Journal of Agricultural Education, 65(2), 112-128
https://doi.org/10.5032/jae.v65i2.2389

Pedagogical Pigs: Experiential Learning for Boundary Crossing

Jorhie Beadle [1]
Laurie Thorp [2]
Seven Mattes [3]
Ellie Vondette [4]
Dale W. Rozeboom [5]

Abstract

Preparing college students with the skills to engage in multidisciplinary problem solving, especially as it relates to the wicked problems of agriculture, has been called for by scholars for nearly two decades (UNFAO, 2006; Boyer, 1998; NRC 1998). Our nation's Land Grants, with the mission to provide practical education, and particularly campus-based farms, play an important role in addressing this challenge (Parr, 2007, Evans, 2023). Toward this end, we conducted a project at Michigan State University's Student Organic Farm in response to a call from MSU's Hub for Innovation in Teaching and Learning for cross-disciplinary curricula that addresses grand global challenges. In 2021, a team of five faculty designed and taught an experiential course focused solely on the care and management of two sows and their litters. Students from five colleges and over 15 different majors toured the MSU Swine Farm, met with a campus chef, and sold the piglets to a local farmer. Data collected includes student reading responses, video reflections, and an oral final examination. Key findings from qualitative data analysis reveal that students gained boundary crossing skills from the shared responsibility of working in a team to care for animals, developing problem solving skills in an agricultural context with their professors and peers through innovative pedagogy, and learning agricultural skills from farm stories shared by the senior faculty.

Introduction

In a world characterized by divisiveness, deeply entrenched political camps, mega droughts and rapidly declining biodiversity, our responsibility as environmental and agriculture educators to address these challenges cannot be avoided. Although the need for a critical pedagogy that provides opportunities for undergraduates to gain skills to problem solve, make compromises, and boundary cross with others from a wide range of backgrounds has been urgently recommended for decades (Akkerman & Bakker, 2011; Boyer 1998; National Research Council 2009; Orr, 1991, Hartmann & Martin, 2021), we continue to see students who are ill prepared to manage wicked problems (Selingo, 2018; Rittel and Weber, 1973). Many of these challenges are tightly wedded to agriculture and the food system (UNFAO 2006; Pimentel and Pimentel 2008; Lengnick, 2015).

[1]Jorhie Beadle is the Assistant Director of the Residential Initiative on the Study of the Environment at Michigan State University, 988 S. Brody Rd, East Lasing, MI 48825, beadlej1@msu.edu
[2]Laurie Thorp is an Academic Specialist in the Department of Community Sustainability and Director of the Residential Initiative on the Study of the Environment at Michigan State University, 988 S. Brody Rd, East Lasing, MI 48825, thorpl@msu.edu
[3]Seven Mattes is an Assistant Professor of Cultural Anthropology in the Center for Integrative Studies at Michigan State University, 221 Leslie St, Lansing, MI 48912, bryant22@msu.edu. ORCID: 0000-0002-9858-9794
[4]Eleanor Vondette is a B.S. in Animal Science from Michigan State University, Doctorate of Veterinary Medicine Candidate at The Ohio State University, 1900 Coffey Rd, Columbus, OH 43212 vondette.1@osu.edu
[5]Dale W. Rozeboom is Professor Emeritus in the Department of Animal Science at Michigan State University, 474 S Shaw Lane, 2209I Anthony Hall, East Lansing, MI, 48824, rozeboom@msu.edu

As a Tier 1 research institution and Land Grant University, Michigan State University (MSU) is ideally suited to take up the challenges suggested by the Boyer Commission, the Intergovernmental Panel on Climate Change, and the United Nations Food and Agriculture Organization (UNFAO). MSU has multiple colleges and disciplines pursuing new knowledge necessary to manage the wicked problems associated with feeding nine billion people. Michigan State University students come from a wide range of backgrounds and enroll in diverse courses pertaining to agriculture, ecology, economics, anthropology, mathematics, and so on. Sadly, climate science *and* our students tell us that this curriculum has not kept up with the urgent needs of a warming planet (UNESCO, 2021). In 2011, Ferkany and Whyte urged the academy to educate students in deliberative practices to address problems in natural resource conservation, climate change, and food systems. "We will argue for the importance of future research on how environmental education can incorporate participatory virtues to equip future citizens with the virtues they will need to deliberate about wicked environmental problems" (p. 1).

The complexity and "wickedness" of the problems we now face demand more from our college curriculum. A response to this need for curricular change was MSU's HUB for Innovation in Learning and Technology (referred to as HUB throughout this paper), which provides faculty with resources to pursue curricular improvement. In 2019, the HUB put out a call for instructors interested in designing 'studio courses', which are experimental course design projects aimed at innovative teaching and assessment practices. Studio courses are selected annually to receive additional funding to support these innovative designs. We submitted a proposal to design such a course based on informal, field-based teaching and learning at MSU's Student Organic Farm (SOF) with an aim to teach undergraduate students the boundary crossing skills necessary to address wicked problems. The Student Organic Farm is a 20-acre farm located just three miles south of campus among the seven livestock farms that comprise the hundreds of acres of teaching and research farms at MSU. Founded in 2001, the SOF provides certified organic produce for campus dining venues and Community Supported Agriculture (CSA). The farm is run by a paid crew of six to seven students and a full-time farm manager.

Pig Project leads, Laurie Thorp and Dale Rozeboom have been engaging students in the farrowing of piglets at the SOF for nearly a decade. Pigs were first brought to the farm as a scale appropriate way to respond to students' requests for more opportunities to learn about integrating livestock into diverse cropping systems. The project also met the needs of CSA members asking for more local, organic sources of animal protein. What we never anticipated was the collateral outcomes that came from student engagement with growing pork. During this decade, Thorp and Rozeboom witnessed the impactful learning that occurred when students were given high stakes learning opportunities at the farm. They also recognized the boundary crossing that took place in this project across their own disciplines– extensive/intensive farming, environmental studies/animal science, large/small scale, organic/conventional farming to name a few. They felt this was an ideal framework for a HUB studio course.

The 'pig course' (NSC 192) was approved for funding by the HUB with key objectives being that of mentoring junior faculty in interdisciplinary teaching and learning for boundary crossing. Students and faculty were recruited for the course from multiple colleges and disciplines. The teaching team was comprised of faculty from the College of Agriculture and Natural Resources, the College of Natural Science, and the College of Social Science. Students represented 15 different majors from five colleges. For this course, the authors experimented with a dynamic and fluid syllabus, driven by the needs of the students and instructors. The original student learning outcomes for this class included boundary crossing, understanding systems thinking, articulating a food ethic, and animal husbandry skills. Each class period had a hands-on portion, as well as a classroom lesson. Husbandry activities included observation of pending parturition, day and night observation of parturition, several days of round-the-clock observation of sows and nursing piglets to prevent crushing of newborn piglets, daily feeding and watering, castration, and vaccination. The course far exceeded expectations for student learning outcomes and pedagogical experimentation. The field-based learning model paired with a multi-disciplinary teaching team created the

context for students to engage in boundary crossing skills necessary to engage in the work of wicked problems.

Research Objectives

The purpose of this study was to assess the impacts of a multi-disciplinary, field-based course on student learning and development for undergraduates at Michigan State University. Specifically, we were seeking to understand the impact of the non-traditional course format on students' ability to cross boundaries to address wicked problems. Boundary crossing (Akkerman & Bakker, 2011) involves the ability to legitimize the need for collaboration with others, to enhance communication skills with boundary permeability, to reflect on one's practice with a less idealized view, leading to transformation in ability to work with others. The objectives that guided this course were influenced by the demands outlined in the Boyer Report (1998), UNFAO (2006) and National Research Council (2009) for institutions of higher education to develop innovative teaching and learning experiences that provide undergraduates with the opportunity to critically approach the wicked problems of our time. The following objectives guided our research:

1. Understand undergraduate perceptions of boundary crossing in agriculture.
2. Understand undergraduate experience with a multi-disciplinary teaching team.
3. Understand impact of field-based learning set on a campus farm.

Conceptual Framework

The conceptual framework for this project is grounded in Lonergan and Andresen's (1988) theory of field-based learning (FBL). This model utilizes a set of goals or aims that define the justification for field-based education which are as follows:

- demystification: The field is a setting where classroom-based knowledge can be "demystified." For most of the students – as discussed in the Findings section – "farming" is a construct that has never been experienced first-hand. Their knowledge of farming is formed from words on paper or scenes from YouTube.
- holism: Field settings enable knowledge to be gained in the most "holistic" manner when large structures such as buildings, lakes, mountains, or, in this case, farms, are seen in their entirety.
- originality: Students are encouraged in the field to obtain information which is "original," such as mapping the vegetation of the area or unearthing fossils in a bed.
- integration: The field setting can enable parts of information from lectures or texts to be integrated into a meaningful whole. In this case, those parts come from a variety of courses such as Horticulture, Supply Chain, Integrated Studies in Social Science, Animal Science, and Environmental Studies.
- tacit knowledge*:* The field setting can be an ideal setting where tacit knowledge (Polanyi, 1958) can be imparted. In this case this tacit knowing from Instructor 1 and Instructor 2 (removed for review) years of raising pigs with students or their personal farming experience was surfaced and shared. This conceptual framework model is also discussed in greater detail in the literature review.

The goals of field-based learning (Table 1) inform this work by aligning the pedagogy and learning objectives of this course. We view Lonergan and Andresen's FBL goals as mechanisms for facilitating boundary crossing in the context of this study. Table 1 further defines these goals and the ways that they were exemplified throughout the project. FBL will be further explored in the literature review.

Table 1

Field-based Learning Goals & Project Equivalents

Goals/ Aims	Definition	Project Equivalent
Demystification	Experiences that demystify classroom knowledge	Animal science students performing vaccination, which they had only read about in textbooks
Holism	Learning derived from experiencing whole systems	All students observing pigs' role in a larger farm ecosystem (and their human role in that ecosystem)
Originality	Building original knowledge	Students engineering a more efficient watering system based on knowledge of animal needs and farm infrastructure
Integration	Learning from synthesizing fragmented knowledge	Students understanding the intersection of current ethical demands from consumers and economic needs of a small farm
Tacit Knowledge	Gaining knowledge that is possessed by others but is not codified or propositional	Students working alongside instructors with tacit farm knowledge

Literature Review

As an interdisciplinary course and team, the breadth of literature areas and trajectories that apply to this area are robust. In line with the interdisciplinary nature of this work, this study is embedded at their intersections – finding the most relevant connections in the questions and foundations that look beyond traditional silos. The key foci here are those of wicked problems, boundary crossing, and field-based learning.

Wicked Problems

The concept of "wicked problems" entered the literature as a way for planners to differentiate so called tame or definable problems from those that were becoming increasingly complex or using the language of Ritel and Webber (1973), "stubborn". In their seminal paper they discussed the evolution or reconceptualization of planning to include a new way of thinking about goal formulation, problem definition, and equity issues. This included a critical appraisal of professional practices and systems that had failed the public they serve. The critique addressed the widely held notion that planners and engineers could apply their professions to shaping a "perfect" future for society. Shaping this ideal future was only a matter of defining a problem and applying the solution using scientific management. Their paper signaled the cracks in the foundation for an elitist way of knowing and being in the world of systems planning. Here Rittel and Webber proposed the concept of societal problems as wicked problems. This type of problem is ill-defined, never solved, has no right/wrong answer, full consequences cannot be assessed, has no opportunity for trial and error, and every wicked problem is unique. Wicked problems are also characterized by causal links to other problems creating new connected or messier problems.

Agriculture is not immune to wicked problems. Godfray and Garnett (2014) point to the nexus of price volatility, hunger, population growth, and environmental damage driving competing calls to action in agriculture. Further complicating the wickedness of food production is that different stakeholders prioritize the various challenges differently depending on their underlying motivation and values (Conklin, 2006). In

their paper, Godfrey and Garnett (2014) argue that the magnitude of the challenge in the next decade calls for a systems approach across the spectrum of disciplines that touch agriculture (Kuhmonen, 2018). Those of us educating the next generation of farmers, food policy analysts, land use planners, agronomists, nutritionist, and so on, play a critical role in preparing graduates with the necessary skills to communicate, navigate, and negotiate wicked agricultural problems. The literature surrounding wicked problems suggests that college curriculum should extend beyond teaching students to solve 'tame' problems, or problems that are resolvable with simple solutions (Rittel and Weber, 1973). Rather, curriculum should be aimed at developing students' problem-solving skills to align with wicked problems- especially those wicked problems that threaten food security and the environmental challenges of the next decade.

Boundary Crossing

Boundary crossing is an ideal medium for approaching wicked problems within animal agriculture. Boundaries are a part of human cultures – delineations between oneself and others, along a wide variety of socio-cultural lines. These constructed lines can prevent interactions from occurring among groups of people (Akkerman & Bakker, 2011; Veltman, et. al, 2019). Engeström, Engeström, and Kärkkäine (1995) note the barriers to boundary crossing as "groupthink" or the lack of shared mental models, in which members of a given group do not consider (or are not motivated) to consider alternative approaches. They assert, "Such fragmentation may make it impossible for experts from different contexts to "speak the same language" and "exchange ideas about a problem" (p. 321). When one is an expert in their own compartmentalized area, for example, it may be more challenging to think outside of the traditional box - missing connections and alternatives that could significantly add to the issue at hand. Learning to move behind this box, to attempt "cognitive retooling" (p. 322) requires practice and effort to directly build bridges and work beyond the usual silos.

Akkerman and Bakker (2011) add depth to the concept of boundary crossing by delineating four dialogical learning mechanisms: identification, coordination, reflection, and transformation. Identification requires recognition of "othering" - understanding where and how one is cognitively separate and acknowledging the need for coexistence. A bridge is not built until both sides understand the value of putting forth the effort of connection. Coordination includes the variety of actions that facilitate these connections, emphasizing and coordinating continuity between the two areas via actions such as translating different ways of communicating shared boundary objects and topics. Reflection occurs when one expands beyond their traditional bounds, perceives the issue at hand from a broader perspective, or from the perspective of the other party. Transformation is the final stage, in which practices, perspectives, approaches, etc. may be altered with these new understandings now applied and understood.

Boundary crossing is especially urgent for animal agriculture, where divides along ethical and disciplinary positions can be stark and polarizing. Within academia, in oversimplified terms, there may be a divide between those who work with animals as commodities or objects (e.g., Animal Science) and those who work with them as subjects, companions, marginalized others, etc. (e.g., Human-Animal Studies). Similarly in general terms, outside of academia such camps could be those who produce and consume animals and those who object to part of, or all these processes. Wilke (2017) refers to this as an unrealistic binary perspective on both "sides" of the aisle. When, in fact, the reality of both animal production workers and animal welfare/rights activists are far more nuanced. The need for boundary crossing between these two deeply divided groups is necessary to understand these nuances and remove the "single story" each side has about the other. Wilke states,

Re-engaging with those at the pragmatic hub of food animal productive contexts is not only long overdue, but also imperative if we are going to (re)nuance and (re)contextualize our understanding of, and debates about, a long-standing and increasingly contentious 'zoological connection' that many of us have become distanced from (p. 293). In a similar vein, Haraway (2016) urges scholars (and beyond) to negotiate the difficult environmental context that unites us. She speaks to the need to step back from traditional

bounds, to perceive interconnections and overlaps as beneficial bridges for managing complex problems – especially of the wicked variety.

Field Based Learning

The goals of field-based learning (FBL) provide educators with a framework to teach boundary crossing for wicked problems. For this course, the merits of FBL grounded the curricular design and pedagogy of the pig class in part because 'the field' offered diverse boundaries and boundary objects. As an extension of the 10 years informally teaching at the Student Organic Farm, we knew the needs of our learners and the challenges related to food systems education, farm teaching and learning, and crossing boundaries within agriculture. Lonergan and Andresen (1988) capture the educationally relevant characteristics of field-based settings that are just as relevant today as they were 25 years ago. In their seminal paper, they outline four key characteristics that we as educators also recognized as highly aligned with our goals and aims for the project. These characteristics are: reality, complexity, multiple stimuli, and release. Need we tell our readers that the "reality" of working on a farm is qualitatively different from reading about a farm or watching a video about farming? Given that systems thinking and boundary crossing were two of our learning objectives, providing our students with a setting where they could *experience* the complexities of farming was critical. The "multiple stimuli" provided by the intense experience of farrowing at midnight with headlamps simply cannot be replicated by other means, including video. Lastly, Lonegren and Andresen list "release" as a characteristic found in field settings. They discuss the signaling that occurs from the field setting that tells the learner they are free to move, respond, inquire, and challenge.

Methodology

Research Design

This case study followed key principles of naturalistic inquiry (Lincoln & Guba, 1985) and emergent design (Schwandt, 2015). According to Merriam and Tisdell (2016), a case study is "an in-depth description and analysis of a bounded system" (p. 37). Given the bounded nature of the course, we felt this research design was most aligned with this study. Naturalist inquiry is also well suited for this type of fluid inquiry in an educational setting. Naturalistic inquiry is always carried out in a natural setting, in other words, the study is conducted without intervention or manipulation of subjects. Among the principles of naturalistic inquiry, this study followed: 1) "the human as instrument" (p.192), which recognizes the capacity of humans to collect data reliably and with greater nuance, 2) successive iterations of design given the fluid or emergent nature of the setting, and 3) inductive data analysis. We, as collaborative teachers/ researchers, facilitated the surfacing of issues that were most pressing to all participants. This design fits best with this project's teaching and learning goals and our methodological training. The research design and protocols were reviewed and approved by the [University] Institutional Review Board for Social Science (IRB).

Population and Sample

Although generalizability is not the aim of naturalistic inquiry, we do aim for transferability of the findings to other contexts within agricultural education. The population for this study was undergraduates at Land Grant universities. Purposive sampling (Patton, 1990) was used to recruit students for this class and research. The power of purposive sampling is situated in its ability to ground the inquiry in emic views of the participants. The logic in purposive sampling lies in selecting information-rich respondents for study. An email inviting students from all 12 colleges at MSU was sent to 425 students in the Environmental and Sustainability Studies minor, flyers were posted in 12 campus buildings with high traffic, recruitment emails were sent to over 500 integrative studies students, and 10 professors with courses related to food and agriculture were sent flyers and the recruitment link. Students were invited to apply to this closed class by answering four background questions pertaining to their experience and interest in food systems, dialogue, animal agriculture and boundary crossing. In total, 35 students applied for the course and 18 students enrolled. Students who did not enroll had scheduling conflicts or decided against taking an elective course.

Data collection methods and sources

Data were collected using four methods.

1. Written responses: Students responded weekly to open ended prompts which were uploaded to our weekly classroom learning management portal Desire to Learn (D2L). Topics for these responses were drawn from the course readings and guest lectures which included: agricultural leadership, animal sentience, welfare science, animal ethics, cross-cultural perspectives, and artificially grown meat to name a few. Students were also asked to respond to at least two of their classmates' responses. These responses were downloaded, purged of their identifier and transcribed for analysis.
2. Video recordings: Students were asked to videotape ten, three-minute reflections following key experiences with the animals and/or their classmates. These reflections were uploaded to MSU MediaSpace where all could view and comment. The reflections followed events such as farrowing, castration, guest lectures, and loading. Videos were viewed by the entire research team who noted salient themes and key quotes. These themes and quotes were then shared using a group process to subsume and eliminate redundancies and assess the relative strength of the themes. Five final reflection videos answering "What Stuck?" were transcribed and uploaded for coding in Taguette.
3. Verbal reporting: A group oral final examination was also a source of qualitative data. The oral final examination was administered over a two-week period at the end of the semester. Students were given a bank of over 50 questions in advance to prepare for the exam. During the exam students could seek help from a classmate and were prompted by the instructors if necessary. The oral exam was transcribed by a member of the research team and audio recorded by two instructors. All instructors took notes throughout the exam. The transcript was then used for content analysis using Taguette. The open codes were cross-referenced with the entire team of instructors then refined during closed coding.
4. Additional emergent data sources such as photographs (Harper, 2000), participant observation field notes (VanMaanen, 1995), and weekly teaching team meetings were used during the final analytic and writing process. VanMaanen (1995) wrote extensively during his career about the "most unsystematic activity" that ethnographers engage in when making meaning from their field notes and participant observations. We too, toggled between our data and our personal observations over a semester.

Data Analysis

A codebook was developed following the instructors' group open coding session. During this session, all instructors nominated codes independently identified from a ten-page reading selection of the transcript. Our group process resulted in over 30 open codes. A subset of three instructors performed axial coding to further refine, subsume and develop a code book (Meriam and Tisdel, 2016). The resulting code book was comprised of ten categories (Appendix A). The categories and transcripts were uploaded into the data management software, Taguette (Rampin, 2021). Three researchers independently coded data for reliability of thematic findings. Once data was coded, three team members grouped categories into three themes (Table 2). These findings were then shared with the entire research team to inform the writing and further analytic process (Richardson, 1994).

A significant portion of the data in this study followed naturalistic data analysis guidelines as described by Lincoln and Guba (1985). Data were interpreted using a form of content analysis. Naturalistic data analysis differs from conventional analytic methods in that it is done throughout the study. This method of data analysis cannot be done serially (as in conventional research: develop questions, gather data, analyze data, write up findings, make conclusions). Naturalistic data analysis is not a linear process; rather, it is a highly recursive function. In using this method questions are developed, data is gathered, questions are refined, more data is gathered, data is analyzed, increasingly sophisticated questions are posed, more data

is gathered, and so on. The process has a built-in mechanism for self-correction and validation. This type of analysis breaks down the illusory canonical barriers between researcher, researched, and data.

Table 2

Research Themes Defined and Exemplified

Code	Definition	Example
Boundary Crossing (Abbr. BC)	Expresses mutual respect by acknowledging differing viewpoints from instructors and peers	*"This class has opened my eyes in terms of trying to see and understand things from a farmer's perspective."*
Agricultural Knowledge (Abbr. AK)	Articulates technical knowledge about agriculture, farming, and farmers. Defines Production trade-offs and demonstrates awareness of agriculture to educate others	*"I also learned about farrowing stalls and the use of them. I found this fascinating as it opened my eyes to the inventions and complex thought processes that go into the production of pigs"*
Pedagogy (Abbr. PDY)	Articulates preferences related to the structure of the course/ learning model	*"Our class didn't stop there; we went next to learn about the food bank and how we are donating to people who are food secure. Our class doesn't stop at the slaughter, but it keeps going to people. People are going to benefit and appreciate and love this food and it's going to provide people with food like we provided for the pigs."*

To ensure credibility, we triangulated data through cross-evaluating codes between three researchers at multiple stages throughout data analysis (open and axial coding). Additionally, we triangulated across multiple data sources including final exam transcripts, video reflection transcripts, and D2L reflections. In doing so, we also ensured interrater reliability (Merriam & Tisdell, 2016). A thorough and organized audit trail was kept maintaining consistency and dependability of the research. MediaSpace, D2L, and Taguette served as data repositories throughout this research. The primary limitations of this study are aligned with the boundedness of case studies. Primarily this study was limited by the number of participants, the course context, and other finite factors typical of case studies (Merriam & Tisdell, 2016). Despite this limitations, the rich data collected point to three transferrable findings: boundary crossing, pedagogy, and agricultural knowledge.

Findings

The findings we present here are the result of several iterations of content analysis by three of the authors. Data were coded and analyzed using Taguette software. These data were then further analyzed by a fourth member of the research team. This higher order analysis utilized all thematic reports generated from Taguette to subsume overlapping themes and identify the most robust themes from the content analysis. Findings were then circulated back to the team for confirmation. The three key findings included clear evidence that students learned skills necessary for boundary crossing, gained agricultural knowledge, and articulated the impact of innovative pedagogy.

Boundary Crossing- "I have a toolbox now…"

The data analysis very clearly shows that the class helped students learn how to cross boundaries. Students referenced a wide range of course experiences that set the stage for this skill development. These experiences included: a trusted professor's stories, witnessing birth, death, and weaning, touring the MSU

Swine Farm, Thorp and Rozeboom's interactions and stories, and the diverse background and majors of their peers in the class. Creating a class ethos of trust, respect and honesty was a critical component in laying the foundation for boundary crossing. Within this safe space of trust students spoke about wanting to understand others that normally they would dismiss. Likely this can be attributed to a combination of many elements in the class, however, our analysis shows that having two instructors who have worked together respectfully while holding very different views on animal agriculture inspired many in the course to boundary cross. One student stated:

> From both Dale and Laurie's stories, I appreciated the importance of different backgrounds and points of views in the world. Their stories are motivating to me personally because they acknowledge that not one system for the treatment of animals is right or wrong, they are just different perspectives.

Working with the pigs as a team of students with very different backgrounds provided weekly opportunities to cross boundaries with a common focus—the care for live animals. Our students were not just boundary crossing with words; they were boundary crossing for action with a shared responsibility. In reflecting on this, one student said, "I was so stressed in my farrowing shift, so afraid a piglet would get crushed, and those with farming backgrounds were not. They were able to help and offer knowledge." Students also recognized the longstanding value of this skill. One student stated, "I have a toolbox now—dialogue and boundary crossing – which I will be able to use in my day-to-day life."

Students expressed the higher order thinking we were hoping to see as an outcome from our course objective of boundary crossing skill development. Here they articulated that it is not simply boundary crossing for the sake of boundary crossing; we boundary cross to solve problems, to improve lives, and to gain new perspectives on deeply entrenched problems. One of our seniors reflected in her final video post that she has been trained in her education to "respond and be defensive." However, because of our class she now recognizes the "power of silence" when working in challenging situations in her discipline of zoology. One student directly pointed to the pigs themselves as supporting this learning, saying:

> Philosophy and science need to be in a closer realm, *or we risk missing a solution that could have come from a mix of both views* [emphasis added]. With pigs we lose the ability to see their needs and wants, and their specific natures if we view them from a solely scientific way, or we lose the ability to see how behavior and evolution shapes a pig's life if we view them from a solely philosophical way. I believe we can bridge this gap and bring the different ways of thinking together and hopefully make the lives of animals a little better.

Pedagogy- "It's not just a one semester thing…"

Given that the funding for this course came from the HUB, we were especially interested to hear from our students about the innovative pedagogy employed throughout the semester. Analysis of the data revealed that it is safe to say our students are starved for classes where they are engaged, listened to, given responsibility, where they know each other, and form relationships with their professors. Students developed deep connections with their peers, the pigs, and instructors, stating, "I will miss my peers, I loved the community we formed, and I loved the professors." Another student stated, "We've gone into a role where class is where we be quiet, mute, and sit alone. This class lets you build relationships and make connections."

Our students also valued having their assumptions challenged, witnessing slaughter, and being able to discuss "hard topics." Student reflections reveal that they appreciated the opportunity to stretch their learning, grow, and even engage in disturbing/ troubling experiences. Our pedagogy in part was grounded in prior years' experience with the pig project, knowing that farrowing, loading, and slaughter were often the most impactful experiences for students. Here students must make significant decisions in the absence

of rules or authority and rely on each other in a way not often experienced in college courses. One student stated:

> The pig project (NSC 292) is a very unique and interesting opportunity to interact directly with both life and death. In reflecting on this class, the two strongest moments were assisting with the birth of the piglets and the deaths of the sows. Students frequently reflected on life and death and the sentience of the pigs. This moved students to think about their own place in the world and their humanity. One student said,
>
> > At the slaughter I had been so far removed from death and what it means…so seeing how miraculous and special life is and seeing it taken away was jarring and shocking. It gave me more gratitude for life. The experiential learning [for me] was – life is sacred.

Surprisingly, one of the most pronounced themes that emerged in this analysis was the impact of storytelling in our course. Multiple students wrote about the role this played in their learning. One student said, "In the paper, Laurie and Dale used different storytelling elements—I liked how the class had elements of that all semester." When two trusted colleagues teach it is quite natural for stories to be part of their repertoire. Laurie and Dale also are farmers, so their stories formed a background tapestry where difference was embraced rather than rejected. The stories we told created the conditions for students to listen and be receptive to ethically challenging concepts. All too often our students see images of animal agriculture that are stripped of context and cherry-picked to elicit strong emotional reactions. As one student reflects, "I've been able to *hear* Dale's stories on the farm—running around barefoot as a child—so I believe the people in charge of livestock, even in mass capacity production, really have the intentions of animals at their hearts." Another student stated:

> It's easy in the academic world to get so fixated on numbers and scientific studies to the point where you don't look at events in a personal light. Hearing their firsthand accounts of how raising the pigs and other animals has affected them reminded me of the importance of listening to these stories.

Another student reflected on the value of storytelling in their weekly written reflection stating:

> Dale refers to this as the 'carcass merit of animals', an essential component that had never even crossed my mind until now. Although this idea was foreign to me and it could have easily perplexed me, causing me to write it off as something I would never understand, its placement in the context of his story made it easily palatable, logically following from his recounting of numerous showings at the county fair.

Agricultural Knowledge- "Now I can tell you details about farrowing…"

Our analysis of the data coded "agricultural knowledge" revealed that our students gained a much deeper understanding of what it means to farm. Nearly every student talked about increasing their very limited knowledge about farmers, farming, and pigs. Our students frequently coupled this new agricultural knowledge with their growing ability to cross boundaries into the discipline of agriculture, since, for a majority of our students, this was decidedly not familiar territory. By semester's end, students became quite fluent in their ability to map out key components in an agricultural system and discuss trade-offs. A student demonstrated this in their final video reflection, "…farmers make a choice that benefits them economically and considers the welfare of the pigs…" This was a student who had a strong negative reaction to the tour of the technology intense MSU Swine Farm, yet by semester's end was able to reconcile her reaction with the realities of farming. Students that were previously unfamiliar with 'farmwork' began to empathize with farmers they previously made assumptions about. This was especially true of students that participated in the late-night farrowing shifts. One such student said, "A lot of things crossed my mind while doing these shifts – I can't imagine being one farmer doing all this." Another student writes, "It was easy for me to think people in the field were heartless, but after seeing the impact the animals had on Dale I started to

realize the process is more delicate, thoughtful and complex." Other students spoke to the crossover between disciplinary assumptions of farming and agriculture,

> In my major – Supply Chain – economies of scale are typically a good thing and achievable with non-living products, but it is interesting it can be achieved with livestock as well to feed more of America, but it comes at a cost.

For this course, our specific learning objectives directly tied to agricultural knowledge were framed as "practical skills," including general "animal husbandry" and more broadly "farm skills." As an interdisciplinary elective, our objectives and assessments were not tied to any of MSU's agricultural majors' curriculum. Having said this, our students spoke and wrote about a wide range of agricultural knowledge gained from this course. One student wrote, "I told my mom at the beginning of this course I just want to raise baby pigs. Now I can tell you details about farrowing, vaccines, humane slaughter, pork production, boundary crossing and food security."

Not only did students take away knowledge about swine management and care, when asked to reflect on "What Stuck?" during their final exam, many spoke about expanding their knowledge of the entire food system, forcing them to think about their food ethic, food regulations, cultural food taboos, and killing/death broadly. One student reflected on this in the final oral exam stating, "I realized I had this perspective before this class that pigs were animals, but meat is just an object and never connected the two." Another student responded to 'What Stuck?' by stating, "Hands-on experience – this class taught me such a valuable lesson that I've been lacking. It's the removal of animal agriculture from our everyday lives, of knowing where our food comes from, and systems thinking."

We would be remiss if we didn't mention the bonds formed between our pigs and the students as agricultural knowledge. Students routinely spoke and wrote about the sows and their litters by name. Frequently these reflections offered insight into unresolved moral considerations about meat eating, animal ethics, or animal mind. These moral considerations were grounded in their newly found agricultural knowledge. Students frequently mentioned the unique personalities in specific detail, indicating a depth of observation and learning well beyond our expectations. In this knowing, students said they felt better prepared to educate others about food and farming.

Conclusions and Recommendations

Our initial research objectives sought to understand undergraduate perceptions of boundary crossing in agriculture, understand the undergraduate experience of multi-disciplinary teaching team, and the impact of field-based learning set on a campus farm. The innovative course design that guided these objectives was a direct response to the call for undergraduate curriculum that better prepares students for the wicked problems of our time. Our findings suggest that designing a course focused on these three elements results in enhanced agricultural knowledge, impactful pedagogy, and skill development for boundary crossing among participants. Based on these findings, we have developed a set of recommendations for course designers that include strategies to develop pedagogy focused on wicked problems and boundary crossing, enhancing course designs to embrace vulnerability and the unknown, and identifying non-traditional classroom spaces that allow students to engage in off-screen learning. These are summarized in Table 3.

Wicked problems and boundary crossing as our pedagogy

This project demonstrated what can be accomplished when participatory virtues and intentional boundary crossing are infused into course pedagogy. Both students and instructors collectively grew into a space where multiple 'stories' about animal agriculture were embraced. We intuitively knew that animal agriculture is not monolithic, but we had never completely and intentionally taught from that perspective.

Further, these stories could be incomplete, shifting and under erasure. Perhaps this is what teaching needs to look like in a world of wicked problems. We think this tells us that we as educators need to get comfortable with "managing" *the wicked problem of education* in this time of crisis. For the authors, this feels right. The team has taught through the Larry Nassar scandal, a global pandemic, and a school shooting. We also feel fortunate to have colleagues from across many disciplines at our institution who are ready to embrace a new/old paradigm in education.

Thorp and Rozeboom began this work 15 years ago out of their concern with the "camps" they saw in the College of Agriculture and Natural Resources. Now 15 years later, the camps are still there, but less rigid; calls for interdisciplinary teams are common, yet still not necessarily effective. Boundary crossers are no longer seen as suspect as we once were. We encourage you to cross boundaries at your university. We crossed farm boundaries, faculty boundaries, discipline boundaries, research methodology boundaries, age boundaries, and background boundaries. Get out of your usual sandbox.

Students stretched themselves beyond the human boundary and crossed into the non-human animal dimension where they frequently pondered the sentience of pigs, animal mind and animal behavior. This level of boundary crossing and curiosity could only be achieved by creating a safe space (both physically and emotionally) for both human and non-human animals to interact with each other. And when that safe space was absent the students created their own version of a safe space (both physically and emotionally). Students brought blankets and chairs, gave hugs and empathy, they shared rides and suggested modifications to our assessment— "can we video tape our reflections with a partner?"

This type of learning demanded that we as instructors allow for a certain level of elasticity within the course structure. We quickly learned that the syllabus offered us a foundation for the course but could not be used as a directive road map. We remained agile in teaching and learning as our students and the pigs took us in new directions not outlined on the syllabus. We recommend instructors of courses focused on boundary crossing in this context lean into mutualistic and co-constructed additions and edits to the syllabus. This is to be viewed as a living document that evolves.

Table 3

Recommendations Based on Findings

Findings	Recommendations
Boundary crossing	**Wicked problems and boundary crossing as our pedagogy** *Findings indicate that students respond to content focused on wicked problems and boundary crossing. This recommendation addresses all three of the findings but suggests that instructors should look to content that is not 'tame' but encourages students to engage in dialogical learning mechanisms (Akkerman & Bakker, 2011) that prompt them to cross boundaries to address wicked problems. Actions associated with this recommendation include teaching on interdisciplinary team and intentionally including boundary objects and boundaries in course designs.* FBE Alignment: Originality
Pedagogy	**Entering a space of unknowing, unknown, and vulnerability** *Findings suggest that learners respond to a pedagogy that is less rigid and elastic. This often includes high stakes learning opportunities. In this case study, farrowing piglets. We recommend instructors and course designers approach pedagogy with this ethos. Pedagogical actions may include a fluid course syllabus, hiring an experienced ULA for technical support, and opportunities for storytelling.*

	FBE Goal Alignment: Integration & Holism
Agricultural Knowledge	**Get out of the classroom, off your screens and into the physical world** *A clear theme that emerged through the coding process was the development of 'agricultural knowledge'. In line with the FBE literature, we recommend instructors and course designers utilize campus farms or non-traditional classroom spaces to allow students to build this knowledge through experiential learning and engaging with peers and instructors in the field.* FBE Goal Alignment: Tacit knowledge & Demystification

Entering a space of unknowing, unknown, and vulnerability

It is so obvious that we almost overlooked this. The high impact practices (Kuh, 2008) involved in this course (e.g., experiential learning, collective problem solving), often led to cognitive dissonance and vulnerability. We frequently were navigating unknown territory, most of the students had never been around livestock, thought about their food, worked on a farm, experienced birth or death of an animal, seen afterbirth, handled manure, the list is endless. As instructors we were constantly building bridges for our students and each other. This made us better listeners and educators; it forced us to slow down, to translate, and to remain open. Our vulnerability was evident in our weekly class, which gave students permission to stay open to emergent learning. The course forced students to confront the messiness (physical, emotional, and cognitive) of food and farming. They learned to wrestle with their inability to reconcile paradox in their agricultural ethics, their relationship to the land, and to non-human animals.

Letting go of the tyranny of the syllabus was briefly frightening and eventually liberating. We all agreed to follow the learning as opposed to the syllabus, recognizing that authentic learning is not linear, it emerges in unexpected ways and places. We took full advantage of the many "teachable moments" that two sows and 18 piglets provide. Be fluid and flexible. If you communicate clearly and regularly with your students, they will come along for the ride. This signaled to our students that we were deeply committed to their learning. Creating a space for new knowledge, honoring the drive for new knowledge from the students was stewarded by all of us. Many students were entering their first in-person class since the COVID-19 pandemic. Moving from five Zoom classes per day to an in-person, on-farm course with livestock was a transformation in the way many students understood the learning paradigm. A student reflected on this transformation stating:

> As we sat in the dark, wrapped in blankets, shivering, and waiting for farrowing, I had some of the best conversations I had ever had with students I had never met before. I had never experienced a group of students so diverse yet still so tightly interconnected this early in their relationships.

Students relished their newfound agency/responsibility in caring for the sows and their litters. This tells us as educators that we should take risks far beyond what we commonly call "stretch learning." Our students demonstrated that they would take the opportunity to take on big tasks with consequences. All but two students in a class of 18 wanted to participate in castrating and vaccinating our piglets. A student writes, "This class is more than just learning about raising pigs, it's about learning about yourself and your connections to the world."

Throughout the semester, we grew to accept and respond to the flexibility required of the course-the need to go "off book." This didn't happen without growing pains. As co-instructors we quickly learned that we are not exempt from the challenges of working on a team. We were reminded to establish roles, communicate frequently, and distribute responsibilities among team members. We also recommend hiring a second-year student as the course undergraduate learning assistant (ULA). This position grounds

instructors in the student experience. For us, our ULA was essential in communicating student concerns because they were close to the experience.

Get out of the classroom, off your screens, and into the physical world

In education, place matters (Hartmann & Martin, 2021). Where we learn often affects how we learn. For this class, the SOF was foundational in shaping student learning. Providing our students with a holistic context forced an immediate re-evaluation of their assumptions. Our classroom was not forward facing, via Zoom, seated or even indoors. The farm as a classroom was quiet, sometimes muddy, often buggy, painted with a woodlot backdrop of autumn color. The Student Organic Farm offered us a 360-degree learning space that celebrates wholeness and interdependence. The farmscape encouraged students to listen to the world around them, not just human voices. We learned to listen to the sow's song signaling milk let-down, crickets in summer nights fading to fall, along with migrating geese providing a much fuller picture of what it means to farm.

A vivid memory from the beginning of the semester came from our group texting app, in which two student caregivers at the farm reported they were scared. When faculty arrived at the farm, they found that students who had never worked with livestock were simultaneously thrilled by their "stretch learning" and risk taking but also very scared (bug-eyed to be exact) of one particularly restless sow. When the faculty climbed into the sow house with the students and helped them reconstruct the interior protective fencing while cursing Tami ("Tami you are such a brat!"). We began to laugh, and laugh even harder, as we sank into exhaustion, anger and, of course, love for these animals. In this very teachable moment two students learned about problem solving, vulnerability in learning, practical hand skills, animal husbandry, and *the exhilaration of being fully present in the material world.* This cannot be underscored enough. Our students rarely are fully present in the material world. As one stated during our oral final exam, "You (MSU) sent us into this virtual world and until this class, nobody gave us the tools to come out."

We would argue that for the past decade we have been drawn into the virtues and ease of online learning without any critical assessment of how much is too much. COVID answered that question. Online learning was largely a failure for learners in higher education. We continue to consult with students who were left behind, dropped out, or nearly left college due to their inability to learn online. Our course was taught during a period of the pandemic when most courses at our institution were online, with in-person instruction constituting less than 10% of instruction. We were masked during the lecture portion of our class, but our time at the farm with the pigs was a glorious release into real human-animal, human-human relationships. How grand that our pigs gave us the space to be humans again and communicate with each other. How sad that we have become so removed from human experience that it took two gestating sows on a small campus farm to remind us of our humanity. We also suggest that this authentic learning occurred because we got out of the classroom, but it was much more than getting them out of the classroom. If that were the case, a field trip would do**.** Our students participated in midnight watches of live-birth, still-birth, and malpresented piglets; they castrated eight-day old piglets; gave vaccinations; and observed the euthanization of a piglet with a crushed lung. We cried together and wiped blood on our jeans. We shoveled manure and buried the dead. A student summed it up this way, "This class allowed me to learn about death first-hand and understand what it means to live. I learned to love an animal and experience the sentience of non-human animals. This allowed me to make a re-connection with nature."

References

Akkerman, S. F., & Bakker, R. (2011). Boundary Crossing and Boundary Objects. *Review of Educational Research*, *81*(2), 132-169. http://dx.doi.org/10.3102/0034654311404435

Boyer Commission on Educating Undergraduates in the Research University (1998). https://doi.org/10.1021/ed075p935

Bulliet, R. (2005). *Hunters, Herders, and Hamburgers.* Columbia University Press.

Reinventing Undergraduate Education: A Blueprint for America's Research Universities, SUNY Stonybrook ERIC. https://doi.org/10.1021/ed075p935

Denzin, N. (1999). Interpretive ethnography for the next century. *Journal of Contemporary Ethnography, 28*(5), 510-519. http://dx.doi.org/10.1177/089124199129023631

Edwards, R., & Fischer, Z. (2007). Unsettling Boundaries in Making a Space for Research. *British Educational Research Journal*, *33*(1), 107–123. http://dx.doi.org/10.1080/01411920601104565

Engeström, Y., Engeström, R., & Kärkkäinen, M. (1995). Polycontextuality and boundary crossing in expert cognition: Learning and problem solving in complex work activities. *Learning and instruction*. *5*(4), 319-336. https://doi.org/10.1016/0959-4752(95)00021-6

Evans, J. and Roggio, A., (2023). The college campus as a living laboratory for meaningful food system transformation. *Journal of Agriculture Food Systems, and Community Development, 12*(3), 1-14. https://doi.org/10.5304/jafscd.2023.122.014

Ferkany, M., & Whyte, K. P. (2012). The importance of participatory virtues in the future of environmental education. *Journal of Agricultural and Environmental Ethics*, *25*, 419-434. http://dx.doi.org/10.1007/s10806-011-9312-8

Galt, R., Parr, D., Kim, J., Beckett, J., Lickter, M., Ballard, H., (2012). Transformative food systems education in a land-grant college of agriculture: The importance of learner-centered inquiries. *Agriculture and Human Values, 30*, 129-142. http://dx.doi.org/10.1007/s10460-012-9384-8

Geertz, C. (1995). After the fact. Cambridge: Harvard University Press. http://dx.doi.org/10.2307/j.ctv260717f

Glaser, B. & Strauss, A. (1967). The discovery of grounded theory. Chicago: Aldine. http://dx.doi.org/10.4324/9780203793206

Godfray, H. C. J., & Garnett, T. (2014). Food security and sustainable intensification. *Philosophical transactions of the Royal Society B: biological sciences*, *369*(1639). https://doi.org/10.1098/rstb.2012.0273

Goralnik, L., Thorp, L. Rozeboom, D., Thompson, P. (2014). Storytelling morality: Ecofeminsim, agrariansim, and pigs in the field. *The Trumpeter, 30*(1), 15-32.

Goralnik, L., Ferkany, M., Thorp, L., Whyte, K., (2015). Philosophy in the field: Care ethics, participatory virtues and sustainability. *Resilience: A Journal of the Environmental Humanities, 1*(3), 1-28. http://dx.doi.org/10.5250/resilience.1.3.002

Grauerholz, L., Weinzimmer, J., Kidder, E. N., & Owens Duffy, N. (2020). Teaching about Animals: Incorporating Nonhuman Animals into Sociology Classrooms. *Teaching Sociology, 48*(2), 120–139. https://doi.org/10.1177/0092055X20906563

Greenwood, D. J., & Levin, M. (2000). Reconstructing the relationships between universities and society through action research. *Handbook of qualitative research*, *2*, 85-106.

Harper, D. (2000). Reimagining visual methods. In Norman Denzin and Yvonna Lincoln (Eds.) *Handbook of qualitative research (*2nd ed.) (pp. 717-730). Thousand Oaks, CA: Sage.

Hartmann, K., & Martin, M. (2021). A Critical Pedagogy of Agriculture. *Journal of Agricultural Education*, *62*(3), 51-71. https://doi.org/10.5032/jae.2021.03051

Haraway, D. (2016). *Staying with the Trouble: Making Kin in the Chthulucene.* Duke University Press. https://doi.org/10.1215/9780822373780

Kalof, L., Fitzgerald, A. (2007). The Animals Reader: The Essential Classic and Contemporary Writings. *Anthrozoos*, *20*(1), 76.

Kuhmonen, T. (2018). Systems view of future of wicked problems to be addressed by the Common Agricultural Policy. *Land Use Policy*, *77*, 683-695. https://doi.org/10.1016/j.landusepol.2018.06.004

Kuh, G. D. (2008). Excerpt from high-impact educational practices: What they are, who has access to them, and why they matter. *Association of American Colleges and Universities*, *14*(3), 28-29.

Legnick, L. (2015). Resilient agriculture: Cultivating food systems for a changing climate. New Society Publishers.

Lincoln, Y., Guba, E. (1985). Naturalistic inquiry. Newbury Park, CA: Sage. http://dx.doi.org/10.1016/0147-1767(85)90062-8

Lloro-Bidart, T. & Banschbach, V.S. (Eds.). *Animals in Environmental Education: Interdisciplinary Approaches to Curriculum and Pedagogy.* Palgrave Studies in Education and the Environment. http://dx.doi.org/10.1007/978-3-319-98479-7

Lonergan, N. and Andresen, W. (1988) Field-Based Education: Some Theoretical Considerations, Higher Education Research and Development, 7:1, 63-77 https://doi.org/10.1080/0729436880070106

Merriam, S. B., & Tisdell, E. J. (2015). *Qualitative research: A guide to design and implementation*. John Wiley & Sons.

McKim, A. J., Raven, M. R., Palmer, A., & McFarland, A. (2019). Community as context and content: A land-based learning primer for agriculture, food, and natural resources education. *Journal of agricultural education*, *60*(1), 172-185. http://dx.doi.org/10.5032/jae.2019.01172

National Research Council (2009) Transforming Agricultural Education for a Changing World., Committee on a Leadership Summit to Effect Change in Teaching and Learning, National Academies Press.

Orr, D. W. (1994). *Earth in mind: on education, environment, and the human prospect*. Island Press.

Patton, M. (1990). Qualitative evaluation and research methods. Newbury Park, CA: Sage.

Parr, D. M., Trexler, C. J., Khanna, N. R., & Battisti, B. T. (2007). Designing sustainable agriculture education: Academics' suggestions for an undergraduate curriculum at a land grant university. *Agriculture and Human Values*, *24*, 523-533. http://dx.doi.org/10.1007/s10460-007-9084-y

Pimentel, D., Hepperly, P., Hanson, J., Seidel, R., & Douds, D. (2005). Environmental, Energetic, and Economic Comparisons of Organic and Conventional Farming Systems. Bioscience. 55(7), 573-582. https://doi.org/10.1641/0006-3568(2005)055[0573:EEAECO]2.0.CO;2

Polanyi, M. (1958). Personal knowledge: Towards a post-critical philosophy. University of Chicago Press. http://dx.doi.org/10.7208/chicago/9780226232768.001.0001

Rampin et al., (2021). Taguette: open-source qualitative data analysis. Journal of Open Source Software, 6(68), 3522, https://doi.org/10.21105/joss.03522

Reason, P. (1996). Reflections on the purposes of human inquiry. *Qualitative Inquiry*, *2*(1), 15-28. http://dx.doi.org/10.1177/107780049600200103

Richardson, L. (1994). Writing: A Method of Inquiry. In Norman Denzin and Yvonna Lincoln (Eds.) Handbook of qualitative research (pp. 516-527). Thousand Oaks, CA: Sage.

Rittel, H. W., & Webber, M. M. (1973). Dilemmas in a general theory of planning. *Policy sciences*, *4*(2), 155-169. http://dx.doi.org/10.1007/BF01405730

Selingo, J. J. (2018). *The new generation of students: How colleges can recruit, teach, and serve Gen Z.* Chronicle of Higher Education.

Steinfeld, H., Rosales M., M., Haan, C. de, Wassenaar, T. D., Gerber, P., & Castel, V. (2006). *Livestock's long shadow: environmental issues and options*. Food and Agriculture Organization of the United Nations.

Shapiro, K., DeMello, M. (2010). The state of human-animal studies. *Society & Animals, 18*(3), 307-318. https://doi.org/10.1163/156853010X510807

United Nations Educational, Scientific and Cultural Organization (UNESCO). 2021. Getting every school climate-ready: how countries are integrating climate change issues in education. https://doi.org/10.54675/NBHC8523

Van Maanen, J. (1995). An end to innocence. In John Van Maanen (Ed.) *Representation in ethnography* (pp.1-26). Thousand Oaks, CA: Sage.

Veltman, M. E., Van Keulen, J., & Voogt, J. M. (2019). Design principles for addressing wicked problems through boundary crossing in higher professional education. *Journal of Education and Work, 32*(2), 135-155. http://dx.doi.org/10.1080/13639080.2019.1610165

Wilkie, R. (2017). Animals as Sentient Commodities. In L. Kalof (ed.), *The Oxford Handbook of Animal Studies*, Oxford Handbooks. https://doi.org/10.1093/oxfordhb/9780199927142.013.16

Wilkie, R. (2015). Academic "Dirty Work": Mapping Scholarly Labor in a Tainted Mixed-Species Field. *Society & Animals, 23*(3), 211-230. https://doi.org/10.1163/15685306-12341312

Zavaleta, E., Beltran, R., Borker, A., (2020) How field courses propel inclusion and collective experience. *Trends in Ecology and Evolution, 35*(11), 953-956. https://doi.org/10.1016/j.tree.2020.08.005