlinson, 2013). In particular, I contrast the dominant approach to achieving food security, characterized by reductionist, market-based, techno-scientific, and productionist logics with an emerging systems-based approach that seeks to integrate natural and social science perspectives and traditional and local knowledge systems (Maye & Kirwan, 2013). Following this, I relate the traditional framing of agriculture and food system education to our current sustainability crisis in the modern food system, and identify educational theories and practices that lay the foundation for alternative SFSE approaches. Specifically, I focus on educational praxis that targets student epistemic and ontological cognitive development as a threshold process for applying systems principles to food system issues.
1.3 Literature Review

1.3.1. The Fractured Consensus of Global Food Security

The dominant discourse around achieving food security, with a particular emphasis on raising agricultural production, dates back to the early to mid twentieth century (Lang & Barling, 2012). However, the term food security emerged from the 1974 World Food Conference in response to two years of rising food prices and a concern that the global food system was moving towards crisis (Maxwell, 1996). Currently, the most commonly cited definition of food security is from the United Nation Food and Agriculture Organization (FAO): “food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life” (World Food Summit, 1996 as cited in FAO, 2008, p. 1). As expressed by Mooney and Hunt (2009, p. 470), food security is a powerful concept that resonates across ideological lines: “framing an issue to favor ‘food insecurity’… is strategically dysfunctional under most conditions, even for those whose goals might effectively lead to objectively insecure or unsustainable outcomes”. Yet despite the utility of food security as a consensus frame, dissonance exists due to competing visions for achieving its objectives.

The food crises of 2007-2008 revealed the fragility of the global food system in maintaining access to minimum levels of food for millions of people. Ironically, the historically highest level of global hunger coincided with two other records: global harvests and profits for the world’s major food corporations (Holt Giménez & Shattuck, 2011). This unsettling co-occurrence revitalized food security debates around the world and sparked an “outpouring of major reports, events and appeals to policymakers to address the global challenge of food security” (Lang & Barling, 2012, p. 1). Analysis of the global food system was revealing significantly different challenges than seen in preceding decades, placing food security as “one of
the central ‘master frames’ of early twenty-first century public policy” (Maye & Kirwan, 2013, p. 1). The approach to achieving global food security has been described as fractured, with competing directives on how to meet the demands of a growing population within the new realities of ecological and global resource constraints (Maye and Kirwan, 2013). Mooney and Hunt (2009, p. 471) identified the alleviation of global hunger as a “collective action frame” within the food security master frame, and further distinguished between flat and sharp keys within the hunger frame. A sharp keying of a frame is defined “as critical, suggestive of crisis and a challenge to dominant institutionalized social and discursive conventions”, whereas flat keying “tends to reinforce dominant institutionalized practices” (Mooney and Hunt, 2009, p. 473). The following sections will compare the flat and sharp keys within the hunger frame of food security, punctuating the divergent beliefs and ideological commitments that distinguish the two.

The flat key of the hunger frame of food security has at its core the belief that “food insecurity must be centrally addressed by producing more food” (Lang and Barling, 2012, p. 1). Tomlinson (2013, p. 82) describes the flat key as the “new productivist” approach, similar to Lang and Heasman’s (2004) articulation of the productionist paradigm, whereby the food supply chain came to prioritize increasing agricultural yields over all other elements. This approach “lends itself to seeking technological solutions contributing to the further intensification of agriculture” (Tomlinson, 2013, p. 82). In addition, capital investment is deemed necessary to increase agricultural productivity. Accompanied with increased efficiency in distribution and storage, food prices will naturally decrease and access and availability to basic foodstuffs will therefore improve (Lang and Heasman, 2004).

Proponents of this approach often state two projections that have become pillars of global food security discourse (Maye & Kirwan, 2013) – food production needs to rise by 50% by
2030; and, food production needs to double by 2050 to feed 9 billion\(^4\). This narrative implies that food security is a global issue and therefore the solution lies in developing a more efficient global food system (Tomlinson, 2013). This is in line with the neoliberal trend of the modern food system, which advocates “expanding global markets and increasing output through corporate-led technological innovation, and pushing peasant producers out of agriculture to make way for more efficient ‘entrepreneurial’ farmers” (Holt Giménez & Shattuck, 2011, p. 116). Further, emerging national agriculture programs are being encouraged to specialize in a small range of commodity crops to benefit from comparative advantage within an increasing liberalized network of global markets. The key actors in the flat key are the international finance and development institutions, transnational food corporations, the FAO of the United Nations, and philanthropy capitalism\(^5\) (Holt Giménez & Shattuck, 2011; Mooney and Hunt, 2009). Despite considerable evidence of the limitations and detrimental consequences to achieving food security through this linear perspective, the flat key of the hunger frame continues to be the dominant, status quo frame for international food policy.

Critics characterize the flat key perspective as oversimplifying a complex set of issues through a singular focus on increasing availability of food by maximizing agricultural production for export markets (see Sage, 2013; Lang and Heasman, 2004, Tomlinson, 2013). Furthermore, evidence suggests that “the era of ‘productivist’ agriculture produced profits for a few, reduced food security for the many, and used resources at an unsustainable rate” (Allen, 2013, p. 135). In the early 1980s, Sen (1981) distinguished between food availability and access, noting that hunger is a condition of individuals not having enough to eat, which is significantly different than there not being enough to eat. “Whether and how starvation relates to food supply is a matter

\(^4\) See Tomlinson, 2013 for a critique of the uses of these statistics to create normative goals for global food security policies.

\(^5\) Philanthropy capitalism refers to global funding programs such as the Bill and Melinda Gates Foundation and the Rockefeller Foundation.
for factual investigation” (Sen, 1981, p. 1). The productivist privileging of techno-scientific, reductionist ways of knowing coupled with neoliberal, free-market policies creates a structural framework that marginalizes and excludes poor rural farmers and poor urban consumers alike (Allen, 2013; Lang & Heasman, 2004; Sage, 2013; Shiva, 1993). Additionally, this perspective overlooks two pressures facing the global food system: the nutrition transition (the process by which, as societies become richer, diets shift towards more sweeter, fattier, processed foods, which in turn generate non-communicable, diet-related ill-health patterns) (Popkin, 2001) and global food waste, which some estimates place close to 30% of post-harvest calories (Parfitt, Barthel, & Macnaughton, 2010). Both of these pressures are considered as significant to feeding 9 billion mouths as increasing food production, but have been noticeably sidelined from food security analysis at the international level (Tomlinson, 2013). As noted by Lang and Barling (2012, p. 3) on the FAO’s High Level Task Force on the Global Food Security Crisis in 2010, “missing from [discussion] was any comprehensive attempt to address the effects of deeper structural environmental and natural resource depletion factors on demand and the complexities of the evolving global demands for food”.

The sharp key of the hunger framing of food security is aptly characterized by the following quote from Hans Herren, co-chair of the International Assessment of Agricultural Science and Technology for Development (IAASTD) report:

“The question we keep hearing today is how will the world increase food production by 70 percent to meet rising food demands and feed more than one billion hungry people. A growing consensus is asking whether this is the right question. 400 of the world’s top agricultural scientists asked a different question: How do we rethink our global food system so that it can feed people, create healthy communities and economies, and sustain the planet” (Herren, 2010 as quoted in Tomlinson, 2013, p. 87).

Recognizing food systems as socio-ecological systems, the sharp key seeks to address the multifunctional nature of food production, processing, distribution, and consumption in relation to ecological, economic, social, and human health (McIntyre et al., 2009). Due to the inherent
complexity and uncertainty that characterize the current food system, food security policy needs to shift from maximizing one objective, agricultural yields, to optimizing inter-functionality across all components (EU SCAR, 2013; McIntyre et al., 2009). This transition requires knowledge systems beyond the natural sciences, inclusive of the social sciences and local, traditional ways of knowing (Allen, 2013; McIntyre et al., 2009). This also involves a critical analysis of objectives that seek to apply universal solutions and best practices, most often developed in the global North and requiring capital- and resource-intensive technologies. The sharp key recognizes the value of locally adapted, context-dependent, low-technology solutions to issues of sustainability in the modern food system—solutions characterized as cases of “good practices” (Horlings & Marsden, 2011, p. 450).

Concerning distribution and market mechanisms, the sharp key framing does not exclude the possibility of agricultural production for export markets; it prioritizes domestic consumption and the practice of regional food storage capacities over reliance on global commodity crop markets in times of need (Mooney and Hunt, 2009). The sharp key can be seen in the discourse and efforts of food sovereignty organizations like La Via Campesina and Food First as well as the increasing theoretical and empirical support for agroecological production practices (Holt-Giménez & Altieri, 2013; Horlings & Marsden, 2011; Wittman, 2011).

How food security is defined, addressed, and evaluated reflects distinct worldviews, comprised of societal beliefs and assumptions about the nature of reality (ontologies) and the nature of knowledge and knowing (epistemologies) (Bawden, 2005; Jordan et al., 2008). The comparative analysis of flat and sharp keying reveals the salient ontological and epistemic dimensions of these competing action frames. The productivist, flat frame assumes that reality can be known through fragmented, linear, and reductive approaches, with a privileging of expert, disciplinary knowledge from the natural sciences. This is demonstrated through the main response to 2008 food crisis, which has been “to resuscitate the ‘grow more to feed more’ policy position”
Additionally, further deregulation and commodification of the global market are considered direct avenues for addressing issues of distribution and access. But as Mooney and Hunt (2009, p. 475) state, “knowing that there is enough food to go around does not mean that the food does go around”. The dominant response also includes the Cornucopian-like belief that technological advances hold the key to a safe and prosperous future. In relation to the exclusion of other ways of knowing in the food system, Allen (2013, p. 136) affirms, “many of the most crucial food security questions are outside the phenomenological reach of the biological and physical sciences, engineering, and even medicine.”

The sharp key to hunger has been referred to as the “waxing holistic organic paradigm”, markedly different than the “waning reductive mechanical paradigm” of the productivist frame (Callicott, 1990, p. 42). Lang (2010, p. 94) councils that “there is the danger of unintended consequences in single solutions...[food security] must be addressed systemically”. The principle feature of the sharp key lies in its systems perspective, which acknowledges the interconnected nature of socio-ecological systems and their manifestation of emergent properties: “properties that are neither reducible to nor predictable from the properties of the parts” (Callicott, 1990, p. 42). Adopting a pluralistic approach is central to a systemic worldview, critical to addressing uncertainty in “wicked” (Batie, 2008) or “ill-structured” (King & Kitchener, 1994) problems. This is evident in the sharp key’s inclusivity of multiple perspectives, incorporating natural and social sciences as well as traditional, local, and indigenous ways of knowing, leading directly to recognition of context and place when tackling issues of food security. Locally appropriate

---

6 Cornucopians believe that the solution to all of humanities problems lie in our unlimited capacity to innovate and develop technological solutions. Julian Simon was a famous spokesman for the Cornucopians and succinctly summed up their perspective in his article: More People, Greater Wealth, More Resources, Healthier Environment (Simon, 1994).

7 Hamm (2009) describes the new nature of food system issues as “wicked”. Problems that are not easily defined, worked on, or solved; synonymous to ill-structured problems as defined by King and Kitchener (1994, p. 11): problems that cannot be described with a complete degree of completeness or resolved with a high degree of certainty.
solutions are acknowledged as situated in a network of socio-cultural and ecological phenomena and thus cannot be directly applied in distant contexts (Elliott, 2012). Emphasized in the International Analysis of Agricultural Science and Technology for Development (IAASTD) report (McIntyre et al., 2009, p. 380), “agricultural knowledge, science and technology will [need] to find ways for combining local knowledge with innovations developed in similar contexts to generate locally adapted new options”. This type of knowledge generation incorporates diverse ways of knowing, a practice that has been accepted as being “more likely to yield systemic improvements in current practices” (Elliot, 2012, p. 338).

1.3.2. Worldviews and Modern Educational Systems

It is not surprising that the dominant approach to food security is entrenched in linear, fragmented, reductionist worldviews. This reflects the context in which we educate our future experts within the food system (Ison, 1990; MacRae, Hill, Henning, & Mehuys, 1989; Parr, Trexler, Khanna, & Battisti, 2007). Conventional agriculture and food system pedagogies and curricula, “with a narrow emphasis on production questions and economic return in the short term, leave our graduates ill-prepared to deal with uncertainty and complexity in designing future systems, and generally ignore the overwhelming importance of the ecological context and of social and political decisions that affect the food system” (Lieblein & Francis, 2007, p. 83). Our current institutes of higher education are based on, and perpetuate, an objectivist ontology, reductionist epistemologies, and mechanical worldviews that dominate Western culture (Callicott, 1990; Rees, 2003; Shiva, 1993). As a result, students “graduate without knowing how to think in whole systems, how to find connections...patterns, and root causes” (Orr, 1994, p. 23). This kind of education leads to an incomplete understanding of socio-ecological systems and emphasizes students’ roles as technical agents in the global economy, rather than freethinking problem solvers (Sterling, 2004).
When individuals do not possess a strong understanding of how one discipline connects with another, the result is the inability to make long-term sustainable choices for the environment and community (Bawden, 2005). In a recent paper on dietetics education, the authors acknowledge this problem and respond by stating,

“there is an increasing call on dietetic professionals to participate in policy and public education that supports the redirecting of contemporary food systems toward sustainability. To effectively accomplish this, dietetic professionals need to be knowledgeable about and engaged with multiple aspects of the food system as it relates to sustainability” (Harmon, Lapp, Blair, & Hauck-Lawson, 2011).

This reflects Lang's (2010, p. 94) assertion that “the complex challenges of the modern food system cannot be addressed singly, but must be addressed comprehensively and collectively”. In 2009, the National Academy of Science released Transforming Agriculture Education for a Changing World. A central conclusion of the report states that agriculture and related fields in food, health, and the environment now ask questions that cannot be confined to a single discipline, re-affirming a need for pedagogical changes to address the fragmentation of knowledge created by compartmentalized university structures and degree specializations.

As Orr (1991, p. 52) stated, “it is not education that will save us, but education of a certain kind”. It is, and has been, our most successful students, educated with the beliefs, values, and assumptions of our currently unsustainable society, that enter the workforce and create our socio-ecological realities. Current ecological destruction and social ills are “largely the result of work by people with BAs, BSs, LLBs, MBAs, and PhDs” (Orr, 1991, p. 52). In order to address the real-world issues of sustainability, complexity, and uncertainty in the modern food system, we need to make changes in higher education that help graduates combine discipline-based expertise with contextual and relational systems thinking skills. Graduates need to be cognizant of the interdependent nature of socio-ecological systems and the limitations of reductionist approaches to solving ill-structured problems (Ison, 2012). Instructors need to “assist learners to
develop competencies for dealing with worldview-based controversies that frequently arise whenever sustainability is set as the context for development” (Jordan et al., 2008, p. 98).

1.3.3. **Sustainable Food System Education**

SFSE programs exist across the world in a variety of formal and informal educational settings. Over the past 25 years in the U.S.A., growth has occurred in the number of university programs offering sustainable agriculture degree programs (Jacobsen et al., 2012). Repositories of SFSE syllabi and resources, such as the Sustainable Agriculture Educator Materials database at Cornell University, the Association for the Study of Food and Society, and the Canadian Association for Food Studies reveal the efforts of educators engaged in this area. Across the existing institutional and geographical diversity, there are three common pedagogical themes evident in SFSE program designs: systems thinking, inter- and trans-disciplinarity, and use of experiential learning approaches. To demonstrate these three themes, I draw upon cases that have documented their theoretical and philosophical frameworks in peer-reviewed publications.

There is a body of scholarly literature concerning SFSE program development. Within this collection, a small group of scholars describe guiding philosophies of pedagogical and curricular activities of their programs (see Bawden et al., 1984; Francis et al., 2013; Galt, Clark, & Parr, 2012; Galt, Parr, Kim, et al., 2013; Jordan et al., 2008; Parr et al., 2007; Rojas, 2009). Other articles provide lists of institutions offering SFSE programs and general curricular descriptions (see Francis et al., 2011; Jacobsen et al., 2012). Another category of scholarly publications remain at a disciplinary level, discussing the necessary changes in educational practices required to appropriately develop future experts within a specific food system field (see Harmon et al.,

---

I draw upon each perspective to bring forth the salient themes that create a shared framework for SFSE.

The starting point for each publication in the SFSE literature is the complexity and uncertainty of the modern food system and the limitations of a reductionist, discipline-based approach in developing future experts capable of addressing issues of food system sustainability. The uniting element across all programs is an emphasis on systems, inter- and trans-disciplinary, and experiential learning approaches. The following section will further explore these components of SFSE programs. In advance, I briefly describe the experiences from the Hawkesbury Agriculture College at the University of Western Sydney, as their efforts in the early 1980s provide the earliest record of pedagogical transformation. Elements of the Hawkesbury approach are prominent reference points for the application of systems principles and experiential learning theories in many subsequent SFSE publications (Francis et al., 2011).

Richard Bawden and colleagues at the Hawkesbury Agriculture College began experimenting with pedagogical change in a traditional school of agriculture in the late 1970s. The college offered undergraduate degree programs for agricultural managers and technologists. The first academic paper describing their transformation was published in 1984: *Systems Thinking and Practices in the Education of Agriculturalists* (Bawden et al., 1984). The authors outline the context and rationale for embedding hard and soft systems methodologies to compliment traditional, scientific reductionist methods in agricultural education. The Hawkesbury approach addresses meta-cognitive and epistemic development as processes essential to effective extension work in rural Australia. Specifically, the role of these processes in pedagogical experiences that combined “the epistemic development of learning systems, the relationships between epistemic development and the development of systemic competencies, and the role of experiential stimuli in promoting both” (Bawden, 2005, p. 153). Later publications incorporate the concept of food system sustainability and sustainable development into the narrative that
emerged from the experiences at Hawkesbury (Bawden, McKenzie, & Packham, 2007; Bawden, 2008, 2010).

Bawden directly collaborated with other SFSE scholars including Francis and Lieblein, both prominent agroecologists with the Agroasis Nordic program (Francis et al., 2011; Francis et al., 2013; Lieblein & Francis, 2007). Jordan from the University of Minnesota has published articles on pedagogical change with Bawden and colleagues from Agroasis (see Jordan et al., 2008; Francis et al., 2011). Bawden and Jordan co-designed and taught a course on agroecology and sustainable food systems that laid the theoretical groundwork for the current Food Systems major in the College of Food, Agriculture, and Natural Resource Sciences at the University of Minnesota (Jordan, 2014, personal communication Feb. 4).

Demonstrating further influence of the Hawkesbury approach, published works of Bawden, Francis, and Lieblein informed the conceptual framework of a Delphi survey of leading sustainable agriculture and food system academics and industry stakeholders administered by scholars at the Agricultural Sustainability Institute of University of California (UC), Davis (see Parr, Trexler, Khanna, & Battisti, 2007). The survey set out to determine the knowledge domains and competencies required for developing a new SFSE program. The results of the survey contributed to the development of an undergraduate major in Sustainable Agriculture and Food Systems at UC Davis.

### 1.3.3.1 SFSE Theme: Systems Thinking

The first theme I identified in SFSE programs is systems thinking. The complexity and uncertainty of modern food systems requires an ontological shift away from a reductionist position towards a systems perspective (Bawden, 2007). At the core of a systems approach are the principles of holism and pluralism, both of which are prominent in the theoretical framing of SFSE programs. The former applies to how we perceive, make sense of, and approach ill-structured
problems in the real-world; and, the latter applies to the role of multiple perspectives in defining systems objectives, boundaries, interventions, and evaluations. Pluralism also manifests in the enrolment and structure of SFSE programs through inter- and trans-disciplinarity, which will be discussed following the section on systems theory.

To think holistically means to shift one’s attention to the relationships and interactions between the component parts of a system to understand the whole; to seek multiple interrelated causations when analyzing a situation; to be aware of the contextual factors that surround an issue; and, to be attentive to processes that impact situations, not only outcomes (Reynolds & Holwell, 2010). From this perspective, system properties cannot be understood from the study of component parts in isolation. System characteristics arise from interactions amongst parts, resulting in emergent properties that cannot be located in any individual component. This ontological transition from seeing isolated parts to connected wholes stresses the non-linear and unpredictable nature of systems, allowing SFSE programs to accomplish “the necessary shift in emphasis from teaching how to maximize production to teaching how to optimize for a suite of environmental, social, and economic objectives” (Jacobsen et al., 2012, p. 17). With a similar emphasis on holism, nutritionists and other health professionals are calling “for a ‘new paradigm’ of nutritional science and food systems that integrates the biophysical aspects of nutritional health with social and environmental antecedents and outcomes” (Harmon et al., 2011, p. 115).

Adopting a pluralist approach is critical to addressing issues in the modern food system because “the cognitive and practical capacities of individual disciplines and professions are too limited to manage complex sustainability problems” (Jordan et al., 2008, p. 93). The opposing short- and long-term needs and interests of stakeholders increase complexity within a system (Francis et al., 2013). Checkland’s (1981) Soft-Systems Methodology (SSM) is the most referenced systems methodology in SFSE literature. SSM as an inquiry framework provides “a clear recognition that farming and food sectors comprise many interacting human activity systems, and
that any viable change will require communication with and understanding the goals of multiple principal decision makers" (Francis et al., 2013, p. 63). SSM was developed for investigating problems in human activity systems, analogous to issues of socio-ecological systems. It involves examining and discussing the root assumptions, beliefs, and values that underlie the conceptualization of a problem situation, interventions within, and potential solutions (Checkland, 1981). SSM is a useful method for investigating issues in the modern food system because it “pays attention to the existence of conflicting worldviews, something which characterizes all social interactions” (Checkland & Poulter, 2010, p. 198). By stressing the importance of diverse socially constructed realities in defining, taking action within, and evaluating complex issues, a soft systems approach brings multiple perspectives and their attendant worldviews to the forefront of a systems approach. SSM contributes to systems theory by highlighting that the tension between diverse stakeholders working towards common objectives occurs at the ontological and epistemological level. Therefore, in order to apply an SSM approach to ill-structured problems, it is necessary to begin by acknowledging and discussing the root assumptions that are at the basis of divergent worldviews.

1.3.3.2 SFSE Theme: Inter- and Trans- Disciplinarity

The second theme I identified is inter- and trans- disciplinarity. Emerging from and consistent with pluralism as fundamental to a systems approach, SFSE programs seek to incorporate multiple academic and non-academic ways of knowing into pedagogical activities. Francis and colleagues (2011, p. 228) make a useful distinction between multi-, inter- and trans-disciplinary approaches: a multidisciplinary approach “brings together multiple disciplines, but does not guarantee an integration of perspectives or research methods, nor any emergent value of the process”; interdisciplinary approaches address issues single academic disciplines are incapable of managing by allowing for a blending or modifying of approaches to better suit the
problem at hand; and, transdisciplinary strategies incorporate non-academic ways of knowing into knowledge generation activities, acknowledging that certain types of issues require engagement beyond narrowly defined expert knowledge.

At the level of interdisciplinarity, “perhaps the most widely recognized reason for such interactions is the need to avoid ‘blind spots’ associated with particular disciplines and professions and to escape their characteristic reductionism in the face of systemic complexity” (Jordan et al., 2008, p. 93). SFSE programs frame their curricula in a manner that intentionally integrates the natural and social science dimensions of the food system to inform the study of production, distribution, and consumption (Jacobsen et al., 2012; Jordan et al., 2008).

To extend the reasoning that “everyone is sustained by food, and, in a democratic society, everyone should have a say in food governance”, non-academic ways of knowing are brought into SFSE curricula (Galt et al., 2012, p. 10). That is, an intentional inclusion of perspectives from farmers, distributors, processors, consumers, politicians, and educators, at all levels in the food system. This provides opportunities for students to interact with diverse stakeholders and “determine a set of goals that will lead to an improved future food system, using social, ecological and economic indicators of sustainability” (Lieblein & Francis, 2007, p. 85). Through this structure of curricula, SFSE programs can bring the voice of the community into the classroom in a manner that frames the interaction as collaborative and reciprocal. Further, SFSE students can participate in a process that co-creates a “socially constructed definition [of sustainable food systems] that evolves as individuals and groups learn to negotiate meanings, power inequalities, and conflicting worldviews” (Parr et al., 2007, p. 530).

1.3.3.3 SFSE Theme: Experiential Learning

The third theme I identified in the SFSE literature is experiential learning. Drawing upon the educational theories of Dewey (1966), Freire (1970), Kolb (1984), and Mezirow (1991), SFSE
programs problematize the traditional, didactic pedagogies common in institutes of higher education and integrate critical, reflexive experiential learning strategies into their curricula. Francis and colleagues (2013, p. 62) are concerned that an education with a “predominantly theory-based, constricted focus on elements of systems will not prepare future scientists to cope well with broad and complex challenges in farming and food systems”. Incorporating critical reflection on theory and practice has been found useful for unveiling worldviews and frames of reference (Mezirow, 1991). If students are to be sent into the community to navigate diverse stakeholder perspectives in a transdisciplinary setting, being critically reflective of personal and societal worldviews is vital.

SFSE programs report incorporating experiential learning and critical reflection into their curricula in different ways. A Critical Learning System (CLS) theory emerged from experiences at the Hawkesbury School of Agriculture, characterized as a critically self-reflective subsystem based on Kolb’s (1984) experiential learning cycle: integrating theory and action through reflection (Bawden, 2005; Jordan et al., 2008). Lieblein and Francis (2007, p. 87) also cite Kolb’s experiential learning cycle and further conceptualized “a learning ladder metaphor that integrates a personal dimension including values, attitudes, and emotions into the learning landscape, in addition to cognitive elements”. Students involved in these two projects typically carried out traditional agricultural extension activities, such as meeting with farmers to explore current research on production, processing, distribution, and market strategies. Scholars at the University of California, Davis place a similar emphasis on values in SFSE curricula development (Galt, Parr, Kim, et al., 2013; Galt et al., 2012). The primary objective of their courses is to challenge and shift students’ taken-for-granted meaning perspectives through critical reflection and experiential learning strategies. Students participate in farm production, processing, distribution, and marketing activities as well as advocacy and outreach work with community food system organizations.
1.3.4. Epistemic and Ontological Cognitive Development

The three central themes that frame SFSE programs have direct implications for the epistemic and ontological cognition of the individual learner (Bawden, 2010). From the outset, students need to adapt to the fundamental ontological shift from certainty to uncertainty in an educational setting. Didactic methods of content delivery and assessment strategies that focus on well-structured problems dominate our traditional educational systems. If students’ ontological commitments steer them towards seeking the ‘right’ answer from a source of authority (e.g. professor or textbook), they are likely to feel discomfort and frustration with curricula that involves addressing complex, ill-structured issues.

A shift from reductionism to systems approaches to addressing complex and uncertain issues in the modern food system, like global food security and food system sustainability, requires an ontological shift away from understanding reality as an iterative process of reducing complexity into smaller and smaller parts. Understanding of complexity is captured through the analysis of the relationships between components and the subsequent emergent properties of the system. At the epistemic level, pluralism (manifested through inter- and trans-disciplinary pedagogical structures and processes) requires a transition away from beliefs about knowledge and knowing as discovered and held by academic experts. Rather, knowledge acquisition is seen as a socially constructed process, requiring active evaluation of positions arising from multiple perspectives.

Experiential learning strategies are employed in SFSE programs to allow students to engage directly with and critically reflect on personal, historical, and contemporary perspectives in the modern food system. For these strategies to be effective, students need to shift their epistemologies and accept personal experiences as a valid source of knowledge and way of knowing in the study of food systems. Again, this is often not encouraged in traditional science curricula, which portray personal experiences and aspirations as a source of bias and therefore
detrimental to the pursuit of objective knowledge (Rojas, 2009). Students need to recognize their own experiences and the experiences of others outside of academia as valid sources of knowledge. Any pedagogical strategy that involves interacting with community stakeholders in an inquiry process will have to address this epistemological issue in order for collaboration to proceed on an equal level.

Essentially, SFSE programs aim to transform students’ epistemic and ontologic cognitive development to support systems thinking competencies (Bawden, 2006; Galt, Parr, Kim, et al., 2013; Jordan et al., 2008). The following section describes the field of personal epistemology, starting with its origins in the work of Perry (1970) and a description of two models that inform the conceptual and methodological dimensions of this study: the Reflective Judgment Model (King & Kitchener, 1994) and the Model of Epistemic and Ontological Cognitive Development (Greene, Torney-Purta, & Azevedo, 2010; Greene, Azevedo, & Torney-Purta, 2008).

From a cognitive psychology and educational perspective, studies of personal epistemology focus on “how the individual develops conceptions of knowledge and knowing and utilizes them in developing understanding of the world” (Hofer & Pintrich, 2002, p. 4). These studies are interested in “beliefs about the definition of knowledge, how knowledge is constructed, how knowledge is evaluated, where knowledge resides, and how knowing occurs” (ibid). The foundation of this field lies in Perry’s (1970) work on the epistemological development of Harvard freshman. Perry and colleagues’ longitudinal study involved extensive interviews investigating why students experienced the diversity of college experiences in different ways. The study lead to the discovery of a trajectory of epistemological beliefs, beginning with a dualistic view of knowledge and evolving towards a more complex recognition of the necessity of intellectual commitments in the face of competing truth claims. From Perry’s work, a body of
research\(^9\) has used this trajectory as a heuristic to explore issues about knowing and knowledge and their implications on teaching and learning (Hofer & Pintrich, 2002).

### 1.3.4.1 Reflective Judgment Model

In 1994, King and Kitchener published, *Developing Reflective Judgment*, summarizing more than 15 years of theory building and research on epistemological development and epistemic cognition. Beginning with Perry’s model of intellectual development, King and Kitchener developed an in-depth interview process that used ill-structured problems to surface epistemic assumptions, revealing how participants frame problems and justify their beliefs in the face of uncertainty (King & Kitchener, 2004). The Reflective Judgment Model “describes a developmental progression that occurs between childhood and adulthood in the ways that people understand the process of knowing and in the corresponding ways that they justify their beliefs about ill-structured problems” (King & Kitchener, 1994, p. 13).

The model has seven stages based on increasingly complex assumptions held by an individual when justifying, evaluating, and defending a point of view. The stages are categorized into three levels: pre-reflective, quasi-reflective, and reflective thinking. Individuals at the pre-reflective thinking stages believe knowledge is gained by direct personal observation or through an authority figure. And, they assume that knowledge is simple and certain – there are no ambiguities, just right and wrong answers where facts remain facts. Individuals at this level do not differentiate between well- and ill-structured problems. Reasoning at the quasi-reflective stage involves acknowledgement that uncertainty exists in certain problems but the individual lacks the cognitive skills to evaluate such situations. Reflective thinking is characterized primarily by recognizing the socially constructed nature of knowledge and the necessity of the individual’s active role in this process. Uncertainty is acknowledged in the process of making knowledge

\(^9\) See Hofer & Pintrich, 1997 for a review of the literature.
claims, and through specific criteria for evaluation, some claims may be more reasonable than others.

1.3.4.2 Model of Epistemic and Ontological Cognitive Development

Greene and colleagues (2008, p. 152) propose a Model of Epistemic and Ontological Cognitive Development (MEOCD) that is “an integration of numerous developmental and system of belief personal epistemology models”. The development of the model also integrates positions of philosophical epistemology to address conceptual issues critiqued in other personal epistemology models (Greene et al., 2010; Hofer & Pintrich, 2002). Insight from philosophical epistemology led to the distinction between epistemic and ontological factors within the model to separate more sophisticated uses of justification when discerning between positions within the model.

The MEOCD has four positions: realism, dogmatism, skepticism, and rationalism. A realist believes that there are no disagreements that cannot be resolved by appealing to facts. Their view of knowledge and reality is simple and certain. Their justification comes from personal experience or appeal to an authority. If there is a disagreement, one side is correct, the other is wrong. The three remaining positions have a more complex ontology, where “knowledge categories are not simple and certainty is but one possible attribute” (Greene et al., 2008, p. 153). The realization that disagreement is legitimate brings about a crisis for the individual and it is through the resolution of this tension that development towards more complex epistemic positions is possible. When an individual recognizes the possibility of false beliefs, she must choose between two pathways for acceptable grounds of justification: appeal to authority or personal experience; the former position defines a dogmatist, the latter a skeptic. Both positions recognize that knowledge claims require justification but are unable to integrate the two sources
for evaluative purposes. Rationalists\textsuperscript{10} see that both personal experience and expert knowledge can contribute to the justification of knowledge. A rationalist “maintains a high need for justification but acknowledges that different means of justification may be more or less valid depending upon the circumstances” (Greene et al., 2008, p. 153). Neither personal experience nor justifications from authorities are accepted without scrutiny, as the origins, nature, limits, and methods of knowledge claims need to be taken into consideration.

The two models (the RJM and the MEOCD) have commonalities in their conception of cognitive development and provide a theoretical framework for the cognitive development goals of SFSE programs. The central pedagogical strategies of SFSE programs require intentional targeting of epistemic and ontological cognition to develop students’ competencies to understand and apply systems principles to issues of food security and food system sustainability. These strategies assist the learner in carefully negotiating between expert knowledge, personal experience, and the historical and contemporary processes that shape societal and personal beliefs, values, and assumptions. Through learning to identify why one thinks the way one does rather than what one thinks, students can “generate their own syntheses and arguments in support of their value positions” (Salner, 1986, p. 231). SFSE students will only accidently solve complex problems that have their roots in epistemic cognition if teaching strategies in these programs fail to consciously develop these higher level cognitive skills (Salner, 1986).

Understanding and applying systems theory is not a straightforward matter (Bawden, 2010; Salner, 1986). Due to the dominance of analytical reductionism in western thought, seeing the world in a systemic manner requires a transformation of beliefs, values, and assumptions that often go unnoticed, commonly described as our collective blind-spot (Kay & Bawden, 1996).

\textsuperscript{10} In the remainder of the dissertation, the term rationalist will be replaced with evaluativist. The former is derived from the MEOCD, the latter term is utilized in the cognitive and educational psychology fields (see Hofer, 2004; Kuhn & Weinstock, 2002; Muis, Bendixen, & Haerle, 2006). I feel that evaluativist is a more appropriate title for this position in the sense that it does not privilege rationality as having the highest status amongst the diverse ways of knowing.
These transformations require an examination of epistemic and ontological processes and skills that are not commonly associated with our current educational system, as they are ‘not reducible to information processing skills or formal problem solving operations’ (Salner, 1986, p. 231). In order to develop systems competencies to address complex issues in the modern food system, like global food security and food systems sustainability, SFSE programs must attend to student epistemic and ontological cognitive development.

1.3.5. Summary

“If what we do in this world is a function of the way that we see it, then it follows then that if we want (or need) to do things differently as communities we need to change the way that we collectively view the world” (Bawden, 2007, p. 19). Our dominant approaches to addressing complex issues within the modern food system, like global food security and food system sustainability, reflect the dominant worldviews of society. Analysis of the discourse surrounding global food security reveals a distinct flat and sharp keying of the hunger frame. The dominant perspective, described as the flat key, continues to promote reductionist, linear solutions to achieving food security, which often only benefit those who have access to global capital to implement technological and resource intensive development strategies. Whereas the more critical alternative perspective, described as the sharp key, acknowledges the complexity of global hunger issues and seeks solutions that take into account the multifunctional nature of food systems. This alternative approach promotes policies and solutions with optimizing rather than maximizing solutions, intent on achieving benefits at multiple scales, geographically as well as with respect to access to capital.

Our modern institutes of higher education play a significant role in shaping our collective worldviews. There are explicit parallels between current unsustainable practices in the global food system, the flat key, productivist approach to food security, and the fragmentation of
knowledge that characterizes institutes of higher education. SFSE programs are developing systems-based, inter- and trans- disciplinary, experiential approaches to initiate a cognitive shift to address issues of complexity and uncertainty that are at the core of the modern food system. Central to this cognitive shift are epistemic and ontological beliefs that students utilize in developing understanding and pursuing action in the world. As stated by Bawden (2007), if we wish to change how we act in the world, we first need to change how we perceive the world. This requires educational strategies to develop more encompassing epistemic and ontological cognition for applying systems principles to complex, ill-structured problems, such as those represented by global food security and food system sustainability. And, therefore, educational strategies of this nature ought to be of primary concern for SFSE programs that aim to change the way future food system experts and professionals act in the world.

1.4 Research Objectives

The overarching objective of my research is to describe, analyze, and test assumptions within the Land, Food and Community (LFC) series approach to developing a sustainable food system education program. My research contributes to the growing number of publications dedicated to the development of SFSE program theories and concepts, all of which emphasize the need for a systems-based, inter- and trans- disciplinary, experiential learning approach. Specifically, my research aims to

- Identify and situate the LFC theoretical framework within a diversity of scholarly domains;
- Determine the impact of specific pedagogical strategies on students’ epistemic and ontological cognitive development;
- Investigate the correspondence between epistemic and ontological cognitive development and systems competencies in solving food systems problems.

1.5 Research Questions

I investigate two research questions concerning the theoretical framework of the LFC series:

28
• What are the theoretical dimensions of the LFC series approach to SFSE program development?
• How does the theoretical framework of the LFC series situate within other scholarly domains?

I then investigate three research questions in relation to the experiences of the students in the second-year course, Land, Food and Community I (LFS 250):

• Is there evidence that specific pedagogical activities employed in LFS 250 are impacting student epistemological and ontological beliefs?
• Is there evidence that students understand and apply systems principles to a food system problem-situation?
• Is there correspondence between epistemic and ontological development and competence in applying systems principles?

Addressing these research questions contributes to the growing interest in SFSE program development. Identifying and situating LFC theories and practices within other scholarly domains will assist other SFSE scholars to understand the transformations occurring within the Faculty of Land and Food Systems at UBC, and potentially contribute to similar efforts elsewhere. The focus on the relationship between pedagogical strategies, epistemic and ontologic development, and systems competencies emerges from descriptions of untested assumptions implicit in publications of SFSE scholars (see Salner, 1986; Bawden, 2005, 2007, 2010; Jordan et al, 2008; Galt, Parr, & Jagannath, 2013).

1.6 Research Methodology

This study adopts a qualitative case study approach to the analysis of the LFC series and the second year course, Land, Food and Community I (LFS 250). There are two components to this study. The focus of the first component is the LFC series as a whole, investigating the theoretical and conceptual frameworks created in the development of the series as a SFSE program. For the first component, I adopt an autoethnographic approach (Duncan, 2004; Ellis, Adams, & Bochner, 2010), drawing upon peer-reviewed publications that focus on the LFC series and personal
experiences within the LFC series as sources of data to identify and situate the key elements of the theoretical framework of the LFC series.

In the second component of the study, I investigate the experiences of students in the second-year course, Land, Food and Community I (LFS 250) through semi-structured interviews, analysis of student responses to an ill-structured food system problem, and comparison of these responses to determine correspondence between systems competencies and student level of epistemic and ontological cognition. A qualitative case study approach is appropriate for developing a rich description of the LFC series and accessing participants’ (LFS 250 students) interpretations of the events associated with my research objectives (Stake, 1995; Thomas, 2011; Yin, 2009).

1.7 Dissertation Outline

There are six chapters in this dissertation. In Chapter One, I have shared my research rationale, study focus, and context followed by a literature review that integrates food security analysis, sustainable food system education (SFSE), and cognitive psychology. Chapter One included my research objectives, questions, and methodology. I introduced my case study of the LFC series of core courses in the Faculty of Land and Food Systems at the UBC as a sustainable food system education program. There are two components of my study, the LFC series and students’ experiences in the second-year course.

In the second chapter, I introduce the empirical history of the LFC series. The thick description of the case begins with a description of the context of transition within the faculty in the late 1990s, which lead to the creation of the series. I then provide an overview of the design and progression of the six courses in the series, including descriptions of the instructional models, instructional strategies, and methods of evaluation and assessment common across the series. I provide a more detailed description of the three core courses of the series: Land, Food, and
Community I, II, and III (LFS 250, 350, and 450); and the chapter concludes with an in-depth description of the LFS 250 curriculum.

In the **third chapter**, I present the research methodology of the two components of my study. In the first component, I adopt an autoethnographic approach, drawing upon peer-reviewed publications focusing on the LFC series and my personal experiences within the LFC series as sources of data to identify the key elements of the LFC theoretical framework, which are further situated within scholarly literature. In the second component, I use semi-structured interviews to investigate the impacts of specific pedagogical strategies in LFS 250 on student epistemic and ontological cognitive development. Student responses to an ill-structured food system response are analyzed for system competencies and compared to student levels of epistemic and cognitive development.

In the **fourth chapter**, I answer the first two research questions and present the findings from the first component of my study, identifying and situating the theoretical framework of the LFC series in scholarly domains. Specifically, I relate the theories of the ecology of knowledge, community of learners, and polycultures of the mind to Freirean critical constructivist learning theory. The LFC ecology of knowledge is analyzed with respect to Cognitive Flexibility Theory (Spiro et al, 1998) and scholarly literature surrounding the epistemological and ontological orientation of Community-Engaged Scholarship.

In the **fifth chapter**, I answer the three research questions and present the findings from the second component of the study, the objectives of which are to determine the impact of specific pedagogical strategies on students’ epistemic and ontological cognitive development; and, to investigate correspondence between epistemic and ontological cognitive development and system competencies in solving food systems problems.

In the **sixth chapter**, I present an overall analysis and integration of the research from both components of my study. From Shulman’s (2005) theory of signature pedagogies, I propose
a framework for a signature pedagogy for sustainable food system education (SFSE) programs. I then discuss the complementarity and effectiveness of the four pedagogical strategies investigated in the second component of the dissertation. Next, I present epistemic and ontological cognitive development (EOCD) as a threshold process for developing systems competencies, leading to a description of a possible scaffolding of EOCD and systems competencies in the LFC series. I conclude the chapter and the dissertation with reflections on future research directions and the contributions of SFSE programs to developing food security and food system sustainability.
CHAPTER 2  Case Description: the Land, Food and Community Series

2.1 Introduction

The purpose of this chapter is to begin the process of creating a thick description\textsuperscript{11} of the Land, Food and Community (LFC) series of core courses in the Faculty of Land and Food Systems at the University of British Columbia, Vancouver, Canada and to provide context for the two components of the study. The chapter begins with an account of the institutional context and circumstances that led to the creation of the LFC series at the end of the 1990s and is followed by an overview of the six courses in the series as of 2013. Next, the goals, design, and progression of the series are presented. The learning outcomes and competencies of the core series are then described along with the instructional models, instructional strategies, and the methods of evaluation and assessment common across the series. After this, the distinctions between three main courses in the series (LFS 250, LFS 350 and LFS 450) including a description of the community-based action research (CBAR) projects associated with each course are outlined. The chapter concludes with an in-depth description of the LFS 250 curriculum, as it is the student experiences and pedagogical activities in this course that are the primary focus of the second component of this study.

2.2 Institutional Context

At the end of the 1990s, the UBC Faculty of Land and Food Systems was in crisis due to a decline in student enrollment, curricular relevance and community engagement (Gudz, 2004; \textsuperscript{11}“Thick description” refers to process of describing the context under which qualitative research interpretations are being made in a manner that allows the reader to gauge for herself or himself the credibility of the author’s intent (Ponterotto, 2006).
Rojas, Sipos, & Valley, 2012). The faculty was also experiencing a lack of integration of the body of knowledge being produced through its research. The culture within the faculty fostered isolation among its members; and, research and teaching were marked by a lack of dialogue and cross-fertilization between the different program specializations. Moreover, the Faculty of Agricultural Sciences was failing to address the larger problems of agriculture and food within regional and global contexts. In 1997 a new Dean, Moura Quayle, was appointed. She recalls stating during her interview for the position: “If you’re going to choose me, you’re going to choose change” (Gudz, 2004, p. 160). Upon hiring, Quayle promptly met with key stakeholders – students, staff, faculty, alumni, campus colleagues, and industry, community and government contacts – to frame the circumstances for initiating change. An action plan was created in collaboration with faculty stakeholders that outlined the faculty’s core values, principles and vision. The concept of sustainability was at the core of the action plan, grounding all activities including research, teaching, administrative, and human resource systems (Gudz, 2004). The traditional department structure was dissolved and replaced by theme-based academic programs. Three undergraduate programs were created, each divided into specific majors: Applied Biology (Food and the Environment, Applied Soil and Plant Sciences and Applied Animal Sciences), Food, Nutrition and Health (Dietetics, Food Market Analysis, Food Science, International Nutrition, and Food and Nutritional Sciences) and Global Resource Systems. A core series of courses, the Land, Food, and Community series, was developed to allow the undergraduate students in the faculty to work on integrative themes. An institutional precedent for a core series was already present as the faculty had had core courses in various forms since the 1960s, comprising second and fourth year courses that focused on agricultural systems such as the BC dairy system, fruit and berry production and range management.

The vision for the new mandatory core curriculum was based on the values and principles of the faculty – integrating research and education to address global issues surrounding health.
and sustainable food systems\textsuperscript{12}. Whereas the previous curriculum focused on understanding primary agricultural production, what set the new curriculum apart was the emphasis on food, health and the environment, with sustainability as the overarching theme. This shift reflected the diversity within the faculty, was more inclusive of the increasingly popular Food, Nutrition and Health program, and was more in-line with the fundamental considerations of the social, economic and ecological domains of sustainability. Officially beginning in the fall of 1999, these required courses were entitled Land, Food and Community (LFC) I, II and III (respectively, LFS 250, 350 and 450). The series was designed to provide opportunities for integration amongst the diverse perspectives and expertise within the faculty without compromising specialization requirements. Students were still expected to gain expert knowledge in their field of specialization but were now required to apply their skills in inter/transdisciplinary, community-based, experiential learning settings.

2.3 Land, Food and Community Series Courses

As of June 2013, the LFC series contained six courses, four of which are required for all students enrolled in the faculty (see Table 2.1). Course credits\textsuperscript{13} within the series range from one (LFS 100) to six (LFS 250). Both LFS 250 and 350 are offered on-line to accommodate the diverse needs of students, as each course is mandatory and a common pre-requisite for other courses in the faculty. LFS 150, which is in the design phase and will be piloted in the fall of 2014, focuses on developing research writing competencies specific to food system studies. LFS 450 was required for all students in the faculty from 2000-2010. It is currently not required for all students and has an average enrollment of 60 students. This study will focus on the central

\textsuperscript{12} The vision and goals of undergraduate teaching and learning in the Faculty of Land and Food Systems at UBC, in which the LFC series plays a significant role, can be found at www.landfood.ubc.ca

\textsuperscript{13} A standard, one term undergraduate course at UBC is worth 3 credits.
courses within the LFC series, which are the three Land, Food, and Community course: LFS 250, 350, and 450.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LFS 100</td>
<td>Orientation to the programs, learning environment, and core values of the Faculty of Land and Food Systems.</td>
</tr>
<tr>
<td>LFS 150</td>
<td>A small-class experience introducing academic writing and argumentation in land and food systems.</td>
</tr>
<tr>
<td>LFS 250</td>
<td>Land, Food and Community I: Introduction to managed systems and concepts of sustainability; economic, ecological and social components; managed landscapes, food systems, and communities; urban and rural systems; the land, food, nutrition and human health continuum.</td>
</tr>
<tr>
<td>LFS 252</td>
<td>Introduction to tools needed for data analysis of the economic, ecological, health, and scientific components of land and food systems.</td>
</tr>
<tr>
<td>LFS 350</td>
<td>Land, Food and Community II: Introduction to tools and skills required in assessing the economic, ecological, social, and technological components of managed landscapes, food systems and communities comprising the land, food, nutrition and health continuum.</td>
</tr>
<tr>
<td>LFS 450</td>
<td>Land, Food and Community III: Problem-based analysis of complex case studies aimed at increasing the sustainability of the UBC Vancouver campus food system. The main activities are integrated into the ongoing UBC Food System Project. Cases are specifically designed to require development of integrated disciplinary and inter-disciplinary analysis.</td>
</tr>
</tbody>
</table>

Table 2.1 LFC Series Course Descriptions

2.4 Goal of the LFC Series

The primary goal of the LFC series is to overcome the fragmentation of knowledge characteristic of a scientific reductionist way of knowing (Rojas, 2009; Rojas et al., 2012). Students are introduced “to the idea that [the] fragmentation of knowledge and overspecialization needed by industrialization, and the consequent inability to see the entire picture, are ultimately key contributors to the crisis of agriculture and are behind the unsustainable nature of our contemporary civilization” (Rojas, 2009, p. 139). Epitomized by the common metaphor of the blind men touching parts of an elephant and describing unrelated objects, over reliance on reductionist ways of knowing have the potential for preventing one from seeing the big picture. This way of seeing and thinking about the world is limited in its ability to address complex issues of food security and food system sustainability.
However, at the same time, fragmentation could be a considered a defining characteristic of the modern university - in its organizational structure, its relationship with the society and through the traditional domains of the professoriate, that is, teaching and learning, research, and service. The silo-like structure of university faculties, departments and programs effectively isolates students and professors from their colleagues in other domains of knowledge. The LFC series is structured to overcome this fragmentation by structuring student activities in collaborative, inter- and trans-disciplinary groups, in the classroom and in the community. Students experience and reflect on local and regional issues, and are encouraged to recognize these issues as microcosms of larger global patterns. Students have the opportunity to engage in food system scenarios in a number of contexts: the UBC campus, the Vancouver School Board, the City of Vancouver, and in communities throughout the province of BC. The role of community members is framed as a co-partnership in knowledge production and mobilization where each stakeholder is considered an integral asset to the improvement of the particular issue at hand. Students are exposed to diverse stakeholder knowledge and are encouraged to critically reflect on relationship between academic and other ways of knowing and the perception of communities as passive recipients of university resources. Student activities are structured towards contributing to local food system enhancement and provide an opportunity for the students to become positive agents of change. The community-based action research (CBAR) projects associated with each of the central courses (LFS 250, 350, and 450) embed research processes within curricular activities, seeking to further create positive synergies between teaching and learning, research, and community service.

2.5 Design of the Three Central LFC Courses

The three central courses in the series are designed to provide scaffolding for the development of system thinkers capable of working in inter- and trans-disciplinary, food systems
settings. The focus of LFS 250 is to bring about awareness of diverse ways of seeing and knowing, food security theory and related debates, and the value and process of community collaboration. LFS 350 provides students with opportunities to become familiar with methodologies associated with community-based food system action research by participating in a process of problem definition, designing and implementing interventions, evaluating outcomes and reporting back to community partners. LFS 450, the capstone course, integrates the knowledge, skills and experiences of 4th year students into a more consultant-like arrangement, whereby students are given autonomy to define, conduct, and evaluate food system research activities. As stated previously, CBAR projects have been developed in association with each course to provide opportunities for students to gain experience in different contexts of the food system. These projects are pedagogical explorations geared to overcome the separation of teaching from research and to bridge the gap that separates academic work from community concerns. Details specific to each CBAR project will be described in subsequent sections in this chapter.
2.6 LFC Learning Outcomes and Competencies

The figures below provide the background, context, and learning outcomes of the series (Figure 2.1) as well as a list of desired student competencies (Figure 2.2).

<table>
<thead>
<tr>
<th>Core Series Learning Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land and Food Systems students who have completed the Land, Food and Community (LFC) core series are systems thinkers, able to work collaboratively in multicultural, inter- and trans-disciplinary teams to develop solutions for complex, multi-stakeholder issues related to food, health and the environment. Incorporating academic and community perspectives, they apply their knowledge in an environmentally, socially and economically sustainable manner to community food security challenges.</td>
</tr>
<tr>
<td>The LFC courses provide students with the opportunity to acquire and apply the fundamental knowledge, skills and expertise required for successful participation in food security and sustainability initiatives.</td>
</tr>
<tr>
<td>Upon completion of the LFC courses, successful students will be able to:</td>
</tr>
<tr>
<td>• Apply systems principles to land, food and community challenges, and design and implement sustainable strategies to enhance food security within urban, suburban and rural communities across British Columbia.</td>
</tr>
<tr>
<td>• Critically reflect on the historical and current socio-ecological context of land and food systems issues.</td>
</tr>
<tr>
<td>• Recognize, value and engage with diverse academic and community ways of knowing and how they contribute to addressing food system sustainability challenges.</td>
</tr>
<tr>
<td>• Collaborate effectively and professionally as members of a transdisciplinary community of learners comprised of academic and community stakeholders using a community-based action research framework.</td>
</tr>
</tbody>
</table>

**Figure 2.1 LFC Series Learning Outcomes**
<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Competencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>LFS 100</td>
<td>1</td>
<td>Awareness of the faculty, food systems, learning strategies, and the practice of reflection</td>
</tr>
<tr>
<td>LFS 150</td>
<td>3</td>
<td>Scholarly writing (introduction to literature reviews, academic writing, library use, citation management, and evaluating internet sources)</td>
</tr>
<tr>
<td>LFS 250</td>
<td>6</td>
<td>Critical and systems thinking</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Introduction to reflective learning</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Collaborative and teamwork skills (meeting skills, interdisciplinary group work, conflict resolution, ethical frameworks)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Community engagement &amp; social responsibility</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Research communication (writing and oral, video, power point, diagramming)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dialogue and facilitation</td>
</tr>
<tr>
<td>LFS 252</td>
<td>3</td>
<td>Quantitative data analysis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hypothesis testing</td>
</tr>
<tr>
<td>LFS 350</td>
<td>3</td>
<td>Research proposal development (formulation of research questions, situational assessment, research ethics, research methods, evaluation, presentation)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Introduction to project management - leadership/acting for positive change</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reflective practice</td>
</tr>
<tr>
<td>LFS 450</td>
<td>3</td>
<td>Synthesizing ideas and perspectives</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Professionalism</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Leadership</td>
</tr>
</tbody>
</table>

**Figure 2.2 LFC Series Competencies**
2.7 Instructional Models

To overcome the difficulties of teaching systems perspectives in a culture deeply rooted in fragmentation, the instructors and designers of the LFC series have been experimenting with forms of collaborative inquiry and learning. The instructors strive to create a learning process that, while embedded in scholarly work, encourages participants to recognize past experiences and future aspirations as valuable sources of knowledge when investigating food systems. Using interdisciplinary team-based work in partnership with community organizations, the community of learners seeks to addresses issues of food security and takes action to improve situations. The following sections elaborate on three specific instructional models employed in the series: a modified form of Problem-Based Learning (PBL), Rojas’ (Rojas et al, 2007; Rojas, 2009) Learning with Life, and Transformative Sustainability Learning as described by Sipos, Battisti and Grimm (2008) and Sipos (2009).

Initially, Problem-Based Learning was adopted in the faculty as an appropriate instructional model to achieve the objectives of the series. The intention was to structure all of the courses along PBL principles. PBL is a learner-centred approach that allows content and skills to be taught through problem scenarios, with knowledge acquisition triggered through facilitated, group processes (Jonassen, 2011). Typically, students in PBL courses are placed in small groups of four to six students. Each group is assigned a trained PBL facilitator. However, due to the large size of the classes (200+ students in each course), strictly adhering to PBL processes was cost and resource prohibitive, as it would have required too many facilitators and learning spaces. To circumvent the cost and resources, the second and fourth year courses blended key aspects of PBL with traditional lecture-based plenaries and small breakout room sections of 30-35 students, each led by a teaching assistant. The third year course maintained a PBL format from 2001-2006 but, due to aforementioned barriers, following 2006 switched to the blended inquiry style of the other two courses.
Rojas’ (2009) Learning with Life model challenges the notion that an individual must disregard their personal experiences and influences in order to be successful learners and researchers. Instead the model encourages participants to integrate passion, emotion, dreams, personal stories, and imagination into scholarly activity in a disciplined manner. Most activities in the LFC series follow the model by incorporating its three dimensions of knowledge: a) personal experience and interests related to food; b) accounts of reality as “it is” as represented by scholarly literature on food systems; and c) accounts of reality as “it should be” as represented by the participants’ collective envisioning of a secure food system. The integration of these three distinct ways of knowing coalesces into what Rojas (2009) describes as the Realm of the Potential, where past experiences, scholarly knowledge, and utopian ideals direct academic pursuits. The Learning with Life model presumes that working in the Realm of the Potential helps students become engaged in their subject. Students in the LFC series are encouraged to identify the ways in which past experiences contribute to the construction of their current understanding of food systems. At the same time, students are encouraged to utilize their interests, passions and dreams to help guide their creativity as they engage with the curriculum - whether through individual assignments, group work, or larger food system projects.

Transformative Sustainability Learning (TSL) emerged from the study of other transformative, environmental, and sustainability pedagogical models as well as through the pedagogy experienced in the LFC series in the Faculty of Land and Food Systems (Sipos et al, 2008). The TSL model incorporates Head, Hands and Heart (HHH) as an organizing principle to integrate transdisciplinary study (head); practical skill sharing and development (hands); and translation of passion and values (heart) into behaviour (Sipos et al, 2008). Traditional lectures, discussions and academic writing assignments are combined with food literacy activities and participation in CBAR food system projects to bridge the cognitive (head) and psychomotor (hands) domains of learning. Reflexivity is central to achieving learning objectives in the affective
Guided by the TSL model, instructors structure pedagogical activities that facilitate personal experiences that are intended to result in profound changes in knowledge, skill, and attitude regarding issues of ecological, social, and economic justice. The LFC series curricula provides opportunities to connect theoretical content with personal experiences, enhancing the former and validating the latter as meaningful contributor towards learning in higher education and becoming an expert, professional, or practitioner within the food system.

### 2.8 Instructional Strategies

Each instructional strategy used in the LFC core series relates to the instructional models that shape learning experiences in the courses. There is a spectrum of content delivery strategies varying from teacher- to learner- centred approaches. A blending of diverse pedagogical strategies is necessary due to the large class sizes, which create logistical limitations to individual and small group learning plans. Adopting a diversity of approaches is congruent with the overall philosophy of the series and accommodates different learning preferences amongst participants.

There has been an annual increase in student enrollment in the Faculty of Land and Food Systems since 2000. All three courses had an approximate enrolment of 200 students between 2000-2010, and the on-line versions of LFS 250 and 350 accommodated the needs of excess students. In 2011 and 2012, enrollment in LFS 250 increased to approximately 230 and 260 students, respectively. Enrollment in LFS 250 reached 300 in the fall of 2013. Growth in LFS 350 is equal to that of LFS 250, but deferred by a year. In 2010, LFS 450 was no longer required by all students in the faculty and enrollment decreased from 200 students to approximately 60 in 2012.

Each course uses a large lecture hall for plenary sessions, facilitating content delivery by course instructors or guest lecturers. There are multiple guest speakers in the series with a range of backgrounds including academic (natural and social scientists), university staff (e.g., directors of
food services, waste management and campus sustainability), and community practitioners (e.g., community nutritionists, school board officials, staff of community organizations, school teachers, farmers, chefs, and butchers). Depending on the material and presenter, lectures are passive or interactive, and use methods of content delivery common for a large classroom setting such as power point presentations, audio-video technologies, question and answer sessions, and think-pair-share discussions. Time spent inside of the lecture hall decreases with each course, from 50% of course time in LFS 250, to approximately 33% in LFS 350, and 25% of course time allotted in LFS 450. In all three courses, students are assigned to small discussion groups of 30-35 students, each led by a teaching assistant. Approximately 20-30% of each course is devoted to student-led presentations and facilitated discussions in this setting, based on course readings or reporting on student activities.

Students are provided opportunities to learn outside of the classroom through field trips and community-based experiential learning projects. Two field trips are scheduled in LFS 250. The first is a visit to the Centre for Sustainable Food Systems at UBC Farm – a 24 hectare, organically certified campus farm. During the field trips, students learn about the cultural, educational, and agriculturally productive components of the farm. The second trip is to a local, third-generation dairy farm with 400+ dairy cows and 500 hectares of cropland. The farm owners provide a tour of all the components of the farm, including the milking parlour, calving barn, and manure pit. The farmers discuss the changes that have occurred in their community as farms have consolidated and the number of neighbouring farms decreased, as well as the problems related to the interface between urban sprawl and farmland, resulting in tensions between agricultural production, wildlife conservation, and urban conceptions of acceptable living environments.

Community-based projects are designed to expose students to diverse ways of knowing and diverse methods of generating knowledge, challenging the assumption that universities have
sole ownership of knowledge creation and expertise. The projects provide students with opportunities along a spectrum of community inquiry to community engagement (see Rojas et al., 2012 for a graphical representation and discussion of this spectrum). Inquiry activities do not require strong relationships and interactions between undergraduate students and community members. Students may carry out observations at a public meeting on a food security topic. Or, they may document and analyze levels of access to fresh fruit and vegetables in a neighbourhood in Vancouver. Engagement activities require a firm relationship with a community partner or organization. Activities are planned, implemented and evaluated in full collaboration with community partners. For example, students may co-develop, deliver, and evaluate a workshop to meet the needs identified by a community partner organization. Or, students may collaboratively plan, facilitate, and evaluate the outcomes of a community meeting on a food security topic.

Inquiry activities familiarize students with the process of leaving the classroom and engaging in curricular work in a community setting. Engagement activities allow students to experience making contact with stakeholders and working more deeply within a community setting, progressively becoming more responsible for the consultation, design, implementation, and evaluation of the projects. The community activities have ranged from assessing aspects of food security in a neighbourhood in Vancouver or delivering a food-based workshop in a K-12 classroom (LFS 250), to developing a food security project within a community in British Columbia (LFS 350) and conducting campus-based food system sustainability projects at UBC–Vancouver (LFS 450). More details of the CBAR projects will follow in subsequent sections. There are three general classifications of activities within the community: community-service learning (CSL), whereby experiential projects are situated within explicit reflexive assessment activities; community-based research (CBR), with activities being structured to reflect a modified research
process; and, experiential activities that lack the rigorous reflection or inquiry nature of either CSL or CBR, such as delivering a bread-making workshop to K-12 students.

Critical reflection and communication skills are key learning objectives for the LFC series and feature prominently in the assessment of individual and group activities. Grading in the series is split equally between individual and group assignments. In groups, students are required to give presentations, facilitate discussions, create food system models, and write research papers. Individually, students are assessed through weekly quizzes, reflexive journals, scholarly literature reviews, and in-class participation. There are no mid-term or final exams in any of the courses.

In the following section the three central courses will be described in detail: Land, Food and Community (LFC) I, II and III (respectively, LFS 250, 350 and 450). Since LFS 250 is the focus of the second component of this study, the majority of the following discussion focuses on this course.

2.9 Course Descriptions

2.9.1. Land, Food and Community I (LFS 250)

From 1999 to 2012, LFS 250 was offered in the fall term of each year (from September to December) with two four-hour sessions (a total of eight hours per week for 13 weeks). The curriculum is comprised of four units: the Ecology of Knowledge; the BC Dairy System; Environmental, Food, and Agricultural Ethics; and a community-based experiential learning activity, associated with a CBAR project – currently, the Think&EatGreen@School Project.

14 In 2013, LFS 250 was offered over two terms, from September to April, with one three-hour session per week.
15 For more information on the Think&EatGreen@School Project, visit www.thinkeatgreen.ca.
The Ecology of Knowledge Unit begins with discussions and activities about ways of seeing (ontology) and knowing (epistemology). A variety of pedagogical strategies\textsuperscript{16} are used to demonstrate and critically analyze the socially constructed nature of reality and ways of knowing. Once students have more experience with ontological and epistemological concepts, the class discusses how ontological beliefs relate to sources of knowledge, influence ways of presenting evidence, and justify conceptions of truths in the food system. Students are then asked to identify and assess the dominant and alternative paradigms that exist in the global food system. Concurrently, the class explores the strengths and limitations of reductionist and systems approaches to addressing complexity and uncertainty in the global food system.

The second unit is centred on the BC Dairy System. This unit is structured in a manner that reveals the nested systemic levels of the dairy system and facilitates direct experience with disciplinary and community ways of knowing in a local food system. Drawing upon concepts from the Ecology of Knowledge Unit and applying them to a 'real-world' setting, field trips, guest lectures, and experiential learning activities provide diverse perspectives and experiences to inform student understanding of the provincial dairy system. Systems and sustainability theories provide a framework for the analysis of the dairy industry, and students are asked to reflect on a wide range of topics including the policies affecting the dairy industry, the impact of the dairy on human nutrition and ecological systems, and market influences that govern, and are shaped by, the dairy industry. Due to time restraints, no other food system is analyzed as closely as the dairy system for a comparison in this course. However, through class discussion, students are made aware that the processes and skills that they are developing through analyzing the BC dairy system can be applied to analyze other sectors within the food system. Recognizing the transferable nature of process-based skill development to a variety of contexts resonates with

Bateson’s (1979) emphasis on abductive reasoning: the lateral extension of recurring abstract relations amongst different components of a system. For example, within BC, the aging population of farmers is having an impact across all farming sectors. Therefore, solutions oriented to meeting this challenge will be present in any agricultural system within the province (and across Canada). Further, the increasing power of food retailers (Sage, 2012) within the modern food system will create similar tensions between primary producers, processors, and distributors across the food system.

The third unit, Environmental, Agricultural, and Food Ethics, begins with a comparison between anthropo-, bio- and eco-centric traditions as well as individualistic, socially, and community oriented traditions of ethical thought, and how the values and beliefs associated within this spectrum manifest in the conception of food security. The intention of this stage of the course is to help students become more adept in identifying and applying diverse perspectives to the analysis of complex food system issues. Genetic engineering and animal welfare are examined to explore the competing ethical perspectives and approaches to food system issues. Specific topics include genetically engineered crops, concentrated animal feeding operations, hunting, and vegetarian and vegan dietary choices. To ensure that students are exposed to diverse opinions and ideas, guest lecturers from academia (e.g., a plant breeder and an animal welfare ethicist) and the community (e.g., a small-scale livestock farmer and a local butcher of ethically raised livestock) present their perspectives and discuss food security topics with students in lecture hall plenaries.

The last quarter of the term is spent exclusively on the CBAR project. As part of the process of preparing students to work collaboratively with community stakeholders in the third and fourth years of the LFC series, the second year course focuses on the initial process of leaving the classroom and learning in a community setting. This is a critical step in the series, as it is first time that the majority of the students are asked to conduct an unsupervised, experiential project.
off-campus. The challenges range from travelling as a group, to maintaining open communication channels with community members, and adapting to the constraints of different schedules. The teaching team provides the initial coordination of the projects for the students, including developing relationships with community partners, gathering materials, and formulating workshop design templates. The workshop and activity framework provided by the teaching team permits student groups to focus on action and reflection in their initial introduction to community-based experiential learning. The projects are often challenging for the students; however, in spite of the hard work and long hours involved, students commonly report their involvement in the community as the highlight of the course. Students are assessed through a final report and presentation of their experiences in delivering a food-literacy workshop. As a central requisite of the final assessments, student groups are required to demonstrate the theoretical connection between their experiences with the K-12 system and the more abstract themes of the class, such as food security and food system sustainability.

From 1999 to 2004 and from 2007 to 2008, students conducted food security assessments of the neighbourhoods in the city of Vancouver as part of the Food Security in Vancouver CBAR project. Each group was assigned one of the 23 Vancouver neighbourhoods and asked to assess food security issues within the community. With the annual iterations of the project, the student groups focused on different aspects of the individual communities, creating a mosaic image of overlapping and interdependent food security issues within the city as a whole. The community inquiry approach primarily consisted of ethnographic observation and surveys developed by the student groups; however, a number of groups over the years have taken the initiative to carry out activities that are more directly engaged with community stakeholders. For example, students have presented project findings in city council meetings, informing policy decisions within the City of Vancouver. And, beginning in 2002, the project was conducted in cooperation with the Social Planning Department of the City of Vancouver. Delegations of LFS
students have directly addressed Vancouver City Council to provide information about food security issues based on their experiences and findings. In the fall of 2008, students conducted an environmental scan of Vancouver neighbourhoods as part of a Vancouver Food Policy Council study\textsuperscript{17} of citywide food security.

In 2009, the Think&EatGreen@School Project was initiated as a direct result of the community relationships developed through LFS 250 course and associated CBAR projects. Think&EatGreen@School is a formal collaboration between academic researchers, the Vancouver Board of Education, Vancouver Coastal Health, the Vancouver Food Policy Council and a number of non-profit organizations that work in the area of regional food security and food system sustainability. The mission of the project is

\textit{“to contribute theoretical understanding (knowledge creation) and practical applications (action and knowledge mobilization) in the areas of food education across the curriculum, multi-level food system changes (in production, procurement, distribution, delivery, preparation, and end products recycling/composting) that will support regional food security with an emphasis on environmental sustainability and policy recommendations for schools”} (Think&EatGreen@School, 2013, p. 3).

In 2010, the Think&EatGreen@School Project received a 5-year Community-University Research Alliance grant from the Social Sciences and Research Council of Canada. LFS 250 students played a significant role in the generation of the Think&EatGreen@School Project. In 2009, more than 200 LFS students conducted surveys of the 108 elementary and secondary schools in the Vancouver School District as a baseline assessment of food related activities occurring in the school district. Since 2010, students have been delivering food-related workshops to stakeholders in the school district; this form of engagement continues to be the model of community-based activities for the course. Workshops include preparing and sharing a seasonal salad in a classroom, creating a lasagna garden, planting garlic in school gardens, creating a food system themed art project, and establishing a classroom vermicomposting bin.

\textsuperscript{17} For more information on the Vancouver Food Secure Study, go to http://foodsecurevancouver.ca/.
2.9.2. Land, Food and Community II (LFS 350)

The second central course within the LFC series, LFS 350, is offered in the fall term of each year (September to December) once a week for 3 hours. The central objective of the third year course is to provide opportunities for students to design, implement, and evaluate a community-based food security initiative, in direct collaboration with a community partner from a variety of organizations and municipalities across the province of BC. The LFS 350 projects are the second stage of the scaffolding process for developing competencies in collaborative project development in a community setting. The projects build directly on experiences from LFS 250 where students were familiarized with entering and delivering a community-based project within the city of Vancouver. In LFS 350, the teaching team and the Centre for Community Engaged Learning18, a UBC-based organization that facilitates community-university partnerships for enhanced student learning, develop relationships with community partners and prepare the overall project objectives. The students are responsible for translating the objectives into actions, evaluate the outcomes, and report back to the community partner.

Student assessment in LFS 350 is based on group presentations and discussion facilitation, writing a research proposal and final paper, blog postings on project progress, reflective journals, and individual quizzes.

In LFS 350, each student collaborates in a team-based CBAR project and has an individual option to participate in hands-on, community-service learning or complete a policy essay related to their community project. The research question(s) developed in the CBAR project are initiated by the community partner and refined by the students, with some guidance from the teaching

18 For more information on the Centre for Community Engaged Learning, go to http://students.ubc.ca/about/centre-community-engaged-learning
team. Starting in 2006, the UBC-based Community Food Assessment Project (CFAP)\(^1\) became the primary focus of LFS 350. This project, which grew out of the initial CBAR project in LFS 250, the Food Security in Vancouver Project, introduces students to a province-wide perspective on food system questions across urban, suburban, peri-urban, and rural communities. The outcomes of the student projects cover the range of the food system, including fostering young farmer networks, addressing relevant food policies for remote and rural communities, developing food-related social enterprises, investigating more effective means of food recovery and distribution, developing curricular and extra-curricular programs on nutrition and food production, investigating cultural connections with food, and helping in waste management pilot programs. From 2006 to 2012, students in LFS 350 have worked with over 40 community organizations within a wide range of communities in the province. The community partners who work with LFS 350 students are leaders and key stakeholders in the field of food system sustainability, including rural and urban farmers, community gardeners, politicians, health authorities, teachers, food distributors, and resource and waste activists. The depth and breadth of the topics under investigation illuminate the complexity of food security and help students understand the research methods needed for effective, integrative investigation and community-based action research (CBAR).

2.9.3. **Land, Food and Community III (LFS 450)**

The capstone course in the series, LFS 450 is offered in the winter term of each year for 3 hours once a week from January to April. The central curricular focus in LFS 450 is the UBC Campus Food System Project. The project is a collaboration between a variety of campus community groups: the Centre for Sustainable Food Systems at UBC Farm, UBC Food Services, the

\(^{1}\) Dr Yona Sipos, a former graduate student, course coordinator, and instructor of LFS 350 completed her doctoral dissertation in 2013 on which the CFAP project was her central case. Her dissertation can be found at https://circle.ubc.ca/handle/2429/45713.
Campus Sustainability Office, the Alma Matter Students’ Society Food and Beverages
Department, the University Neighbourhood Association, and UBC Plant Operations. This course is the final setting for community-based project development and, compared with LFS 250 and 350, provides the least amount of prescribed structure for the projects. The teaching team develops scenario documents that describe the context of the problem; however, students are required to meet directly with community stakeholders to formulate research questions and projects to address their specific issue.

In 2001, the first year of the LFS 450 course, students conducted an exploratory assessment of the ecological, social, and economic sustainability of the UBC campus food system, and delivered 17 reports with recommendations to the Campus Sustainability Office. In the second and third years of the course, students extended this same project. They were involved in the development of more advanced models for assessing, envisioning, and transitioning the campus food system towards sustainability. From 2004 to the present, students have continued to implement the project’s research plan, adding new dimensions of sophistication and specificity each year. To the best of the author’s knowledge, when this project began, it was the first study of the sustainability of the entire food system of a university led by undergraduate students.

Once a year, the UBC Campus Food System Project hosts a one-day workshop with campus food system stakeholders. At this meeting, student findings from projects conducted that year are presented and the scenarios for the following iteration of the project are agreed upon. In the first week of the term, students choose the scenario that interests them most, form groups, and begin the process of consultation with campus partners to address the particular issue identified. Plenary sessions within LFS 450 are minimal and mostly used to communicate the diversity of projects that are occurring in the semester as well as the value and impact of the

For more information on the UBC Campus Food System Project, see Rojas, Richer, & Wagner, 2007, published in the international journal EcoHealth.
students efforts from the perspective of the campus partners. Student findings and recommendations have been used to make actual changes in the operations of the campus food system before the end of the semester. These changes are shared with students as they begin LFS 450 to help them understand how their project has real world implications.

2.10 Detailed Description of Units One and Two in LFS 250

In the final section of this chapter, in-depth descriptions of specific pedagogical and curricular activities in Unit One and Two of LFS 250 are provided. These descriptions will provide context for the objectives of the second component of the study: (1) to assess the impact of specific pedagogical activities on student epistemic and ontological cognitive development (EOCD), and (2) to determine if there is correspondence between EOCD and the application of systems principles to the resolution of an ill-structured, food system problem. This section focuses on the activities of LFS 250 that target students’ ways of seeing and knowing, their relationships with knowledge, and their understanding and application of general systems principles. These are the instructional strategies that are referred to in the semi-structured interview process (see the overview of the study methodology in Chapter One). There are a number of learning objectives in LFS 250 that compliment but do not directly target EOCD; these objectives and instructional strategies are not described here as they have been described sufficiently in prior sections.

This section starts with course logistics. Next, the first two unit themes of the course are described, highlighting the learning goals, objectives, and instructional strategies. This section concludes with a description of the forms of assessment used in the course that directly relate to EOCD and systems principles.

The LFS 250 course is worth six credits, the equivalent of two standard courses at UBC. Since 1999, the course has been team-taught and the number of instructors has varied from two to three, with each instructor having a different disciplinary background (sociology, food science
and/or soil science). As the course enrollment has increased over the years, the number of teaching assistants has grown from five to ten. In 2011, a course coordinator was added to the teaching team to accommodate the increasing level of logistical complexity associated with placing over 200 students in classrooms in the Vancouver School District. The class typically runs for eight hours a week, four hours each Tuesday and Thursday from 2pm to 6pm, beginning in the first week of September and ending in the first week of December. The class is primarily composed of students enrolled in one of three program majors: Food, Nutrition and Health (55-65%), Applied Biology (15-20%), and Global Resource Systems (15-20%). Class contact hours are divided between lecture hall plenary sessions and small breakout rooms of 30-35 students, lead by a teaching assistant. During the last unit of the course, four sessions are dedicated to the community-based experiential learning (CBEL) activity. Students use this time to work off-campus directly with community stakeholders.

2.10.1. Unit One: The Ecology of Knowledge

The goals for Unit One are to critically engage with diverse ways of seeing and knowing and to begin to participate effectively in a community of learners. The following are the objectives for Unit One:

- Compare and contrast reductionist and systems approaches to scientific knowledge.
- Identify characteristics of scientific, indigenous, and place-based knowledge.
- Recognize personal and societal values, beliefs and assumptions as they relate to the food system.
- Reflect on the relationships between the learning environment, the learning process and knowledge.
- Describe a “community of learners” and its components.

This unit primarily explores how socio-cultural factors influence ways of seeing (ontology) and knowing (epistemology). Beginning at the level of the individual, students are asked, “How do you know what you know?” A dialogue about epistemology and ontology is initiated that includes discussions about the socio-cultural factors that influence what, and how, one knows, such as the
learning environment and societal beliefs, values, and assumptions. It is here that instructors introduce and discuss the concept of an ecology of knowledge. Identifying and critically analyzing characteristics of a learning context and the processes involved in learning activities is an important step in recognizing how an individual learner identifies facts and truths, evaluates competing claims, and what one accepts as appropriate approaches to uncovering truth in scientific, indigenous, and place-based ways of knowing. Reductionist and systems approaches to acquiring scientific knowledge are presented to help students understand the strengths and limitations of each. Each of the four activities discussed below expose students to systems principles, holism and pluralism, and facilitate further discussion and exploration of systems thinking in a food system context. Students are placed in their term-long groups and introduced to the concept of a community of learners. In order to prepare the students for effective team collaboration, they participate in two workshops focusing on techniques to better understand cognitive styles and personality traits. The first unit begins the process of interdisciplinary collaboration as the structure for addressing complexity and uncertainty within the food system.

There are four key instructional activities in Unit One that target student EOCD. Three of these activities are carried out in the lecture hall plenary sessions and one is conducted in the breakout room. All of the activities are supported with course readings and time devoted to discussions in plenary and breakout rooms. The first activity, analysis of the image of the elephant and the blind men (see Figure 2.3), is also the central theme of the first plenary session. This image is a metaphor that is intended to demonstrate the limitations and consequences of disciplinary and reductionist ways of seeing the world. This metaphor is used to indicate the structure of the university, fragmented into different faculties and departments, with embedded organizational impediments to interdisciplinary communication. The image leads to questions of the limitations of a reductionist approach to knowledge creation and flows naturally into a
discussion of other approaches, at which time the course instructors offer systems approaches to complement reductionism and the development of disciplinary expertise.

Figure 2.3 The Elephant and the Blind Men Diagram

The second activity is called “Flashlights in the Forest”. The instructor presents students with a challenge: it is dusk and they must enter a thick forest and emerge on the other side by dawn. On a table at the front of the lecture hall lie multiple light sources: a narrow-beamed focused flashlight, a broad-beamed diffuse flashlight, a flashlight that offers both focused and broad beams, and matches. Students are told to choose which source they would take with them to survive the dark forest at night. They are also given the choice of not choosing any of the options and allowing their eyes to adjust to the darkness. The lights in the lecture hall are turned off and the classroom is left in complete darkness, and after a few minutes, the instructor demonstrates the differences between the light sources. The classroom lights are turned back on and students are given time to talk to each other about their preference followed by a large class discussion. The exercise with the flashlights is intended to introduce the concept of paradigmatic lenses and the

21 Image is in the public domain and retrieved from https://en.wikipedia.org/wiki/Blind_men_and_an_elephant#mediaviewer/File:Blind_monks_examining_an_elephant.jpg
value and limitations that accompany their use. The narrow, focused beam can show rich detail but does not reveal the background of the illuminated object or space. The broad, diffuse beam allows the background to be present but lacks clarity in specific details. These two options are presented as metaphors for reductionist and systems approaches, respectively. Participating in this 20-minute activity provides students with a tangible experience of a challenging theoretical concept. The use of matches leads to a discussion of the value and limitations of technology. The choice to not use any light source and to let one’s eyes adjust to the darkness leads to a discussion of traditional and indigenous ways of knowing. In particular, how the other senses become more engaged and how one’s perception of reality would be different than when relying on technological assistance.

The third activity involves showing students a short video called Zea (Leduc & Leduc, 1981). It is a five-minute film, distributed by the National Film Board of Canada. Students are asked to record their impressions on paper as the film progresses. It begins with a close-up of a spherical, pale yellow object covered in a liquid, with bubbles covering the surface of the object at its edges. The background music is a string composition by Richard Vaughan Williams that begins slowly, surges, swells and finishes in a dramatic crescendo. For the majority of the video, the camera stays intimately close to the object until 4 minutes into the film, where the object begins to transform into something white. It is at this point that the camera zooms out and reveals the object to be a popping kernel of corn, the previous state being a close-up of the kernel in oil in a hot frying pan.

The purpose of this activity is two-fold: to re-iterate the limitations of reductionism and to experience an event as a large group and hear the diverse interpretations of individuals in the group. That is, to experience the subjective and interpretive nature of reality in a large group setting. Students are invited to describe what they wrote down as the film progressed. Impressions vary: an egg, an embryo or a bald, human head under water are most commonly reported.
Rarely, despite the title, do students surmise that what they are seeing is popcorn (Zea is Latin name of the genus for corn and we are a Faculty of Agriculture). The discussion leads to the experience of collectively witnessing an event but coming to different conclusions, and the significance of this for our relationships with knowledge. How do we know we are all witnessing the same phenomena? Whose interpretation is more valid? What are the implications on how we interpret socio-ecological phenomena that occur in the food system?

The fourth activity in Unit One connects directly to individual and societal values, beliefs, and assumptions. It is a simulation card game about intercultural communication called Barnga (Thiagarajan, 2006). In this game, participants experience the shock of realizing that despite their good intentions and the many similarities among them, people act and interpret events in profoundly different ways, especially people from differing cultures. Players learn that they must understand and reconcile these differences if they want to function effectively in a cross-cultural group. The activity experientially breaks down the assumption that we all operate with the same rules-of-the-game in daily life and assists students in learning the art of walking in another's shoes22.

To play Barnga, students are placed into groups of four to six at a table and given a game package consisting of general instructions, rules and cards. They are told to memorize the rules and play a few practice rounds to familiarize with the game because once the game begins, oral and written communication is not allowed and the rules will be taken away. After a few practice rounds, the rules sheet is removed and the general instructions sheet remains, which states the direction to move if one has won or lost the round at play. They are told that winners will move to tables in one direction and losers to move in the opposite direction, often two or more students remain at each table after each round. Based on their practice and initial rounds,

22 “A systems approach begins when first you see the world through the eyes of another” (Churchman 1968, p. 231) – remains one of the most frequently quoted descriptions of systems thinking (Reynolds & Holwell, 2010, p. 8)
participants are confident they understand the game, know the rules and know how to win. However, they are not told that the initial rules given to each team were slightly different, and soon confusion and frustration appear, which often develops into unspoken conflict. After seven to ten rounds, the game ends. The teams are then debriefed and it becomes clear that the game is a metaphor for encountering the unwritten rules of another culture. And lacking oral and written communication, this game vividly demonstrates that if we assume that we are all operating with the same rules of the game, we are likely to make serious errors when adapting to a new context, be it cultural, professional or other. This assumption equally affects both members and newcomers to the mainstream receiving culture, raising awareness of the hidden values, assumptions and beliefs inherently shared amongst human groups. The discussion following the game is always impactful and profound, providing another opportunity to experience diversity in ways of seeing and knowing.

2.10.2. Unit Two: The BC Dairy System

The goal for Unit Two is to apply systems principles to issues in land and food systems through the analysis of the BC dairy system and a school food system. The following objectives for Unit Two pertain to the second component of the study:

- Identify the key elements of a food system
- Apply holistic thinking and diverse perspectives to interpret food systems issues
- Model a specific food system
- Utilize systems principles to evaluate food system sustainability

This unit coalesces a variety of learning strategies and disciplinary perspectives into an experientially focused set of activities. Leaving the lecture hall, the class visits a dairy farm in order to witness first hand the complexities and nuances (as well as the smells) of a working farm. Student groups rotate through five stations and are given the opportunity to have a dialogue with the farm owners and workers. The topics of each station are (1) soil and field operations, (2) feed and nutrition, (3) the milking parlour, (4) the calves and breeding program, and (5) community
perspectives. In the lecture hall, faculty experts present a diverse range of topics including Canadian dairy policy, dairy and human nutrition, and the science behind processing, distributing and marketing milk and milk alternatives. In the breakout rooms, students complete a sensory evaluation session of 14 different milk and milk alternative samples to experience variance amongst products in the market and gain an understanding of milk sampling methods commonly used by food scientists. In this activity, which is based on industry protocols for evaluating food products, each product (e.g. skim milk, 1%, 2%, soy milk, goat milk, organic milk) is labeled with a code to conceal the nature of the product. Students drink a small sample and evaluate the degree to which they like the product on a scale of 1-12. The data are collected and used in the following plenary session to demonstrate statistical differences for milk and milk alternative preferences within the class.

As part of the group assignment for Unit Two, students are required to make two food system models – the BC Dairy System and a school. Students are required to model the systems by incorporating the goals, boundaries, inputs, outputs and interactions between components and role of key stakeholders in the system. The purpose of creating the models is to communicate understanding of complex systems in a form that emphasizes relationships and interactions between multiple components and elements of the system, a task that is difficult to achieve in written form. This allows students to begin to apply systems concepts and principles.

The pedagogical activities in Units Three and Four are described in the prior section of this chapter. The objective of the last two units of LFS 250 are to build upon and provide opportunities for preliminary application of the epistemic and ontological foundations and systems competencies of Units One and Two.
2.11 Summary

This chapter provided a description of the Land, Food and Community (LFC) series of core courses in the Faculty of Land and Food Systems, focusing specifically on the three central courses within the series: LFS 250, LFS 350, and LFS 450. The in-depth description of the LFS 250 curriculum and the four pedagogical activities central to this study is intended to provide an adequate background for connecting the study’s methodology, findings and conclusions, which are reported in the subsequent chapters.
CHAPTER 3  Methodology

3.1  Introduction

This chapter presents the methodology used for this study of the LFC series, and the research methods associated with the two components of the study. I describe my research paradigm, theoretical perspective, relationship to the case, and the methods of data collection and analysis used in each component of the study. Following this, I discuss issues related to trustworthiness, reliability, validity, ethics, and limitations of the methodology.

I addressed this research from a social constructivist paradigm with an educational design research (EDR) theoretical framework (McKenney & Reeves, 2012). I used a qualitative case study approach as my methodology. Case study is an appropriate methodology for this study as it provides significant overlap with the EDR theoretical framework, which values contextual descriptions of inquiry and the situated nature of the subject of inquiry, contributing to both theoretical and practical knowledge generation, and constructing generalizations from findings (Anderson & Shattuck, 2012; Flyvbjerg, 2006; McKenney & Reeves, 2012; Thomas, 2010).

There are two components to this study. The objective of the first component is to identify and situate the LFC series pedagogy and program in theories of current scholarly literature in order to further articulate the theoretical basis of the series for an internal and external audience – the former being within the teaching teams of the series and other stakeholders in the Faculty of Land and Food Systems and on the UBC campus; the latter being scholars in educational settings attempting to accomplish similar goals of developing sustainable food system education curricula and/or system thinkers in other domains of knowledge. To accomplish this objective, my insider’s perspective is an asset. Through an autoethnographic approach (Duncan, 2004; Ellis et al., 2010), I draw on peer-reviewed publications focused on the LFC series and my personal experiences in the LFC series as sources of data.
In the second component, I examine the experiences of students in LFS 250 with specific pedagogical strategies employed in the course, focusing on students’ ways of seeing and knowing. I also test the assertion put forth by Salner (1986) and Bawden (Bawden & Packham, 1993; Bawden, 2005; 2007; 2010) that a more encompassing epistemic and ontological cognition is a necessary characteristic of a systems thinker. To address the research objectives in the second component, I explored the experiences of specific pedagogical activities on students’ epistemic and ontological cognition through semi-structured interviews. From the interview responses, I created a profile of each student’s epistemic and ontological cognition based on the model of epistemic and ontological cognition proposed by Greene and colleagues (2010). Students wrote responses to a dual-position problem on an ill-structured, food security scenario and their written responses were analyzed for evidence of an understanding and application of systems principles. Lastly, these written responses were compared to student cognitive profiles to determine if there was evidence of correspondence between understanding and applying systems principles and participant epistemic and ontological cognitive development.

3.2 Research Paradigm

Social constructivism centres on human meaning making as the primary focus of inquiry and draws on human participation in the construction of knowledge (Raskin, 2002). This implies a subjective ontology, where reality is not comprised of external, discoverable truths. Rather, truth is contextual, temporal and situated, dependent upon the interpretations of human perception and cognition (Moses & Knutsen, 2007). The epistemological theory of social constructivism holds knowledge as mediated between sense-making interactions amongst individuals. Values, beliefs, and assumptions of a society shape the origins, limits, and nature of knowledge, as well as legitimate methods of evaluation (Hofer & Pintrich, 2002). Therefore, any methodological initiative for knowledge generation will take into account the perspectives of the human
stakeholders involved. And, it is an analysis of the meanings prescribed by those that have experienced a phenomenon that provide a source of evidence for that particular aspect of reality.

The complexities of educational contexts are immense. It is challenging to capture the impacts of instructional design and the subsequent knowledge construction that is intended to occur at the level of the individual learner. Although experiencing the same educational activity, each participant’s prior knowledge, expectations, and experiences of the event, in and outside of the classroom, are unique, and therefore, create as many interpretations and realities as there are individuals experiencing the phenomena.

The theoretical premises of social constructivism are made tangible in the LFC series. The intentions of the instructors can be misconstrued. The interpretation of course content by teaching assistants can stray from the intended meaning of the material when being relayed to students engaging with new knowledge domains and novel pedagogical strategies. The amount of time dedicated to group work is a heavy filter through which many elements of the course are experienced – enjoying the course and feeling that it is a worthwhile experience is often synonymous with enjoying one’s group.

Being part of the LFC series demonstrated to me that although we are all experiencing the same educational activities – in the lecture hall, on a farm, in the community, or in a small group setting - each participant constructs diverse interpretations and understandings from a common experience. Subsequently, a social constructivist perspective is an appropriate framework for an investigation within this context.

### 3.3 Author’s Connection to the Case

Having been a participant in the LFC series for the past seven years, as student, teaching assistant, course coordinator, community partner, instructor, and researcher, my identity in the
research process and context of the study has been blurred. In the methods section of the first component of the study, I will describe in-depth my various roles and experiences with the LFC series as they pertain to autoethnographic sources of data. Here, I discuss my role as researcher and its implications on research design in both components of the study.

I began my work in the LFC series as an outsider, slowly gaining an understanding of the intentions of the original creators of the LFC series as well as becoming a co-creator of the series through membership in the teaching team. Entering the teaching team after the LFC series had been in place for nine years was beneficial. By this time, the context of the transition and branding of the faculty towards sustainability had been progressing for nearly a decade. The instructional strategies, activities and content, although annually reviewed and adjusted, had reached a logistical and theoretical steady-state. I was not entering a program that was operating in its first years where few activities had been field-tested. This meant that certain levels of uncertainty that are inherent to new educational programs had been eliminated or minimized. The timing of my arrival in the teaching team meant that there was opportunity for conversations about past experiences and future directions the core series could take. Through the processes of collaborative reflection amongst members of the teaching team while simultaneously planning for future iterations of the courses, my experiences have provided access to varying perspectives in the series. And for that reason, I am in a position to construct a well-informed portrait of the LFC series.

In the methods section of the second component of the study, I will discuss the implication of my dual role as instructor-researcher and how it impacted data collection strategies. In the following section, I consider my role as researcher at the level of knowledge generation.

The objectives of the second component are to interpret students’ experiences with particular pedagogical strategies in LFS 250, assess students’ ability to understand and apply systems principles, and determine if there is evidence of correspondence between this ability and
levels of epistemic and ontological cognition. Exploring correspondence between epistemic and ontological cognition and systems thinking present an opportunity to analyze the researcher as interpreter, co-constructor, and embedded participant in a social web of meaning.

Being involved in a program that seeks to engage food systems students with community-based learning experiences made me curious about whether other organizations have had success with similar objectives. Through the writings of Richard Bawden from the Hawkesbury School of Agriculture at the University of Western Sydney, I recognized a similar pattern of transformation in a similar context, but with a primary agricultural production focus, not a food systems focus (Bawden & Packham, 1993). Bawden and colleagues posited that complex epistemic beliefs were a key component to systems thinking. Therefore, educational programs that sought to develop systems competencies would need to also target student levels of epistemic cognition (Bawden & Packham, 1993; Bawden, 2005, 2007, 2010). They assert this claim as rationale for certain aspects of their educational design of critical learning systems, but they have not published accounts that empirically test this assumption. This is an example of social constructivist theory. My understanding of reality has been transformed by interacting with Bawden and colleagues’ writings. Their claims resonated with the goals and experiences of the teaching teams in the LFC series and influenced my approach to this research.

In order to explore Bawden’s assertion, it was necessary to seek evidence that support his claims. In my research, this involved the participation of another set of social actors, the students in LFS 250, and their interpretations of events as elicited through semi-structured interviews, with my adopting the role of researcher. I interpreted the students’ responses to my questions and compared the data to the initial assertion. This process was influenced and mediated by my doctoral supervisory committee, which added another layer of social interaction to the co-creation of knowledge. At each step, each actor’s previous experiences and interests affected key decisions in the process, from knowledge disseminated findings from a particular time and locale
in Australia, to my interest in the LFC series pedagogical initiatives, our students willingness to engage in the interview and data collection process, and the processes of qualitative research guided by my dissertation committee.

### 3.4 Theoretical Perspective

In this section, I describe the theoretical framework that guides my study. I situated my research within an Educational Design Research (EDR) framework. EDR is a form of scientific inquiry in which “the development of solutions to practical and complex educational problems also provides the context for empirical investigation, which yields theoretical understanding that can inform the work of others” (McKenney & Reeves, 2012, p. 7). Being situated in learning experiences in classroom settings, both theory and practice are enhanced in EDR, engaging researchers and practitioners in the direct improvement of educational practices. My research strives to yield “useable knowledge and interventions built on sound reasoning and robust evidence” (McKenney & Reeves, 2012, p. 30).

Van den Akker (1999) describes EDR as having four prominent elements: a preliminary investigation; theoretical embedding; empirical testing; and, documentation, analysis, and reflection on process and outcomes. The first component of the study, situating the LFC series in current scholarly literature, provide a context for the second component, and develops a framework for sustainable food system education programs aiming to address food systems as socio-ecological systems. Educational programs whose objective is to develop student competencies to address issues of this nature will have to incorporate interventions that target epistemic and ontological cognitive development into their design. This is the context for empirically validating, refining or refuting the theoretical orientation of the above objective (McKenney & Reeves, 2012). The intervention under investigation in the second component is the set of pedagogical activities in the first two units of LFS 250. The methods of the second
component provide empirical data for analysis and reflection on process and outcomes. The results of that analysis and reflection are reported in Chapter Five results and discussed in the concluding chapter of this dissertation.

The objectives of both components connect to McKenney and Reeve’s (2012) classification of EDR goals as descriptive, developmental and predictive. The first component describes the theoretical elements of the LFC ecology of knowledge for cultivating students that can understand and apply systems principles to food system issues. The second component seeks to understand the significance of the interventions within the design of the LFC series. The second component also provides empirical testing of the assertion that students with more encompassing epistemic and ontological cognition will display a greater understanding and application of system principles.

The outputs of EDR are both theoretical and practical (Anderson & Shattuck, 2012; Edelson, 2002; McKenney & Reeves, 2012; Van den Akker, 1999). The former allows for abstracting from empirical findings and contributing to a body of knowledge useful to others. The latter contributes to solving problems of practice and offers an opportunity to reflect and learn about the process of educational design and instruction, a process Schön (1983) describes as being a reflective practitioner. In terms of generalizability of outputs, EDR scholars emphasize the need to clearly report the contextual specifics of any EDR study in order to allow the reader to compare to the context and setting of her own practice (Anderson & Shattuck, 2012; Edelson, 2002; McKenney & Reeves, 2012; Van den Akker, 1999). In a classroom setting, it is difficult to control the innumerable factors that may influence the outcome of an intervention, making replication, in the experimental sense, impossible. However, explicating the local conditions as an integral element of the results of a EDR study can enable researchers to cautiously extrapolate findings from one context to the next (McKenney & Reeves, 2012, Van den Akker, 1999).

With that discretion in mind, Edelson (2002) describes EDR as contributing to two types of domain theories: context and outcome. Context theory characterizes the challenges and
opportunities of a class of design contexts, which for this research would be educational programs whose objective is to cultivate system thinkers capable of designing and implementing solutions in domains with high levels complexity and uncertainty. Outcome theory is characterized by the set of outcomes associated with an intervention, which for this research would be the pedagogical activities that target student epistemic and ontological cognitive development.

3.5 Qualitative Case Study Methodology

Having described my social constructivist research paradigm and educational design research theoretical framework, I define what a case study is and why it is an appropriate methodology for this study. I then describe the nature of the two components in this study, making a distinction between the subject and object within each.

As a number of authors have expressed, there are many definitions of a case study – as method, methodology, research design, or approach to inquiry (Creswell, 2012; Thomas, 2011; Van Wynsberghe & Khan, 2008). I have adopted Thomas’ (2011, p. 513) definition:

"Case studies are analyses of persons, events, decisions, periods, projects, policies, institutions, or other systems that are studied holistically by one or more methods. The case that is the subject of the inquiry will be an instance of a class of phenomena that provides an analytical frame—an object—within which the study is conducted and which the case illuminates and explicates."

What is of particular importance when adopting a case as a unit of inquiry is the distinction between the subject and object of the study (Thomas, 2011; Van Wynsberghe & Khan, 2008). This separation, and the coherence between the two, allows inquiry to move beyond a narrative of practice and establish an analytical or theoretical framework (Cousin, 2005; Thomas, 2011). The object of the case constitutes “the analytical frame within which the case is viewed and which the case exemplifies” (Thomas, 2011, p. 514). The object, or class of phenomena, of this study is sustainable food system education programs. The subject of the first component of the study is the theoretical framework of the LFC series. The subject of the second component of the
study is the set of pedagogical activities carried out in LFS 250 that target student epistemic and ontological cognitive development and systems thinking competencies.

According to Thomas (2011), it is important to recognize that the subject of the case is not a representative sample from a wider population but rather, the subject is an “interesting or unusual or revealing example through which the lineaments of the object can be refracted” (Thomas, 2011, p. 514). Subjects can be classified as local, key, or outlier cases. A local case is of particular interest to those that are within the boundaries of the study and familiarity of the subject is an asset to the inquirer. Key and outlier subjects are able to “exemplify the analytical object of the inquiry” through representative similarity or difference of a phenomenon, respectively (Thomas, 2011, p. 514).

The subject of a case is recognized as a unique phenomenon, singular in its existence, and therefore cannot be replicable in the experimental sense. This removes any ability for a case to be considered “typical” of any other case as the system is always changing (Thomas, 2011). The essence of the case, then, lies in the relation between subject and object, and the findings or assertions that can be taken from the inquiry are constructed by the efforts of the case inquirer and the case reader (Thomas, 2011). Thomas (2010, 2011) distinguishes this type of understanding as exemplary knowledge, distinct from generalizable knowledge.

Equally important for assuring understanding for readers of the inquiry is a thick description of the context and characteristics of the case (Stake, 1995; Yin, 2009). Chapter Two provides the historical and contextual details of the LFC series and a thick description of LFS 250, the subjects of the first and second components of the study, respectively.

Thomas (2011, p. 518) provides a case study typology which presents a range of trajectories based on differing purposes, approaches, and processes available to a case inquirer and connections to the subject, object, methods of data collection, and category of time use. I use
this typology to frame both components of the study, and to distinguish between the two. Both rely on qualitative methods of data collection but vary in the other categories of classification.

In Thomas’ (2011) typology, the purpose of the case is intrinsic if findings are of value to those involved in the case; instrumental if findings are of value to a wider audience; evaluative if it seeks to assess the outcomes of a case; or, exploratory if framed as a plausibility study or arrives at notions of problems to solve (Thomas, 2011). The approach to the case can be considered either theoretical or illustrative, the former being theory testing or theory building, and the latter being descriptive. The process of a case delineates the boundary considerations of the study, conceptually and chronologically. A case study can be considered single or multiple, the latter determined by a comparative element being present in the study. Chronologically, for a single case study, a case can look at events in the past (retrospectively), over a defined period (via a snapshot) or as change over time (diachronically). For multiple case studies, it is useful to distinguish between nested (comparison of elements within a case), parallel (components of the case are occurring concurrently) or sequential (one element of the study follows another and this relationship has an impact on the outcomes of the case) (Tomas 2011, p. 517). In the next sections, the two components of this study will be characterized using Thomas’ (2011) typology, followed by details of the analytical approaches taken.

### 3.6 Component One: The Theoretical Elements of the LFC Series

The subject of the first component of the study is the Land, Food and Community (LFC) series in the Faculty of Land and Food Systems at the University of British Columbia. Following Thomas’ (2011) typology, the LFC series can be considered a local and key case. It is local, as I am, and have been, embedded within the case in a number of roles over the past seven years. Fenno (1986, 1990 as cited in Thomas, 2011, p. 514) refers to this as the “soak and poke” position. That is, I am already soaked in the context of the study and I am in a good position to
poke around and ask questions. At the same time, the LFC series can be considered a key case as it exemplifies the object of study, an undergraduate SFSE program with the objective of cultivating a particular ecology of knowledge to develop system thinkers. Although this educational program is in the domain of food systems, the elements of this particular ecology of knowledge, and how it is actualized in an institutional setting, is of use to others interested in achieving similar educational objectives - developing students that can understand and apply systems principles to ill-structured problems. This blended nature, both local and key, can be considered a “contextual study of theory-informed practice that has transformative value both for local practice and practices elsewhere” (Corcoran, Walker, & Wals, 2004, p. 9).

The purpose of the first component is both intrinsic and instrumental. The results of the inquiry will contribute to increased conceptual coherence amongst the faculty and instructors involved in the LFC series as well as the faculty body as a whole: the academic administrators that oversee curricular development, faculty that teach within the other programs, and the students that are enrolled in the mandatory courses. The study is instrumental as the findings can inform a wider audience about the nature of the LFC series – both its strengths and limitations – which will contribute to efforts in similar settings.

The approach can be viewed as both illustrative and theory building. Identifying and situating the key theories of the LFC series within different scholarly domains can be considered a descriptive task; however, the synthesizing and integrative nature of an interdisciplinary analysis is a unique form of knowledge production in itself, and has the potential to contribute to theory building (Aboelela et al., 2007; Bateson, 1972; Golde, 1999). In terms of process, this study is a single case study. The analysis is limited to the theoretical framework of the LFC series. The chronological process of the study is retrospective due to the nature of the data collection methods: autoethnographic and document analysis.
3.6.1. **Research Questions**

In component one of the study, my research questions are

1. What are the theoretical elements of the LFC series approach to SFSE program development?
2. How does the theoretical framework of the LFC series situate within other scholarly domains?

3.6.2. **Autoethnographic Approach**

I adopted an autoethnographic approach to identify the theoretical elements of the LFC series as a SFSE program. Autoethnography “is an approach to research and writing that seeks to describe and systematically analyze (graphy) personal experience (auto) in order to understand cultural experience (ethno)” (Ellis, Adams, & Bochner, 2010, p. 1). As a method of data collection, a researcher retroactively and selectively analyzes past experiences and may rely on other sources of data to inform this lived experience (Ellis et al, 2010). My different roles within the LFC series over the past seven years (see table 3.1) have allowed me to gain insights into the theoretical framework of the series in a way that would be difficult for an outsider to achieve. These experiences allow me to report directly through a coalescence of perspectives from multiple roles I have inhabited. As stated by Duncan (2004, p. 3), in autoethnography, the “researcher is not trying to become an insider in the research setting. He or she, in fact, is the insider.”

3.6.3. **Methods of Data Collection**

I drew upon peer-reviewed publications focused on the LFC series and reflections on personal experiences in the LFC series as sources of data to identify the key theoretical elements of the LFC series as a SFSE program. The elements were then situated in the domains of learning theory, systems theory, cognitive psychology, and community-engaged scholarship. Findings of the first component of the study are reported in Chapter Four.
3.6.3.1 Document Analysis

To identify the key elements of the LFC series, I analyzed peer-reviewed articles published in scholarly journals. Although the structure and content of the LFC series has been developed collaboratively over the past 13 years with the help of numerous professors, teaching assistants, students, and community members, Rojas has been the primary formulator of the theoretical elements of the series. Specifically, I reviewed and analyzed four scholarly articles (Rojas, Richer, & Wagner, 2007; Rojas, 2012; Rojas, 2009; Rojas, Sipos, & Valley, 2012), and nine lessons published in an academic workbook edited by the Academy of Nutrition and Dietetics, Hunger and Environmental Nutrition Dietetic Practice Group (Harmon, 2013) to complement my personal experiences derived from inhabiting multiple roles with the LFC series. In the document analysis, I searched for ordering devices like keywords, themes, and messages, which act as signals for interpreting information and concepts (Hajer & Laws, 2006).

3.6.3.2 Personal Experiences in the LFC Series

As a student in the LFC series, I experienced first-hand the transformative potential of the series’ perspectives, processes, and content. As a teaching assistant with the first, second, and fourth year courses over four years, I was able to witness the longitudinal development of the students in the series. I was involved in the design and evaluation of student assessments in this role as well. This provided opportunity to be immersed in individual student understanding and competencies while at the same time being aware of the scaffolding of the learning objectives of each course and the series as a whole.

As the project coordinator of the Think&EatGreen@School project, the community-based action research project that involves students from LFS 250 and LFS 350, I was placed in the role of community partner engaged with overseeing student groups in defining, designing, implementing, and evaluating community-based experiential learning projects. This is a different
perspective than being part of the teaching team. This often allowed for working more intimately with one or two groups of students on specific projects in the community, as compared to being responsible for connecting the experiences to curricular content and delivering academic assessments, which in the role of teaching assistant is with a significantly greater number of students.

As course coordinator of LFS 250, I was responsible for organizing the community-based experiential learning projects, communicating with instructors, teaching assistants, and thirty-six K-12 schoolteachers who were acting as community partners. Further, I was responsible for connecting with both the LFS 250 teaching team and the academic and community co-investigators of the Think&EatGreen@School. Engaging with each stakeholder group to arrange student projects enabled recognition and appreciation for the different perceptions, needs, and wants of the diverse groups, which all fundamentally aligned around elements of creating meaningful learning experiences for the students involved and the hope of creating positive change. And finally, as instructor of LFS 250 and LFS 450, my academic responsibilities increased to include a greater portion of the course logistics, content delivery, teaching team management, and engagement with the CBAR project stakeholders. Table 3.1 lists my roles within the LFC series beginning as a student in 2006 to my role as instructor of LFS 250 and LFS 450 in 2012.

<table>
<thead>
<tr>
<th>Year</th>
<th>Role</th>
<th>Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>Student</td>
<td>LFS 250</td>
</tr>
<tr>
<td>2007</td>
<td>Student</td>
<td>LFS 350</td>
</tr>
<tr>
<td>2008</td>
<td>Teaching Assistant</td>
<td>LFS 250</td>
</tr>
<tr>
<td>2009</td>
<td>Teaching Assistant</td>
<td>LFS 450</td>
</tr>
<tr>
<td></td>
<td>Teaching Assistant</td>
<td>LFS 250</td>
</tr>
<tr>
<td></td>
<td>Teaching Assistant/Course Coordinator</td>
<td>LFS 100</td>
</tr>
<tr>
<td></td>
<td>Community Partner</td>
<td>LFS 350</td>
</tr>
<tr>
<td>2010</td>
<td>Teaching Assistant</td>
<td>LFS 450</td>
</tr>
<tr>
<td></td>
<td>Teaching Assistant</td>
<td>LFS 250</td>
</tr>
<tr>
<td></td>
<td>Teaching Assistant/Course Coordinator</td>
<td>LFS 100</td>
</tr>
<tr>
<td></td>
<td>Community Partner</td>
<td>LFS 350</td>
</tr>
<tr>
<td>2011</td>
<td>Teaching Assistant</td>
<td>LFS 450</td>
</tr>
<tr>
<td></td>
<td>Course Coordinator</td>
<td>LFS 250</td>
</tr>
</tbody>
</table>
### Table 3.1 Personal Roles in LFC Series since 2006

<table>
<thead>
<tr>
<th>Year</th>
<th>Role</th>
<th>Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>Community Partner</td>
<td>LFS 350</td>
</tr>
<tr>
<td></td>
<td>Community Partner</td>
<td>LFS 450</td>
</tr>
<tr>
<td>2012</td>
<td>Instructor</td>
<td>LFS 450</td>
</tr>
<tr>
<td></td>
<td>Instructor</td>
<td>LFS 250</td>
</tr>
<tr>
<td></td>
<td>Community Partner</td>
<td>LFS 350</td>
</tr>
</tbody>
</table>

#### 3.7 Component Two: EOCD and Systems Thinking Competencies

The object of the second component of the study is an introductory undergraduate course in a SFSE program: Land, Food and Community I (LFS 250). The subject of the second component is student experiences with specific pedagogical activities within the course that target students’ relationships with ways of knowing and seeing, or more formally, their epistemic and ontological cognition, as well as pedagogical activities directed at students’ abilities to understand and apply systems principles to food system problems. For similar reasons as the first component of the study, the subject of the second component is classified as both local and key. The purpose of the second component is intrinsic and instrumental, similar to the first component.

The approach to the second component is theory testing. The research objectives are founded on the assertion that in order to understand and apply systems principles, students need to develop more sophisticated epistemic and ontological cognitive abilities (Bawden, 2010; Salner, 1986). Data analysis will either provide evidence to support or refute this assertion. The second component is a single case, with data collection being limited to a cohort of students (n=37) enrolled in the course in the fall semester of 2012 (September to December). The data collection methods consist of semi-structured interviews and responses to a dual-position, expository food security problem completed by the study participants.

#### 3.7.1 Methods of Data Collection

The following are the research questions answered in the second component of the study:
1. Is there evidence that specific pedagogical activities employed in LFS 250 are impacting student epistemological and ontological beliefs?
2. Is there evidence that students understand and apply systems principles to a food system problem-situation?
3. Is there correspondence between epistemic and ontological development and competence in applying systems principles?

To address the research questions, I developed a semi-structured interview guide and a dual-position food security problem that required participants to write an expository conclusion. A semi-structured interview approach is appropriate when research questions seek to elicit participant descriptions of their experiences and explanations of their answers given (Rubin & Rubin, 2012). The goal of the interview process was to yield rich information about how the pedagogical activities impacted participants ability to use evidence to construct interpretations and conclusions, and whether they were able to arrive at a judgment without fear that doing so denies an appreciation for other perspectives (King & Kitchener, 1994). By having participants write a conclusion to a dual-position problem, I aimed to reveal their approaches to evaluating competing claims and their justification for supporting a particular position (Kardash & Howell, 2000; Mason & Boscolo, 2004). Specifically, texts were analyzed for evidence of participants’ use of the systems principles, holism and pluralism. In the following sections, I outline the design, adaptation, and implementation of the interviews and dual-position problem.

3.7.1.1 Semi-structured Interviews

The recruitment process for inviting students to participate in the study began after the final marks of the course were submitted. The invitation for interviews was sent out to the entire LFS 250 cohort in 2012 through a UBC faculty email service. If students were interested in participating, they were asked to contact the author through email. Attached to the initial email were ethical review board consent forms and a description of the study informing the student that the interviews would be recorded and written responses would be used as data for the study. Anonymity and the ability to withdraw from the study at anytime, for any reason, were
emphasized in the recruitment process and again before beginning the interview. Thirty-seven participants, approximately 14% of the students enrolled in LFS 250 in 2012, were interviewed in February and March of 2013.

Following Rubin & Rubin’s (2012) stages of the responsive interviewing, my initial interview guide (see Appendix A) began with an introduction to the topic of the interview (students’ experiences in LFS 250) and asked participants to provide background information about themselves (e.g., why did they enroll in the faculty? What was their degree specialization? What careers were they interested in pursuing?). Following the introduction, I asked broad questions about their experiences in the course, such as “Were the majority of experiences and concepts in LFS 250 new to you?” and “What were one or two significant themes that have remained with you from our course?” After the general questions were complete, the interview focused on specific pedagogical activities from the course (e.g., the elephant and the blind men diagram, the flashlights in the forest activity, and creating systems models). These formed the basis of the main questions of the interview and were interspersed with questions derived from the Model of Epistemic and Ontological Cognitive Development Questionnaire (see Appendix D) (Greene, Torney-Purta, & Azevedo, 2010). Probing questions were drawn from the Reflective Judgment Interview (RJI) (King & Kitchener, 1994). Questions from the former focused on dimensions of knowledge (simple and certain) and justification (by authority and personal experience), and the basis for holding a certain belief or the certainty with which it is held. Probes from the RJI were used to elicit participants’ understanding of differences in perspectives and opinions and how respondents used the point of view of an expert to make decisions. The interview closed with the open-ended question: “Is there anything else about your experience in LFS 250 that you would like to talk about?” and my thanking the participant for their time.

Prior to interviewing the students, I conducted pilot interviews in January 2013 with five teaching assistants from the 2012 course. Apart from improving the flow and clarity of the
interview process (i.e. my familiarity with recording equipment, finding the optimal distance to the microphone, and comfort with delivering the sequence of questions), the pilot interviews assisted in developing more concrete prompts and follow-up questions.

3.7.1.2 Dual Position Expository Food System Problem

After the interview, participants were asked to write a concluding paragraph to a dual position expository problem prepared by the author on the topic of increasing food security of a fictional island (see Appendix B). Students were familiar with the concept of food security from the course but had not been presented with a scenario of this nature. The text was divided into three sections. The first section contained instructions for completing the task and a neutral introduction containing island demographics and food system assets. The second section offered a Food Citizenship proposal to increasing food security. The third section offered an Economic Development proposal. The problem was circulated for review by three university professors: two food security experts and one science education and food literacy expert. They were asked to consider the problem in terms of difficulty, strength of arguments, and plausibility of the two proposals. The problem was also piloted with the teaching assistants that participated in the pilot interviews. All three experts accepted the final version of the dual-position problem as appropriate for eliciting student responses in an accurate, balanced, and non-leading manner. The problem contained no overall concluding paragraph or final statement. Two versions of the dual position problem were used. Half of the participants received a version in which the Economic Development proposal was presented first, and half received the Food Citizenship proposal presented first.

The problem framed the two proposals as being submitted to the municipal government of the island by interested parties that lived on the island. Student participants were asked to place themselves in the role of a food system consultant hired to assist the government in evaluating the
proposals. The introduction of the problem provided quantitative and qualitative descriptors of the island: number of residents, rural/urban population, number and type of farms, composition of food producing assets of the island (cultivated and wild), number and type of food retail outlets and restaurants, percentage of crops exported and food imported, and the average cost of transporting food to the island over the past five years. This informed the participants of the components and context of the island’s food system. The instructions given to the students were as follows:

- Write a response to the council describing a course of action for increasing food security for island residents based on the two proposals
- Support your decision with explicit justifications
- Limit your response to 1000 words

The purpose of the Economic Development proposal lay in creating a stinging nettle processing plant that would create six full-time and four part time jobs on the island using nettles as an abundant and renewable natural resource. Profits of the processing plant would offset the cost of shipping food to the island, maintaining the convenience and diversity of the current food system at a lower cost to island residents. The objectives of the Food Citizenship proposal focused on creating a local food non-profit, whereby the community could re-assess its food system assets and determine ways to become more self-reliant. This would require increasing the connections between island farmers, food producers, and food retail outlets; increasing the number of residents that grew their own food in household gardens and hunted and foraged in the forests of the island; increasing awareness and skills for preparing nutritious meals from seasonal, local ingredients; and, developing a facility that turned the island’s organic waste material into a soil amendment for gardeners and farmers of the island. The non-profit organization would create two full-time jobs and would require annual funding from the municipal government.
3.7.2. Data Analysis

All audio recordings of interviews and written responses to the dual-position problem were transcribed by the author and reviewed for accuracy before entering into a qualitative data coding software program (Atlas.ti 7.0). Students’ responses were then coded with a priori codes based on interview questions, research questions, and the theories upon which the latter questions were based. The coding framework is located in Appendix C. Themes were generated through in-depth examination of transcripts by sorting, clustering, and comparing segments of transcribed text (Boyatzis, 1998) to characterize

a) student experiences of specific pedagogical strategies,
b) participants’ epistemic and ontological cognitive profiles (Greene et al., 2010), and
c) students’ understanding of and ability to apply system principles (Reynolds & Holwell, 2010),

3.7.2.1 Semi-Structured Interview Analysis

To answer research question one, coded responses were organized based on the specific pedagogical activities addressed in the interview. Codes associated with a pedagogical activity were exported into a spreadsheet with associated coded responses. Summary statements for each activity were analyzed and are reported in Chapter Five.

3.7.2.2 Determining Understanding and Application of Systems Principles

During semi-structured interviews, participants were asked to define a systems approach (Q: What does taking a systems approach mean to you?). Reponses to this question were coded for evidence of pluralism, holism, or both. A table of participant responses is located in Appendix E. Additionally, based on Reynolds and Holwell’s (2010) core principles of systems thinking (holism and pluralism), participants’ written responses to the dual-position problem were analyzed using the rubric below (Table 3.2). Responses were analyzed for presence or absence of holism, pluralism, and linear thinking and, assessed on the strength of their argument based on examples
given to support their claims. Based on this analysis, participants’ written responses were rated on a scale of one to seven.

<table>
<thead>
<tr>
<th>Rating</th>
<th>Description</th>
</tr>
</thead>
</table>
| 1      | • Significant reliance on linear thinking in justification  
|        | • Absence of holistic and pluralistic justification |
| 2      | • Some linear justification  
|        | • Presence of either holistic or pluralistic justification, but not both |
| 3      | • Minimal linear justification  
|        | • Presence of either holistic or pluralistic justification |
| 4      | • Linear justification absent  
|        | • Indications of holistic and pluralistic justification but not supported with examples |
| 5      | • Linear justification absent  
|        | • Holistic and pluralistic justification present with minimal examples |
| 6      | • Linear justification absent  
|        | • Holistic and pluralistic justification present with examples |
| 7      | • Recognition of nature of problem and reference to systems approach  
|        | • Linear justification absent  
|        | • Holistic and pluralistic justification present with examples |

Table 3.2 Dual Position Text Analysis and Rating Rubric

3.7.2.3 Epistemic and Ontological Cognitive Profiling

Research question three was answered by comparing participants’ cognitive positions with the food security problem response rating. In Greene and colleague’s (2010, p.154) Model of Epistemic and Ontological Cognitive Development (MEOCD), participant responses to survey items indicate ontological beliefs about the nature of knowledge and levels of agreement or disagreement with sources of justification. The relationship between ontological and epistemological dimensions determines the position to which participant responses match (see Table 5.2).

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Position</th>
<th>Simple and Certain</th>
<th>Justification by Authority</th>
<th>Personal Justification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Realist</td>
<td>Strong</td>
<td>Strong</td>
<td>Strong</td>
<td>Strong</td>
</tr>
<tr>
<td>Dogmatist</td>
<td>Weak</td>
<td>Strong</td>
<td>Weak</td>
<td>Strong</td>
</tr>
<tr>
<td>Skeptic</td>
<td>Weak</td>
<td>Weak</td>
<td>Strong</td>
<td>Weak</td>
</tr>
<tr>
<td>Evaluativist</td>
<td>Weak</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
</tbody>
</table>
Table 3.3 MEOCD Position from Dimension Response (adapted from Greene et al, 2010)

On a likert-scale, realists would agree strongly with statements concerning knowledge as simple and certain, whereas all other positions would respond to statements of this nature with a weak agreement. A strong agreement with the justification by authority or personal justification dimension separates dogmatists from skeptics. A moderate agreement in these two dimensions indicates that justification can occur from either authority or personal experience depending on the context.

Interview transcripts were analyzed and coded following the three dimensions of Greene and colleagues' (2010) MEOCD: knowledge as simple and certain (SC), justification by authority (JA), and personal justification (PJ). Codes representing the oppositional statements to the 3 dimensions were also used in analysis (XSC, XJA, and XPJ). For example, the following statement, “You can’t trust scientific evidence anymore, it’s all biased by corporate funding” would be coded as XJA. Statements that matched a particular stage of the MEOCD were coded as Realist, Dogmatic, Skeptic, or Evaluativist23.

Coded statements for each participant were then clustered together and analyzed to develop a profile indicating their position in the MEOCD: realist, dogmatist, skeptic, and evaluativist. Analysis considered the quality of the responses (weak or strong endorsement for the source of justification) and consistency across the interview. The following two interview questions were particularly useful in revealing participants’ ability to integrate and evaluate different sources of knowledge (from personal experiences and authority) within the context of the food system.

• How do you decide who has the most accurate opinions in the food system?

23 The first three terms are based on positions in the MEOCD, the fourth term is broadly utilized in the cognitive and educational psychology fields (see Hofer, 2004; Kuhn & Weinstock, 2002; Muis, Bendixen, & Haele, 2006). I feel that evaluativist is a more appropriate title for this position in the sense that it does not privilege rationality as having a higher status amongst diverse ways of knowing.
If two food system experts from different cultures disagreed on a fact, how do you decide whom to believe?

### 3.8 Methodological Issues

In this section, I highlight methodological issues related to trustworthiness, ethics, and limitations of the methods employed in the study.

#### 3.8.1. Trustworthiness of Methods and Analysis

Lincoln and Guba’s (1985) model of trustworthiness of qualitative research has four components: truth-value, applicability, consistency, and neutrality. I explain each of these components and then describe my research methods and analysis with respect to each.

##### 3.8.1.1 Truth-Value

Truth-value refers to the elements of the study that allow for accurate representation of the interpretations and responses of participants (Lincoln and Guba, 1985). In the first component of the study, my description and interpretation of the LFC series and its objectives has been reviewed by Alejandro Rojas, one of the original creators of the series, and Andrew Riseman, a member of the LFC team of instructors since 2008. I use direct quotations as evidence to support my analysis of the peer-reviewed publications on the LFC series. In the second component of the study, interviews were recorded and transcribed by the author. I then reviewed the transcripts with the original interview audio recordings a second time to ensure accuracy. When reporting results in Chapter Five, I use the words of the participants in direct quotes as much as possible.

##### 3.8.1.2 Applicability

Applicability is defined as “how one determines the extent to which the findings of a particular inquiry have applicability in other contexts or with other subjects/participants” (Lincoln and Guba, p. 290). Within an Educational Design Research (EDR) theoretical framework, scholars emphasize the need to clearly report the contextual specifics of a study in order to allow the
reader to compare to the context and setting of his or her own practice (Anderson & Shattuck, 2012; Edelson, 2002; McKenney & Reeves, 2012; Van den Akker, 1999). I have written elements of Chapter One and the whole of Chapter Two to represent the theoretical and contextual characteristics of the study. My creating a thick description of the theories and context within the study is an attempt to provide the reader with enough information to extrapolate findings to his or her own context.

3.8.1.3 Consistency

Consistency within qualitative research relates to the ability of the reader to follow the sequence of decisions undertaken by the researcher to come to findings and conclusions within the study (Lincoln and Guba, 1985). Variability in a qualitative research setting is expected. To increase the dependability of results and conclusions, “the exact methods of data gathering, analysis, and interpretation in qualitative research must be described (Krefting, 1991, p. 221). This ideal of repeatability was considered from the beginning of the research process and is reflected in the level of detail provided in this chapter. Further, data collection instruments and samples of data collected from participants are presented in the appendices.

3.8.1.4 Neutrality

Neutrality in qualitative research relates to the researcher’s ability to establish the “degree to which the findings of an inquiry are determined by the subjects and conditions of the inquiry and not by the biases, motivations, interests, or perspectives of the inquirer” (Lincoln and Guba, 1985, p. 290). My many roles within the LFC series provided direct access to key actors in the course – instructors, teaching assistants, community partners, and students. This access afforded me a level of intimacy with the theories, strategies, reflections, and limitations of the LFC pedagogical approach that would be unattainable from an outside perspective. However, in terms of researcher neutrality, this degree of proximity to the subject of investigation may imply
concerns regarding researcher bias. In one sense, my position within the series has allowed access to perspectives from key stakeholders in the series and in the faculty, including candid reflections on the good, the bad, and the ugly elements of this program. These insights have given me a broad understanding of the LFC series. I have listened to the well-reasoned and articulated perspectives of the most vocal opponents to the series as well as its champions. Both sides inform my research approach.

3.8.1.5 Ethical Considerations

My position as instructor for LFS 250 of the cohort of students that I interviewed may raise questions of power and coercion, which raise concerns of trustworthiness and ethics. To address ethical concerns of coercion, contact with the students occurred after the course marks had been finalized and submitted, eliminating the perception that participating in this research could positively or negatively affect grades. At the beginning of the interview process, I was careful to emphasize my role as sessional instructor in the faculty. I explained that the likelihood of my being an instructor in any other course was very small. Finally, students were told that they were free to drop out of the study at any point without consequences. This was stated in the study advertisement, consent form, and repeated before the interview proceeded. No use of deception was used in the case study. UBC Research Ethics approval was received before inviting students to be interviewed (Certificate Number H12-00771).

3.8.2. Strengths and Limitations of the Methods

3.8.2.1 Selection Bias

Participation in the second component of the study was voluntary. There was no attempt to select specific students based on predetermined characteristics such as age, gender, race, grade point average, or major. The recruitment goal for the study was 1.5% of the student cohort. There was no attempt to define or recruit a representative sample of students. Seeking
“representativeness” was not attempted, as I was not seeking to construct and report an average experience of students in LFS 250. Rather, I am seeking to draw forth and report on a range of experiences of students in the course.

3.8.2.2 Sample Size and Qualitative Methods

Research in epistemic and ontological cognitive development has had a conceptual struggle between qualitative and quantitative data collection methods (Greene, Azevedo, & Torney-Purta, 2008; Hofer & Pintrich, 2002). The most effective approach to understanding participants’ processes of reasoning and justification is in-depth interviews. However, the interview process is cumbersome and expensive, limiting its use to small sample sizes (King & Kitchener, 2004). Due to my sample size (n=37), the interview process was feasible and provided opportunity to ask follow-up questions when responses were unclear. With all small sample sizes comes the inability to design a study that can produce statistically significant results. Generalizability in the positivist sense was never an intention of this research; therefore, a small sample size and use of qualitative interview methods were not viewed as limitations for the study.

As with all interpretative methodologies, researcher bias and error are a concern. To mitigate these concerns, I have attempted to provide sufficient detail of the context and openly stated assumptions that guide this research. Interview coding frameworks and examples of application of the rubric to written responses can be found in Appendix C and F, respectively. Transcripts of interviews and written responses to the dual-position text are available upon request.
CHAPTER 4  Results – Key Elements of the Land, Food and Community Series

4.1 Introduction

The purpose of this chapter is to report the findings of the first component of the study, the objectives of which are to identify and situate the elements of LFC series to articulate the theoretical foundations of the LFC approach to sustainable food system education (SFSE) program development. I adopt an autoethnographic approach, drawing upon peer-reviewed publications and my personal experiences as sources of data, to identify the key elements of the LFC theoretical framework, which are further situated within scholarly literature. My analysis identified four key elements, allowing for an articulation of the LFC theoretical framework into a single statement. The elements are then situated within critical constructivist learning theory, with emphasis on the educational theories of Freire (1970, 1987) and Bateson (1972, 1979). I relate the LFC use of systems theory to the broader systems literature. Next, I compare the LFC ecology of knowledge with Cognitive Flexibility Theory of learning, instruction, and knowledge representation. Finally, the LFC ecology of knowledge is presented as an epistemological orientation towards Community-Engaged Scholarship.

4.2 Theoretical Framework of the LFC Series

I adopted an autoethnographic approach to address the two research questions of the first component of the study:

1. What are the theoretical elements of the LFC series approach to SFSE program development?
2. How does the theoretical framework of the LFC series situate within other scholarly domains?

Five scholarly publications were analyzed to identify the theoretical framework of the LFC series (Harmon, 2013; Rojas, 2009; Rojas, Richer, & Wagner, 2007; Rojas, Sipos, & Valley,...
yielded four key elements of the LFC framework (in bold), which I have articulated into a single statement to demonstrate how the elements relate to each other.

The LFC series seeks to cultivate a particular ecology of knowledge that enables individuals within a community of learners to develop polycultures of the mind in order to apply systems principles to issues of food security and food system sustainability.

The first three key elements are theories developed by Rojas to describe and guide the development of the LFC series. Systems principles are used in each of the core series courses to frame students' process of inquiry.

In the following sections, I first describe and analyze the Ecology of Knowledge theory as a critical constructivist learning theory with an emphasis on the critical pedagogy theories of Freire (1970, 1987) and Bateson’s theory of cognition (1972, 1979). I then describe and analyze the other key three elements of LFC theoretical framework that shape the particular ecology of knowledge cultivated in the LFC series.

4.2.1. The Ecology of Knowledge as a Critical Constructivist Learning Theory

The foundational element of the LFC theoretical framework is Rojas’ conception of the Ecology of Knowledge (Rojas, 2009). I refer to the Ecology of Knowledge in this study in three distinct ways, mirroring how the term is used within the LFC series. First, as a critical constructivist learning theory, which questions the taken-for-granted assumptions about teaching, learning, and the learning environment, and how they impact ways of seeing and knowing; second, as the particular ecology of knowledge cultivated in the LFC series though construction of curricular and pedagogical activities meant to challenge and address the taken-for-granted assumptions about teaching and learning within a university lecture hall setting; and third, as the initial set of pedagogical activities undertaken in the second year course, LFS 250, which seeks to develop students’ epistemic and ontological cognitive development. The initial set of pedagogical activities
in LFS 250 have been described in Chapter One and are the subject of the second component of the study; therefore, they will not be analyzed in this chapter.

Constructivist learning theories differ in level of focus. The term constructivism, as a general learning theory, considers learning as a “change in meaning constructed from experience” (Tam, 2009, p. 63). Constructivists believe that individuals construct knowledge and understanding of the world through an active learning process (Berger & Luckmann, 1967; Jonassen & Rohrer-Murphy, 1999). While the individual is central to the learning process, as exemplified in psychological constructivism, social constructivists emphasize engagement within a social sphere as central to cognitive development (Richardson, 2003; Tam, 2009; Vygotsky, 1986). Critical constructivists emphasize relations and dynamics of power that permeate social interactions and how social inequalities in the context and process of learning significantly influence knowledge construction (Kincheloe, 2005).

Within critical constructivism, the writings of Paulo Freire have been major contributors to challenging the purpose of education and the recognition of historical developments of power embedded within educational systems (Malott, 2011). Freire developed an understanding of power dynamics through his observations of the “learning experiences of Latin American peasants and of their strategies to attain food security, often under conditions of severe resource scarcity and minimal land bases” (Rojas, 2012, p. 258). Freire recognized the ontological and epistemological implications of learning within a banking concept of education, where “knowledge is a gift bestowed by those who consider themselves knowledgeable upon those whom they consider to know nothing” (Freire, 1970, p. 58). In this system, knowledge is simple and certain, residing within the minds of an authority and received passively by the learner. “The more students work at storing the deposits entrusted to them, the less they develop the critical consciousness which would result from their intervention in the world as transformers of that world” (ibid, p. 60). The goals of Freire’s critical pedagogy are to enable learners to “perceive social,
political, and economic contradictions, and to take action against the oppressive elements of reality”, an act that Freire calls conscientizacao (ibid, p. 19). The process of achieving conscientizacao requires both reading the world and reading the word: a reflexive process that recognizes the outside world of situated experiences as a source of knowledge and the value of theoretical learning in informing our understanding of the oppressive elements of reality (Freire & Macedo, 1987).

The influence of Freire might not be apparent in the LFC series, receiving little reference in Rojas’ publications and rarely, if ever, mentioned during instructional time. However, a dinner conversation between the author and Rojas revealed a key, formative interaction between Rojas and Freire. The story takes place in Santiago, Chile in 1970. Rojas was a student at the University of Chile and the president of the Chilean Student Federation. Rojas and fellow students were preparing to conduct a literacy campaign with campesinos24 in rural Chile. The purpose of the campaign was to empower campesinos through developing literacy skills. It was a time when campesinos had attained a high level of organization and mobilization for agrarian reform in Chile, supported then by the centrist government of Christian Democrat Eduardo Frei (1964-70). The movement was further radicalized in September 1970 by the elections of the socialist President Salvador Allende, who campaigned for the deepening and further extension of the redistribution of land. In that context, peasant and workers organizations requested support from the universities to conduct literacy campaigns, as literacy was considered a democratic and human right, key to overcoming the power inequalities between landowners and the rural workers. Rojas recounted that he and his student colleagues did not have a clearly articulated plan to deliver a literacy campaign as they were not well versed in pedagogical strategies, and neither was there a tradition among university scholars to go into the countryside to perform work of this nature.

24 Campesino is the Spanish term for peasant farmer or an individual living in a rural area.
During one of the nightly meetings in preparation for mobilization for the literacy campaign, Rojas answered a knock at the student federation’s office door and a gentleman holding a brown paper bag said, “I’ve heard of your plans to conduct a national literacy campaign among campesinos and thought that perhaps my book might be of assistance”. The gentleman was Paulo Freire and inside the bag was a manuscript of *Pedagogy of the Oppressed* that would soon became a classic in adult education. Indeed, it did help the students organize and conceptualize their intentions and initiate the literacy campaign in the summer of 1970. However, the radicalization of Chilean politics and subsequent polarization of the country due to the rightwing military coup d’etat led by Augusto Pinochet (September 11, 1973) prevented the literacy campaign from being further implemented.  

Rojas’ theory of the Ecology of Knowledge emerges as an interrogation of the multiple influences on a learner from the learning environment and how the “content of education and the process of learning that content, shape each other, and in fact are inseparable” (Rojas, 2009, p. 132). Rojas states that this questioning and challenging of taken-for-granted assumptions about teaching, learning, and the learning environment, and how they impact ways of seeing and knowing, is further informed by Bateson’s theory of the *Ecology of the Mind*, which calls for a necessary unity between mind and nature, bringing attention to the cognitive and emotional aspects of ecological knowing (Bateson, 1972, 1979). The interactions between context, content, and processes within every learning event create an interrelated network of theories, facts, ideas, and opinions. Bateson (1972, p. xxiii) refers to the analysis of the closely related phenomena of context and meaning as an important “way of thinking about ideas and about the aggregate of those ideas”. Therefore, designers of educational activities are asked to “pay attention to the

---

25 Rojas and other leaders of the student movement, who were seen as central players in Chilean left-wing politics, were persecuted and forced to live underground and seek political asylum before fleeing the country in exile, avoiding the fate of dozens of thousands of prisoners in concentrations camps or of the desaparecidos (missing persons).
relationships among any learning object and its multiple surrounding influences” (Rojas, 2009, p. 136). In SFSE programs, these surrounding influences emerge from the integrative nature of knowledge within the domain of food systems as well as the context and processes in which learning takes place.

The Ecology of Knowledge theory, with roots in Freirean critical pedagogy, stresses the fundamental role of power dynamics in the structure and processes of a learning context, with a particular emphasis on ontological and epistemological consequences for the learner. Where, from whom, and with whom learning occurs can influence the perceived legitimacy of what is being taught. Learning in a large lecture hall from a singular authority, as compared to learning in a community setting with multiple sources of expertise, has implications about where knowledge resides, how it is constructed, how it is evaluated, and how knowing occurs. The tacit ontological and epistemological messages within a learning context may impact participants’ ways of seeing, knowing, and acting in the future. How students develop expertise can impact how they act as future experts. Therefore, learning to see knowledge as residing in a single authority and evaluated by academic methods alone, and knowing occurring by receiving knowledge from an expert, could possibly lead to an expert who interacts with others in a manner similar to the banking concept of education: a one-way transaction where the expert deposits knowledge in the community. This form of interaction is problematic in a knowledge domain that relies on multiple perspectives to address the inherent complexity and uncertainty of food systems issues.

The Ecology of Knowledge theory draws on Bateson’s theory of ecological knowing, emphasizing the relationships between ideas and context, and how these interactions impact meaning. For example, when studying healthy diets, can we consider food grown through ecologically destructive practices beneficial to individual health? Can we consider locally grown, organically certified vegetables part of a healthy diet if exploited migrant workers harvest them? There are ecological and social impacts of diet that lead back to the health of the individual,
including the health of the ecosystems from which the food is produced, the social well-being of
human participants in the food system, and the welfare of the non-human entities involved in the
food system. Further, the study of healthy diets ought to recognize diverse definitions and
perceptions of the concept of health at individual, collective, and ecological levels. An individual
raised in an indigenous culture might see the health of the environment and the health of the
community as inseparable (Armstrong, 2000). This individual's past experiences, visions of
potential futures, and present sources of knowledge may construct a different conception of
health compared to an individual raised in a western socio-cultural context.

Combining insights from Freirean critical pedagogy and Bateson's ecological knowing, the
Ecology of Knowledge theory reveals key relationships amongst a learner and the learning
environment. In particular, the Ecology of Knowledge uncovers the ontological and epistemological
implications of the roles of teacher and learner, the learning setting, and the pedagogical
activities that guide the learning process in educational programs. To demonstrate how Rojas'
theory guides the curricular and pedagogical activities in the LFC series, I discuss and analyze the
other three key elements of the LFC theoretical framework to illustrate the particular ecology of
knowledge cultivated in the LFC series.

4.2.2. The LFC Ecology of Knowledge

The particular ecology of knowledge cultivated in the LFC series seeks to challenge and
address the taken-for-granted ontological and epistemological assumptions within a university
lecture hall. Rojas (2009, p. 132) states that

“institutions involved in the production and dissemination of knowledge, such as universities,
all too often promote a reductionist culture that objectifies and simplifies reality, fragmenting
it into isolated independent parts while at the same time disconnecting people from each other
and from nature's complex interactions”.

The organizational structure of institutes of higher education has tacit ontological and
epistemological implications. First, the university model portrays knowledge and knowing as
occurring through a continual process of reduction through structural divisions: faculty, department, and major. This fragmentation explicitly denies the value of holistic thinking - seeing connections, patterns, interdependence, and emergent properties of wholes. It discourages the learner from making connections between disciplines and domains of knowledge, minimizing the likelihood that university graduates would encounter other disciplinary ways of seeing and knowing, further entrenching the worldview of the learner in disciplinary blinders. Second, the university system privileges abstract, theoretical knowledge in a classroom setting. Experiential, hands-on learning outside of a formal classroom setting is the exception, not the norm. This reinforces the belief that knowledge is received from an expert and learning occurs top down, in a passive setting. It also implies that knowledge and learning outside of the Ivory Tower is not as valuable or not academically relevant.

In order to overcome this fragmentation, the LFC series is designed to challenge and address the common assumptions of learning in modern institutes of higher education (Greenwood, 2007; Rojas, 2009):

* The instructor is the authoritative expert and holder of knowledge;
* The learner is the receiver of expert knowledge;
* The learner is not a significant contributor to knowledge construction;
* Knowing is a passive, individual process which occurs through reductionist, disciplinary methods and content;
* The learning context does not significantly impact what is being learned.

Within the description and analysis of the three elements, I provide examples of strategies in the LFC series designed to address ontological and epistemological beliefs that arise from learning immersed in “lectures and regurgitation of the banking concept of education” (Greenwood, 2007, p. 257). These strategies, what Jonassen & Rohrer-Murphy (1999, p. 70) refer to as “cognitive tools”, enable learners to see course content, processes, and structures in novel ways. These tools are used to support the learner’s “exploration, articulation, and reflection in the [learning] environment” (ibid, p. 70).
4.2.2.1 Community of Learners

Rojas’ conceptualization of the LFC community of learners\textsuperscript{26} is derived from the Latin American tradition of adult education and refers to “explicit valuing of dialogue, collaboration, and diversity amongst course participants, including instructors, teaching assistants, staff, students, and community partners” (Rojas, 2012, p. 272). Each member of the community of learners brings a unique perspective that helps illuminate a particular aspect of a complex problem, opening up “new, richer vistas to any subject matter” (Rojas et al., 2007, p. 91). Framing all participants as learners helps overcome institutionalized hierarchies and power dynamics that often emerge within a traditional university learning environment. Without diminishing the responsibilities of each participant, establishing a culture of a community of learners is a central approach to addressing the belief that certain participants have more or less to contribute to the collective understanding of the issue. I will describe the community of learners element of the LFC theoretical framework at the level of the instructor, the learner, student groups, and community partners.

In both social and critical constructivism, the role of the teacher shifts from expert and authority to facilitator of knowledge construction and co-learner (Jonassen, Cernusca, & Ionas, 2007). However, in critical constructivism, the perception of teacher as having authority and power in relation to the learner is openly addressed. Responsibilities within the learning process are maintained but in an environment of trust. “To resolve the teacher-student contradiction, to exchange the role of depositor…for the role of student among student would be to undermine the power” (Freire, 1970, p. 62). By establishing all participants in the LFC series as learners, the belief that knowledge resides external to the knower is questioned. The perception of teacher as source of truth shifts to teacher as a resource with specific expertise; the role of student shifts from

\textsuperscript{26} Community of Learners is commonly used in scholarly publications with other connotations; see for example Brown & Campione, 1994; Brown, Metz, & Campione, 1996; Rogoff, Matusov, & White, 1996
passive receptor to “active agent in defining arguments and creating new knowledge” (Moore, 2002, p. 22).

The primary responsibility of the teacher then, from a constructivist’s perspective, is “to create and maintain a collaborative problem-solving environment, where students are allowed to construct their own knowledge, and the teacher acts as facilitator and guide” (Tam, 2009, p. 67). From a critical constructivist perspective, the teacher is also responsible for challenging “the assumptions, practices, and outcomes taken for granted in dominant culture and in conventional education” (Gruenewald, 2003, p. 3). Across the LFC series, analysis of learning contexts is a regular activity in lecture discussions. For example, students are asked to analyze the learning context of a lecture hall with seats bolted to the floor and facing forward, implying that the most important source of knowledge is at the front, where the expert is located. Concurrently, the immobility of the seating might indicate that knowledge does not reside in fellow learners. These discussions challenge the epistemological assumptions of a lecture hall, which emphasizes the source of knowledge as residing in an authority external to the learner. Further, evaluating knowledge in a lecture context favours the ability to identify and access an authority. This deconstruction is an important process for establishing the community of learners, demonstrating to students that there are implicit messages in our learning settings and that they are encouraged to question and challenge these assumptions.

To continue to challenge assumptions at the level of the individual learner, the Learning with Life instructional model described in chapter two (see section 2.7 Instructional Models) addresses elements of the banking concept of education. Acknowledging past experiences and future aspirations as valid elements of knowledge targets beliefs about where knowledge resides. Learning with Life invites the persona of the learner into the learning process, validating emotions, dreams, personal experiences, and experiences of others as significant contributors to learning in higher education – not sources of bias that need to be suppressed upon entering the lecture hall.
This is a central framing in the critical constructivist process as “ideas can elicit strong emotional responses, especially new ideas that challenge the taken-for-granted, underlying worldviews that inform the cognitive schemas we use as interpretative frameworks to understand and act in the world” (Malott, 2011, p. 54). Kincheloe (2005, p. 4) remarks that “a key skill of a critical constructivist teacher involves nurturing this synthesis of personal experience and academic knowledge”. When constructing learning opportunities, instructors in the LFC series consider the complete persona of the learner to enable students to recognize personal experiences and experiences of others, not just expert knowledge, as valid sources of evidence that need to be considered when analyzing competing claims and points of view in the food system.

By validating personal experience and future aspirations as sources of knowledge in food system scholarship, the community of learners element simultaneously sets the stage for establishing collaborative, interdisciplinary teamwork as a central organization of the learning process, taking advantage of the diversity of disciplines that exist in the faculty. In the LFC series, students are placed in interdisciplinary teams within the first few sessions of the central courses (LFS 250, LFS 350, and LFS 450). The LFC approach to interdisciplinary pedagogy, including content presentation and emphasis, is illustrative of conceptual interdisciplinarity in that it seeks “to preserve the complexity of the phenomenon of learning; and includes disciplinary perspectives [but] has no compelling disciplinary focus” (Lattuca, Fath, & Voigt, 2004, p. 26). Conceptual interdisciplinarity places significant emphasis on critically demonstrating the strengths and limitations of all forms of inquiry when dealing with complexity and uncertainty (Lattuca, 2001). In this way, students address complex issues that cannot be solved by any one discipline, highlighting the significance of pluralism in food system scholarship.

Similar to other SFSE programs, the LFC series values the contributions of non-academic ways of knowing in addressing food system issues. The LFC community of learners incorporates community perspectives and transdisciplinary approaches into the core series in a number of
ways. Community partners participate as guest lecturers, often sharing sessions with academics, enabling dialogue among individuals with diverse perspectives and providing opportunities for students to witness how each stakeholder approaches, defines, and addresses food system issues. However, as Jonassen and Rohrer-Murphy (1999, p. 89) point out for the development of constructivist learning environments, one cannot simply “embed characteristics from the outside” into a non-reflexive learning environment. The “contradictions that characterize the system” - the institutional location and architecture of the lecture hall – limit the power of community perspectives by requiring communication to occur at, and in, the university setting (ibid, p. 89). Inviting community stakeholders to only participate as guest speakers in a university lecture hall has the potential to replicate beliefs of knowledge as residing in an authority, and perpetuates the position of the university as the site of true knowledge production. To address this contradiction, guest lectures are supplemented with community-based experiential learning (CBEL) strategies to allow students access to community partners expressions of expertise and knowledge-in-use.

CBEL “is an overarching term that encompasses a number of community-based pedagogical practices and a guiding principle that…provides students with opportunities to apply their academic knowledge to real-world issues” (Centre for Community Engaged Learning, n.d.). As described in Chapter 2 (see section 2.8 Instructional Strategies), students enrolled in the LFC course are required to leave the campus and engage in activities co-designed and negotiated with a member of the community to fulfill curricular needs for course credit. Community partners who provide CBEL placements vary from K-12 teachers, farmland and wildlife trust organizations, regional food banks, municipal governments to community food security organizations. Similar to Freire’s (1970, p. 66) process of praxis, CBEL creates the conditions for “action and reflection of men [sic] on their world in order to transform it”. Additionally, experiential learning in a community setting allows students to take part in the process of
“authentic thinking, thinking that is concerned about reality, [which] does not take place in Ivory Tower isolation, but only in communication” (Freire, 1970, p. 64).

The complexity and uncertainty that exists in a community learning setting cannot be replicated in the classroom. Brown, Collins and Duguid (1989, p. 32) suggest that by “ignoring the situated nature of cognition, education defeats its own goal of providing useable, robust knowledge ideals”. A robust understanding of the challenges of the modern food system require engaging with community, local, and practitioner ways of knowing, which cannot be fully comprehended through dialectical processes in a classroom. SFSE programs therefore need to “embed learning in activity and make deliberate use of the social and physical context” (ibid, p. 32). In addition, moving learning off-campus through CBEL validates the community as a legitimate source of knowledge. This can open conversations about where knowledge resides and how knowing occurs. Rojas' theory of Polycultures of the Mind provides further rationale for extending the LFC ecology of knowledge beyond the university. The next section will discuss and analyze the Polycultures of the Mind theory.

4.2.2.2 Polycultures of the Mind

In the LFC ecology of knowledge, integration of academic and non-academic perspectives is complemented with access to diverse learning contexts, with the aim to create what Rojas (2012) refers to as a polycultural mind. A polycultural mind is able to “mimic and assimilate the complexity and uncertainty of life”, make use of diverse ways of knowing, and be aware of contextual relationships when addressing issues of food security and food system sustainability (ibid, p. 266). Rojas’ theory draws on Bateson’s theory of mind, stating that the external environment is a mirror of the mind (Bateson, 1979); therefore, if we wish to integrate diversity into real-world socio-ecological systems, we first need to address a lack of diversity in our ways of seeing and knowing.
Rojas (2012) uses the case of Latin American peasant agriculture and its practical knowledge “rooted in...physical locations, which equip them with a type of knowledge that is involved and participatory, rather than detached and remote” (ibid, p. 263). Further, peasant knowledge is “subjective and value-laden, because it overtly appreciates personal experiences and beliefs as resources for knowledge, rather than as obstacles” (ibid, p. 263). Rojas argues that traditional peasant knowledge, which tends to be site-specific and grounded in place, contributed to the formation of the agroecological approach to knowledge, which proposes that “it is by attempting to replicate the complexity, diversity and resilience of the natural world that we can find the path towards cultural adaptation to the fundamental challenges faced by humanity today” (ibid, p. 266/267).

Rojas’ understanding of the important connections of diverse landscapes and mindscapes conveys resonance between Polycultures of the Mind and Shiva’s (1993) representation of Monocultures of the Mind, which she argues is the precursor to the monoculture system of production that dominates modern agricultural practice. The techno-scientific, reductionist approach that characterizes agriculture and food system education is reproduced in modern food systems, with singularity and control pursued at the consequence of diversity, stability, and sustainability (Altieri & Toledo, 2011). Rojas asserts that designing curricula that values, encourages, and provides space for diverse ways of seeing and knowing is a step towards avoiding the negative consequences of the monocultures of the mind associated with western scientific reductionist knowledge.

To further the process of being critically aware of the ontological and epistemological implications of learning contexts, instructors in the LFC series ask students to identify the most common shape in the lecture hall, which is often a square or rectangle. This question is followed by, “do you think that spending a considerable amount of time learning within spaces like this has an impact on the way you see and understand the world?” Students are left with the task of
finding a perfect square in nature as homework, which after thirteen years, has yet to be found. The next session begins by asking, “Do you think you would see and understand the world differently if your classroom was outside in nature, void of right angles and evenly spaced rows of immobile seating?”

The purpose of questioning and challenging the dominant context of university learning is to prepare the students for the curricular work in the community associated with the CBEL activities. Instructors in the LFC series use CBEL to facilitate learning in contexts that mimic the complexity and uncertainty of life, integral to developing polycultures of the mind. As Freire (1985, p. 20) stated, “the basic question in school is how not to separate reading the word and reading the world”, meaning that scholarly learning needs to be balanced with access to the context from which the knowledge emerged and in which it will be applied. Care is taken in the LFC series to frame and discuss student experiences in the community as providing access and opportunities to practice complementary ways of seeing and knowing, not only as means to gaining competencies that will prepare them for the workforce.

Rojas’ emphasis on contextual, place-based knowledge and learning processes that embrace rather than eliminate diversity and complexity in order to develop problem-solving competencies resonates with a theory of learning, instruction, and knowledge representation called Cognitive Flexibility Theory (see Spiro, Coulson, Feltovich, & Anderson, 1988). Cognitive Flexibility Theory promotes multiple representations of concepts and cases across ill-structured knowledge domains while simultaneously fostering learners’ ability to evaluate diverse knowledge sources (ibid). Cognitive flexibility and its relation to the LFC ecology of knowledge will be discussed in-depth later in this chapter.
4.2.2.3 Systems Principles

Systems principles is the fourth key element of the LFC theoretical framework. Two core systems principles are emphasized in the LFC series: holism and pluralism. Holism, or holistic thinking, is recognized as a necessary requisite to overcome the fragmentation of knowledge and to address complex issues surrounding food, health, and the environment (Rojas, 2009; Rojas et al., 2007). Pluralism is defined in the LFC series as the incorporation of multiple ways of seeing and knowing, and has many manifestations in the series; it is reflected in the engagement and integration of diverse academic domains represented by guest lecturers and undergraduate specializations in the faculty. Pluralism is further represented by the different ways of knowing exemplified by our community partners: personal, practitioner, traditional, local, and indigenous. The LFC series emphasizes that by engaging with these systems principles, a community of learners enhances its ability to understand, act, and evaluate change within the food system.

Various instructional strategies in the LFC series require students to explore different scenarios within the food system at local, regional, national, and global levels. Emphasis is placed on identifying patterns that exist within the food system at each level. In Rojas et al (2007, p. 91), a microcosm is used as a metaphor to describe this way of framing systems inquiry:

“A good microcosm should be the equivalent of a piece of a tapestry that visibly contains all the threads ‘weaved’ into the larger design of the tapestry. In the case of [LFS 450], the tapestry is the global food system and the microcosm that represents many of its ‘weaved threads’ [is] the UBC food system.”

Due to the global nature of modern food systems, a regional manifestation, such as a university campus food system, has similar components of other institutional and regional food systems, from production, distribution, processing, and consumption to the management of end products. Students begin analyzing household and school food systems in second year, community food systems in third year, and the campus food system in fourth year.
The learning process involved in identifying relationships and patterns and applying the process to novel food system contexts is similar to Bateson’s (1979) definition of abductive reasoning: the lateral extension of recurring abstract relations amongst different systems. In this way, students are provided opportunities to apply system principles to new food system contexts while developing process-oriented competencies associated with holism and pluralism.

As a cognitive tool to understanding a system as “an interconnected set of elements that is coherently organized in a way that achieves something” (Meadows, 2008, p. 11), students in the LFC series practice creating numerous systems models of food systems at different scales. Constructing system models requires organizing components and interconnections in a manner that denotes the sub-systems, nested levels, boundaries, and the overall function or purpose of the system. Studying system structure is key in understanding system behaviour (Meadows, 2008). The process of developing systems models is also used as an introductory cognitive tool to prepare student for thinking about systems, the precursor to developing systems thinking competencies (Cabrera, Colosi, & Lobdell, 2008; Reynolds & Holwell, 2010). Thinking about systems occurs when we consider the whole before its constituent parts, an “informal process that each of us does on a daily basis” (Cabrera et al., 2008, p. 301). In contrast, systems thinking is “more formal, abstract, and structured cognitive behaviour (Cabrera et al., 2008, p. 301). Unlike thinking about systems, which is content-specific, systems thinking is based on contextual patterns of organization. Systems thinking competencies are developed in the LFC series by asking students to practice adopting multiple perspectives when addressing specific food system scenarios and making distinctions between nested levels of components. For example, students in LFS 350 are required to identify the perspectives through which they are describing the community food system that they are investigating. And, they are asked to reflect upon the meaning of whose voices are represented and whose are absent in order to reveal the different ways issues and strategies to address those issues are interwoven with stakeholder worldviews.
4.2.2.4 Summary

The theoretical framework of the LFC series consists of four key elements: the ecology of knowledge, the community of learners, the polycultures of the mind, and systems approaches. Rojas’ theory of the Ecology of Knowledge, a blending of Freirean critical pedagogy and Bateson’s theory of cognition, creates the theoretical foundation of the series. Recognizing the complexity and uncertainty inherent in food systems as a knowledge domain, the LFC series is designed to cultivate a particular ecology of knowledge to challenge and address the taken for granted assumptions within a university lecture hall setting, with particular focus on the elements of teaching and learning that impact students’ ontological and epistemological development. The LFC series creates a community of learners in which all participants are valued for their contributions to the scholarly investigation of food system issues. Diverse contexts outside of the lecture hall provide opportunities to learn in, and learn from, settings of uncertainty as well as multiple ways of seeing and knowing. Further, students become familiar with applying holism and pluralism to address issues of complexity and uncertainty in the food system. These system principles provide an approach to synthesizing complexity within the food system while at the same time, integrating academic and non-academic ways of seeing and knowing.

4.3 Cognitive Flexibility Theory and the LFC Ecology of Knowledge

The particular ecology of knowledge cultivated by the LFC series is illustrative of “approaches to learning, instruction, and knowledge representation” required to cultivate cognitive flexibility (Spiro, Coulson, Feltovich, & Anderson, 1988, p. 556). Cognitive flexibility is defined as the

“disposition to consider diverse context-specific information elements while deciding on how to solve a problem or to execute a (learning) task in a variety of domains and to adapt one’s problem solving or task execution in case the context changes or new information becomes present” (Elen, Stahl, Bromme, & Clarebout, 2011, p. 2).
Additionally, according to Spiro and Jehng, (1990, p. 165, as cited by Elen et al., 2011, p. 2),
cognitive flexibility is “the ability to spontaneously restructure one's knowledge, in many ways, in
adaptive response to radically changing situational demands”. Cognitive flexibility theory centres
on problems of advanced knowledge acquisition and application in ill-structured domains –
domains characterized by “content complexity and irregularity of application contexts” (Spiro &
Jehng, 1990, p. 165). The ability to develop cognitive flexibility is directly applicable to food
system education as the modern food system is increasingly being recognized as an ill-structured
domain due to socio-ecological interactions within the system (Weissman, Gantner, & Narine,
2012). Issues of food system sustainability and food security require problem solvers to be
attentive to context and multiple perspectives, and to cultivate a disposition to adapt in light of
new information or as changing situations demand.

Cognitive flexibility puts forth a general theory of learning, instruction, and knowledge
representation in ill-structured domains.

“One learns by criss-crossing conceptual landscapes; instruction involves the provision of
learning materials that channel multidimensional landscape explorations under the active
initiative of the learner (as well as providing expert guidance and commentary to help the
learner to derive maximum benefit from his or her explorations); and knowledge
representations reflect the criss-crossing that occurred during learning” (Spiro & Jehng,

The scholars that established cognitive flexibility theory propose conditions for developing
mastery of complexity and knowledge transferability, summarized in seven themes (Spiro et al.,
1988):

• Avoidance of oversimplification and over regularization;
• Multiple representations;
• Centrality of cases;
• Conceptual knowledge as knowledge in use;
• Schema assembly (from rigidity to flexibility);
• Noncompartmentalization of concepts and cases (multiple interconnectedness);
• And, active participation, tutorial guidance, and adjunct support for the management of
  complexity.
The following section examines the LFC ecology of knowledge as it relates to cognitive flexibility theory of learning, instruction, and knowledge representation and the seven themes for advanced knowledge acquisition.

4.3.1. Avoidance of Oversimplification

Spiro and colleagues (1988) put forth an assertion similar to the ontological premise of Greene and collaborators' (2008) model of epistemic and ontological cognitive development. That is, in order to address the complexity and uncertainty of ill-structured domains, knowledge and reality cannot be viewed as simple and certain. “Advanced knowledge acquisition must place a high premium on making salient those ways that knowledge is not as simple and orderly as it might first seem in introductory treatments” (Spiro et al., 1988, p. 548). Efforts are made at the beginning of the LFC series to target this specific belief. The image of the elephant and the blind men, the film Zea, and the Barnga game on intercultural communication all target students’ beliefs about the certainty to which knowledge can be considered universal and unchanging. This is not an attempt to promote the merits of relativism but rather the first step towards developing competencies for evaluating evidence from multiple perspectives. If one does not recognize certain domains of knowledge as being more complex and uncertain, then there would be no reason to engage with multiple perspectives to justify one’s understanding of the world. Rather, one would simply seek the correct answer, either from an authority or personal experience.

Without this initial ontological shift away from simplicity and certainty, the value of participating in an inter- and trans-disciplinary community of learners would be diminished. Students would likely resist incorporating diverse academic and community ways of knowing into their understanding of the world, lessening their ability to address issues of complexity and uncertainty. This resistance has been observed among some students during the early stages of participating
in the LFC courses, in the form of discomfort and perplexity, yet is gradually overcome as course activities progress.

4.3.2. **Multiple Representations**

According to Spiro and colleagues (1988, p. 548), “single representations (e.g., a single schema, organizational logic, line of argument, prototype, analogy, etc.) will miss important facets of complex concepts. Cognitive flexibility is dependent on having a diversified repertoire of ways of thinking about a conceptual topic”. Corresponding to the valuing of multiple perspectives in the community of learners, inhabiting diverse learning contexts in developing polycultural minds, and pluralism in systems principles, cognitive flexibility theory explicitly acknowledges access to multiple representations and learning contexts as a fundamental condition for developing mastery in ill-structured domains. In the LFC series, this is achieved through structuring instructional strategies along inter- and trans-disciplinary lines. Course readings, guest lectures, field trips, community-based experiential learning projects, and team membership are designed to portray diverse ways of seeing and knowing as central to investigations in the modern food system. “Knowledge that will have to be used in many ways has to be learned, represented, and tried out (in application) in many ways” (ibid, p. 548/49).

4.3.3. **Centrality of Cases**

In food systems, as in any ill-structured domain, abstract theories become limited in the process of knowledge application. “That is, the way abstract concepts (theories, general principles, etc.) should be used to facilitate understanding and to dictate action in naturally occurring cases becomes increasingly indeterminate in ill-structured domains” (Spiro et al, 1988, p. 551). This recognition of the limitation of theoretical knowledge in learning about and resolving real-world issues resonates with a key element of the LFC series theoretical framework, the theory of the Polycultures of the Mind. In the LFC series, instructors create learning
opportunities in the community to allow students to apply knowledge in diverse settings. Case studies are key to the process of preparing our future food system experts and professionals for engaging with the complexity they will encounter upon graduation. Ill-structured domains have “great variability from case to case regarding which conceptual elements will be relevant and in what pattern of combination...general principles will not capture enough of the structured dynamics of cases” (ibid, p. 551). Throughout the LFC series, students are assessed primarily on processes rather than outcomes to emphasize the conceptual and procedural connections amongst cases they encounter throughout the series. This promotes abductive reasoning skills (Bateson, 1979) required to understand how knowledge and skills developed in one case can be applied to the next, even if the central focus shifts amongst broad themes within the food system. For example, students working on hedgerow composition and predator-prey dynamics with regional farmers might participate in a subsequent CBEL project that seeks to determine a range of sustainable meat alternative products for a campus food system. The processes of community engagement, systems analysis, evaluation of evidence, justification of findings, and professional communication with stakeholders are continuous amongst the cases. This framing of distinct yet overlapping processes within the various cases of the series helps students recognize that “increased flexibility in responding to highly diverse new cases comes increasingly from reliance on reasoning from precedent cases” (ibid, p. 551). Therefore, despite the change in content specifics of case studies, the learning that occurs is valuable and applicable to future investigations within the food system.

4.3.4. Conceptual Knowledge as Knowledge in Use

Reflection on the application of knowledge in an ill-structured domain is central to understanding the uncertainty of knowledge, the value of diverse perspectives, and the limitations of learning within a single context. “If a concept’s meaning in use cannot be determined
universally across cases (as in an ill-structured domain), then one must pay much more attention to
the details of how the concept is used—knowledge in practice, rather than in the abstract” (ibid, p. 552). In the LFC series, experiential learning activities complement theoretical knowledge
gained in the classroom. CBEL activities connect many of the tenets of the other elements of the
LFC ecology of knowledge. Application of conceptual knowledge with and for, not on, a
community embodies the community of learners approach and provides the setting to develop
polycultures of the mind. CBEL as a knowledge-in-use strategy, when approached from a critical
constructivist position, demonstrates that theoretical concepts must be tailored to specific contexts,
enhanced by accepting diverse perspectives as part of the knowledge generation and
application process. Problem resolution in ill-structured domains is framed as being contextual and
socially constructed amongst diverse stakeholders. Further, personal experience is integrated as a
valid source of knowledge, to be compared to and evaluated amongst knowledge from
authoritative sources, like university lectures, textbooks, and scientific articles. In this way, students
are exposed to multiple sources of knowledge and assisted in navigating the challenging process
of evaluating competing sources when justifying their positions. Reflexive knowledge-in-use then is
a central framing and process for students to develop more encompassing epistemic and
ontological cognition necessary for cognitive flexibility (Greene et al., 2008; King & Kitchener,

4.3.5. Schema Assembly from Rigid to Flexible

As stated by Spiro and colleagues (1998, p. 553) in describing problem solving
competencies in ill-structured domains, “for any particular case, many small precompiled
knowledge structures will need to be used” (Spiro et al., 1988, p. 553). An aggregate of pre-
compiled knowledge structures creates a schema, or pathway, for problem resolution. Applying a
specific schema can solve problems in well-structured domains, which are characterized by clear
objectives and definitive solutions. For example, if a crop is displaying characteristics of micronutrient deficiency, one can perform an analysis to determine the nutrient profile of the soil. With this information, one can supplement the soil with the appropriate fertilizer. The problem will be considered resolved if the crop displays characteristics of optimal health. In ill-structured domains, the complexity and uncertainty within each case requires adoption of a more flexible schema. The entire schema that resolved a prior case may not be adequate for the next. In the LFC series, case studies of the BC Dairy System and the UBC Campus Food System are presented and discussed as ill-structured problems. Instructors discourage adoption and “retrieval of intact, rigid, precompiled knowledge structures” (Spiro et al, 1988, p. 552). That is, strategies for addressing issues within cases are not presented as one-size-fits-all. Through guidance, students are expected to assemble “knowledge from different conceptual and precedent case sources to adaptively fit the situation at hand” (ibid, p. 552). Knowledge and skills developed in a community setting in LFS 250 provide a starting point for initiating and implementing projects in LFS 350 and 450. Through the community of learners approach, students access methods available in their inter- and trans-disciplinary teams. Further, students are assessed on their ability to demonstrate integration of various approaches from personal experiences, academic disciplines, and community perspectives in the inquiry process of problem definition, implementation, and evaluation. They are not assessed on their ability to adopt and apply a pre-existing schema from a lecture, textbook, or scientific paper.

4.3.6. Noncompartmentalization of Concepts and Cases

Central to cognitive flexibility theory is avoidance of committing the “reductive bias”, reflecting an oversimplification of complex material (Spiro et al, 1988, p. 546). This is an essential premise of systems theory as well, where systems thinking “undermines the boundaries between our categories of things in the world” (Ison, 2010a, p. 17). In this sense, Spiro and
collaborators (1988) contend that the aggregate reassembly of facts derived from the decomposition of complex issues frequently results in conceptual errors. For example, food security first appeared in global political discussions in 1974, at the World Food Conference. Initially, insecurity was seen to be resulting from overpopulation and environmental conditions, such as drought, floods or soil erosion (Sage, 2012). However, the work of Sen (1981) demonstrated that food insecurity was not an inevitable consequence of availability but rather access to food, raising awareness to the complexity of hunger and starvation with respect to other issues such as labour, distribution, access to land, and other social assets. Considering food security as an “arithmetic of food supply and population” (Sage, 2012, p. 213) is an example of a reductive bias.

Spiro and colleagues state that the “remedy is to take pains to highlight component interactions, to clearly demonstrate the intricate patterns of conceptual combination” (Spiro et al, 1988, p. 548). This is analogous to the concepts of interconnectedness and emergent properties central to systems theory, invoking the well-known systems aphorism, “the whole is greater than the sum of its parts” (Flood, 2010, p. 269). Recognizing and making use of interconnected pathways amongst cases, concepts, and perspectives is a shared critical competency amongst cognitive flexibility and systems thinking. Establishing many alternative pathways allows the learner to “get from one part of the overall knowledge base to any other part of the knowledge base that aspects of some future case may signal as relevant”, increasing the “potential for flexible, situation-adaptive schema assembly” being fostered (Spiro et al., 1988, p. 553). In the LFC series, systems modeling and analysis of systems concepts like stocks, flows, feedback loops, boundaries, and leverage points allow students to recognize similarities and relationships amongst different food system cases.
4.3.7. **Active Learning**

Echoing Freire’s articulation of the banking concept of education, cognitive flexibility states that knowledge in ill-structured domains “cannot just be handed to the learner” (Spiro et al, p. 555). The conditions for developing mastery of complexity and knowledge transferability in ill-structured domains requires the learner to be actively involved in “knowledge acquisition, accompanied by opportunistic guidance by expert mentors” (ibid, p. 555). Students participating in the LFC series are exposed to multiple perspectives and must transform diverse sources of knowledge to “adaptively fit the needs of understanding and decision making in a particular situation” (ibid, p. 545). For example, when analyzing healthy eating in K-12 schools, students are first introduced to the theoretical landscape of the topic through lectures, readings, and small group discussions. Students then travel to a specific school to make observations of school food system assets (e.g. gardens, kitchens, cafeterias, and compost systems), interview school stakeholders (e.g. teachers, staff, administration, parents, and community organization staff), review school district policy reports, and conduct food-literacy workshops. After accessing and reflecting on diverse perspectives and experiences, a comprehensive understanding emerges of the complex relationships that govern healthy eating in a school setting. This active learning process cannot be achieved in lecture halls and classroom settings alone.

4.3.8. **Summary**

*Cognitive flexibility involves the selective use of knowledge to adaptively fit the needs of understanding and decision making in a particular situation; the potential for maximally adaptive knowledge assembly depends on having available as full a representation of complexity to draw upon as possible* (Spiro et al, 1988, p 548).

The LFC ecology of knowledge seeks to develop student competencies for selective use of knowledge from diverse sources, appropriate to the context under investigation. Increasingly, issues within the food system are being recognized as ill-structured, requiring professionals capable of adapting to new situations and making decisions under uncertainty. A SFSE program
that is delivered within a traditional lecture hall setting will be limited in its ability to represent complexity or provide opportunities for students to experience uncertainty and complexity within the food system. By establishing a community of learners and inhabiting diverse learning contexts, coupled with the promotion of system thinking competencies, the LFC ecology of knowledge cultivates an educational context and process for developing cognitive flexibility.

4.4 Community-Engaged Scholarship and the LFC Ecology of Knowledge

The LFC ecology of knowledge creates a framework for an ontological and epistemological orientation towards Community-Engaged Scholarship (CES). The Committee on Institutional Cooperation, an academic association of the Big Ten Universities and the University of Chicago, defines CES as:

“The partnership of university knowledge and resources with those of the public and private sectors to enrich scholarship, research, and creative activity; enhance curriculum, teaching, and learning; prepare educated, engaged citizens; strengthen democratic values and civic responsibility; address critical societal issues; and contribute to the public good” (Bloomfield, 2005, p. 3).

The term community-engaged scholarship describes a range of faculty work with communities, through the integration of teaching, research, and service (Calleson, Jordan, & Seifer, 2005). As a practice, faculty involved in CES “apply their expertise to real-world problems and collaborate with peers in other sectors, who also bring their knowledge and wisdom to the table, in order to generate, disseminate, and apply new knowledge” (Gelmon, Jordan, & Seifer, 2013, p. 59).

The following sections outline the development of CES beginning with Boyer’s (1990) landmark report, Scholarship Reconsidered: Priorities of the Professoriate, which outlines the epistemological beliefs that form the basis of research, service, and teaching in CES. I then connect the ontological and epistemological orientation of the LFC ecology of knowledge to CES.
4.4.1. Scholarship Reconsidered

“Ultimately, we need scholars who not only skillfully explore the frontiers of knowledge, but also integrate ideas, connect thought to action, and inspire students...if the nation’s colleges and universities cannot help students see beyond themselves and better understand the interdependent nature of our world, each new generation’s capacity to live responsibly will be dangerously diminished” (Boyer, 1990, p. 77).

Boyer’s (1990) report to the Carnegie Foundation, Scholarship Reconsidered – Priorities of the Professoriate, articulates a more capacious definition of scholarship. Reflecting on the evolving role of institutes of higher education in society, Boyer (1990, p. 13) stressed a need “to clarify campus missions and relate the work of the academy more directly to the realities of contemporary life”. Four separate yet overlapping functions of the professoriate were put forth: the scholarship of discovery; the scholarship of integration; the scholarship of application; and, the scholarship of teaching (Boyer, 1990, p. 16).

The scholarship of discovery matches closely to activities of basic research. Scholarly investigation “is at the very heart of academic life, and the pursuit of knowledge must be assiduously cultivated and defended” (ibid, p. 18). The scholarship of integration emphasizes the increasing need to make connections amongst the vast amount of knowledge generated by the scholarship of discovery. Integration for Boyer meant “making connections across the disciplines, placing the specialties in larger context, illuminating data in a revealing way” (ibid, p. 18).

The scholarship of application addresses the gaps between the values of academic institutions and the needs of the communities in which they are embedded, commonly falling under the category of service. Boyer notes that there has been a movement away from the early twentieth century principles of institutes of higher education in America, whereby “higher education must serve the interests of the larger community” (ibid, p. 21). Additionally, Boyer makes a distinction between service through social and civic activities and service “tied directly to one’s special field of knowledge and relate to, and flow directly out of, this professional activity. Such service is serious, demanding work, requiring the rigor--and the accountability--traditionally
associated with research activities” (ibid, p. 22). However, Boyer asserts that the scholarship of application is a not a one-way street or transactional arrangement with community. Rather, it both applies and contributes to human knowledge through a reflexive practice that allows social issues to help define research agendas and better serve those in need.

Boyer recognizes the scholarship of teaching: “the work of the professor becomes consequential only as it is understood by others” (ibid, p. 23). Boyer stresses the fact that good teaching is time-consuming, challenging work that ought to promote active, life-long learning for both the student and the professor. “Teaching, at its best, means not only transmitting knowledge, but transforming and extending it as well” (ibid, p. 24).

In a subsequent publication, Boyer (1996) expands upon his prior categories of scholarship by articulating a scholarship of engagement. The latter encompasses a set of practices that integrates the previous four realms of scholarship with pressing social and ethical needs through deepening forms of community participation (Barker, 2004). Boyer’s perspective resonated with the academic community, initiating reflexive dialogue on the role of institutes of higher education in society, their relationships with their communities, and dimensions of the undergraduate experience. Boyer has been credited with bringing this debate from the fringes towards the centre of academia (Duke & Moss, 2009; Lowery et al., 2006). In the two decades since his publication of the Scholarship of Engagement, campuses across North America have been re-aligning their institutional mandates and visions to better reflect Boyer’s description of scholarship in a manner that invigorates scholarly research, community engagement, and student learning.

In the Canadian context, Hall (2013, p. viii) points out that until the late 1990s, the “engaged scholarship movement was located outside the walls of academia largely, but where it had a university base, there were direct and accountable links to the social movements of the times.” Furthermore, the Community-University Research Alliance granting program (1998-2012)
of the Social Sciences and Humanities Research Council played a significant role in developing the contemporary foundations of engaged-scholarship in Canada (Hall, 2013). The CURA program supported scholars “whose ideological or epistemological preferences were aligned to working with community groups, to listening to their issues and concerns and co-constructing knowledge together” through participatory research traditions (Hall, 2013, p. viii).

Currently, the prominence of community-university engagement is increasing in Canadian university strategic plans (Hall, 2009). In 2013, 50-60 Canadian universities “either have engaged scholarship written into their strategic plans or have a university-wide structure to support engaged scholarship or both” (Hall, 2013, p. viii). The University of British Columbia has research excellence, community service, and student learning at the centre of its strategic vision (UBC, 2011). The UBC core commitments are directly supported by institutional goals and action plans, developed to build on historical strengths, such as research, while paying closer attention to teaching and community-engagement (Toope, 2010). Similarly, across the Salish Sea, the strategic plan for the University of Victoria seeks to integrate scholarship, teaching, and real-life involvement.

4.4.2. Practices of Engagement

A key challenge in the domain of community-engaged scholarship (CES) is accounting for the varied activities that potentially fall under its definition (Barker, 2004; Shultz & Kajner, 2013). Practices commonly include forms of public and participatory scholarship such as community-based and action research; and, community-based experiential learning activities such as community-service learning (Kajner, 2013). Common to all approaches is an orientation towards addressing community-identified needs and ensuring mutually beneficial collaboration (Stanton, 2008). Regardless of the label of the activity, there are common ontological and epistemological commitments shared amongst scholars pursuing CES, leading to reflection on “how
they and their [community] partners are positioned in relation to one another, and in relation to knowledge” (Kajner, 2013, p. 11).

Significant efforts have been devoted to better understand the theoretical and practical implications of CES, integrating research, service, and teaching in a mutually reciprocal manner for community and academic stakeholders. It is beyond this study to provide a full summary of the literature; however, the following sections will draw on recent scholarly work to distinguish the epistemological implications of each of the three realms of CES. Specifically, the following sections will analyze CES literature based on ontological and epistemological assumptions surrounding the nature of reality, how knowledge is constructed and evaluated, where knowledge resides, and how knowing occurs, as they relate to research, service, and teaching. This review of the literature will provide a basis for comparison of CES to the ontological and epistemological foundations of the ecology of knowledge cultivated in the LFC series.

4.4.2.1 Community-Engaged Research

Research approaches in CES problematize common assumptions and beliefs around expert knowledge and the legitimacy and appropriateness of positivist approaches to knowledge generation in social science contexts (Barker, 2004; Coghlan, 2011; Kajner, 2013). The belief that knowledge is discovered by and resides in possession of an expert, requiring translation and transmission to a public audience is challenged. Rather, knowledge that addresses the needs of the community is approached through dialogue and collaboration with those that are embedded in the situation. This requires inviting participants into the “design, unfolding, and sense-making processes” of inquiry as well as being aware of “who decides the research agenda and how voices are heard and or silenced, however covertly” (Coghlan, 2011, p. 57). Equally, this contests the belief that knowledge in social sciences is decontextualized, requiring the scholar to take an objective, detached perspective. Instead, “collaborative knowledge production is a power sharing
activity that positions all parties as knowledge holders and creators, an approach to knowledge that includes creating a relationship of equality between scholars and communities” (Kajner, 2013, p. 13).

This egalitarian approach to knowledge generation affects ways in which knowledge is evaluated in a CES context. When scholarly work is jointly planned and carried out by university and community partners, there is evidence that research outcomes are more useful and practical compared to traditional methods of research, where the research design is completed without the input of the groups most affected by the results (Stanton, 2008; Strand, Cutforth, Stoecker, Marullo, & Donohue, 2003). The improvement lies in the recognition that human systems are best understood if one involves “the members of the system in the inquiry process itself” (Coghlan, 2011, p. 58). The positivist criteria of neutrality and objectivity in this context have less epistemological legitimacy due to their isolation from social practices and stakeholder involvement (Schon, 1995). Writing in the context of action research, Coghlan (2011, p. 58) states that the “tradition of involving the members of an organization in the change process…originated in a scientific premise that this is the way (a) to obtain better data and (b) to effect change”.

Comparably, Kajner (2013, p. 11) puts forth that “engagement is distinguished not by the kind of knowledge generated, but if that knowledge and its use is inclusive of other sources of knowledge”.

Ontologically, CES recognizes the contextual and relational nature of human reality: “social science research practice is first and foremost a socially embedded practice by bringing forth understandings and descriptions of other humans, other species or the biophysical world” (Ison, 2010b, p. 268). Genuine understanding of the social world requires an ontological awareness of the layered relationships that bring forth subjective meanings. A positivist ontology, which seeks to unveil universal truths that can be applied across any social context, is limited in improving our understanding of the social world. Kajner (2013) extends this assertion to the
epistemological foundations of CES by stating that in the context of “engaged scholarship, a socially transformative approach would include looking at the structure of the relationship between scholars and communities in terms of how they position each other as knowledge holders and how they relate to knowledge overall” (Kajner, 2013, p. 13).

4.4.2.2 Community-Engaged Service

There is a need to link the intellectual resources of universities with social issues in a manner that creates benefits for the academy and the community. Institutes of higher education “represent our largest accessible, available, and underutilized resource for community change and sustainability” (Hall, 2009, p. 13). Collaboration in a CES program can benefit community partners by contributing to organizational mandates and objectives. A publication released by the Canadian Alliance for Community Service Learning has documented examples of long-term, beneficial changes to community partners, including enhanced program delivery, empowerment of agencies, more effective operations, increased research capacity, and an enhanced commitment to the non-profit and voluntary sector through student participation (Gemmel & Clayton, 2009). Stanton (2008), summarizing discussions from 23 scholars involved in community engagement, emphasizes how faculty working to bridge the gap between university and community contribute positively and effectively to their local communities and those more distant.

Academics pursuing forms of CES work on the epistemological assumption that “the purpose of academic research and discourse is not just to describe, understand, and explain the world, but also to change it” (Coghlan, 2011, p. 65). Greenwood and Levin (2005, p. 51) assert that knowledge of the world implies “knowing how in a given context in which appropriate actions emerge from contextual knowing”. This contextualization is a process of shifting knowledge production away from being experimentally reliable to socially robust - knowledge that is field-tested and more likely to work in a variety of different contexts (Stanton, 2008). Therefore,
scholars that seek to positively contribute to community needs, commonly described as service, pay particular attention to how knowledge is put in use.

4.4.2.3 Community-Engaged Teaching

The relationship between researcher and community in forms of positivist research is representative of the same epistemological beliefs underlying the “asymmetrical relationship between all-knowing professor and the ignorant student” (Greenwood, 2007, p. 257). Knowledge is portrayed as created by and residing in the minds of an expert and knowing occurs by transmission from the authority to the uninformed. The latter, being community or student, is not actively involved in the creation of knowledge, simply receiver of knowledge that exists elsewhere. Community-based experiential learning pedagogies, like community-service learning and community-based research, intentionally challenge these epistemological assumptions. Curricular activities are framed as partnerships between “students, faculty, and community who collaboratively engage in [activities] with the purpose of solving a pressing community problem or effecting social change” (Strand et al., 2003, p. 3). Community-based experiential learning activities are accompanied by reflective assessments that guide students through the process of questioning commonly held beliefs about the role of the university, professor, student, and community in a learning context. As Orr (1994) declared, no student should graduate without the opportunity to participate in the creation of real world solutions to real world problems. Scholars participating in CES programs demonstrate a shift in epistemological perspectives resulting in research, pedagogies, and curricula that also reflect this shift, influencing the next generation of citizens and scholars (Greenwood, 2007).
4.4.3. The LFC Ecology of Knowledge as a Framework for an Epistemological Orientation towards Community-Engaged Scholarship

The previous section outlines the common ontological and epistemological beliefs associated with CES activities. The following section first analyzes the relationship between these beliefs and the ontological and epistemological framework of the ecology of knowledge cultivated in the LFC series, using the four key elements highlighted at the opening of the chapter: the ecology of knowledge (as critical constructivist learning theory), the community of learners, polycultures of the mind, and a systems approach. Then, I discuss community-based action research (CBAR) and community-based experiential learning (CBEL) as the practical expression of CES in the LFC series.

Central to Rojas’ (2009) concept of the ecology of knowledge as a critical constructivist learning theory is an awareness of the epistemic and ontological implications of educational and research activities. In an educational setting, where learning happens (in a lecture hall versus in a community setting), how learning happens (passive receiver of information versus active co-constructor), and with whom learning happens (isolated, individualistic, and disciplinary versus collaborative, inter- and/or transdisciplinary) have significant impacts on what (content) is being learnt. Parallel questions can be raised concerning other scholarly activities: where, how, and with whom are decisions being made surrounding research agendas, evaluation criteria, and knowledge dissemination activities? Ultimately, these are issues of power distribution amongst those who engage in knowledge creation activities parallel to issues of power within a classroom setting. The designers of the LFC series believe that scholarly activities that seek to have positive outcomes for communities and achieve social change need to first consider the ontological and epistemological assumptions of teaching and research practices. Without critically reflecting on the relationships amongst knowledge generation activities, it is unlikely that scholarly outcomes will align with emancipatory objectives.
Additionally, considering the ecology of knowledge emerging from an inquiry process, with all its inherent complexities, can bring forth awareness of how research activities relate to participants’ past experiences, future aspirations or utopian visions, and the state of scholarly knowledge on the topic. This attentiveness to subjective elements that impact an individual’s relationship with knowledge is critical for both educational and scholarly knowledge generation activities. By acknowledging and inviting past experiences as significant sources of understanding in both settings, expertise is recognized as residing in many participants, inclusive of students and community stakeholders, not just scholarly experts. Similarly, emphasizing shared desires for a better future lays the foundation for a common set of evaluative objectives of scholarly activities. Collaboration and co-inquiry can then begin with epistemological beliefs that recognize knowledge as being co-constructed, residing amongst diverse perspectives, and evaluated on criteria that represents shared visions of the future. Scientific knowledge is essential to this process for imparting the subjective elements of the process with perspectives from others involved in similar efforts. The rigor of the scientific method and peer-review process is central to creating knowledge that can enhance local understanding.

With respect to the beliefs and objectives of CES, the rationale for creating a community of learners, in both an educational and research context, is clear. Collaboration and co-inquiry with the purpose of achieving social change in a community setting requires epistemological beliefs that recognize all participants as significant contributors to the knowledge production process. The dualism between teacher/learner and expert/community needs to be dissolved at the epistemological level, facilitated by explicitly acknowledging all participants as learners: each with something to learn and something to contribute in the collective learning process.

The development of a polycultural mind, one that demonstrates cognitive flexibility to adapt to diverse epistemological contexts, is a fundamental characteristic of those involved in CES activities. An individual with characteristics of a polycultural mind recognizes the value of multiple
perspectives when involving diverse stakeholders in knowledge production and dissemination processes. Additionally, an individual with characteristics of a polycultural mind can strategically adapt to the diverse contexts and relationships involved in CES activities, leveraging scholarly and local ways of knowing to construct co-generated agendas.

Holism and pluralism, the foundations of a systems approach, can be considered elements of requisite ontology and epistemology for CES. Similar to the emphasis on the relational and contextual nature of reality described in CES literature (see Shultz & Kajner, 2013), a holistic approach characterizes the nature of reality as embedded in relationships. The ontological assumptions of a reductionist approach, seeing reality as fragmented, is limiting in a CES context. Pluralism has similar resonance and connection within a community of learners perspective and essential to developing polycultures of the mind.

To merge teaching and learning with research in the CES framework, the three central courses of the LFC series (LFS 250, 350, and 450) are each associated with community-based action research projects, as described in Chapter Two. Through CBEL activities, curricula in the LFC series are designed to integrate learning objectives with research objectives. Undergraduates in LFS 250 carry out workshops with students and teachers in K-12 classrooms in Vancouver as part of their course work. The second year undergraduate students contribute to Think&EatGreen@School’s action-research objectives by increasing hands-on, food literacy activities in Vancouver School District classrooms. The workshops are designed with input from multiple stakeholders in the Think&EatGreen@School project: teachers, community partners, and academic co-investigators. In LFS 350, student projects are co-designed by the instructors of the course and community partners to meet the particular needs of the community organization. One of the objectives of the BC Food Security CBAR project is to document the process and assess the impact of community-university partnerships on community food system change. Similarly, in LFS 450, campus stakeholders and course instructors collaboratively design student projects each
year. Student course work contributes directly to campus food system change and provides opportunities for students to apply theoretical knowledge in a real-world context.

The co-development of research objectives and student projects is a representation of equal distribution of power that is commonly described in the CES literature, as described in prior sections of the dissertation. In the LFC series, community partners are portrayed as full co-investigators of the CBAR projects, not research participants. Effort is taken to highlight the relationship between university researchers and community partners to demonstrate the complementarity of ways of knowing, emphasizing the value of the latter in grounding theoretical knowledge in contextual meaning. In this way, expertise is acknowledged as being present in and outside of the university. Further, by creating opportunities to design, implement, and evaluate interventions within a community, knowing is shown to be knowledge-in-action and students as agents of change. As a result, the ecology of knowledge cultivated in the LFC series aligns the epistemological and ontological beliefs of CES through integrating student learning, community service, and research.

4.5 Summary

In this chapter, I report the findings of the first component of the study, identifying and situating the key elements of the LFC series theoretical framework. The four key elements are the ecology of knowledge, the community of learners, the polycultures of the mind, and systems approaches. My analysis revealed the influences of Freirean critical constructivist learning theory and Bateson’s theory of ecological knowing. Further, systems theory and modeling activities are used to help develop students’ process of inquiry from thinking about systems to systems thinking.

Comparing the seven themes of Cognitive Flexibility Theory to the particular ecology of knowledge cultivated in the LFC series illustrates the significant level of overlap between the two. As an SFSE program, the ill-structured nature of the content of the LFC series requires developing
student competencies for addressing issues of complexity and uncertainty. In addition, the
particular ecology of knowledge of the LFC series creates a framework for an ontological and
epistemological orientation towards Community-Engaged Scholarship (CES). The critical
constructivist processes that inform the pedagogical activities of the LFC series are parallel to the
processes described in CES theory, whereby knowledge generation activities are carried out with
recognition of equality amongst academic and non-academic stakeholders. By understanding and
acknowledging the strengths and limitations inherent in each perspective, the outcomes of CES are
more likely to meet the needs of all stakeholders involved: students, faculty, and community.
CHAPTER 5  Results: EOCD and Systems Thinking Competencies

5.1  Introduction

The purpose of this chapter is to report the findings of the second component of my study, the objectives of which are to determine the impact of specific pedagogical strategies on students’ epistemic and ontological cognitive development; and, to investigate correspondence between epistemic and ontological cognitive development and system competencies in solving food systems problems. A sample of 37 students of LFS 250 were interviewed and asked to write a conclusion to a dual-position food security problem. Participant interviews and text were transcribed, coded, and analyzed by the author.

5.2  Research Questions

I investigate three research questions in relation to the experiences of the students in the second-year course, Land, Food and Community I (LFS 250):

• Is there evidence that specific pedagogical activities employed in LFS 250 are impacting student epistemological and ontological beliefs?
• Is there evidence that students understand and apply systems principles to a food system problem-situation?
• Is there correspondence between epistemic and ontological development and competence in applying systems principles?

I begin by describing participant demographics. This is followed by a summary of the findings associated with each research question. Each section begins with background context of the question, a review of the methods taken to address the question, results from data collection, and analysis.
5.3 Participant Description and Demographics

There were thirty-seven participants in the study, representing fourteen percent of the LFS 250 cohort in 2012. The average grade for the participants was 84 percent, slightly higher than the course average of 82. The average age of participants was 21 years. The relationship of participants’ age to the average age of students in LFS 250 is not known as statistics on the age of students enrolled in a course is not available to instructors at UBC. Students in Canada are eligible to enroll in university directly from high school, typically at 17-18 years old. Students in second year classes are typically 19-20 years old. The gender ratio of the sample matched the ratio within the course. The relative number of academic majors in the study sample did not match that of the course. The study sample contained more Global Resources System majors and fewer Food, Nutrition, and Health and Applied Biology majors than the class distribution. Additionally, there were three study participants who were not enrolled in faculty programs. Table 5.1 compares the class and sample characteristics.

<table>
<thead>
<tr>
<th></th>
<th>LFS 250</th>
<th>Study Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enrollment</td>
<td>264</td>
<td>37</td>
</tr>
<tr>
<td>Average Grade</td>
<td>82</td>
<td>84</td>
</tr>
<tr>
<td>Average Age</td>
<td>n/a</td>
<td>21</td>
</tr>
<tr>
<td>Female</td>
<td>78%</td>
<td>78%</td>
</tr>
<tr>
<td>Male</td>
<td>22%</td>
<td>22%</td>
</tr>
<tr>
<td>Food &amp; Nutrition Major</td>
<td>61%</td>
<td>42%</td>
</tr>
<tr>
<td>Global Resource Systems Major</td>
<td>12%</td>
<td>32%</td>
</tr>
<tr>
<td>Applied Biology Major</td>
<td>22%</td>
<td>16%</td>
</tr>
<tr>
<td>Other Major</td>
<td>5%</td>
<td>8%</td>
</tr>
</tbody>
</table>

Table 5.1 Comparison between Class and Sample Characteristics

5.4 Findings for Research Question 1

The following is the first research question addressed in the second component of the study:

• Is there evidence that specific pedagogical activities employed in LFS 250 are impacting student epistemological and ontological beliefs?
5.4.1. Context

Knowledge content in SFSE programs focuses on ill-structured problems, characterized by high levels of complexity and uncertainty inherent in the knowledge domain of food systems. Competencies for addressing ill-structured problems require an encompassing set of epistemic and ontological beliefs, beyond knowledge as simple and certain, residing in an authority, or only accessible through direct personal experience. Rather, these competencies rely on an understanding of knowledge itself and recognition that alternative solutions “may have some validity and may contain some error and there may be no absolutely correct choice between them” (King & Kitchener, 1994, p. 12). In order to help students develop abilities to meaningfully address ill-structured problems, SFSE educators will need to design pedagogical strategies that target epistemic and ontological beliefs. In the LFS 250 course, the four activities were intentionally developed to influence beliefs about the nature of knowledge, where it resides, how it is constructed and evaluated, and how knowing occurs. An analysis of participants’ responses to questions about their experiences with and understanding of these activities was undertaken to reveal if, and to what extent, these activities did impact epistemological and ontological beliefs.

5.4.2. Methods Review

Interviews began with questions about participants’ general opinions of LFS 250 and lead into questions focusing on four specific pedagogical activities carried out in the course: the Elephant and the Blind Men activity, the Flashlights in the Forest activity, the film Zea, and the Barnga Game (see section 2.10.1.1, Unit One: The Ecology of Knowledge for detailed descriptions of the activities). Students were asked if and how the concepts and ideas presented in the activities were useful, significant, and increased their understanding of food systems theories. Analysis of the responses to these questions coalesced into a single theme and reported under the heading, Did this activity help you understand food systems? Participants were also asked to
explain the metaphor or underlying message behind each activity. Responses were coded and analyzed to identify students’ epistemological and ontological beliefs and understanding of systems principles (the latter coded for the presence of holism or pluralism). Limitations to reductionism, opposing knowledge as simple and certain, and confusion regarding the purpose of the activity emerged as common themes in student responses. Appendix C presents the code framework used to analyze responses, including code definitions, and examples from interviews.

5.4.3. Findings and Analysis

All participants except one identified the activities in LFS 250 as having impacted their ontological and epistemological beliefs. Seventy-eight percent of participants stated that LFS 250 was the first time that they had encountered the concepts of holism, pluralism, epistemology and systems thinking. Sixteen percent reported that they had previously explored the concepts in other courses and educational settings but not in through systematic and sustained approach of LFS 250. One participant reported that the epistemic and ontological material was not new but supported her existing views of reality and views of knowledge. The one participant that did not identify the activities in LFS 250 as having an impact on her views of reality and views of knowledge offered responses that demonstrated a strong dogmatist preference for justification by authority – scientific ways of knowing in particular.

5.4.3.1 The Elephant and the Blind Men Diagram

Q: Did this activity help you understand food systems?

Fifteen of the thirty-seven participants reported that the elephant diagram was useful in articulating problems with the dominant, reductionist approach to solving problems in the food system, a conceptually difficult theme.

I thought it was a good metaphor of the problem with over specialization compared to taking a more systems approach and seeing interconnectedness. So I thought it was a really nice
easy simple to understand metaphor. It’s just right there, there’s an image to it is not just conceptual. It was something I hadn’t considered before though [P28].

One participant had taken a sustainability and systems themed course prior to LFS 250 and remarked:

*It kind of made it easier by making it one visual so I can understand right away. Whereas with the other course it wasn’t as clear, you really have to reflect on it. But with this exercise it pops up right away.* [P2]

One participant applied the metaphor to analyze experiences she had had with students who were dissatisfied with the general content and theoretical approach of the course. Her colleagues’ resistance to engaging in interdisciplinary learning directly confirmed the theoretical meaning of the diagram. The implications of her colleague’s behaviour reinforced the significance of the diagram and the solution proposed by the course, learning to adopt a systems approach to food systems issues.

*I heard from my friends that they didn’t think [the course] was important for them, and it should be an elective because they want to do actual food science learning. For me I think this is part of that issue because all that they will do is part of the food system, they need to look at the system as a whole and what they do as part of it. They think it is an independent profession or career but it is all interrelated.* [P18]

**Limitations of Reductionism**

Fifteen participants associated the elephant activity with the limitations or possible traps of becoming overly specialized in the food system.

*They were touching the elephant but they couldn’t tell that it was an elephant. To me it represented that if we are blind and we just stay within our niche [within the food system] then we will only know what’s in our niche and I feel like we will be moving blindly around. Our areas, our [disciplinary] specializations, they prevent us from wanting to go outside our comfort zones.* [P9]

The diagram invoked epistemological reflection on disciplinary specialization within food systems and how knowing occurs. When asked if the men in the diagram were incorrect about what they were concluding, Participant 16 responded:

*I would say that assuming you are correct about the effects you’re feeling, your facts might be right but maybe you don’t have all the facts. You are right about what you are seeing but*
maybe you aren’t seeing all that’s happening. Or conversely you might be right if your assumptions are correct but your assumptions are wrong because not seeing everything that is happening in the [food] system [P16].

Holism

Of the four pedagogical activities, the elephant and blind men was the activity most often connected to holistic ways of seeing and knowing. This activity helped students recognize and articulate the interconnected and relational nature of food systems, the fundamentals of holistic thinking.

Well, the food system is composed of many things so when you’re looking at one thing you have to be aware of all the other things that affect it. Everything works together and everything is impacted by the other things in the system, so you can’t just look at one aspect and judge it or talk about it you, need to like look at it as a whole [P12].

Twelve participants reflected on disciplinary knowledge and the fragmented structure of the university as being troublesome when attempting to understand the world.

I think the elephant represents all of the disciplines, all connected together as a whole. And the thought bubbles represent different perspectives, kind of the same things but just different points of view. I thought about how a lot of disciplines seem so isolated from each other, like arts and science. They can work together to improve our learning in general than two [separate] disciplines [P23].

One participant applied the elephant and blind men metaphor to his experiences with his group members in the course, recognizing the value of being able to step back to coherently incorporate different perspectives into assignments.

Yes, I feel like I’m always going back to that. The elephant is whatever is happening, a situation, any problem or any concept. And the blind men are kind of like approaching things from different points of view but only seeing one thing. It was kind of like that in our group, we all had different perspectives and were looking at different things, and to be effective, we needed someone to be able to see the big picture [P3].

A final theme that emerged from analysis of participants’ responses was relating specialized, expert knowledge back to the bigger picture as a necessary process in knowledge creation. Knowledge that did not reconnect was considered not as valuable.

I think it is important to take time to stop and look around and recognize various other people in your area of interest, and see that everything works together. So studying an area
to a really fine detail is cool and great but if you are not stopping to see how you can use that information to benefit people and the world then it seems a little useless [P25].

**Pluralism**

The elephant activity was the activity most often identified with “pluralism”, and one participant succinctly captured this pluralistic understanding:

*The food system can’t be understood from just one perspective [P3].*

Nineteen participants spoke to the direct impact of the diagram in portraying the value of multiple perspectives in a number of contexts: global issues, academic disciplines, and in relation to course group work.

*That picture was really good; it was a really good picture of how many things are perceived and why we need to change when tackling global issues. Things aren’t just one-sided [P4].*

*It helped me understand the role of different majors and disciplines [P23].*

My first thought that was for the group because within the group each person, when we get into an argument, it’s people see things from different perspectives so it’s important to get everyone’s ideas and opinions and then draw a conclusion [P26].

Participants also reported the diagram signified to them the importance of multiple perspectives, indicating their understanding of the role of pluralism in knowledge construction and evaluation.

*I think we have to sort of rely on people with all different perspectives because we can’t get an accurate conclusion without any of them [P26].*

*I think they are correct in what they are focused on but in order to get a conclusion from there you have to combine different aspects and perspectives and then come back and bring everything together in order to make a picture of the entire food system [P28].*

**Opposing Knowledge as Simple and Certain**

In the context of the elephant diagram, participants were asked a probing question taken from Greene and colleagues’ (2010) *Epistemic and Ontological Cognition Questionnaire*: When thinking about food systems, does the truth mean different things to different people? The purpose of this question is to identify beliefs on knowledge as simple and certain. Responses to
this question indicated that most believed that the truth does mean different things to different people; however, most participants also qualified their agreement by stating that incorporating other’s perspectives can increase the likelihood that one is getting closer to the truth.

*I think [the men] are right from what they know but once they start to learn about everyone else’s point of view they will change or modify what they already consider is right* [P4].

Further, participants identified the role of interpretation amongst academic disciplines within the food system as being a possible source of uncertainty.

*I think some things are left more open to interpretation than others. Looking at maybe the nutritional aspect of food, there’s a lot more that we can improve scientifically. But then if we look at something like food ethics and farmers’ rights, they are less concrete. Maybe truth isn’t consistent* [P6].

Additionally, the diversity of perspectives and complexity were other source of uncertainty about absolute truths and the study of food systems.

*It depends on why you’re looking at the facts. I don’t think we can all arrive at the same point of view. There are 6 billion ways at looking at a fact* [P14].

*But the food system as a whole because it’s so complex people are going to have different opinions so it’s hard to say who’s perspective will be best* [P6].

**Summary**

The elephant and the blind men activity was effective in succinctly conveying complex, abstract, epistemological and ontological concepts. The metaphor was easily understood by most study participants and clearly demonstrated the pitfalls of over-specialization.

*I saw this image in my elementary textbook in China. It’s a really famous story. I think every kid in China knows it. When you only look at something in one way, you won’t be able to see the whole image. So you have to look at it from different angles and from different positions when you look at it, then you will be able to understand the whole story about that thing* [P22].

Participants reported that this diagram revealed that the nature of knowledge in the food system is uncertain. Further, knowledge construction and evaluation in the food system requires consideration of multiple perspectives in order to understand the big picture and avoid the limitations of being overly specialized. Additionally, one participant stated that the diagram
made her reflect on how knowing and learning occurs, allowing her to articulate a social constructivist view of learning.

*My first thought on it was the need for communication. What each person is doing is valuable but the need to communicate is important for our understanding. There are limitations. Each person might not be capable of doing what everyone is doing, but we need to communicate our experiences and our learnings and accept what other people are doing too [P1].*

### 5.4.3.2 Flashlights in the Forest

**Q: Did this activity help you understand food systems?**

Similar to the elephant and the blind men, most participants reported the flashlights in the forest activity was a significant and useful activity for understanding the nature of food systems inquiry. Eight participants stated that the flashlights activity reinforced the concepts of the elephant diagram, further emphasizing the need for engaging multiple perspectives and being aware of connections when learning about food system issues.

*Yes, I think it’s really important, it’s a big deal for learning food systems, it solidifies the importance of the elephant, and how by broadening our learning we can understand more topics and get a better picture. And so in regards to food systems I think it’s beneficial [P4].*

Additionally, the flashlights activity helped students reflect on the need for balance between adopting reductionist and system approaches in the study of food systems.

*Yes it is because this idea that there always will be some sort of trade-off when you’re looking at the food system and that you need both of them to get a better understanding. You need the reductionist to get a fine detail and you need the systems to get a broader view [P23].*

*I guess just how people choose their academic endeavors, if they want to specialize in one thing or take little bits from different areas and integrate them. And how effective those two mindsets can be. I think both approaches are useful for the food system [P24].*

**Confusion Regarding the Purpose of the Activity**

However, when participants were asked to explain the metaphor behind each activity, flashlights had the highest frequency of being misunderstood amongst the four activities, with 22%
of participants incorrectly describing the objective of the activity as articulated by the course instructors.

The first thing I thought about was, I guess like, how much you want to see. I don’t know, personally I didn’t want to use a flashlight. If things could smell you but they couldn’t see you I think you’d be safer. The first thing is how much far ahead you like to look [P2].

I feel like the type of diffuse lens represents what were looking at right now and the narrow lens would be looking at the past. So to be able to shine the light backwards to see how things really work would be great [P5].

Three participants stated that they didn’t remember or understand the activity at the time it was delivered. In combination with the number of students that misunderstood the objective of the activity, this finding indicates that course instructors should spend more time discussing the flashlights activity and creating more ways for students to demonstrate their understanding.

I don’t really remember this activity [P36].

That was a metaphor for something to do with paradigms and something and then I don’t know [P35].

Oh god, I have no idea. He lectured about it but I can’t really remember. One you can see more but one you really couldn’t see. Sorry what was the metaphor then [P21]?

**Limitations of Reductionism**

Similar to the elephant diagram, the limitations of reductionism emerged in discussion of the meanings behind the flashlight activity.

A similar metaphor but just coming from a different angle, that tunnel vision and over specialization where you think you can see something crystal clear but it’s in a very small context so you are missing out on the environment around it. It has no context [P28].

The specialization thing and sort of just looking with blinders on, not really looking at the whole picture [P31].

**Holism**

Holism was identified as a significant theme in discussions about the flashlights in the forest activity. Participants stated that the activity further solidified the need for seeing the big picture
when investigating issues within the food system. Participant 22 provides an excellent summary of this theme:

The narrow light might be just looking at something as an animal biologist or a farmer or a food market person. The broader light is that when you try to look at many different components together and see how they affect each other, like a big picture. I think in the past I just thought about food basically, but I think right now, especially this system thinking thing, it really helps when you try to understand one thing and that thing is in the system working together with other things, you have to know all the other factors as well in order to understand better what the single thing is [P22].

However, only three students referred to the significance of interconnectedness within a system as a pathway towards greater understanding of any single component. Finally, taking a holistic approach, as portrayed by the flashlights activity, resonated deeply with 43% of participants. The following statement best captures the sentiment.

For myself, if I had to focus, I could study that and I would have a very clear picture of one thing. But intuitively I don’t want that, I want a broader view, even if I don’t know every single detail, I would still like a general view that encompasses more been just one view [P7].

**Pluralism**

The value of engaging both lights when attempting to understand a complex system was the most frequent viewpoint emerging from the flashlights activity.

I think they are both very important. The narrow beam allows us to see the fundamental principles of life and we can use that in a way to understand yields and soils, but it is also important to always keep in mind what the system is. I think it is important to have the two together [P20].

Participant responses indicated a range of views regarding how knowing might occur when different lenses are used to understand a situation. Sixty-two percent of participants suggested that we need many individuals with each type of lens working together.

I think you kind of need both. Lots of people pointing their focus lenses and lots of people kind of discovering the forest. So, like maybe one person in the middle trying to work with all the other focus lenses [P3].

Another participant extended this idea to include the possibility that one could develop the ability to work with both lenses.
You need both. You need someone with a narrow beam to look at the soil chemistry and someone else to look at the entire thing to see everything, so you need both perspectives. You could probably have both in the same person [P35].

When prompted to consider which lens is more suitable to investigating issues within the food system, numerous participants hesitated to choose one or the other, acknowledging the context dependent nature of the situation.

One is not better than the other it just depends on the situation [P11].

During the LFS 250 course, students were presented with the option of foregoing either light source and letting their eyes adjust to the darkness. Reflecting on the latter option, one participant expanded the metaphor to consider our modern reliance on scientific ways of knowing and suggested that intuition could also be an appropriate way of seeing.

I feel like perhaps we’re too reliant on these types of ways of seeing. The lack of light would represent intuition and the light beams are more scientific knowledge. So sometimes you just rely on yourself, your personal experience but you can have intuition and scientific knowledge at the same time [P20].

**Opposing Knowledge as Simple and Certain**

Although not as prevalent as in responses to the elephant and the blind men activity, participant responses to questions on the meaning of the flashlights activity surfaced beliefs about the nature of knowledge as being complex, influenced by personal and cultural factors.

I don’t think [one way is better than the other]. I think it depends on personal preference and what you want to achieve, what your goals are. The food system is very personalized; it’s how you want to proceed and perceive it. It’s affected by your culture, who you hang around with, your friends [P2].

**Summary**

The Flashlights in the Forest Activity was introduced in LFS 250 to demonstrate the need for taking both a holistic and reductionist approach to understanding the complexities in the food system as well as reinforcing the importance of multiple perspectives.

You don’t want to be too specialized so you can’t see the big picture but you don’t want to be too broad so that you can’t really understand anything [P9].
The frequency of misinterpretation of the metaphor reported by participants is problematic. This suggests more open discussion about its purpose is needed in future iterations of the course. Overall, the flashlight activity emphasizes a key theme of the LFC series, articulated in the statement below. In order to understand and address complex issues, students will need to value and engage with diverse ways of seeing and knowing in the food system.

> I think it represents the different ways of seeing that exist [in the food system], and that when we put the perspectives together, or the flashlights, we get a better sense of the world [P4].

5.4.3.3 Zea Film

Q: Did this activity help you understand food systems?

Participants reported the Zea film to be similar to and reinforcing the concepts of holism and pluralism conveyed through the elephant and flashlight activities. However, it was not universally perceived as relevant to studying food systems.

> I can’t remember what it had to do with food systems, I guess is just another perspective thing [P34].

Limitations of Reductionism

When asked, “what was the metaphor behind the Zea film?” students indicated the film illustrated that overly specialized, disciplinary approaches to issues in the food system may be inadequate in dealing with the complexity of situations.

> It just showed me that if you focus too much on something you might not see the bigger picture. I think it was a better metaphor than the other diagrams and activities. So zooming in too much might not let you see everything. [P17].

Holism

Students’ statements on holism were similar to their responses to the elephant and flashlight activities. This suggests that students viewed making efforts to see the big picture useful for demonstrating new relationships and connections within a field of study.

> What comes up now is how things can change. In the beginning you think it’s something but in the end something else. You keep guessing throughout the film and as we receive more
information and it gets bigger and bigger, our perspective gets greater. It’s a good connection to the lenses, flashlights and values. And how when we see a bigger picture, our own values and perspectives change [P4].

Pluralism

Questions about Zea invoked statements about pluralism when constructing knowledge and how knowing occurs. While watching the film, participants were asked to write down what they thought they were seeing. This presupposed that over the course of the film, their minds would change as the film progressed. At the end, when the kernel of corn pops and reveals that the object was a kernel of corn in oil on a frying pan, students are asked to share what they wrote down. The ensuing dialogue uncovers the diversity of speculation that was occurring despite everyone witnessing the same event. Reflecting on this during the interview, participants reported questioning how it is possible to come to a single conclusion and what constitutes evidence of knowing or understanding.

Well, we are all looking at things closely so we need to figure out some way of communicating that. But maybe it’s more than just communication, maybe we need at least one person to piece together all of the ideas, but that probably still doesn’t mean that we’re right. It just means that just these portions are together. I think taking more perspectives helps you understand [P3].

Students’ responses indicated many different strategies were used to deal with the uncertainty of pluralism. The most common strategy was to gather as many perspectives and possible and seek consensus on interpretations of an event.

I think to some degree your previous experiences will always contribute to decisions so that is not necessarily the issue I think that’s when that’s it’s the only thing... But that’s common too. But how do we make it so it’s not a problem? Like when two experts in the field of opposing ideas but you have to make one decision I guess that’s when it’s a problem because you have to take their advice. So I don’t know I guess get a lot of experts in that situation. I don’t know, for journal articles, have more than one author more often, but then that’s just four or five perspectives, so I’m not sure [P11].

A small number of participants recognized that consensus was not sufficient for resolving issues of uncertainty and that it is important to question how people came to their conclusions.
I think that’s fine but I think it’s challenging to work around if you ever want to solve things. For me, I will push for certain things and an understanding that each person has a different perspective. In reminding myself that will allow me to not think that everyone that doesn’t hold my point of view is completely wrong, I can remember that they’re seeing things from a different perspective. Just having that open-mind, it is a challenge to admit that you are wrong but it is also an eye-opener if you let it in. I guess we would have to discuss and have a storytelling discussion about not only what you think but what you thought it was and why you thought it was [P4].

**Opposing Knowledge as Simple and Certain**

Participants reported that at the centre of the Zea experience is the uncertainty and changing nature of knowledge and truth.

*Similar to the blind men and the elephant, when you only look at one aspect of the object, even if you believe you are right, you might not be. You might make mistakes of what you think is true [P22].*

However, participants also reported being comfortable with the challenge of encountering people with different beliefs and understandings, leading to recognition that truth and knowledge are continually evolving.

*I think it’s problematic to have one person decide what is right for everyone else and to determine what is right to do. That one person can form an opinion on their own but to say that this is correct and this is what we have to do is problematic to me. I don’t necessarily think that this is something should be done. I think looking at things in a more collective way is more effective. This film…led me to thinking about how our understanding of something is continuously changing and changing. We are always in this stage of shifting focus and learning about the world [P20].*

**Summary**

Interviews indicated that of the four activities, viewing and discussing the Zea film had the lowest impact on students’ understanding of food systems. However, the statements associated with pluralism demonstrate that this was an effective exercise for eliciting assumptions about how knowledge is constructed and evaluated, as well as how knowing occurs. Participants witnessed their own uncertainty as the film proceeded and then identified a similar struggle occurring within the minds of their colleagues, but with entirely different speculations as to what was happening on screen. As they experienced uncertainty, some participants relied on seeking more perspectives to
reach a reliable conclusion, whereas others acknowledged that simply seeking more interpretations might not resolve the issue. Furthermore, some participants stated that it is necessary to question how conclusions are made in order to obtain more reliable knowledge and understanding in situations of uncertainty.

5.4.3.4 Barnga Game

Q: Did this activity help you understand food systems?

Participant responses to this question were mixed. Forty-three percent of participants recognized the connection to the cultural differences in food systems and the potential challenges that may occur when one is unaware of the “rules” of another culture and other academic disciplines.

Definitely good for food systems, I think it was the most helpful out of all three examples so far because we didn’t know what was to be expected it really showed what was happening. Especially in food systems where you have farmers and activists and policymakers and agriculturalists, and economists, all these different fields. I would say that it is extremely helpful for food systems because you definitely have clashes happening [P16].

Additionally, reflections on the Barnga game prompted participants to appreciate that improvements in the global food system can come from studying other cultures and adapting lessons to other contexts.

Eating is a primitive activity for every single culture and every single nation. If we want to look into food systems as a system, we will have smaller systems and seeing big systems like the planet, and we want to advocate our ideas what we think is more healthy for the planet, we will have to know what other nations ideas about the whole thing and communicate with them. And if they know better we can learn from them [P19].

Yes, food systems, I mean there are regional and expand from there out into global, and food is, more than often, it is about bringing people together, I hope. And different cultures have different ceremonies and there is a lot of significance with food. And because there are so many different people in the world, there is no one model that’s going to work [P25].

However, 19% of participants did not see the connection of this activity to the food system. Some simply stated, “no, not really” [P8]. Others saw the lesson to be targeting functional group work by raising awareness about different personality types.
I didn’t really see how connected the food system. I thought it was more about cooperation with people in our groups [P30].

It’s interesting for being introspective about your personality, but not that applicable to the food system [P23].

**Pluralism**

Participants identified the challenges of engaging with diverse stakeholders as a key learning outcome from the Barnga game.

That communication is key and you shouldn’t judge other people. We had this one girl at our table who was being really aggressive and we all thought that she was kind of crazy, but then at another part of the game I went down to the people that she came from and I was arguing about the rules and those people thought I was the crazy one. That’s when it clicked and I realize that the rules were different. So when you go into different cultures or a different environment you just have to accept what they’re doing because it's their table, their rules [P17].

Similarly, tolerance and awareness of cultural differences was reported by 18 of the 37 participants.

If it’s other cultures, which is what I related to, I don’t think you can say what is right or wrong you just have to go with an open mind, and culturally it’s wrong for you because that’s what you were raised with but for them it’s right, so you just have to accept it. I think this is helpful for food systems. It reminds you to listen to what other people are saying and so you hear and listen to more opinions. So like if someone gave me better information they could change my opinion about something in the food system [P17].

Further, participants made the connection from differences amongst cultures to the possible barriers to working with experts from other academic disciplines in the food system.

In food systems, you need to know how to work with those who don’t look at things the same way as you. So like people from different faculties, is the same in the game, you need to figure out how to work with other people that you can’t easily communicate with. You need to find a way to work together [P34].

Well, that like, economists have a very different way of viewing the food system compared to animal rights people, and they do have common goals but a different way of thinking and talking about something. It’s totally important to understand that there’s different ways that people communicate and talk about things and to kind of learn how to move between those types of dialogs I think is really important [P27].
Opposing Knowledge as Simple and Certain

Taking part in the Barnga game in a university course exposed a wealth of views and beliefs about the uncertainty of knowledge. Participants experienced first hand what it is like to believe one holds knowledge and to be confronted by a group of “others” who behave counter to one’s beliefs.

I think it was important to realize that you need to be patient and that other people don’t maybe have the same ideologies that you do, and they weren’t given the same rules that you were. And if you jump to the conclusion that they are wrong it’s just going to blow up. Society is fluid and not static and that rules don’t apply to everyone. You can’t just say that your idea of what a community food system is wrong and that I know these things because I have been told what’s true. You have to listen and find out where people are coming from [P15].

This led some participants to feel unsure about their own knowledge and question the stability of commonly accepted truths.

It represented people’s personalities in an interesting way. At first I was trying to help people but then I thought later on that I may have got the rules wrong. So I went up and down, sometimes confident and then sometimes doubtful. I also saw that groups that created a consensus and moved on were the most successful. You kind of have to think that facts aren’t always true, the rules may not be the only rules [P14].

Further, participants reflected on sources of knowledge and understanding, concluding that we may not all think the same because our knowledge is constructed from different experiences and evaluated by different rules.

We may not all have the right information or the same information, or we might not all have the same rules. Because we may not all have access to the same experiences. For example what if one person read one article and another person read a different article so we have different backgrounds to the same situation. Then we all would not think the same [P3].

I remember at first I had no idea what was going on, but then, like, depending on what family or country you grow up in, you are given a set of rules to live by and that you experience. So when you meet someone else who has been given a different set of rules to live by its always kind of a shock and it can cause a lot of misunderstanding and conflict if you don’t already have an idea that there are very different rules. Does it mean that certain people’s knowledge is wrong? No it just means that it’s incomplete. They might just not know all the options [P7].
Summary

Although not perceived as applicable to understanding food systems by all participants, the Barnga game had an impact on all participants. The power of this activity lies in its universal ability to make players feel uncertain about what they believe to be true. Further, without the ability to communicate orally, participants easily made the connection to an experience in another cultural context. The uncertainty of knowledge, how it is constructed, and how it is evaluated are made tangible, leaving participants aware that when engaging with diverse stakeholders, they may not be “playing by the same rules”.

5.4.4. Comparison of Four Pedagogical Activities

The four activities examined in this study occur at the beginning of the LFS 250 course with the purpose of initiating awareness and discussion on ways of seeing, ways of knowing, and how we know what we know. These are challenging topics; however, there is evidence that these four activities, individually and together, assist students in understanding difficult epistemological and ontological concepts.

The effectiveness of the elephant diagram for invoking rich reflection on challenging epistemological and ontological topics lies in its simplicity. Amongst the four activities, it is the most direct in its delivery and conveys its message well. As one participant stated, he remembers seeing the diagram at an early age in elementary school, indicating that the diagram can be an effective learning tool at an early age. Participants reported having more difficulty with the other three activities, both in comprehension (the most incorrect or misunderstanding occurring with the flashlights activity) and in their recognizing the application to the content of the course, food system analysis. These other three activities are more complex and abstract in facilitation and interpretation. Further, debriefing and discussions of the activities are unequally distributed within the course, in time and expertise. The elephant and the flashlight activities are allocated 50
minutes each and introduced by the instructor. The Zea film is often allocated 30 minutes within the lecture hall, introduced by the instructor, who also facilitates the post-activity discussion. The Barnga game, which due to logistics and physical seating requirements of the game, needs to be carried out in small breakout rooms with groups of 30 students, is allocated 120 minutes. In this time, teaching assistants are required to set up their room, explain the directions, carry out the activity (approximately 45 minutes), debrief and discuss, and return their rooms to the previous state. With ten teaching assistants, the debriefing cannot be assumed to be consistent for all students across the course (teaching assistants are informed of key points for debriefing but it is unclear if all points are covered equally). With high turnover rates of teaching assistants, new teaching assistants often are often learning the game the week before through reading the instructions and discussions within the teaching team. The game is difficult to understand from paper alone and until one witnesses the action first hand, it is hard to understand how it will unfold. With these factors, the facilitation of the Barnga game and the content of subsequent discussion are uneven across the course and therefore student understanding can be assumed to be uneven as well.

All four activities have capacity to invoke discussion of issues related to pluralism as demonstrated by the interviews. This was expected based on the nature of each activity. Concurrently, each activity illustrates the uncertainty of knowledge and how knowing occurs. Participant responses to addressing uncertainty were commonly tied to the need for engaging diverse perspectives. Accommodating uncertainty was also related to the need to step back and see the “big picture”, appealing to the themes of holism and the limitations of reductionism.

Findings from the interviews suggest that these four pedagogical activities are impacting student epistemological and ontological beliefs. Two quotes from the interviews illustrate the impact of the four activities and the course as a whole.
After LFS 250, I have tried not to judge right away right after hearing something. I just take a step back and look at it, how did the person grow up maybe it’s right for them or maybe it’s right in a certain situation. This came through from the class in general [P12].

Building student awareness of different ways of viewing reality and viewing knowledge, the value of pluralism and holism, and a systems approach to addressing issues of complexity and uncertainty in the modern food system all begin with these four activities. The statement below further demonstrates that awareness.

*It’s so important to see things from both the specific focus view and the big picture. You need to take multiple perspectives and then see how it all ties together [P37].*

### 5.5 Research Question 2

The following is the second research question addressed in the second component of the study:

- Is there evidence that students understand and apply systems principles to a food system problem-situation?

#### 5.5.1. Context

Systems thinking, or taking a systems approach, is identified as a core competency and learning outcome of SFSE programs (Jacobsen et al., 2012; Jordan et al., 2008; Parr et al., 2007; Rojas, 2009). Furthermore, applying systems principles to land, food, and community challenges is a central learning outcome of the LFC series. There are numerous systems approaches and methodologies, however, holism and pluralism are identified as foundational principles of systems thinking (Reynolds & Holwell, 2010). Analysis of interview responses and student written responses to a food system problem were analyzed to reveal evidence of participants’ understanding and application of systems principles.

#### 5.5.2. Review of Methods

During semi-structured interviews, participants were asked to define a systems approach (Q: *What does taking a systems approach mean to you?*). Additionally, students were presented
with a dual position food system problem describing two proposals for increasing the food
security of an island. Students were asked to write a concluding paragraph recommending a
course of action for the island’s municipal government from the perspective of a food security
expert. Students’ responses were analyzed for presence or absence of holism, pluralism, and
linear thinking; and, assessed on the strength of their argument based on examples given to
support their claims. Participants’ written responses were rated on a scale from one to seven. The
rubric used to score participants’ written responses is described in section 3.7.2.2 in Chapter
Three.

5.5.3. Results

During the interview, students were asked, “What does taking a systems approach mean
to you?” Figure 5.1 summarizes the results of my analysis of students’ responses and evidence of
understanding the concepts of pluralism and holism as an indication of their understanding of
systems thinking.
Analysis of students’ responses to the interview question about what a systems approach means to them indicated that 44% of participants demonstrate an understanding of systems principles, including both concepts of holism and pluralism. Thirty-nine percent only included holism in their response, 8% included pluralism only, and 8% were unable to answer the question or gave responses that did not indicate any understanding of systems principles.

Below, I provide examples of each category of responses to the interview questions about what a systems approach means to them.

**Pluralism**

You can’t just go at things from one angle; you have to go from different perspectives. [P33].

**Holism**

That no one thing is everything on its own. You can’t look at something and say cause-and-effect there you go as the direct correlation between something. Everything is going to affect something and everything is interrelated and you can’t just think that one action has one consequence. It’s like a web, if you interact here you change six other things [P32].
Both Concepts

If you are taking a systems approach you are looking at something specific and you have to assess what other groups or whatever policies or what have you, influence that. You need to look at what are the influences, what is it connected to, how was it connected, and who is it connected to [P15].

Neither Concept

I feel like taking a systems approach is more like trying to adapt to people’s needs whereas specializing in a specific science you are just looking at hard facts. Whereas a systems approach, you’re trying to apply those concepts and adapting to people needs, so if you look at different communities and having different needs, the ways to go about things is all different [P35].

5.5.3.1 Analysis of Written Responses

The responses to the food system problem given to participants were analyzed and assigned a value from one of seven, with one representing no application of system principles and seven representing a full and complete application of systems principles. The rubric used for rating the written text is described in section 3.7.2.2 in Chapter Three. Examples of responses for each rating are provided in Appendix F. Figure 5.2 illustrates the distribution of responses in the sample.

Twenty-seven percent of participants gave responses that were rated from six to seven. Seventy-three percent of the written responses ranked from one to three, with 49% receiving a ranking of one or two. These results indicate that almost half of the participants in this sample were unable to demonstrate the ability to apply systems principles to a food system issue.

5.5.4. Summary: Comparison of Data Sets

Figure 5.3 displays participants understanding of systems approaches based on students’ responses in the interview and written responses. If there were correspondence between the two data sets, the graph in this figure would display a close match between the number of students that used both concepts in their interview definition of a systems approach and the number that
received a high rating for their written response. For example, 44% of participants used both concepts of holism and pluralism in their definition during the interview process, indicating an understanding of these systems principles. When given an opportunity to apply their understanding of systems principles to a food system problem, one would expect to see those participants’ written showing similar understanding and receiving a rating in the range of five to seven. The bar graph would then have a skew right. However, the skew on the graph is to the left, indicating that, regardless of the quality of the students interview definitions, most could not apply their definition to a food system problem.

![Bar Graph](image)

**Figure 5.2 Rating of Participants Understanding of Systems Approaches Compared to Written Responses to Food System Problem**

My evidence supports a conclusion that overall, participants in this sample do not understand and apply systems principles to food system issues at a high level. Less than 50% of participants included the concepts of holism and pluralism in their definition of a systems
approach. Furthermore, results from text analysis suggest that close to half of the participants in this sample do not demonstrate the ability to apply systems principles to a food system issue.

5.6 Research Question 3

The following is the third research question addressed in the second component of the study:

- Is there correspondence between epistemic and ontological cognitive development and competence in applying systems principles?

5.6.1. Context

From her experiences teaching systems principles at the graduate level, Salner (1986, p. 231) argues that “one of the teaching tasks of a systems program is to assist students to examine their...epistemic cognitive processes”. Similar claims have been made by prominent food systems experts and educators (see Bawden, 2006; Galt, Parr, & Jagannath, 2013; Jordan et al., 2008). Primarily, understanding and applying systems principles to food system issues requires a more encompassing epistemological and ontological cognition. To address the complexity and uncertainty of issues within the modern food system, students need to think holistically, recognizing the contextual and relational nature of reality, and the uncertainty of knowledge in this domain. Additionally, students will need to engage multiple perspectives and sources of evidence when arriving at a conclusion and assessing alternative interpretations. Students’ abilities to apply systems principles will be limited if they consider knowledge to be simple and certain, residing in either authority or derived solely from personal experience.

5.6.2. Review of Methods

5.6.2.1 Determining Epistemic and Ontological Cognitive Positions

Participants’ responses to the semi-structured interview questions were analyzed for indicators of the following:
• Assumptions about knowledge as certain and simple
• Beliefs about the role of authority and personal experience in knowledge generation
• Methods of justification for evaluating competing evidence.

Interview transcripts were analyzed and coded following the three dimensions of Greene and colleagues' (2010) model of epistemic and ontological cognitive development: knowledge as simple and certain (SC), justification by authority (JA), and personal justification (PJ). Codes representing the oppositional statements to the 3 dimensions were also used in analysis (XSC, XJA, and XPJ). The coding framework is presented in Appendix C.

Coded statements for each participant were then clustered together and analyzed to develop a profile indicating their position in the MEOCD: realist, dogmatist, skeptic, and evaluativist. Analysis considered the quality of the responses (weak or strong endorsement for the source of justification) and consistency across the interview. Once participant profiles were created, the results were compared to the scores and responses attained from questions of systems thinking in research question two.

In the process of transcript analysis to determine EOCD as used by Greene and colleagues (2010), I found some participant responses did not fit the existing model and were indicative of a fifth position. Responses by some individuals indicated a view of knowledge as contextual, uncertain and complex, with justification requiring engagement with multiple perspectives and sources of evidence. At the same time, these individuals did not indicate an ability to compare evidence across contexts. Rather, they indicated a level of satisfaction with seeking balance and compromise across opinions as an indicator of reliable knowledge. I adopted King and Kitchener’s (2004) description of Stage 5 in the Reflective Judgment Model (RJM) to describe this new position.

As described in section 1.3.4.1, the RJM is categorized into three levels: pre-reflective, quasi-reflective, and reflective thinking. Individuals at the pre-reflective thinking stages believe knowledge is gained by direct personal observation or through an authority figure. And, they
assume that knowledge is simple and certain – there are no ambiguities, just right and wrong answers where facts remain facts. Individuals at this level do not differentiate between well- and ill-structured problems. Reasoning at the quasi-reflective stage involves acknowledgement that uncertainty exists in certain problems but the individual lacks the cognitive skills to evaluate such situations. Reflective thinking is characterized primarily by recognizing the socially constructed nature of knowledge and the necessity of the individual's active role in this process. Uncertainty is acknowledged in the process of making knowledge claims, and through specific criteria for evaluation, some claims may be more reasonable than others.

The quasi-reflective thinking stage is divided further into a fourth and fifth stage. Individuals using assumptions associated with these stages “have difficulty when they are asked to draw a reasoned conclusion of to justify their beliefs” (King & Kitchener, 1994, p. 58). Individuals who use stage five assumptions “are able to relate and compare evidence and arguments in several contexts even though they appear unable to coordinate evidence and arguments across contexts into a simple system” (King & Kitchener, 1994, p. 63). As a result, individuals seek balance and consensus across multiple perspectives to address uncertainty rather than proposing justification for their own beliefs (King and Kitchener, 1994). When analyzing interviews, I adopted the term pre-evaluativist to describe student profiles that matched the assumptions characteristic of stage five in the RJM.

5.6.3. **Results**

Figure 5.4 presents the distribution of cognitive positions identified in the study sample. Sixty-five percent of participants were found to give responses identified as pre-evaluativist. The defining characteristic of this position is the recognition that both personal experiences and sources of evidence from an authority are valid forms of justification; however, participant
responses that indicated a pre-evaluativist position do not contain an argument for how to resolve the tension between the two sources.

![Figure 5.3 Distribution of Cognitive Positions in the Study Sample](image)

The following examples are statements representative of the pre-evaluativist position.

*R:* How do we overcome this problem of two experts disagreeing, and you have to come to a decision, how do you make a decision?

*P2:* Like we did in class, when we had different opinions and different experts come in to talk about the same topic, we need to understand the course content, who can provide the best arguments that seem valid and have support, who can support their argument. I was thinking about the discussion questions, why you think you are right needs to be backed up with, it can be facts that you heard in class or your own personal experiences.

*R:* Could you tell if one was right and if one was wrong?

*P2:* Definitely not, I don’t think so. When it comes to food I don’t think you could be right or wrong.

Participants operating at this position could not express differences between academic knowledge and personal experiences.

*R:* Does it matter that the knowledge was coming from his [the farmer’s] personal experiences compared to academic research? If the knowledge was coming from personal experiences,
can you disagree with someone when their understanding is coming from personal experiences?

P3: Well I don’t think that there’s a big difference between personal experience and academic knowledge. Okay, academics have control experiments and all those things but what if someone’s personal experiences are just as accurate as a study?

P5: Maybe there are things that we can measure with accuracy. You can measure up to a certain point. It’s not even about having the most amount of things right either because some things will be weighted heavier than the others. Like how do you make your decisions about food? Is it based on economics, is it based on taste, convenience, what your family cooks? It’s pretty complicated. So what do we weight as the most important and how does that contribute to our decisions? Yeah, I don’t know how to answer that question.

Additionally, participants identified in the pre-evaluativist position often relied on consensus and seeking out more perspectives.

R: If you have two food system experts from different cultures and they disagreed on a topic, how could you tell who is more accurate?

P20: Well, depending on your background really affects the way you see things often especially your educational or cultural background or the experiences you have accrued. People come to different things based on their experiences. I would listen to just try to see things how they actually are.

R: Is this possible keeping in mind the Zea film?

P20: I don’t know. That’s difficult to answer. I think it’s problematic to have one person decide what is right for everyone else and to determine what is right to do. That one person can form an opinion on their own but to say that this is correct and this is what’s due is problematic to me I don’t necessarily think that this is something should be done. I think looking at things in a more collective way is more effective, you can balance people’s biases this way, and gather as much knowledge and opinions.

In contrast to the pre-evaluativist positions, participants espousing an evaluativist position (15% of the sample) are able to recognize the contextual nature of knowledge construction and justify positions with confidence taking into account the strengths and limitations of different sources of knowledge.

R: If the farmer or the butcher disagreed with the scientist, who would you trust?

P13: That’s tricky. Part of the question is, are they even disagreeing on the same topic? They all have opinions and they all have subjective facts. It’s difficult because this kind-of comes to a bias of my own towards academic knowledge, but I don’t think that’s the only opinion. When we were doing our discussions on this topic, I was weighing all the evidence and the opinions presented however scientifically backed up or backed up by experience. And experience is still fact even though subjective. In general I value empirical evidence and find it hard to disagree with, but that doesn’t mean it’s 100% true or that the findings won’t change
the future. If I don’t agree with it, let’s say it feels like the conclusions aren’t in-line with my previous understandings, I would have to go back to their methodology and look at how they conducted the study of the experiment in order to see if the conclusions were correct. Overall I find this type of information reliable.

Sixteen percent of participants were found to be espousing a skeptic position, identified by statements that value personal experience over sources of knowledge derived from authority.

R: So if a scientific article presented a different perspective were given truths compared to what you have experience what would you trust?
P7: I would trust what I have experienced.

R: Which source of knowledge is more reliable?
P7: I would trust my personal experience, I like to experience things. I don’t know if it’s more reliable but I just know that instinctively that what I like to do.

Similarly, in response to the question of whether a farmer or a scientist has more reliable knowledge in the food system, participants espousing a skeptic position sided with the farmer due to direct experience.

R: Does this mean that [the farmer] he has more reliable knowledge about the food system compared to an academic who might not be involved directly in the industry they are studying?
P12: I would believe the one that actually worked with what he’s talking about, or that worked personally with it or that experienced it compared to a person who’s just studied it. I feel like anyone can just study something but not everyone works closely with it.

R: If the farmer or the butcher disagreed with the professor, how can you tell who to trust to form your own opinion?
P37: I think the difference for me is that the butcher is a person, he has experiences from doing his own thing whereas the professor is more theoretical and less personal. She’s not coming to talk about what she does every day but just to talk about theories.

Two participants (5% of the sample) were identified as dogmatists based on their responses in the interview. The dogmatist position acknowledges that facts and truths are not simple and certain. However, to resolve conflict arising from uncertainty, knowledge from authority is privileged over personal experience.

R: So are her personal experiences as valid as scientific findings?
P35: Personal experiences as valid as papers? No, I think that is really questionable. Personal experience is always so biased because even if you make two people do the same thing they’re approaching in different ways so it’s not reliable.
Further, these participants identified formal educational institutes and science as sources of authority.

R: You tell the difference between an accurate and inaccurate opinion?
P35: The only thing I can think of to determine is what you’ve been educated with, what you know from school. More or less people trust what they learned in school so I would think that is the basis for what to trust.

R: How would you know who’s telling the truth? How could you tell who’s telling you the truth and who’s just telling you an opinion?
P9: Science.

R: Are [professors] giving you opinions or facts?
P9: Depends on the subject, like English has lots of opinions. Food systems still relate back to science. And those facts change if one component changes, it’s just like cause-and-effect. Facts change all the time in science.

R: How do you know who to trust then?
P9: The new science.

5.6.4. Comparison of Data Sets

In order to determine if there is correspondence between epistemic and ontological cognitive development and competence in applying systems principles, I compared the results of students’ responses to the dual position food security problem with their epistemic and ontological cognitive positions using a stacked bar graph (Figure 5.5). This comparison was made to identify patterns. Overall, the graph does not illustrate a strong correspondence between cognitive positions and systems competencies with the sample of participants in this study. Evidence suggesting correspondence would reflect a graphical pattern whereby participants identified as dogmatic and skeptic would occupy the left bars of the graph. Participants identified as pre-evaluativists and evaluativists would occupy the right. This is not the case as seen in Figure 5.4 with participants identified as pre-evaluativists being distributed across the spectrum. However, only participants that espoused pre-evaluativist and evaluativist positions occupied the areas on the graph indicating a high rating of systems thinking (five and greater). This association suggests that correspondence between EOCD and systems thinking competencies might exist in this sample.
Figure 5.4 Distribution of Cognitive Positions Relative to Systems Thinking Ratings

The following section will discuss reflections on the limitations challenges to assessing systems thinking in the data collection design revealed during the interview process. Further discussion of the results of study two will take place in Chapter 6.

5.7 Limitations and Challenges to Assessing Systems Thinking

Participants were asked to write a conclusion of less than 1000 words in response to a dual position problem about a fictional food security issue. This task occurred after the interview process, in which participants were asked challenging epistemological and ontological questions. Participant responses were short, on average 86 words, none were longer than 200 words and the shortest was 27. The short length of the text used for analysis is problematic for a reliable assessment of competency in applying systems principles. I suspect participants were fatigued from the interview process and this affected their willingness to devote significant effort to completing the written task. Although other studies have used similar methods for investigating
correspondence between personal epistemology and responses to dual position expository texts (see Kardash & Howell, 2000; Mason & Boscolo, 2004), this single approach may not be sufficient for capturing the complex nature of systems thinking competencies.

A potential method for overcoming the single opportunity to capture and evaluate systems competencies could lie in using course work. Participants completed a number of systems-based assignments in LFS 250. However, in LFS 250, these assignments were completed in a group setting and when questioned about their experiences with group systems assignments, a number of participants reported that their groups often chose the strategy of “divide and conquer”. Essentially, tasks for completing group projects were split up and delegated to different members of the group. Participants reported that individuals in the group that preferred design work often took ownership of creating the system models.

These insights concerning student approaches to group work have two significant implications for the study. First, an assessment of group assignments would not be indicative of an individual’s understanding of the content of the assignment. It is often assumed that students work on group projects together and that each member more or less contributes equally to the final project, leading to an assumption that each group member gained an equivalent understanding of the content. Participant responses suggested that these assumptions are false and therefore student course work in its current form could not provide reliable evidence of an individual’s systems competencies. Second, due to this group work strategy, it cannot be assumed that the systems activities in LFS 250 are developing individual student’s systems competencies. These factors may contribute to the quality of systems understanding under investigation in this study.
CHAPTER 6 Discussion and Conclusion

6.1 Introduction

I begin this chapter with a review of the purpose of the two components of this study, including the research questions and a brief summary of the findings. Based on the findings from the first component of the study, I propose a framework for a SFSE signature pedagogy (Shulman, 2005). Based on the findings from the second component, I discuss the four pedagogical activities as a complementary set of strategies for impacting epistemic and ontological cognitive development (EOCD). Then, I discuss the development of systems thinking competencies, and position EOCD as a threshold process for systems thinking. Further, I propose a scaffolding of EOCD and systems thinking competencies within the LFC series. The chapter ends with considerations of future research and concluding statements.

6.2 Purpose of Research

The objective of my research is to describe, analyze, and test assumptions within the Land, Food and Community (LFC) approach to developing a sustainable food system education (SFSE) program. My research contributes to the growing number of publications dedicated to the development of SFSE program theories, concepts and processes, all of which emphasize the need for a systems-based, inter- and trans- disciplinary, experiential learning approach. Specifically, my research aims to

- Identify and situate the LFC theoretical framework within a diversity of scholarly domains;
- Determine the impact of specific pedagogical strategies on students’ epistemic and ontological cognitive development;
- Investigate correspondence between epistemic and ontological cognitive development and system competencies in solving food systems problems.
6.2.1. **Research Questions**

There are two components of the study addressing my research objectives. In the first component, I investigate two research questions concerning the theoretical framework of the LFC series:

- What are the theoretical dimensions of the LFC series approach to SFSE program development?
- How does the theoretical framework of the LFC series situate within other scholarly domains?

In the second component of the study, I investigate three research questions in relation to the experiences of the students in the second-year course, Land, Food and Community I (LFS 250):

- Is there evidence that specific pedagogical activities employed in LFS 250 are impacting student epistemological and ontological beliefs?
- Is there evidence that students understand and apply systems principles to a food system problem-situation?
- Is there correspondence between epistemic and ontological development and competence in applying systems principles?

Addressing these research questions contributes to the growing interest in SFSE program development. Identifying and situating LFC theories within other scholarly domains will assist other SFSE scholars in conceptualizing the transformations occurring within the Faculty of Land and Food Systems at UBC, and potentially contribute to similar efforts elsewhere. The focus on the relationship between pedagogical strategies, epistemic and ontologic development, and systems competencies addresses untested assumptions implicit in publications of SFSE scholars (see Salner, 1986; Bawden, 2005, 2007, 2010; Jordan et al, 2008; Galt, Parr, & Jagannath, 2013).

### 6.3 Summary of Findings

In chapter Four, I identify and situate the theoretical framework of the LFC series within other scholarly domains. Using an autoethnographic approach and drawing upon Rojas’ publications on the LFC series and my personal experiences in the LFC series, I identified four key
elements of the LFC framework (in bold). These elements are summarized in the following statement:

The LFC series seeks to cultivate a particular ecology of knowledge that enables individuals within a community of learners to develop polycultures of the mind in order to apply systems principles to issues of food security and food system sustainability.

The key elements are examined in terms of their relationship to learning theory, systems theory, cognitive psychology, and community-engaged scholarship. The ecology of knowledge, community of learners, and polycultures of the mind are based on Freirean critical constructivist learning theory and Bateson's theory of ecological knowing. The ecology of knowledge cultivated by the LFC series is illustrative of “approaches to learning, instruction, and knowledge representation” required to cultivate cognitive flexibility (Spiro, Coulson, Feltovich, & Anderson, 1988, p. 556). Cognitive flexibility theory explains problems of advanced knowledge acquisition and application in ill-structured domains, such as food security and food system sustainability. Lastly, the LFC ecology of knowledge provides a framework for an ontological and epistemological orientation towards Community-Engaged Scholarship (CES). The term community-engaged scholarship refers to a range of faculty work in communities, often through the integration of teaching, research, and service, in mutually beneficial manner (Calleson et al., 2005)

Chapter Five presents the findings of the second component of the study, the objectives of which are to determine the impact of specific pedagogical strategies on students’ epistemic and ontological cognitive development; and, to investigate correspondence between epistemic and ontological cognitive development and system competencies in solving food systems problems. At the beginning of LFS 250, students participate in four activities (the elephant and the blind men, flashlights in the forest, the Zea film, and the Barnga game) that are intended to initiate awareness and discussion on ways of seeing, ways of knowing, and how we know what we know. Evidence from the second component of the study suggests that these four activities, individually and together, assist students in understanding difficult epistemological and ontological concepts,
with a number of study participants demonstrating epistemic and ontological cognitive development representative of King and Kitchener’s (1994) quasi-reflective stage five of development. Evidence from the second component further suggests that a number of students in the study sample are not developing the ability to understand and apply systems principles. Further, I found limited correspondence between students’ epistemic and ontological cognitive development and their systems competencies.

6.4 Signature Pedagogy for Sustainable Food System Education

In this study, I identified the theoretical dimensions of the LFC series and summarized the objective of the series in a single statement:

The LFC series seeks to cultivate a particular ecology of knowledge that enables individuals within a community of learners to develop polycultures of the mind in order to apply systems principles to issues of food security and food system sustainability.

My analysis of the LFC supporting documents revealed the similarity of the LFC pedagogy with other SFSE programs27. In particular, there is a common emphasis on critiquing and moving beyond the traditional settings and processes associated with institutes of higher education: the lecture hall or classroom and the didactic method of content delivery. This problematizing of context and process is parallel to critiquing the ecology of knowledge within which learning in a SFSE program takes place. SFSE programs seek out multiple learning settings and activities in order to develop a range of student competencies. This is similar to the LFC series’ integration of diverse learning contexts to facilitate development of polycultures of the mind. Within a SFSE program’s ecology of knowledge, the role of the instructor is particularly significant. To create a community of learners able to appreciate and engage with multiple perspectives, the instructor is positioned as a facilitator with specific expertise rather than as the authority. Further, SFSE programs emphasize the value of interdisciplinary and non-academic ways of knowing when

27 See section Sustainable Food System Education in Chapter 1.
addressing uncertainty and complexity in the food system. This emphasis on pluralism, in combination with a holistic and relational way of knowing, creates the foundations to systems thinking common across SFSE programs.

The commonalities that exist suggest the emergence of a signature pedagogy (Shulman, 2005) for SFSE programs. Shulman (2005, p. 52) defines a signature pedagogy as “types of teaching that organize the fundamental ways in which future practitioners are educated for their new professions”. Shulman (2005) offers examples of commonly recognized elements of signature pedagogies in medicine and law, such as bedside teaching and case dialogue methods, respectively. Signature pedagogies involve choice on the part of the instructor with respect to selecting amongst a variety of pedagogical strategies for developing novices (Shulman, 2005).

Wattiaux (2009, p. 207) put forth elements of a signature pedagogy for agricultural sciences, focusing on agronomy, animal, and dairy sciences, and the skills that are core to successful farming: “self-reliance, problem-solving, decision-making and leadership”. To develop disciplinary and professional levels of expertise, Wattiaux (2009, p. 217) proposes a signature pedagogy through capstone experiences that embed the learner in real-world settings, providing “first-hand opportunities to apply their nascent scientific expertise”. He argues that current realities of the modern food system require complex skills to negotiate between scientific knowledge and experiential learning. In addition, he questions whether learning to deal with uncertainty in the professional world can be achieved through a lecture-based pedagogy alone. Although acknowledging that students enrolled in agricultural sciences will be exposed to curricula beyond agricultural production, inclusive of environmental and social justice perspectives, he does not explicitly discuss the value of interdisciplinary approaches beyond the natural sciences or the inclusion of non-academic ways of knowing into solving complex problems. Further, a clear directive to develop systems thinking competencies is lacking.
Wattiaux’s vision of a signature pedagogy for the agricultural sciences, recognizing the complexity of the modern food system and the value of experiential learning to complement theoretical knowledge, is a step in the right direction towards developing professional competencies and dispositions, but does not sufficiently meet the needs of SFSE programs. First, SFSE programs emphasize the significance of systems approaches in addressing complexity and uncertainty. Second, SFSE programs involve disciplines beyond traditional agricultural sciences, such as those from the life sciences, sociology, and economics. This diversity creates the foundations for interdisciplinarity in the curricula through the presence of both natural and social sciences perspectives and methods. Third, community-based experiential learning approaches not only provide an opportunity for students to apply theoretical knowledge in a real-world setting, they also expose students to non-academic ways of knowing, critical for addressing ill-structured problems in the modern food system.

Extending Wattiaux’s vision, I use Shulman’s (2005) three dimensions of signature pedagogies to describe a framework for an emerging SFSE signature pedagogy. The three dimensions are 1) a surface structure, “which consists of concrete, operational acts of teaching and learning, of showing and demonstrating, of questioning and answering, of interacting and withholding, of approaching and withdrawing”; 2) a deep structure, which is “a set of assumptions about how best to impart a certain body of knowledge and know-how”; and, 3) an implicit structure, consisting of “a moral dimension that comprises a set of beliefs about professional attitudes, values, and dispositions” (Shulman, 2005, pp. 54–55).

6.4.1. **SFSE Signature Pedagogy: Surface Structure**

The surface structure of a signature pedagogy relates to the settings and processes one would identify from observing participants in an educational program. SFSE signature pedagogy should make use of multiple learning contexts: lecture halls, small classrooms, field trips, labs,
community placements, and professional internships. Each context provides opportunities for students to develop behaviours to adapt to learning in different settings. For example, lecture-based learning requires mental focus and reflective engagement with the material whereas small classrooms can be more conducive to activities that require active, spontaneous interactions with other learners. Field trips integrate new knowledge with real-world contexts and engagement with individuals embedded in those contexts; whereas labs, community-placements, and professional internships further incorporate active skill and competency development within a particular setting to complement theoretical knowledge. By design, diverse learning settings increase the level of uncertainty in the overall instructional strategy, an identifying characteristic of signature pedagogies, which “render classroom settings unpredictable and surprising, raising the stakes for both students and instructors” (Shulman, 2005, p. 57).

Similarly, the surface structure of a SFSE signature pedagogy should involve diverse instructional processes and tasks. Students should be given individual and group-based assignments and be required to complete a variety of assessment tasks, such as making presentations, facilitating group discussions, writing academic reports and reflective journals, creating systems models, engaging with community stakeholders, and designing, implementing, and evaluating interventions. The public student performance aspect of a SFSE program is a significant feature of signature pedagogies, by reducing “the most significant impediments to learning in higher education: passivity, invisibility, anonymity, and lack of accountability” (Shulman, 2005, p. 57).

Use of ill-structured, or open-ended food system case studies with inquiry-based instruction is paramount to SFSE processes (Francis et al., 2011; Rojas, Sipos, & Valley, 2012; Spiro, Coulson, Feltovich, & Anderson, 1988). Francis and colleagues (2011) make a distinction between closed- and open-ended case formats, preferring the latter for developing competencies for dealing with the complexity of real-world situations. Closed-ended cases are designed in a
manner that allows the student to discover the “correct” solution, which is already known by the instructor and community partner. An open-ended case promotes collaboration amongst instructor, community partner, and student, acknowledging that “neither the relevant questions nor the answers have yet been identified” (Francis et al., 2011, p. 230) These qualities of the open-case inquiry supports pluralism and invites creativity into the problem solving process. In addition, open-cases provide opportunities to develop transferable skills to apply to future cases, essential to developing cognitive flexibility to address uncertainty of real-world situations (Spiro et al., 1988). As Shulman (2005, p. 57) states, “learning to deal with uncertainty in the classroom models one of the most crucial aspects of professionalism, namely, the ability to make judgments under uncertainty”.

6.4.2. SFSE Signature Pedagogy: Deep Structure

The deep structure of a signature pedagogy conveys how to think like a professional through a tacit set of assumptions about subject knowledge and know-how (Shulman, 2005). To address complexity and uncertainty in the modern food system, SFSE programs must help students develop systems thinking competencies, beginning with supporting students' understanding and application of holism and pluralism. As stated previously, development of systems competencies requires an ontological commitment to a relational view of reality and an epistemological shift towards knowledge as socially constructed, residing in, and evaluated from, different perspectives and approaches. Further, overcoming the fragmentation of knowledge and identifying the strengths and limitations of disciplinary approaches to food system issues are central themes in SFSE programs.

Students in SFSE programs will need to develop the ability to justify and support conclusions within a context of uncertainty by integrating academic and non-academic ways of knowing. The role of the instructor is paramount to initiating this process. The instructor needs to be
positioned as co-learner and facilitator in order to demonstrate the role of expertise versus the role of expert and authority in a food system context. This arrangement will assist in establishing the value of each participant in the learning process, regardless of his or her status, be it undergraduate student, professor, farmer, community nutritionist or CEO. In addition, personal experience needs to be invited into the curricula as a valid form of knowledge in the food system, further supporting the premise that each participant can meaningfully contribute to a collective understanding of the food system.

Signature pedagogies “form habits of the mind, habits of the heart, and habits of the hand” (Shulman, 2005, p. 59). Know-how in the food system is best achieved through engaging head, hands, and heart through a diversity of learning contexts and activities (Bawden, 2005; Parr et al., 2007; Sipos, 2009). SFSE signature pedagogy should balance cognitive, psychomotor, and affective learning tasks in a variety of settings, on campus and beyond. Wattiaux (2009, p. 209) identified experiential, hands-on learning opportunities as a historically integral aspect of agricultural science curricula, important for developing student “aptitudes, attitudes and interpersonal skills”. Due to the socio-ecological context of the modern food system, learning scientific facts and figures will not adequately prepare graduates to address the situations with which they will interact as professionals. SFSE programs need to integrate experiential learning activities to provide opportunities to apply theoretical knowledge in a real-world context. Coupled with critically reflective assessment activities, these experiences will demonstrate the value of combining “learning for knowing, learning for doing, and learning for being” (Ison, 1990, p. 7). Further, placements outside of the university will allow students to experience and critically reflect on the non-academic ways of seeing and knowing in the food system.
6.4.3. SFSE Signature Pedagogy: Implicit Structure

Analysis of the implicit structure of a signature pedagogy reveals “a moral dimension that comprises a set of beliefs about professional attitudes, values, and dispositions” (Shulman, 2005, pp. 54–55). SFSE programs value optimization amongst many variables, objectives, and needs within the modern food system (Francis et al., 2003; Jacobsen et al., 2012; Rojas et al., 2012). A pluralist perspective is central to engaging with multiple stakeholders and achieving optimization within a complex system. However, the varied perspectives that exist in modern society “often give rise to value-laden conflicts between viewpoints” (Gregory, 1996b, p. 606). Future SFSE professionals will need a foundational approach to deal with the inherent disagreement and difference amongst diverse perspectives in modern food system discourse. I propose Gregory’s (1996b) discordant pluralism as the theoretical position which SFSE programs ought to adopt and teach. Further, I draw upon Warren’s (1990) depiction of oppressive conceptual frameworks as a foundation for the necessary temperament of SFSE professionals when engaging with diverse perspectives and power dynamics in an academic and community setting.

Responding to the widespread realization that we have been less attentive to the unintended social and environmental consequences of the modern food system amid significant technological and scientific innovations for increasing agricultural production, the International Assessment of Agricultural Science and Technology for Development (IAASTD) report established the following goals: to determine “how [agricultural knowledge, science and technology] can be used to reduce hunger and poverty, to improve rural livelihoods and to facilitate equitable environmentally, socially, and economically sustainable development” (McIntyre et al., 2009, p. 3). To develop professionals to help society reach these goals, SFSE programs need to shift from teaching about maximizing agricultural output (or any other variable) to optimizing benefits across many environmental, social, and economic issues (Francis et al., 2003; Jacobsen et al., 2012). Professionals educated to value optimization within the food system would then “recognize
and give increased importance to the multifunctionality of agriculture, accounting for the complexity of agricultural systems within diverse social and ecological contexts” (McIntyre et al., 2009, p. 3). This approach relies on intentional dialogue and collaboration with stakeholders with diverse worldviews and possibly contradictory perspectives in a manner that can further our collective understanding of the multiple functions of food systems as a whole (McIntyre et al., 2009).

However, issues within the food system, such as economic growth and environmental health, are often framed as incommensurable, “either/or” positions. Promoting the adoption of a pluralist perspective is futile if individuals become entrenched in fundamentalist positions. Gregory (1996a, p. 55) proposes discordant pluralism, which promotes a habit of “critical appreciation”, whereby issues are reframed “in a way that recognizes the legitimacy of each position” allowing further discussion to take place. This reframing permits discourse to continue “in the face of unresolvable differences”, bringing issues closer to a “both/and” solution (Gregory, 1996a, p. 54). A discordant pluralist perspective seeks to understand familiarities and differences amongst perspectives without attempting to reach consensus, and relies on listening and using one’s critical faculties to come to an appreciation of divergent views. This perspective allows discordant theoretical approaches to challenge and supplement each other without reducing “the other to the same” (ibid, p. 57). A discordant pluralist position is vital when engaging diverse perspectives to address issues of complexity and uncertainty in the food system. This positioning prevents a dominant perspective from imposing a particular worldview into food system discourse; we do not all have to think the same way, but we do need to listen and be critical of each other’s (and our own) ways of seeing and knowing.

In order to achieve a discordant pluralist perspective and successful inter- and transdisciplinary collaboration, it is important that future SFSE professionals be aware of the inherent logic of domination that pervades academic institutions, both between disciplines (Fanelli, 2010)
and in relation to other ways of knowing (Elliott, 2012). Warren (1990, p. 129) outlines the structure of argumentation that “explains, justifies and maintains relationships of domination and subordination”. The combination of value dualisms, such as the objectivity and rigor of natural sciences versus the subjectivity and spuriousness of social science methods (i.e. hard versus soft sciences) or academic versus non-academic ways of knowing, with a logic of domination, creates an oppressive conceptual framework. Warren (1990, p. 130) provides the example of the twin domination of women and nature within a Western, patriarchal conceptual framework.

“(B1) Women are identified with nature and the realm of the physical; men are identified with the "human" and the realm of the mental.  
(B2) Whatever is identified with nature and the realm of the physical is inferior to ("below") whatever is identified with the "human" and the realm of the mental; or, conversely, the latter is superior to ("above") the former.  
(B3) Thus, women are inferior to ("below") men; or, conversely, men are superior to ("above") women.  
(B4) For any X and Y, if X is superior to Y, then X is justified in subordinating Y.  
(B5) Thus, men are justified in subordinating women”.

Commenting on the continual dominance of positivism in academia, Greenwood (2007, p. 257) states that despite positivist perspectives having been “subjected to devastating critiques for more than a generation...they remain hegemonic and are fully and carefully institutionalized in the curricula, teaching, and research practices” of the university. The belief in a hierarchy of science, which ranks scientific approaches based on objectivity and rigor, “is reflected in many social and organizational features of academic life” (Fanelli, 2010, p. 1). Within this hierarchy, data and conclusions emerging from natural science methodologies are deemed more reliable and closer to truth than findings from the social sciences, which are perceived as being influenced by non-cognitive factors such as “scientists’ prestige within the community, their political beliefs, [and] their aesthetic preferences” (Fanelli, 2010, p. 1). Attempts to bring natural and social science perspectives together in interdisciplinary SFSE curricula will require addressing the unequal status between the natural and social sciences, and the perceived “rigor inherent in counting things” (Sankaran, Hase, Dick, & Davies, 2007, p. 296).
Designing open-ended case studies with questions that require students to make use of perspectives and skill-sets of natural and social sciences can demonstrate the strengths and limitations of both. Further, when constructing a SFSE teaching team, attempts should be made to recruit instructors from the natural and social sciences. Diversity in the teaching team provides opportunities to demonstrate different ways of seeing and knowing in “real-time”, as instructors lecture, analyze, and interact with course material, and each other. In the LFC series, the initial three instructors had distinct academic backgrounds: one in soil science, another in sociology, and another in food science. During course time, they would often openly debate and challenge each other, explicitly stating that from their disciplinary perspectives, they see the topic in a different way. These interactions were meant to actively demonstrate to students the value of different ways of seeing and knowing.

To illustrate the problematic nature of the inequality of status and prestige between the natural and social sciences, I will substitute objectivity and subjectivity, coupled with natural and social sciences, respectively, within Warren’s framework for an oppressive conceptual framework:

“(A1) The social sciences are identified with subjectivity; the natural sciences are identified with objectivity.

(A2) Whatever is identified with “subjectivity” in the current, hegemonic definition of the scientific method is inferior to (“below”) whatever is identified with “objectivity”; or, conversely, the latter is superior to (“above”) the former.

(A3) Thus, the social sciences are inferior to (“below”) the natural sciences; or, conversely, the natural sciences are superior to (“above”) the social sciences.

(A4) For any X and Y, if X is superior to Y, then X is justified in subordinating Y.

(A5) Thus, the natural sciences are justified in subordinating the social sciences”.

If sound, the argument above justifies the status of natural science approaches to knowledge generation within the food system as more reliable due to inherently greater rigor and objectivity. If the received conception of the hierarchy of science is not openly contradicted within a SFSE program, the perception that the social sciences and qualitative methods with which they are associated are not reliable will continue. Interdisciplinary collaboration may suffer due
to an oppressive conceptual framework potentially operating in those who identify as natural scientists.

Similarly, SFSE programs will need to develop pedagogical strategies to cultivate culturally-sensitive students who enter collaborations with a realistic sense of their abilities, and are open to critiquing academic ways of knowing (Stoecker, 2008). Community-university partnerships are problematic in that current social relations of knowledge generation preserve the power of the academy to maintain control over knowledge production (Stoecker, 2008).

Reflecting on the power relations between local and scientific ways of knowing, Shiva (1993, p. 10) states that the former is often made to disappear through the latter “denying it the status of a systematic knowledge, and assigning it the adjectives of primitive and unscientific”. Additionally, Elliot (2012, p. 336) suggests that society is increasingly treating issues within the food system “as a set of questions for scientists and engineers”, contributing to selective ignorance by excluding other ways of knowing.

If SFSE program graduates believe that academic ways of knowing are superior to non-academic ways of knowing, then as future food system professionals, they will feel justified in dominating collaborations that involve non-academic stakeholders. Further, if a SFSE program is involving students in community-engaged scholarship programs, integrating research and community service with curricular activities, student perceptions about the role and value of community partners will need to be addressed. To demonstrate this problem, I will substitute academic and non-academic ways of knowing within Warren’s framework to demonstrate this particular oppressive conceptual framework:

(A1) Non-academic ways of knowing are identified with being unscientific; academic ways of knowing are identified with being scientific.

(A2) Whatever is identified with being “unscientific” in the current, hegemonic process of knowledge production is inferior to ("below") whatever is identified with “scientific” or, conversely, the latter is superior to ("above") the former.
(A3) Thus, non-academic ways of knowing are inferior to ("below") academic ways of knowing; or, conversely, academic ways of knowing are superior to ("above") the non-academic ways of knowing.

(A4) For any X and Y, if X is superior to Y, then X is justified in subordinating Y.

(A5) Thus, academic ways of knowing are justified in subordinating non-academic ways of knowing.

6.4.4. **SFSE Signature Pedagogy: Summary**

“Signature pedagogies make a difference...the way we teach will shape how professionals behave – and in a society so dependent on the quality of its professionals, that is no small matter” (Shulman, 2005, p. 59). My proposed elements of a SFSE signature pedagogy can facilitate the knowledge, skills, and attitudes necessary for developing future food system professionals as agents of change for an economically viable, socially just, and ecologically regenerative food system. “As the 21st century unfolds, higher education in agricultural [and food system] sciences must be transformed profoundly to respond to the ever-increasing complexity of food production systems (Wattiaux, 2009, p. 217). To be successful in the 21st century food system, professionals will need to be competent in making decisions to address ill-structured problems, relying on systems approaches and engagement with diverse stakeholders. SFSE programs will need to consider to what extent their graduates have developed cognitive flexibility to be successful within contexts of uncertainty and complexity. Further, to what extent have graduates been exposed to inter- and trans-disciplinary collaborations, and with what values, attitudes, and dispositions towards diverse ways of seeing and knowing? The proposed SFSE signature pedagogy provides a useful framework for considering the surface, deep, and implicit structures of an educational program that seeks to develop professionals for transitioning our current food system towards one that is more just and sustainable.

6.5 **Effects of LFS 250 Pedagogical Activities on EOCD**

Results from the second component of the study provide information about the impact the four pedagogical activities in LFS 250 are having on participants. My findings indicate that the
concepts of holism and pluralism are being understood. The activities are also raising participants' awareness of the fragmentation of knowledge and demonstrating the limitations of reductionist approaches to issues in the modern food system. Evidence further suggests that student epistemic and ontological cognitive development (EOCD) is being impacted by pedagogical strategies in LFS 250 through demonstrating the complexity of knowledge and the value of engaging diverse ways of knowing to overcome uncertainty.

My findings indicate that the effectiveness of the four activities is related to their complementarity. Each activity conveys challenging ontological and epistemological concepts through relatively accessible language and activities; however, in combination, they support, enhance, and extend each other’s fundamental objectives, providing participants with multiple opportunities to question ontological and epistemological beliefs and assumptions. The themes of simplicity and clarity emerged from participant responses to the elephant and the blind men activity. Participants reported that the activity succinctly demonstrated the limitations of reductionist approaches and the need for communication to overcome the fragmentation of knowledge. The elephant activity questions the certainty and simplicity of knowledge while simultaneously offering a possible solution through pluralism. A theme identified from participant responses to the flashlights activity was its ability to convey the strengths and limitations of different ways of seeing and knowing, demonstrating that neither a holistic nor reductionist approach is adequate on its own to address all types of issues. The experience of uncertainty was reported as a theme from viewing and discussing the Zea film, building on the epistemological uncertainty arising from the elephant and blind men activity. Participants also reported that the value of seeing “the big picture” emerged from their experiences of viewing the popcorn pop at the end of the film. Similar to the elephant activity, this represents an ontological realization that reductive ways of seeing may be limiting, and that holism, seeing “the big picture”, may provide an alternative way of seeing when addressing issues of complexity. Finally, participants
associated the Barnga game with revealing uncertainty arising from cultural differences, with some participants relating their experiences to differences amongst academic disciplinary ways of knowing. This represents a questioning of prior epistemological assumptions and beliefs and further questions the level of certainty of knowledge in food systems studies.

All participants except one identified the activities in LFS 250 as having impacted their ways of seeing and knowing. Seventy-eight percent of participants stated that LFS 250 was the first time that they had encountered the concepts relating to ontology, epistemology, and systems thinking, 16% reported that they had explored the concepts previously in other courses but not in the systematic and sustained approach of LFS 250. One participant reported that the epistemic and ontological material was not new but supported her existing ways of seeing and knowing. Sixty-five percent of participants gave responses indicating a position similar to King and Kitchener’s (19944) quasi-reflective stage five of development. Individuals at this stage recognize the value of diverse ways of knowing for addressing ill-structured problems but are not yet confident in their ability to justify a particular conclusion based on conflicting perspectives. Rather, strategies for justification rely on seeking balance or consensus amongst alternative claims. Another 14% of participants gave responses indicative of an evaluativist position. Individuals engaged in thinking that is characteristic of this position are able to justify a particular conclusion based on conflicting perspectives.

Due to the ubiquity and status of scientific reductionism in society, it can be assumed that a significant percentage of students enrolling in a science-oriented faculty in institutes of higher education will not have developed sophisticated ontological and epistemological beliefs (Salner, 1986; Sterling, 2011). The high percentage of participants in the sample that identified the activities in LFS 250 as impacting their ways of seeing and knowing suggests that these activities are effective in promoting EOCD amongst participants. The number of students that are identified as operating at the level of pre-evaluativist suggests that these activities are particularly
effective at demonstrating the complexity and uncertainty of knowledge, the recognition of which indicates operations beyond the position of realist. Further, the number of participants that identified with valuing engagement with diverse ways of knowing to address issues of complexity suggests that LFS 250 is providing students with opportunities to engage in thinking beyond the positions of the dogmatist and skeptic.

However, there are risks associated with moving students along this continuum of ontological and epistemic uncertainty. There is potential for students to have difficulty with the emotional transitions that accompany experiencing this pedagogy. Through engaging with activities that target EOCD, students can be brought into an unsettling experience where previous held assumptions about reality, truth, and knowledge are no longer adequate. Timmermans (2010, p. 14) states, “we must consider and acknowledge that, along with the cognitive experience of doubt, may come the emotional experience of self-doubt: the unsettling feeling that arises when one questions one’s ways of seeing, of being in, the world”. It is the responsibility of the instructor to ensure adequate time for reflection and guidance through this period of transition, as it can be an emotionally challenging experience. Activities and discussions must be planned to help students resolve new uncertainty and develop skills to evaluate evidence, support new conclusions, and become comfortable with a new level of uncertainty in their worldview. Further, Fujieda (2009) cautions educators about the inherent risks of asking students to examine their worldviews and experiences, remarking on the increased level of the emotional labour associated with engaging in this type of instruction for both the student and instructor.

Both Greene and colleagues (2008) and King and Kitchener (2004) argue that ontological cognitive development is a necessary shift towards more encompassing epistemic cognitive competencies. “A person must have a sophisticated ontology of a domain before epistemic cognition and issues of justification become relevant at all” (Greene et al., 2008, p. 150). Once reality is recognized as being uncertain and complex, truth claims require justification
based on sources of evidence. Confronted with the need to justify one’s beliefs, an individual can appeal to an authority beyond the self or decide, “all knowledge claims are subjective and personal” (ibid, p. 153). These positions describe a dogmatist and skeptic, respectively. Confronted with challenging emotional labour of EOCD, there is a risk that students stay within the certainty offered by dogmatism and skepticism rather than resolve the difficulties associated with a worldview that acknowledges a high level of uncertainty (King and Kitchener, 1994).

Addressing disciplinary and methodological dogmatism can happen through judicious use of the flashlights and the forest activity. Of the four activities, flashlights demonstrates the clearest rationale for adopting a pluralist approach. Sixty-five percent of participants in this study stated that the flashlights activity helped them recognize the value of engaging more than one approach when attempting to understand complex issues. The presentation, discussion, and analysis of the supplementarity of diverse approaches are essential to overcome the entrenchment in a disciplinary perspective that defines the dogmatist. However, without thorough discussion, this activity could support the belief that all methods and approaches are equal and therefore there is no difference between scientific knowledge and personal experience, which is the pathway to relativism and the domain of the skeptic. To avoid having students remain operating at a position characteristic of a skeptic, it is necessary to help students develop an understanding of methods for gathering and interpreting evidence associated with diverse perspectives. How this development can occur will be discussed in section 6.5.5, where I outline a plan for scaffolding the EOCD and systems competencies across the LFC series.

6.5.1. Promoting Understanding and Application of Systems Principles: Implications for Practice

Evidence from the study indicates that the approaches taken in LFS 250 to develop understanding and provide opportunities for the application of system principles are not effective. Participant interviews revealed a common “divide and conquer” approach to group assignments.
This means that individual students may not engage with the content and processes of group assignments, and therefore, not all students are meeting learning outcomes specific to understanding and applying systems principles. With any group assignment, unequal distribution of tasks due to disparity amongst participant competencies is a common limitation. Future iterations of LFS 250 will need to address this trade-off between the benefits of learning in a group setting and the opportunity this creates for some students to avoid engaging directly with tasks associated with core learning outcomes. Careful re-assessment of the course’s approaches to promoting systems competencies will need to occur in order to meet this learning outcome.

6.5.2. **EOCD and Systems Competencies**

Despite the limited evidence in this study for a correspondence between EOCD and systems competencies, the rational argument for such a correspondence remains sound. Systems thinking, based on the principles of holism and pluralism, is necessary for dealing with issues of complexity and uncertainty (Bawden, 2005; Checkland, 1981; Sterling, 2011). A systems approach requires thinking in terms of relationships, patterns, and context, recognizing the connections between components of a situation (Capra, 1997; Reynolds & Holwell, 2010). Pluralism, the inclusion and engagement of multiple perspectives in the act of problem resolution, is necessary when dealing with complexity and uncertainty “where an acknowledged part of the problem is to establish and agree what the problem is, and where there will rarely be a single ‘right’ resolution” (Reynolds & Holwell, 2010, p. 8). A pluralist approach allows systems thinkers to make use of multiple ways of knowing and multiple ways of understanding when defining, implementing, and evaluating courses of action in socio-ecological systems. Both holism and pluralism require encompassing ontological beliefs and epistemic cognitive skills (Bawden, 2007). Holism recognizes the nature of reality as relational rather than fragmented or atomistic, as represented by scientific reductionism. Pluralism recognizes knowledge as socially constructed and
residing in multiple sources. As stated previously, it can be assumed that a significant percentage of students enrolling in a science-oriented faculty in institutes of higher education will not have developed these ontological and epistemological beliefs (Salner, 1986; Sterling, 2011).

In order to address the hegemonic nature of reductionist ways of seeing and knowing, instruction in an introductory systems course needs to first demonstrate the limitations of reductionist ontology in addressing issues of complexity. Second, course instruction needs to help students develop an awareness of different ontological perspectives and epistemic cognitive skills congruent with a systems approach. My study suggests that it is ambitious to attempt to develop more encompassing ontological and epistemological cognitive skills and systems thinking competencies in the same course. There is evidence that LFS 250 is helping students experience, understand, and reflect on the uncertainty and complexity of knowledge. Further, there is evidence that students leave the course recognizing the limitations of reductionism and demonstrating an awareness of holism and pluralism. However, there is also evidence that the majority of students have not developed the necessary epistemic cognitive skills to evaluate alternative truth claims or sources of knowledge. This is apparent by the number of participants that sought balance and consensus as means of justification when asked to resolve an ill-structured problem. Without developing cognitive skills at the level of evaluativist, students will be ineffective in making decisions in a pluralist context. My study findings suggest that more specific and targeted instructional strategies are needed to assist students in developing epistemic cognitive skills to the level of evaluativist, wherein students are confident in their ability to weigh competing sources of evidence within the context of the problem-situation. I argue that this development should be intentionally scaffolded throughout the remainder of the undergraduate degree program in third and fourth year courses.

Similarly, developing systems literacy and competencies takes time. Novice systems thinkers need to practice representing systems through diagrams and creating models to identify components, boundaries, nested levels, inputs, and outputs and then relate them to processes of
emergence, energy and material flow, and feedback loops (Meadows, 2008). In this way, interactions amongst components and processes inform an understanding of relationships and leverage points for affecting change within a system as a whole. Once systems concepts and behaviours are understood, the novice can begin to identify stakeholders and their interactions in the system, examining how their worldviews and values influence the goals and objectives of the system. Finally, once students have become familiar with identifying and recognizing the impacts of diverse stakeholder perspectives in systems analysis, power dynamics amongst stakeholders can be considered. Central to this process is identifying the inequalities amongst stakeholders and recognizing those perspectives that are absent from the conception of the system model.

In the next section, I provide a discussion on threshold concepts (Meyer & Land, 2005) to frame the connections between systems competencies and epistemic and ontological cognitive development in SFSE programs. I then propose a complementary process for scaffolding development of epistemic and ontological cognition and systems thinking competencies within the LFC series.

6.5.3. **EOCD as a Threshold Concept**

*Threshold concepts* are defined as those concepts that are essential for the mastery of a particular disciplinary framework (Meyer & Land, 2005). Further, they are key concepts that need to be understood before a student can develop beyond the stage of novice (Kinchin, 2010). These conceptual gateways are considered transformative, irreversible, integrative, and then potentially contribute to the internal reconstruction of subject matter or worldview (Meyer & Land, 2005). They are different than disciplinary core concepts, which are important, but “do not take the learner into a new realm but rather build layers upon the learning foundations already possessed” (Barradell, 2013, p. 266). Examples of threshold concepts are “usually immediately

The idea of threshold concepts has generated much interest and resonated with academics in a range of disciplines, originating in economics and being embraced in biology, accounting, and electrical engineering (Barradell, 2013). In consideration of education for sustainability, Sandri (2013, p. 818) depicts systems thinking as a threshold concept: “effective learning for sustainability must include awareness and appreciation of systems approaches to adequately understand and respond to complex issues”. Citing the works of Salner (1986) and Bawden (2007), Sandri (2013, p. 819) emphasizes in-turn the importance of epistemic cognitive development in understanding and appreciating systems approaches: “without epistemic development, students that are otherwise mature and very capable do not necessarily grasp systems concepts, and thus emphasis must be placed on learning environments that facilitate epistemic development for deep learning for sustainability to occur”.

As an antecedent to Sandri’s thesis, I position epistemic and ontological cognitive development (EOCD) as having the characteristics of a threshold concept for systems thinking - as defined by Meyer and Land (2005) as being transformative, irreversible, integrative, and troublesome. However, I argue further that the term threshold process is a more accurate descriptor for EOCD in relation to systems thinking.

**EOCD as Transformative**

Engaging with threshold concepts elicits a meaningful shift in the perception of a discipline (Meyer & Land, 2005). An ontological shift away from viewing knowledge as simple, comprising discrete and unrelated facts, and certain, being unchanging and context free, forces the learner to seek out means of justification for supporting or rejecting knowledge claims (Greene et al., 2008). This shift transforms the process of knowing in a systems context, which relies on diverse perspectives to overcome the uncertainty inherent in ill-structured domains. Additionally, a
transformation in ways of seeing the world occurs, from a reductive to a relational ontology for recognizing the holistic nature of socio-ecological systems.

**EOCD as Irreversible**

Threshold concepts are “unlikely to be forgotten or unlearned without considerable effort” (Meyer and Land, 2005, p. 373). Epistemic and ontological cognitive development occurs through the resolution of psychological dissonance when a learner experiences an inadequacy in prior understanding (Hofer & Pintrich, 1997; Perry, 1970). When a prior conception of knowledge and reality becomes inadequate to resolve a new problem, a learner must adapt previous schema in order to make sense of the world (Posner, Strike, Hewson, & Gertzog, 1982). Once the complexity and uncertainty of reality and knowledge is encountered and acknowledged within ill-structured domains, prior strategies for meaning making are permanently modified to better address future situations, leading to changes in perspective.

**EOCD as Integrative**

Threshold concepts reveal the interconnected nature of knowledge within a domain (Meyer & Land, 2005). Identifying and evaluating competing perspectives is a central systems competency. Developing more encompassing epistemic and ontological cognitive competencies uncovers the strengths, limitations, and relational nature of different ways of knowing. Natural and social science perspectives and methodologies can be integrated to expose a richer understanding of food system issues than either approach alone (Allen, 2013). Similarly, scientific and local knowledge can be complementary and supplementary within the food system (McIntyre et al., 2009).

**EOCD as Troublesome**

Pedagogical strategies that target issues of epistemology and ontology pose a significant challenge for learners as they are rarely discussed in a classroom setting and may be received as contrary to common sense (Bawden, 2005; Salner, 1986). Further, our epistemic and ontological
beliefs that form the foundation of our worldviews tend to be resilient and resistant to change (Sterling, 2010). EOCD requires moving from ontological certainty towards recognition that “knowing is...approximate, relational and often provisional” (Sterling, 2010, p. 523). This type of learning can be deeply uncomfortable, possibly resulting in a period of “chaos, confusion and being overwhelmed by complexity” before being resolved (Ison & Stowell, 2000, p. 3 as quoted in Sterling, 2011)

6.5.4. **EOCD as a Threshold Process**

Meyer and Land’s (2005) framework of a threshold concept is useful for conceptualizing the relationship between EOCD and systems thinking. Developing more encompassing epistemic and ontological cognitive competencies is a necessary precursor to addressing ill-structured food system issues, which require integrating solutions and developing a more general synthesis through assessing the relative truth value of possible solutions (King & Kitchener, 1994). However, the term concept does not accurately describe the temporal dimensions of EOCD. Reporting on his experiences teaching systems thinking in higher education, Bawden (2007, p. 301/302) observes, “you do not facilitate the transformative development of such complex epistemic states or advanced cognitive systems through once or twice-weekly one-hourly didactic bursts spread out over a single four month semester”. Authors with similar experiences have expressed that change of this nature might be difficult to initiate by rational and analytical methods alone, requiring scaffolding across the affective and psychomotor domains of learning over the duration of the four year college experience (Hofer & Pintrich, 1997; King & Kitchener, 2004; Salner, 1986; Sipos et al., 2008; Sterling, 2011).

Therefore, epistemic and ontological cognitive development should be considered a **threshold process**, essential for the mastery of applying systems principles to complex, ill-structured problems, such as those represented by global food security and food system sustainability. The
term threshold process is a better descriptor of this change than threshold concept, as change in epistemic and ontological cognition requires longer periods of time to allow the individual to first experience then resolve the tensions and psychological dissonance that accompanies confrontation with previously held values, beliefs, and assumptions. Meyer and Land (2005, p. 376) refer to the concept of liminality, a transition state where an individual is “neither fully in one category or another”. Liminality is a useful metaphor for describing the process of developing more encompassing epistemic and ontological cognition, which has been conceptualized as a stage-like process (Hofer & Pintrich, 1997; King & Kitchener, 1994). In this process, “a deep structural shift in the basic premises of thought, feelings and actions [occurs through] a shift of consciousness that dramatically and permanently alters our way of being in the world” (O’Sullivan, Morrell, & O’Connor, 2002, p. xvii).

Since the inception of threshold concepts, others have extended and modified Meyer and Land’s initial conceptualization to include threshold function, practice, capabilities, and experiences (Barradell, 2013). Characterizing EOCD as a threshold process for systems thinking acknowledges the temporal nature of the cognitive transformation that is taking place. This recognition can translate into an intentional targeting of student EOCD through curricular and pedagogical strategies over the course of an undergraduate degree. Educators will need to scaffold experiences and assessments over time in order to support EOCD. This scaffolding has implications for educators who are simultaneously seeking to develop systems competencies. The next section describes a proposed scaffolding of EOCD and systems thinking competencies in the context of the LFC series.

6.5.4.1 Proposed Scaffolding of EOCD and System Thinking within the LFC Series

Evidence from the second component of the study suggests that student EOCD is being impacted by pedagogical strategies in LFS 250, potentially allowing students to approach and
attain a position resembling King and Kitchener’s (2004) quasi-reflective stage five of
development. Further, my findings suggest that the LFS 250 strategies intended to help students
develop systems thinking competencies in LFS 250 are not successful. If these learning objectives
are not being met in LFS 250, it is unlikely that subsequent courses within the LFC series, which
have assumed a certain competency level has been attained through prior instruction, will be able
to successfully achieve their higher order learning objectives.

Pedagogical strategies that target EOCD occupy a significant portion of the curriculum in
LFS 250. The choice to devote curricular time to one pedagogical strategy within a course is at
the expense of another. In LFS 250, strategies that target EOCD (along with curricular
requirements for other content and activities) are undertaken at the expense of being able to
present, assess, and reflect on the wide range of systems theories and approaches. In the current
course design, curricular time is devoted to creating systems models and diagrams; however, my
study participants indicate that not all group members are equally attending to these activities
and assignments. Further, lecture content and course readings are used to describe the theoretical
background and elements of the historical development of systems approaches. The rationale for
going into such detail is the awareness by the instructors of LFS 250 of the lack of theoretical
discussion of systems approaches in the curricula of the third and fourth year courses in the
series\textsuperscript{28}. To relieve the tension between developing EOCD and systems competencies, I propose a
plan for scaffolding EOCD and systems theory and competency development across the LFC
series of courses with consideration of Midgley’s (2007) characterization of the three waves of
systems research.

My study provides evidence that the pedagogical strategies used in LFS 250 for
achieving EOCD are effective in bringing a significant portion of the students to the pre-

\textsuperscript{28} This can be attributed to two reasons: 1) it is assumed that students are adequately learning systems
theories already in LFS 250; and 2) the curricular demands of community-based experiential learning activities in the
3\textsuperscript{rd} and 4\textsuperscript{th} year courses limits attention to systems theory.
evaluativist stage of cognitive development. Pedagogical strategies in LFS 350 should build on this appreciation for diverse ways of knowing, and explicitly target students’ abilities to identify the strengths and limitations of methodological approaches to knowledge generation amongst disciplines in the food system. Lectures, breakout room discussions, and assessments should explicitly draw students’ attention to the process of evaluating alternative and competing scientific and non-academic sources of evidence. The CBEL projects in LFS 350 should assess students’ ability to identify how different sources of evidence are more or less appropriate for their particular context, and the methods for justifying conclusions based on diverse ways of knowing. This process should be continued in LFS 450 by ensuring case study scenarios in the UBC Campus Food System Project do not narrowly focus on one discipline, always requiring inter- and trans-disciplinary approaches. Further, assessment strategies should continue to require students to explicitly identify the multiple ways of knowing that informed their findings. Examples of incorporating academic and non-academic ways of knowing when addressing food system issues should be highlighted through course content and emphasized in lectures and readings. In this manner, students achieving pre-reflective positions in 2nd year can be supported to develop competencies in evaluating competing academic and non-academic ways of knowing when addressing ill-structured problems in the food system.

A logical scaffolding of systems thinking competencies would follow Midgley’s (2007) characterization of the three waves of systems thinking: hard/functionalist, soft/interpretivist, and critical/emancipatory approaches. Although records of systems thinking dates back to the ancient Greeks, our modern use of the term, as associated with holism and change processes, emerged in the first half of the 20th century (Checkland, 1981). Midgley (2007, p. 12) has identified “three waves of systems research since the 1940s, each of which offers a different basic understanding of systems and consequently a different methodological approach”. The three waves are commonly labeled hard, soft, and critical, but because of the evaluative nature of those terms, I
adopt Jackson’s terminology of functionalist, interpretivist, and emancipatory (Reynolds and Hollwell, 2010). Elements of all three waves of systems thinking should be employed throughout the LFC series to prepare students for addressing issue of complexity and uncertainty in the modern food system.

The first wave is commonly referred to as thinking about systems as opposed to systems thinking (Reynolds & Holwell, 2010). Represented by general systems theory, cybernetics, and complexity science, functionalist approaches consider system models as representations of reality. The second wave of systems thinking developed in the 1970s when systems researchers began noticing that recommendations for change from systems experts tended to be resisted, rejected, or left unimplemented by stakeholders within the system (Midgley, 2007). The second wave, or interpretivist systems thinkers, “pointed out that the first wave of systems thinking failed to see the value of bringing the subjective and inter subjective insights of stakeholders into activities of planning and decision making” (Midgley, 2007, p. 20). The ontological shift from viewing systems as real-world entities to epistemological constructs is commonly attributed to Churchman and Checkland, the latter being the originator of Soft Systems Methodology. Second wave system thinkers make the distinction between well- and ill- structured problems; the former being adequately addressed through functionalist approaches, while the latter, characteristic of “human activity systems”, requiring consideration of the root assumptions and perspectives of the human actors that exist in the system (Checkland, 1981, p. 14). This led to the rise of participative methodologies that invited stakeholders to contribute to defining systems objectives and evaluation of system interventions (Midgley, 2007).

The third wave of systems approaches embraces the distinction between systems as heuristic devices for interpreting reality rather than objective entities. However, emancipatory approaches “added emphasis to power relations and how they affect what problems are addressed, and how they are perceived”. Most commonly known as critical systems thinking,
scholars within this category of approaches were dissatisfied with the participative methodologies lack of accounting “for power relationships within interventions, and/or conflicts built into the structure of society” (Midgley, 2007, p. 23). Engaging multiple perspectives in defining system objectives and evaluating interventions would be ineffective if the participants felt coerced, misrepresented, or, if marginalized populations were left out of decision making processes altogether. “Second wave systems approaches are likely to reinforce the viewpoints being promoted by the holders of authority without necessarily accounting for voices that might have been (wittingly or unwittingly) silenced” (Midgley, 2007, p. 24). Key elements of critical system approaches are boundary judgments “determining which empirical observations and value considerations count as relevant and which others are left out or are considered less important (Reynolds & Holwell, 2010, pp. 21–22); and, methodological pluralism, which provides a “rationale for taking the best methods from both the first and second waves and harnessing them into a broader systems practice” (Midgley, 2007, p. 23).

In second year, LFS 250 instruction should focus on developing students’ understanding of systems components, behaviours, and interactions. Meadows (2008) Systems: A Primer is an excellent resource that can be used to build basic comprehension of systems properties, emphasizing inputs, outputs, boundaries, stocks, flows, interactions, and leverage points. This level of systems competency development can be considered loosely analogous to the skills required for a functionalist systems perspective, with an emphasis of describing systems in the world. Essentially, developing students’ abilities to begin thinking about systems. Instructional strategies can focus on applying this level of comprehension to developing systems modeling and diagramming competencies.

In LFS 350, students can use systems modeling as a way to gain a deeper understanding of their community partner and the food system context in which their partner is embedded. Lecture and course readings in the third year course should focus on the interpretivist systems
perspective to complement the diagraming and modeling competencies. Course lectures, discussions, and readings should emphasize the impact of stakeholder perspectives in defining and creating systems, identifying systems components and interactions, and evaluating interventions and improvements. Curricular time would need to be devoted to demonstrating how different stakeholders perceive, identify, and work within systems. This level of complexity complements the scaffolding of EOCD by requiring analysis of how different stakeholders perceive knowledge and how they make use of different evidence when justifying a course of action for change within a system.

In LFS 450, course lectures, discussions, and readings should explore the power relationships and inequalities amongst stakeholders in systems approaches, analogous to the emancipatory wave of systems research. Systems modeling and diagrams can still be used as a heuristic for understanding and describing the aspect of the campus system in which students are engaging. Stakeholder perspectives will still need to be integrated as significant contributors to identifying, intervening, and evaluating courses of action; however, the awareness of the inequalities and power dynamics that shape stakeholder perspectives of the system, or the presence or absence of certain stakeholder groups will need to be addressed as a significant component of the assessment strategy within the fourth year course. Incorporating an emancipatory systems perspective further reinforces EOCD objectives by focusing student attention on different sources of evidence and knowledge within systems thinking. Students should be asked to consider historical and societal inequalities when justifying their conclusions.

CBEL projects are vital to this process of developing EOCD and systems thinking competencies. The community setting provides a context of complexity and uncertainty that requires holistic inquiry and pluralistic, interdisciplinary approaches. Offering opportunities for students to engage with community stakeholders and develop relationships increases the likelihood that students will experience food system issues from perspectives other than an academic
position. This direct engagement is also likely to demonstrate the value of non-academic ways of knowing, further revealing the complementarity and necessity of collaboration when addressing issues in the food system, and dissolving the dualistic expert-community relationship that may occur in a traditional university-community partnership.

In summary, understanding and applying systems principles to food system issues is a central learning objective of the LFC series. Instructional strategies will need to help students develop more encompassing epistemic and ontological cognitive competencies in order to integrate holistic and pluralistic ways of knowing to address ill-structured issues within the food system. Due to inherent time constraints within curricula, EOCD and systems competencies development ought to be scaffolded across an undergraduate degree. The current pedagogical strategies for EOCD are effective in LFS 250 but will require intentional and explicit support in LFS 350 and 450. Instructional strategies that target systems competencies need to be better scaffolded across the series. A pathway that follows Midgley’s three waves of systems thinking provides a logical sequencing within the curriculum of the second, third, and fourth year courses. CBEL projects provide an important opportunity for EOCD and developing systems thinking competencies.

6.6 Future Research

There is need for further descriptive and empirical research on SFSE programs. Within the theoretical perspective of educational design research, studies of descriptive, developmental, and predictive nature are necessary to further the emerging SFSE field (McKenney & Reeves, 2012). In order to gain more reliable measures of correspondence between EOCD and system competencies, studies will need to be designed to accommodate larger sample sizes. This will be challenging as paper and pencil psychometric instruments measuring EOCD have yet to provide reliable data (Hofer & Pintrich, 1997). Further, as demonstrated in this study, solely relying on the
likert-style questions in the MEOCD would not have revealed the pre-evaluativist position in the study sample. In a recent qualitative study on measuring epistemic cognition, Greene & Yu (2014) question whether EOCD can be accurately measured using survey-type items at all.

A similar study investigating the impact of SFSE pedagogical strategies for developing systems competencies in comparison with EOCD with senior undergraduate students or recent graduates would be valuable. Results from such a study would help SFSE programs evaluate the effectiveness of their instructional strategies and further communicate diverse approaches to achieving the similar range of learning objectives common across the field.

Within my investigation of the LFC series, it was not possible to analyze and report on certain significant elements of the vision of the series. Specifically, by choosing to focus on the relationship between EOCD and systems thinking competencies, I was unable to simultaneously investigate the social learning and collective action objectives of the LFC series. In future research, there is an opportunity to explore how participating in the LFC series informs students’ understanding of personal agency and the role of collective action in transforming complex, societal issues, such as food security and food system sustainability. Further, there is an opportunity to explore how the partnership between undergraduate courses helps community-based organizations meet their objectives and thereby potentially impact regional food system change. My dissertation focused on pedagogy and student learning, but there is a rich field of investigation surrounding community and societal impacts of SFSE programs.

6.7 Conclusions

There are two central metaphors within the IAASTD report (McIntyre et al., 2009). The most prominent is in the title: *Agriculture at a Crossroads*. The second, *business as usual is not an option*, is used throughout the report to characterize our current approach to feeding the world. “Our perception of the challenges and the choices we make at this juncture will determine how we
protect our planet and secure our future” (McIntyre et al., 2009, p. 3). There is growing international recognition of the alternatives that we must collectively undertake in order to avoid exacerbating the current detrimental impacts of business as usual on our global food system (Foley et al., 2011; Godfray et al., 2010; Holt-Giménez & Altieri, 2013; Tomlinson, 2013). However, it is not just a matter of doing things better, or even doing better things (Sterling, 2010); rather, the “the central 21st century challenge to sustainable food systems is undoubtedly paradigmatic in its nature” (Bawden, 2007, p. 19). The global food security crisis is of a different scale and complexity than the one of the 1960s (McIntyre, 2009) and therefore requires an epistemic and ontological shift in how we perceive the problems and design strategies for improvement.

As Lang (2010, p. 88) stated,

“We should be wary, however, of assuming that the crisis is primarily in agriculture, when the late twentieth century food revolution has really been characterized by dramatic shifts everywhere in the food system. The entire relationship between people, food systems and the planet has been restructured”.

Our modern institutes of higher education play a central role in shaping our ways of perceiving reality and subsequently determining how professionals act in the world. It has been proposed that the most unsustainable aspect of our current system of higher education is not the ecological footprint of our campuses, but rather, the fragmented, disciplinary mindset that is developed through its silo-like structure and pedagogical processes (Orr, 1991; Rees, 2003; Rees, 2010). There is significant correspondence between the curricula of traditional reductionist agriculture, nutrition, and related food system disciplines and the flat key to the hunger frame in global food security discourse. Both reflect distinct worldviews, comprised of societal beliefs and assumptions about the nature of reality (ontologies) and the nature of knowledge and knowing. Both promote fragmented, linear, and reductive approaches, with a privileging of expert, disciplinary knowledge from the natural sciences. Both perpetuate business as usual policies and practices and deny the existence of an alternative pathway.
The alternative exists in the correspondence between the sharp key to the hunger frame and SFSE program objectives. Both seek inclusivity, diversity, and holistic perspectives to address the complexity and uncertainty of the modern food systems. Both value optimizing social, ecological, and economic benefits over the linear tendency to maximize only one factor. And, in order to develop professionals that can overcome the limitations of reductionism in addressing ill-structured problems, we need to align the way we teach and learn about food systems in our faculties of agriculture and food-related disciplines to be closer to the values and perspectives that guide the sharp key of the hunger frame. This realignment is occurring, represented by the emerging SFSE programs across North America and Europe promoting systems-based, inter- and trans-disciplinary, experiential approach.

This study contributes to the empirical study of SFSE programs by connecting and exploring the relationships between systems thinking competencies with cognitive development and pedagogical strategies. By identifying and situating the dimensions of the LFC approach to food systems education and evaluating specific pedagogical activities focusing on EOCD and systems thinking competencies, I hope to provide other SFSE scholars and educators with a deeper understanding of the strengths and limitations of the efforts in the Faculty of Land and Food Systems at UBC. The proposed framework for a SFSE signature pedagogy builds on prior efforts to make common approaches to SFSE objectives more salient. As the field develops a shared landscape to SFSE, building upon successes and learning from each other’s mistakes will become more feasible. Ultimately, SFSE programs are attempting to develop future professionals that will achieve a just and sustainable food system by promoting the “development of supporting policies and institutions, revalorization of traditional and local knowledge, and an interdisciplinary, holistic and systems-based approach to knowledge production and sharing” (McIntyre, 2009, p. 5).
References


doi:10.1007/BF02014479


doi:10.1080/19416520.2011.571520


doi:10.1108/09696479610131206


doi:10.1080/00219266.2010.9656194


doi:10.1207/s15326985ep3901_2


Appendix A: Interview Framework

Introduction

• Start by thanking the student for giving us her/his time to be interviewed.
• Introduce myself and explain my role as PhD candidate and researcher in the interview and study process
• Inform the student that this is not an evaluative session, there are no right or wrong answers; his/her responses will help the development of the curriculum of the Land, Food and Community (LFC) series, specifically LFS 250, ensuring the best possible experience for future students
• Review and sign informed consent form(s). Student gets 1 copy and interviewer keeps 1 copy.

Initial Script

• “Thank you for joining me. I know that your time is valuable and I appreciate your coming in today to discuss your experiences in LFS 250. I am conducting this interview because I want to learn more about student experiences in LFS 250 and hope to use your experience to develop the curriculum of LFS 250 and the Land, Food and Community series in general. So for the questions I am asking today there are no right or wrong answers. Your participation and answers are helping to make this course better for future students. “
• “I have a consent form that explains 1, 2, 3. Please take a moment to read this - and I am happy to answer any questions. If are willing to participate I need you to sign the bottom. You may keep one copy”

Interview Questions:

Open-ended questions to get student to feel comfortable in interview setting by talking about past experience as well as providing information of previous experiences that will be relevant when trying to understand what can be attributed to their LFS 250 experience.

1. Before we get into a specific discussion of your LFS project, could you tell me a little bit about why you decided to enroll in this faculty?
   • What was it about the program that sparked your interest?
   • Did the program relate somehow to your previous experiences? If so, how?

   Prompts:
   o Have you ever taken courses that are similar to LFS 250?
   o Have you ever encountered systems principles or system thinking approaches before?

Another open question specific to LFS 250 to provide space for interviewee to describe their key highlights or concerns.
2. LFS 250 is a bit of an unusual course compared to other courses at UBC. What did you find different about the course?
   • What did you like? What did you dislike?
   • What was the most significant learning that you will take away from this course?

   Questions that assesses impacts of specific pedagogical activities in LFS 250 on student epistemic and ontological cognitive development:

3. I’d like to hear more about your experiences with specific activities that occurred in the course. In particular, I am interested in hearing what you learned or what understandings you took away from certain activities.

   List of Activities:
   • Lecture based - Flashlights in the Forest, Barnga Game, Zea film, Baraka film, Sensory Evaluation of Milk products, guest speakers
   • Field Trips - UBC Farm, Kitzel Dairy Farm
   • Readings, general
   • Group Discussions, general
   • Assignments – School food system model, Dairy System Model, Mid term lit review, Reflective Journals, final report
   • Community Based Experiential Learning activities – Think&EatGreen@School

   Prompts:
   • What did you find most rewarding? How and why was this rewarding?
   • What did you find most challenging? How and why was this challenging?
   • How do you decide who has the most accurate opinions in the food system?
   • If two food system experts from different cultures disagreed on a fact, how do you decide whom to believe?

   Questions that ask about connection between pedagogical activities and systems principles emphasized in LFS 250 (pluralism and holism)

4. Now that you have completed LFS 250, how do you define taking a systems approach?
5. Did participating in LFS 250 have a significant impact on you?
   Prompts:
   • Why or why not? If so, how? In what areas? Academically, personally, professionally?

   The following questions will indicate the overall picture of the student’s feelings about the course. It may reveal that their overall impression is not the same as the sum of their answers to the previous questions.

6. How would you describe LFS 250 to a friend or a student considering taking the course next year?
   • What would you tell them about the key rewards and/or challenges, what ‘advice’ would you give them to help them have a successful and meaningful experience.
7. What recommendations do you have to the teaching team about LFS 250?

8. Do you think that you will be able to apply what you learned in LFS 250 to other courses or your future career?

9. Is there anything else you would like to add?

Thank you very much for your participation.
Appendix B: Dual Position Food Security Problem

Island Food Security Initiative

You have been hired as a food system consultant by a municipal government of an island off the south coast of BC. The municipal council has set aside taxpayer money to fund one project that will enhance the food security of the island. The council is split between two proposals and would like your expert opinion in deciding which has a greater likelihood of increasing food security for island residents. After considering the information below,

- Write a response to the council describing a course of action for increasing food security for island residents based on the two proposals
- Support your decision with explicit justifications
- Limit your response to 1000 words

Background Information

The island has a large land base with a population of 2000 full time residents. 80% of the population lives in the small town and the remainder lives on rural farms of less than 50 acres. The most common crop on the island, in terms of land use, is hay and sales are predominantly off-island. There are roughly 10 certified organic farms and 10 conventional farms, with mixed farming operations including ground crops, fruit trees and livestock. 80% of these farm sales are off-island; the remaining 20% is sold at the local farmer’s market and to restaurants on the island. There is a small dairy operation on the island with 35 cows. Moocerne, a milk distributor on the mainland, purchases the fluid milk, which is added to its provincial distribution network. There are a number of small-scale shellfish and fishing operations as well as one local resident who has a business harvesting wild mushrooms and plants from the second- and old-growth forests on the island. She sells her products directly to high-end restaurants in Vancouver. The island has a very healthy deer population that is hunted for sport and food.
There is one grocery store on the island and a handful of small cafes and restaurants. All food that is not grown or harvested on the island has to come by barge. Over the past five years, the cost of transporting food to the island has increased by 300%, due to rising service rates and fuel prices. Residents of the island have started making trips to the mainland to purchase their groceries and some folks say that if the price of food increases any more, they will have to consider moving off the island, as most residents are middle to low income.

The municipal government has decided to dedicate a portion of taxpayer money to address food security issues of the island. They received many proposals but have narrowed down their selection to two projects. A summary of the projects is provided below:

A. Creating a Local Food Non-Profit Organization

A small group of local residents would like to create a non-profit organization to help develop the island’s local food assets. They conducted an audit of the food growing and processing potential of the island and believe that within 10 years 80-90% of residents’ nutritional needs can be met from the island’s food assets from late spring to early fall; and up to 60% can be met from late fall to early spring. This would require a shift in consumer purchasing trends, development of local distribution avenues, and a significant increase in individual family food procurement from gardening, wild harvesting and hunting. The non-profit would require annual funding of $150,000 from the municipal government to cover the costs of 2 employees, office space, marketing and educational events. The organization will focus on

- Connecting island farmers and other food producers to the island grocery store and restaurants
- Increasing the volume of edible products being harvested for local consumption from second and old growth forests, like deer, mushrooms, stinging nettle and other wild plants
- Encouraging more island residents to garden, wild harvest and hunt
- Educating residents on how to create nutritional recipes from local, seasonal foods
- Educating local residents about the social and economic benefits of buying and eating local food
• Promoting an island organic waste disposal system that returns organic waste to local food producers

According to this group of local residents, the proposal will increase food security by

• Decreasing the reliance of island residents on the global food system
• Decreasing the volume of waste entering the island’s landfill
• Producing a local and affordable source of compost
• Increasing access and availability of local and seasonal foods for island residents
• Building relationships amongst island growers, producers and consumers
• Creating a sustainable model which has the potential to increase eco- and food-tourism to the island

B. Stinging Nettle Processing Plant Partnership

Due to the large amounts of wild and non-cultivated land on the island, there is a large abundance of Stinging Nettle (Urtica dioica) growing on the island. Stinging nettle is an incredibly nutritious plant and is in high demand from restaurants and markets in the Metro Vancouver and Victoria. It is a perennial plant and can be harvested multiple times in a season. In order to make use of this free resource, one local business is proposing a partnership with the municipality to build and operate a processing plant that would allow the nettles to be preserved, packaged and shipped to off-island markets. The plant will create 6 full-time and 4 part-time jobs for the island, which are much needed to keep local residents employed. Profits from the sales will offset the cost of shipping food to the island. Based on the sales projections in the business plan, within 10 years, the operation will decrease the cost of shipping food to the island by 50% from 2008 levels and the initial municipal investment will be repaid by 2023.

According to the local business, the proposal will increase food security by

• Keeping the cost of food low and more affordable
• Maintaining similar access to the quality and variety of food available in larger urban centres, especially ethnically diverse ingredients
• Maintaining the high level of convenience that already exists in the island’s food system
• Creating a brand associated with the island, similar to Denman Island Chocolates and Salt Spring Coffee, which has the potential to increase tourism to the island
# Appendix C: Coding Framework

Table C 1. Code Framework with Code, Definition and Examples

<table>
<thead>
<tr>
<th>Code</th>
<th>Definition</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>New concept</td>
<td>Concepts newly introduced through experiences in LFS 250</td>
<td>I had never made any systems models before but I think I will use them more in the future.</td>
</tr>
<tr>
<td>Clear understanding</td>
<td>Indicates when participant accurately describes or demonstrates correct understanding of a concept or theme from the course</td>
<td>The elephant diagram represented to me that depending upon where you’re standing or where you are at, you think of something differently. Relating it to the team aspect of my group, we were all working on one thing but we all had a different approach.</td>
</tr>
</tbody>
</table>
| Unclear understanding | Indicates when participant does not accurately describe or does not demonstrate correct understanding of a concept or theme from the course | R: How would you apply the flashlights and the forest activity to the food system?  
P: The diffuse light is what we see now and the narrow can help us move forward. |
| Increased understanding | Participant identifies an activity or concept as increasing their understanding of the course content. | The systems map has helped me understand our food system in real life, I think about it outside of class.                                                      |
| Significant      | Participant identifies a significant learning occurred in LFS 250.         | I’ve been thinking about becoming vegan. But after the unit on the dairy system, I feel I have a better understanding of the role of dairy so I don’t think I will become vegan. I think a little bit of dairy in small amounts is ok, and I didn’t understand that before the dairy system unit. |
| Insignificant     | Participant identifies an activity or learning outcome of the course as being insignificant to their understanding of the course. | R: What did the flashlights in the forest activity mean to you?  
P: I personally didn’t take too much out of that exercise.                                                                                     |
<p>| Limitation of reductionism | Participant identifying the limitations to reductionism.                  | Your facts might be right but maybe you don’t have all of the facts. You are right about what you are seeing but maybe you aren’t seeing all that is happening. Or conversely, you might be right based on your assumptions, but your assumptions may be wrong because you are not seeing everything that is happening in the system. |
| Systems Thinking | Participant refers to systems thinking.                                    | [The reading] helped increase my excitement for becoming a systems thinker.                                                                                   |</p>
<table>
<thead>
<tr>
<th>Code</th>
<th>Definition</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holism</td>
<td>Participant discusses or refers to holism.</td>
<td>I don’t know how you could understand the food system by just looking at one thing. Because when we are at the farm, even when you are thinking about one crop, you’re still thinking about the soil, the weather, and the time it will take to put it all together. The farmers have to think about every aspect and somehow manage it so it works together.</td>
</tr>
<tr>
<td>Pluralism</td>
<td>Participant discusses or refers to pluralism.</td>
<td>I think this is helpful for the food systems. It reminds you to listen to what other people are saying so you hear and listen to more opinions. If someone gave me better information they could change my opinion about something in the food system.</td>
</tr>
<tr>
<td>Simple &amp; certain (SC)</td>
<td>Participant statement about knowledge as simple and certain.</td>
<td>For the meat example, you won’t fully understand it if you cannot say that one is completely right or that one is completely wrong.</td>
</tr>
<tr>
<td>Not simple &amp; certain (XSC)</td>
<td>Participant statement about knowledge not being simple and certain.</td>
<td>It depends on how you think about the issue. If you share the same values as a nutritionist, you are more likely to think she is right. If you start to know more about animal welfare then you might agree more with the animal person.</td>
</tr>
<tr>
<td>Justification by authority (JA)</td>
<td>Participant statement about knowledge being derived from or justified by a source authority</td>
<td>I think that it matters if the opinion is coming from a professor rather than a student. It shouldn’t matter but in reality I think it does. If a professor is there, we think they have a better idea of what is right and wrong.</td>
</tr>
<tr>
<td>Anti-justification by authority (XJA)</td>
<td>Participant statement about knowledge not being derived from or justified by a source authority</td>
<td>I have very little faith in food system research.</td>
</tr>
<tr>
<td>Personal justification (PJ)</td>
<td>Participant statement about knowledge being derived from or justified by personal experience.</td>
<td>My understanding of food systems has definitely been from personal experience. Everything I learn academically I don’t take at face value.</td>
</tr>
<tr>
<td>Anti-personal justification (XPJ)</td>
<td>Participant statement about knowledge not being derived from or justified by personal experience.</td>
<td>A scientific fact is true, it’s undeniable, so you can believe that it’s not true but that doesn’t change it.</td>
</tr>
<tr>
<td>Dogmatist</td>
<td>A statement describing the position of a dogmatist, relying on a single source of authority as justification for a knowledge claim.</td>
<td>You can’t take into account personal bias in making these types of decisions, you have to only look at objective scientific evidence.</td>
</tr>
<tr>
<td>Code</td>
<td>Definition</td>
<td>Example</td>
</tr>
<tr>
<td>--------</td>
<td>---------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Skeptic</td>
<td>A statement describing the position of a skeptic, relying on personal experience as justification for a knowledge claim and/or denying the perspective of authority in justification</td>
<td>I don't think you can be right or wrong in the food system. So sometimes expert knowledge isn't applicable in a real world setting.</td>
</tr>
<tr>
<td>Evaluativist</td>
<td>A statement describing the position of an evaluativist, recognizing the contextual nature of knowing and evaluating different ways of knowing as justification for a knowledge claim.</td>
<td>I will look at the reasons behind their statements and the evidence for those statements so I can evaluate on my own. I would need to know where they are coming from.</td>
</tr>
</tbody>
</table>
Appendix D: Epistemic and Ontological Cognitive Questionnaire

Items from the questionnaire below were used as prompts in the semi-structures interview process.

Adapted from:


This version of the Epistemic and Ontological Cognitive Questionnaire (EOCQ) is annotated to illustrate which dimension and content area each item assesses. After each item is a code representing the dimension that is being measured: simple and certain knowledge (SC), justification by authority (JA) and personal justification (PJ). Items that are reverse-coded are indicated with an (RC).

Instructions for Participants

Participants will be told, “This questionnaire is meant to assess your understanding of food systems. There are no right or wrong answers. Please answer the items honestly, as your responses will be confidential.”

The researcher will describe the response scale as spanning from one to six, with one being completely disagree, two being mostly disagree, three somewhat disagree, four somewhat agree, five mostly agree, and six as completely agree. Participants were given as much time as they need to complete the EOCQ, contingent upon the time allotted by the instructor of the class in which they are taking the questionnaire. It is not expected that the questionnaire will require more than 20 minutes to complete. Participants will fill out the EOCQ individually and be asked to not discuss the questionnaire while completing it. Any content questions participants may have about items on the questionnaire will not be answered to prevent bias. Instead, the participants will be
told to “do the best [he or she] can” in interpreting the item. After collection of the EOCQ, participants will be asked not to discuss the questionnaire with any peers who might be taking it at a later time.

*Likert-Scale*

1. Completely Disagree
2. Mostly Disagree
3. Somewhat Disagree
4. Somewhat Agree
5. Mostly Agree
6. Completely Agree

1. When thinking about food systems, the truth means different things to different people. (SCRC)
2. To know food systems well, you need to memorize what you are taught. (SC)
3. In food systems, what is a fact today will be a fact tomorrow. (SC)
4. Food system experts' knowledge of the facts about food systems does not change. (SC)
5. Food systems are so complex that humans will never really understand them. (SCRC)
6. If a food system expert says something is a fact, I believe it. (JA)
7. Things written in food system textbooks are true. (JA)
8. I believe everything I learn in food system classes. (JA)
9. If a food system professor says something is a fact, I believe it. (JA)
10. In food systems, everyone’s knowledge can be different because there is no one absolutely right answer. (PJ)
11. In food systems, if you believe something is a fact, no one can prove to you that you are wrong. (PJ)
12. In food systems, what’s a fact depends upon a person’s point of view. (PJ)
13. Food system knowledge is completely factual and there are no opinions. (PJRC)
### Appendix E: Definition of Systems Approach from Interview Responses

Table E 1. Participant Use of Systems Concepts within Interview Definition

<table>
<thead>
<tr>
<th>Participant</th>
<th>Neither</th>
<th>Pluralism</th>
<th>Holism</th>
<th>Both</th>
<th>Quotations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant 1</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td>Visualizing all the factors that are involved. It is easier to understand the system when you can see it all in one place, it shows the interconnectedness, what things influence other things and what things depend on other things. All of the factors, at least as many as you can fit on there. This is difficult to do in say in essay form, or simply a conversation. Being aware of the variety of beliefs and experiences that people have on this topic, or any topic, is important. And especially because food is so important, culturally, so we need to be aware of how other people experience food, as it is such a vital part of our lives.</td>
</tr>
<tr>
<td>Participant 2</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td>I don’t know how you could understand food by just looking at one thing. Honestly, I don’t think how you can focus on just one thing in the food system. Because when we are at the farm even when you’re thinking about one crop, you’re still thinking about soil, the weather, and the time it’ll take to put all this together. The farmers had to think about every aspect and somehow sort of manage it so it works together. It was surprising.</td>
</tr>
<tr>
<td>Participant 3</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td>I think it means acknowledging the fact that there is more than one input or we have seen things or doing things and acknowledging the fact that there are multiple people involved, multiple places, multiple stakeholders involved in the situation. So like food in the food system is tied to the economy and tied to culture. And we need to acknowledge all the connections.</td>
</tr>
<tr>
<td>Participant</td>
<td>Neither</td>
<td>Pluralism</td>
<td>Holism</td>
<td>Both</td>
<td>Quotations</td>
</tr>
<tr>
<td>-------------</td>
<td>---------</td>
<td>-----------</td>
<td>--------</td>
<td>------</td>
<td>------------</td>
</tr>
<tr>
<td>Participant 4</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td>I think it means just taking a bigger picture approach, seeing the connections. Things aren't so linear, like this is the problem and here's the answer, more like this is the problem and what recommendations can be made and here are the effects. It could be that there are no complete answers but how things change for the individual, and how things are really complex.</td>
</tr>
<tr>
<td>Participant 5</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td>It means that everything affects everything else and I like looking at things holistically because everything, well, you just can't separate things. You can try, you can try to have control variables but in the real world, like, like everything has an impact. Everything is going to impact you so learning to work with those impacts because are going to happen is important. Like in the food system impacts like drought I'm going to happen so we have to learn to work with them and how they impact the rest of the system. But then again, maybe we get flooding another time, will try to do the best we can but we have to consider everything else that's connected.</td>
</tr>
<tr>
<td>Participant 6</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td>I guess in other more typical learning styles, we just focus on one or two little things, and we don't focus on how things affect the whole, like the environments or how it relates to other food systems. I remember in lecture one day someone behind me saying that learning about food systems doesn't apply to animal biology. I found that interesting because although it might not have that direct relationship, I think there is a valid point in having animal biology put in LFS. I find LFS as a whole, it is a lot more broad than people think it is. We have a lot of different disciplines in the faculty so regardless of what were learning in 250, it can still apply to you, in the way of thinking. The systems way of thinking is very valid to apply to other content. LFS 250 probably helped me see this.</td>
</tr>
<tr>
<td>Participant</td>
<td>Neither</td>
<td>Pluralism</td>
<td>Holism</td>
<td>Both</td>
<td>Quotations</td>
</tr>
<tr>
<td>-------------</td>
<td>---------</td>
<td>-----------</td>
<td>--------</td>
<td>------</td>
<td>------------</td>
</tr>
<tr>
<td>Participant 7</td>
<td></td>
<td></td>
<td>x</td>
<td></td>
<td>Recognizing interactions between what you’re studying as opposed to just focusing on the details, relationships as opposed to facts. Which is why it’s harder to define absolutes because it is based on relationships. The best way to accomplish that is by experiencing things and asking questions rather than just listening.</td>
</tr>
<tr>
<td>Participant 8</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td>No, I don’t remember much about that at all.</td>
</tr>
<tr>
<td>Participant 9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>N/A - Participant wanted to end the interview before the final questions</td>
</tr>
<tr>
<td>Participant 10</td>
<td></td>
<td></td>
<td>x</td>
<td></td>
<td>Ya, you just have to keep on emphasizing the connections. There are some new relationships we have to think about compared to first-year courses who are just like learn this and then answer these questions.</td>
</tr>
<tr>
<td>Participant 11</td>
<td></td>
<td>x</td>
<td></td>
<td></td>
<td>I’m not sure, I’ll take a stab at it. Um, sort of taking not just, trying to get as much background information about something from enough different fields or not necessarily sources because they might not be in the same sector but to try and get not just general understanding of something but balanced.</td>
</tr>
<tr>
<td>Participant 12</td>
<td></td>
<td></td>
<td>x</td>
<td></td>
<td>N/A - although other responses in the interview demonstrate an understanding of the role of holism and pluralism in the food system</td>
</tr>
<tr>
<td>Participant 13</td>
<td></td>
<td></td>
<td>x</td>
<td></td>
<td>N/A - although other responses in the interview demonstrate an understanding of the role of holism and pluralism in the food system</td>
</tr>
<tr>
<td>Participant</td>
<td>Neither</td>
<td>Pluralism</td>
<td>Holism</td>
<td>Both</td>
<td>Quotations</td>
</tr>
<tr>
<td>-------------</td>
<td>---------</td>
<td>-----------</td>
<td>--------</td>
<td>------</td>
<td>------------</td>
</tr>
<tr>
<td>Participant 14</td>
<td></td>
<td></td>
<td>x</td>
<td></td>
<td>Considering the multiple stakeholders with an interdisciplinary approach to an issue to me is more important and powerful than just one component. I think it’s just this larger awareness of what’s included in each issue and who was involved. I just think that it’s more of a holistic way to look at any issue. I think it helps me find gaps in what so-called facts do or do not include. It helps me be more critical about things I hear as facts, and why the research was done in the first place, who funded it, what’s their bias. I may have thought that way before but now I have a word for it. And all the activities we’ve done help contribute to this vocabulary and way of describing how I’m thinking.</td>
</tr>
<tr>
<td>Participant 15</td>
<td></td>
<td></td>
<td>x</td>
<td></td>
<td>If you are taking the systems approach you are obviously looking at something specific and you have to assess what other groups or whatever policies or what have you, influence that. You need to look at what are the influences, what is it connected to, how was it connected, and who is it connected to.</td>
</tr>
<tr>
<td>Participant 16</td>
<td></td>
<td></td>
<td>x</td>
<td></td>
<td>It really shows how everything is interconnected and you can have a degree in economics and how that could work with multiple fields. So broadening of perspectives is what I got out of it, so definitely very interdisciplinary.</td>
</tr>
<tr>
<td>Participant 17</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td>Just looking at the whole thing and seeing how things connect as opposed to just focusing on one thing. Realizing connections between things. I think I am already using this approach in some of my other classes, even like soil science,</td>
</tr>
<tr>
<td>Participant</td>
<td>Neither</td>
<td>Pluralism</td>
<td>Holism</td>
<td>Both</td>
<td>Quotations</td>
</tr>
<tr>
<td>-------------</td>
<td>---------</td>
<td>-----------</td>
<td>--------</td>
<td>------</td>
<td>------------</td>
</tr>
<tr>
<td>Participant 18</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td>you know, like, everything relates.</td>
</tr>
<tr>
<td>Participant 19</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td>To take a systems approach means to step back from what you’re doing and assess how what you’re doing impacts different fields and areas that you might not be considering at the moment. I think systems thinking is not just a way of thinking but it is a way of going about business because you actually have to consult other people to get a really good idea of what’s going on.</td>
</tr>
<tr>
<td>Participant 20</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td>Even though we are talking about that we all don’t know about the truths, people who are taking the system or systematic view of stuff, it’s not perfect, but it is what we need to start to do at first. It’s a more healthy way to improve our food system, our planet. It requires integrative thinking and more collaborative learning which is not often seen in so many studies in University. It has definitely helped me in some way, it definitely shaped my way of thinking about the food system.</td>
</tr>
<tr>
<td>Participant 21</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td>I don’t think I’m at that level yet.</td>
</tr>
<tr>
<td>Participant</td>
<td>Neither</td>
<td>Pluralism</td>
<td>Holism</td>
<td>Both</td>
<td>Quotations</td>
</tr>
<tr>
<td>--------------</td>
<td>---------</td>
<td>-----------</td>
<td>--------</td>
<td>------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Participant 22</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td>I think when you look at the system, or when you study a system, because they interact with each other and impact each other. So I think that's basically what I get from a systems approach. So like you have to look at different angles in the system. It definitely helps me think about food system.</td>
</tr>
<tr>
<td>Participant 23</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>So not just looking at something by itself, isolated but seeing how it works in relation as part of the system and how it connects and relates to each other and how they function together as a very complex functional system. I think it's something important to keep in consideration as I learn a lot of things in the reductionist way, but maybe not apply directly but just thinking about how these disciplines relate to each other or how a goal can be enhanced by how the disciplines come together.</td>
</tr>
<tr>
<td>Participant 24</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td>I just keep thinking about the one article that we read about living systems. And I think about living systems within living systems. So I guess, even just emphasizing the point that everything we see either is a living system or has come from a living system. So in the human body, if one part suffering it will affect your body eventually, and within the food system and within academics in general and life, what happens in one area will affect everything else to some degree. And so it's important to recognize that and to approach learning with that in mind. It's been really useful. I think it's easier to continue to think in that way, to learn that way depending on your class. I'm in a cooking class right now which is really great and a professor said here's what we should think about obesity. Energy in, and energy expended allows us to see what people become obese. And then he said a group of scientists have solved the reason for why people are obese and he put up a crazy mind map with like a different areas that were all interconnected, and then said it's not so simple.</td>
</tr>
<tr>
<td>Participant</td>
<td>Neither</td>
<td>Pluralism</td>
<td>Holism</td>
<td>Both</td>
<td>Quotations</td>
</tr>
<tr>
<td>-------------</td>
<td>---------</td>
<td>-----------</td>
<td>--------</td>
<td>------</td>
<td>------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>This was interesting because it made me realize that I understood what he was saying and understood the map and the problem better because of how we think about things and are asked to frame things in our class, LFS 250.</td>
</tr>
<tr>
<td>Participant 25</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td>I would say it's more about, first of all, to get more familiar with the system and then you have to do some interviews or research with people about what's going on in the system. And then you can get a larger picture of differences.</td>
</tr>
<tr>
<td>Participant 26</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td>A systems approach is looking at something through a lot of different lenses, labeling is something environmentally, ecologically, economically and socially. But also looking at the different layers, like looking at the global food system and the UBC food system and the provincial food system. So looking at these different layers with these different lenses and trying to connect these things.</td>
</tr>
<tr>
<td>Participant 27</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td>It's hard, but I think the most important thing is to remember that there is a context for everything and not to forget that all the disciplines connect in some way.</td>
</tr>
<tr>
<td>Participant</td>
<td>Neither</td>
<td>Pluralism</td>
<td>Holism</td>
<td>Both</td>
<td>Quotations</td>
</tr>
<tr>
<td>-------------</td>
<td>---------</td>
<td>-----------</td>
<td>--------</td>
<td>------</td>
<td>------------</td>
</tr>
<tr>
<td>Participant 28</td>
<td></td>
<td>x</td>
<td></td>
<td></td>
<td>Just having an open mind and being aware that there are different perspectives to take and being open to any way that those opinions can change your opinions. And, being able to collaborate and being able to think about something outside of yourself.</td>
</tr>
<tr>
<td>Participant 29</td>
<td></td>
<td></td>
<td>x</td>
<td></td>
<td>It means, kind of like I said the cycle, where all the ingredients for something came from and what they were. So like wheat where was gone before it was milled and before it became part of something you ate. So like I said about organics, I hate organics. There’s nothing good about an organic apple if it still had to be flown across the world and so the ecological footprints, the loss of yield, there’s no advantage gained. So I have always thought about the systems approach and buying in season, thinking about where your food came from.</td>
</tr>
<tr>
<td>Participant 30</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td>Being open-minded, that really stuck with me because I wasn’t as open-minded before I took the course. Now I know that nutrition isn’t just food but it starts at the farm depending on how well the farm is run. I will probably continue to see the food system in this way now likely take future nutrition courses.</td>
</tr>
<tr>
<td>Participant 31</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td>I think it means looking at the cycle of whatever you’re looking at. So if you are thinking about the food system, you look at how each component effects one another and how it is like a renewing cycle.</td>
</tr>
<tr>
<td>Participant 32</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td>That no one thing is everything on its own. You can’t look at something and say cause-and-effect there you go ask the direct correlation between something. Everything is going to affect something and everything is interrelated and you can’t just think that one action as one consequence. It’s like a web if you interact here you change six other things.</td>
</tr>
<tr>
<td>Participant</td>
<td>Neither</td>
<td>Pluralism</td>
<td>Holism</td>
<td>Both</td>
<td>Quotations</td>
</tr>
<tr>
<td>-------------</td>
<td>---------</td>
<td>-----------</td>
<td>--------</td>
<td>------</td>
<td>------------</td>
</tr>
<tr>
<td>Participant 33</td>
<td></td>
<td>x</td>
<td></td>
<td></td>
<td>You can’t just go at things from one angle, you have to go from different perspectives. All the different activities we did for different things help me understand things more, I don’t know if this is what we were talking about but just having lectures in other classes doesn’t help me learn as well as this type of class where we discuss in a different assignments on trips. So actually like applying it to stuff, worked.</td>
</tr>
<tr>
<td>Participant 34</td>
<td></td>
<td></td>
<td>x</td>
<td></td>
<td>Basically, trying to look at the entire system instead of looking just at the individual constituent parts. Definitely having a broader view of everything from farm to table aspect and we can’t just saw one aspect and expect the entire system to change. Or conversely you could change one aspect and you have to anticipate that there will be repercussions in the other part of the system. You have to anticipate changes within the entire system rather than just changing one thing.</td>
</tr>
<tr>
<td>Participant 35</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td>It’s like...uh. Yes...the systems approach though. Sorry, what’s the question again? I feel like taking a systems approach is more like trying to adapt to people’s needs whereas specializing in a specific science you are just looking at hard facts. Whereas a systems approach, you’re trying to apply those concepts and adapting to people needs, so if you look at different communities and having different needs, the ways to go about things is all different.</td>
</tr>
<tr>
<td>Participant 36</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td>It’s straight up reflection of what the flashlight example was. It’s so important to see things from both the specific focus view and the big picture. You need to take multiple perspectives and then see how it all ties together.</td>
</tr>
<tr>
<td>Participant 37</td>
<td></td>
<td></td>
<td>x</td>
<td></td>
<td>It’s funny because every time we heard that term in the course, I would always think what does that really mean? I interpreted it as an all-encompassing, seeing everything at once and how they relate.</td>
</tr>
</tbody>
</table>
### Appendix F: Summary Examples of Written Responses to Dual Position Problem

**Table F 1. Rating Associated with Examples of Written Responses to Dual Position Problem**

<table>
<thead>
<tr>
<th>Rating</th>
<th>Summary Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>If the goal of the project is to enable as many residents as possible to stay on the island, it makes the most sense to invest and expand the operations that already exist and serve the island as opposed to shifting focus to 10 jobs in the potential of tourism [P7].</td>
</tr>
</tbody>
</table>
| 2      | Transporting food onto the island and reliance of 80% imports onto island seems to be what many problems stem from (food price, accessibility, unable to sustain food source if cut off). Stinging nettle has high economic incentive; it is cheaper to start up and repay. However, considering the volatile price of oil and transportation costs and also the relative timeframe both projects would take (10 years).  
1. Stinging nettle may not offset the transportation costs enough to lower food prices  
2. The benefits associated with costs of nonprofit or higher because it last longer [P2]. |
| 3      | To improve food security on the island I recommend supporting the local nonprofit organization. The primary reason for this is favorable is that good citizenship and an established livelihood around food in the community will create a lasting investment in food security that will transcend generations and emphasize raw relationships with food. The alternative proposal, while a valid means of improving food security, will achieve its goals with economic motives. The development of this business does not create connections amongst food citizens with the same effectiveness nor does it foster social sustainability such as between rural and urban citizens [P5]. |
| 4      | Both plans are well-intentioned and would help the island a great deal. They seem to be improving food security from different approaches. The local food nonprofit, however, might be more feasible in the long term.  
- Look at environment for possible plans (transportation, pollution, etc)  
- Food sovereignty of both plans and health of residents  
- Long-term jobs created (processing plant versus increased tourism and other local food jobs)  
- Strengthening of local community  
The plan would economically benefit the island, but it likely that it would benefit the environment, the community, the health of the food consumed on the island, or the long-term sustainability of jobs and livelihoods. If I had to choose one, I would go with the nonprofit. Besides, residents can consume the nettle plant themselves [P15]! |
<p>| 5      | Option 2 tackles all major areas concerning food security. It has the potential to increase tangible and material quality of food, increase in tangible (societal/community) aspects around food as well as |</p>
<table>
<thead>
<tr>
<th>Rating</th>
<th>Summary Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>decrease the environmental burden of increased shipping, packaging, production and transport, etc. It is a more holistic approach to food insecurity than option 1 as it offers solutions to almost all industries and stakeholders involved in the local food system [P14]. Proposal A (stinging nettle plant): good to note a profitable crop in-line with current mainland trends. However relying on this to rectify the issues with the local food system is expedient and shortsighted…that being said, supplements the local community with a source of revenue could be beneficial in providing funds for local initiatives like the option 2. Access to local food can be difficult in the community geared almost entirely for external markets. I think the organization’s goal of raising awareness of local ingredients, opening avenues of distribution to the residence and encouraging residents to grow their food has merit… in conclusion, have some of the sales of the stinging nettle and fund local initiatives based on collaboration. Talk to all stakeholders. Remain skeptical and single crop models, as these are vulnerable and politically unsound, potentially [P24].</td>
</tr>
</tbody>
</table>