A "TRANSLATOR" TO BRIDGE DISCIPLINARY BOUNDARIES: AN EXPANSION OF AGENCY OF AN INSTRUCTIONAL DESIGNER

by

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I would like to dedicate this work to my husband, Jeffrey Ashby, who supported me unconditionally through the highs and lows of my academic career; to my mother, Nellya Penkina, for being my role model throughout my life and helping me become my best; and to Ukraine, my country of birth, and all Ukrainians, whose unprecedented example of unity, bravery, perseverance, and a sense of humor even when facing much larger forces serve as a reminder to never give up.

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ABSTRACT

Interdisciplinary education has been viewed as a way to give an edge to graduates in terms of developing creativity, innovation, ability to synthesize knowledge, and develop a range of professional skills (Haynes, 2017). However, the push towards interdisciplinarity as opposed to a disciplinary field is a challenge due to strong educational traditions, power dynamics, academic freedom, as well as the power faculty has to form their areas of research interest and disciplines (Ashby & Exter, 2019; Becher & Trowler, 2001; Klein, 2006). Likewise, the diversity of members of an interdisciplinary team can lead to negative forces that can only be overcome with open communication and understanding of both boundaries and ways to address them. This means that an interdisciplinary team may need to have a translator to help build common knowledge, facilitate engagement, and address tacit issues. Instructional designers have the potential to play a translator role. Rooted across the author's three publications, the focus of this dissertation is to establish the vision for instructional designers getting a more proactive role on an interdisciplinary program design team (translator agency), where mediation of knowledge is needed across faculty to build a successful program.

CHAPTER 1: INTRODUCTION

Today's graduates see their professional future as a quilt of careers and multiple pathways, where only some are directly related to a traditional academic degree, they received (Institute for the Future, 2018; Kamenetz, 2012). As such, they tend to look for diverse knowledge and skills that would make them marketable. In turn, universities have to overcome a desire to maintain the century-old tradition of disciplinary-based education and start offering other learning opportunities to their students, including interdisciplinary education (Arvanitakis & Hornsby, 2016; Baker & Däumer, 2015; Denman, 2005; Klein, 2006; Whitaker, 2018). Instructional designers also take an active role in working with faculty as subject-matter experts and clients to develop effective face-to-face, hybrid, and online learning environments (Ritzhaupt & Kumar, 2015) to add the flexibility and multiple pathways for learning for diverse academic and professional programs. Yet, while attempts are made to flip classrooms, introduce technology, and apply problem-based learning, the challenge remains as the content is still delivered using disciplinary venues and strategies that in a way to groom students for a predetermined career (Arvanitakis & Hornsby, 2016).

Interdisciplinary education (or a dialogue between two or more disciplines; Moran, 2010) focuses on bringing together and synthesizing diverse disciplines. It is one way to give students an edge in their future careers (Haynes, 2017). Indeed, integration of the arts, hard and applied sciences, and humanities has positive impact on students' metacognitive skills, as well as the synthesis of soft skills with problem-solving on a team and leadership level (Skorton & Bear, 2018). As a result, the popularity of interdisciplinary programs has been growing multifold (DataUSA, n.d.; Whitaker, 2018). My own exploration of interdisciplinary programs across academic "Big 10" universities revealed over 300 interdisciplinary undergraduate and graduate programs open for enrollment at the time of completing this manuscript.

While the focus on interdisciplinarity is strengthening, faculty face epistemological, pedagogical, and technical challenges when needing to co-design and co-teach interdisciplinary courses, including the dissonance between the need to ensure that the materials important for the specific disciplines are covered, maintain own disciplinary language and traditions, share the "spotlight" with other disciplines, as well as the lack of understanding of pedagogical practices that could enhance student learning in synchronous and asynchronous environments (Ashby, Caskurlu, & Exter, 2018; Ashby & Exter, 2019; Richardson et al., 2018; Sugar et al, 2011).

The field of instructional design itself is both inherently interdisciplinary and discipline-agnostic. Its interdisciplinary nature shows in terms of merging knowledge from different fields (e.g., learning sciences, psychology, education, user experience, marketing, project, and talent management (Czerkawski & Schmidt, 2019). Yet, instructional designers can develop courses across different disciplines while maintaining disciplinary expectations. Because of their fundamental understanding of the teaching and learning process, instructional designers can effectively balance different signature pedagogies (Shulman, 2005), academic disciplines, and diverse faculty to help find commonalties and integrate differences. Yet, they are often brought into a program or course design team when the key design decisions about the program or course are already set. As a result, they end up being limited to providing technical support and activity design consulting (Richardson et al., 2018). Furthermore, while current research and professional publications discuss at length the involvement of faculty in designing an interdisciplinary program, there is an obvious absence of instructional designers in this process based on the peer-reviewed literature.

The Problem

The idea behind, boundaries between, and directions of academic disciplines have been forming for centuries. Our understanding of academic disciplines and subdisciplines has grown thanks to the extensive research across all fields (Skorton & Bear, 2018). Such subdivision also created "silos," or artificially created boundaries for academic disciplines (Arvanitakis & Hornsby, 2016; Bass & Eynon, 2017). Interdisciplinarity aims to break down such silos and help learners enrich their knowledge and understanding using a comprehensive synthesis of disciplines. For an interdisciplinary effort to become successful within the predominantly disciplinary-siloed higher education environment, it is paramount that faculty are willing and able to venture beyond their own academic "territories." Such a move may feel uncomfortable or even unnatural as it goes against their very professional identity (Becher & Trowler, 2001) that was formed thanks to disciplinary enculturation through signature pedagogies (see Footnote 1) that help notices learn how "to think, perform, and act with integrity" within their profession of choice (Shulman, 2005, p. 52). The impact of such enculturation runs deep indeed – not only how to think within the boundaries of a specific profession and the moral that comes with it, but also sharing inherent assumptions about the body of knowledge, scholarship, outlook on student outcomes, and peer

review of research (covered in more detail in Chapter 4) (Aldrich, 2014; Shulman, 2005). While some embrace interdisciplinarity, others may feel threatened by the changes in the focus of programs, ability to teach what is perceived as integral for a discipline or may fear ending up secondary to courses rooted in STEMM programs (science, technology, engineering, math, and medicine) (Exter et al., 2017; Irani, 2018; Kandiko, 2012; Whitaker, 2018).

Prior research on interdisciplinary education has mainly focused on a general overview of its taxonomy and use across higher education institutions (e.g., Gillis et al., 2017; Holley, 2017), design of individual interdisciplinary courses (e.g., Cowden & Santiago, 2016), and assessments of student learning outcomes in an interdisciplinary environment (e.g., Mansilla & Duraising, 2007; Skorton & Bear, 2018). Faculty also struggle with the lack of common pedagogical strategies that fit everybody's needs and ultimately choose the signature pedagogy used in their field (i.e., how they were trained), while team teaching tends to "fail to achieve their objectives precisely because the individual members of the instructional team never really begin to understand their common concerns in a fashion that may be properly called interdisciplinary" (Richards, 1996, p. 16).

Recommendations in literature about interdisciplinarity are also rather general and mainly along the lines of if there is a will, there is a way. In other words, if faculty and administration want to foster an interdisciplinary program, they can do so as long as there is budget and/or desire to collaborate. Kelly (2008) outlined several practical considerations, from creating budgets to engaging an energetic director. Skorton and Bear (2018) suggest that those interested in implementing interdisciplinary programs at their institutions should work with scholars and disciplinary experts to establish agreement as to what is going to be taught. The framework proposed by Gillis et al. (2017) offered ways to evaluate interdisciplinary work of students to encourage interdisciplinarity while enhancing discipline specific knowledge. Yet, these steps do not necessarily remove all obstacles.

Interdisciplinary Communication: Is It Enough Just to Start Talking?

Having a will to start an interdisciplinary program is certainly an important initial step, but certainly not sufficient. As suggested by Klein (2005), it would be naïve to think "that everything will work out if everyone just sits down and talks to each other" (p.4). Communication is key, yet it is also a major stumbling block. The breakdown in communication does not necessarily happen because of the lack of agreement on what to teach and how to teach, as mentioned earlier. But

challenges also arise because, while faculty seems to use the same terminology that has disciplinary differences . Overcoming those barriers is a bigger challenge. Sverre Sjölander (1985) had an apt discussion of ten stages of interdisciplinary communication and the potential outlooks and challenges for each of them:

Stage 1 "Singing the Old Songs": When the team members from diverse disciplines get together, they tend to primarily focus on presentation of their own work and addressing questions that may or may not arise, like what occurs at conference presentations. These meetings are usually short and attended by a larger number of potential members. Many partnerships stop at this stage, when some team members drop out, while the new members continue to join the team – thus, the same step occurs repeatedly.

Stage 2 "Everyone on the Other Side is an Idiot": At this point potential team members may start detecting what are assumed to be deficiencies in the fields or positions of other members, discrepancies in the world outlook and/or how teaching and learning should look like, or what it should focus on. Often unable to grasp the meaning conveyed by another person due to differences in disciplinary outlooks, participants many may even come to see other team members as opponents practicing intellectual rigidity. As Sjölander noted, due to the lack of mutual understanding, this is the time when most leave, as they do not consider it worth their time and attention.

Stage 3 Retreating into Abstraction: I tend to call this stage reification, or the fallacy of misplaced concreteness – an ambiguity in language and understanding – that used as a countermeasure to Stage 2. The more abstract the language is, the easier it is to find points of agreement or common ground. This stage may look like there is a finally a progress, e.g., this could be something as generic a statement as positive learning outcomes for all students – indeed, this would be easy and natural to agree too. But each may understand an abstract notion the way they prefer it and often within the realm of their own discipline and field. For example, as discussed in Chapter 4. However, this breaks apart as soon as more specific questions are asked, e.g., "What do we mean by positive learning outcomes?" Yet, if "unpleasant" questions (the ones that question status quo) are not asked, the project may remain in this stage for a while without a visible progress.

Stage 4 "The Definition Sickness": After the knee-jerk reaction of Stage 3, participants may start asking each other to define technical terms, especially after realizing that the misunderstanding was philosophical or epistemological in nature, rather than the true differences or rigidity. While this sounds like a normal progression towards a consensus, it may also cause some challenges. A significant focus in this stage is given to developing a group-specific jargon, which may become an obstacle for new members to join and learn it, definitions be forgotten, possibility of sliding back to disciplinary outlook, or raise a lot of repeated heated discussions on what, how, and even why to define specific terms.

Stage 5 "Jumping the Tussocks": If participants are able to get to this stage, they are likely to start more on-point discussions. The danger lies in the fact that such discussions can jump from place to place by addressing topics that significantly differ from each other without ever concluding or agreeing upon previous conversation. For example, a discussion on research methods can be immediately followed by general attitudes towards humanities or sciences, or expectations for individual classes without ever coming to an agreement. As a result, participants may feel like they have invested a lot into a discussion, but no specific results are achieved.

Stage 6 "Playing the Glass Bead Game": Here, Sjölander references a Nobel prize - winning book by Hermann Hesse entitled The Glass Bead Game (1943). This book focuses on a group of intellectuals that keep playing an elusive glass bead game that is only understood by that select group. While staying unclear, the rules are believed to synthesize all arts and sciences possible. In other words, this stage can be a positive one, where the group starts developing their own vocabulary and establishing a common ground. Yet, this stage is painstakingly slow and may end up being just as pointless as earlier stages, especially if the participants realize that the framework they tried to develop is more cumbersome than already existing ones.

Stage 7 Surfacing of the "Great Failure": Prior stages take time to pour over terms and abstractions to find the commonalities. The results of this endeavor may be disproportionate to the efforts put into it. As a result, participant may start questioning the actual viability of an interdisciplinary project and give up on it altogether. Yet, at this point,

a project often needs just a slight push to start bringing positive results that may never happen. Interestingly, Sjölander suggests that if participants are asked to produce a report on results at this stage, their interest will often rekindle.

Stage 8 "What's Happening to Me?": At this point, participants start realizing how they have evolved in terms of becoming interdisciplinary in their outlooks. Even if a project does not succeed, participants who reached this stage often become ardent advocates of interdisciplinarity. This especially is obvious after some time has passed. Notedly, evaluations made immediately upon the termination of a project that reached this stage are often much less positive than follow-ups later. Sjölander suggests using such group findings when seeking funds for interdisciplinary projects.

Stage 9 "Getting to Know the Enemy": As opposite to Stage 2, having changed themselves, participants are more open to the differences in philosophy and disciplinary outlook of others. They tend to acquire more in-depth knowledge of other disciplines beyond the boundaries of a single project, like general structures, principles, and ways of thinking and knowing (i.e., a transdisciplinary approach). This is an important stage for the project and should be supported by providing time and resources for such learning. Some suggest having this stage well before the project begins as it looks like it could save all the grievances of the previous eight stages. Yet, Sjölander warns that this would hardly work since participants do not yet know what to explore or which questions to asks.

Stage 10 "The Real Beginning": Reaching this stage requires much time and coordinated effort. Thus, not all teams are destined to reach it. Yet, the observed changes are not only related to project results, but also how individuals work and think. This may give a start to new projects or even disciplines. Like in Stage 8, the immediate results of the project or the perceptions of its success may not be viewed favorably. Later discussions and evaluations would be quite opposite, which can also have more impact of future partnerships and funding

Where is an Instructional Designer in All of It?

While there is a documented struggle in literature of brining diverse faculty together to work on interdisciplinary courses and programs, there is an absence of instructional designers in this overall process of design and implementation. However, there is a growing trend in the number of collaborative projects between faculty and instructional designers on course design with the goal of improving student learning experiences and outcomes and expand the faculty's views of learning theories and instructional strategies (Bawa & Watson, 2017). This becomes even more obvious with the challenges to meet learners' needs with the onset of the COVID-19 pandemic (Pibeam, 2020; Xie et al., 2021). While it yet remains to be seen if the general perception of instructional designers has changed since the COVID-19 pandemic began, earlier research showed that their role is often viewed as a technical support to a subject-matter expert to help with activity and assessment design (Richardson et al., 2018). Yet, professional formation of instructional designers follows the set of competencies outlined by such organizations like International Board of Standards for Training, Performance, and Instruction (IBSTPI) (Koszalka et al., 2013) and Association for Educational Communications and Technology (AECT, 2012) and envisions a range of skills beyond learning design and development, including project management, leadership, and conflict management skills.

Instructional designers can also become change agents (Campbell et al., 2005, 2009), that integrate the following agencies:

- Interpersonal agency: help team members and external stakeholders understand and utilize concepts;
- Professional agency: build resources and internal community of practice, examples, and common language for support and training of existing and new interdisciplinary team members;
- Institutional agency: ensure that the program, language used, and values addressed by the program align with the overall institutional mission, vision, and culture; and finally
- Societal agency: build a community of practice outside the immediate team involved in program design and help disseminating results and best practices of the team to other programs to promote their growth.

In other words, instructional designers possess qualities and skills that enable them to serve as a communication and project mediator (or translator, as I will discuss next) not only between faculty and student, but also faculty and faculty, faculty and administrator, and faculty and external stakeholders.

Instructional Designers and Knowledge Translators on Interdisciplinary Teams

My first exposure to interdisciplinarity started with a practical experience in translation while an undergraduate in Ukraine. To be able to give an accurate translation, I had to explore and learn topics on my own that ranged from medicine to technology to business. I soon became able to recognize similarities in nature (but not terminology) across the related disciplines or fields. After starting my graduate work at Purdue University, I delved into research (both existing publications and my own work), where I could observe a clash of traditional century-old approaches and innovation, structural, cultural, and disciplinary siloes, along with strong intent of individual faculty to go outside the traditional disciplines, individual differences, preferences, and the need to respond to the market (e.g., (Ashby & Walker, 2015; Exter et al., 2017)). This dissonance made me wonder how to explain the delicate balance between faculty intent, reservations, and university support or lack thereof. There are eager faculty and staff across universities who want the best for their students, but still some programs succeed and prosper, others fail. In my past research (including those which are part of the current 3-paper dissertation), I ventured into models and best practices for interdisciplinary programs and ensuing collaboration (e.g., (Ashby et al., 2018; Ashby & Exter, 2019; M. Exter et al., 2017; van Epps et al., 2016). But the findings in these articles felt descriptive or even prescriptive, as they tend to apply a reductionist approach to boil down aspects of program design to foundational elements. After all, even the best-laid plans often crash against the reality of human dynamics, learning and behavioral patterns, individual traits and characteristics, and directives of leadership.

If the problem is rooted in the differences of language and culture, as a translator/interpreter I knew what to do – find the equivalents in the home and target languages that would convey the same meaning, soften up some sharp corners, and help professionals bridge differences to come to a mutually beneficial solution. Back in Ukraine, I worked with presidents, ambassadors, politicians, doctors, architects, manufacturers, artists, and farmers, among others, with diverse educational and professional backgrounds from around the world. They were all eager to collaborate with one

another. Yet, they always kept their own interests in mind and did not want to spend time and money on something they do not understand. They wanted their cultural, professional, and educational backgrounds to be respected and appreciated. Therefore, significant weight of success was on the shoulders of a translator/interpreter. My work as a translator/interpreter was never just about finding the equivalency and let people figure out on their own. The color or connotation of the word should be the same in the target language to convey the full depth of meaning. If a word or the notion was not familiar to one group, I (as the translator/interpreter) would step in and work with both parties to clarify the meaning and find the equivalents to make sure that not only all understand the word used, but also that they could embrace the meaning.

The analogy of a translator can also work in the context of interdisciplinary education. While faculty members have the grasp of the actual language used (e.g., English), relationships and interdisciplinary programs may crumble down under the weight of variations of professional jargon and disciplinary connotations of seemingly similar terminology. In the field of translations studies, we call those "faux friends of an interpreter" – words that sound the same in different languages/dialects, but mean different, even opposite, things. In my role as an instructional designer, I have observed similar tendency. Thus, I recently consulted with an adult educator with a theological background on developing an undergraduate course on adult teaching and learning for ministry educators (e.g., Sunday schools, fellowships). He had a strong background and years of experience in "teaching about teaching." I thought that out of all the other consulting jobs I had had to-date, this should be a breeze. After all, we should surely speak the same professional language. The reality was quite the opposite. The terminology that we both were versed in had different connotations when used in an educational psychology and ministry education. After a couple of failed meetings, I had to take a step back and become more explicit as to what exactly I meant (i.e., translating for both the client and myself) vs repeating the pitfalls of what I later learned to be Stages 1 – 3 as described by Sjölander (1985). Also, I had to navigate quite a minefield in order to avoid offending a well-educated elderly faculty member. The change in relationship and output was immediate. It did not mean that challenges disappeared, but we were able to move beyond differences towards understanding and building the joint form of language for communicating.

The example I shared above only involved two people. But what if there is a team of professionals from different fields coming together to build something new? Such situations are

not simply a case of "we are adults and can figure it out." Or communication and being able to convey and understand the meaning or ideas would not be one of the major challenges faced by interdisciplinary teams (Frodeman et al., 2017). Thus, a professional who can serve as a translator within an interdisciplinary group can make a difference for the success of the program. Instructional designers, who have experience working with diverse professionals and fields, may be well-placed to serve as such translators.

Significance of the Study

The role of a disciplinary "translator" should not be seen as an addendum to an existing job description of instructional designers. Indeed, the conceptualization of an instructional designer as a translator reflects a different aspect of their professional agency – type of engagement, place within a group, broad knowledge and understanding of topics and fields, and a desire to dig deep to understand what is meant first to be able to "translate." The implications of this line of research may have significant strategic and operational impact on the interdisciplinary program design in institutions of higher education in the United States (i.e., composition of program design groups, expectations for involvement, etc.), as well as the preparation of instructional designers themselves, which might include a more significant emphasis on intercultural collaboration, leadership, and managerial skills. There is a definite gap in the current literature on understanding program design as a holistic experience with multiple stakeholders or agency, the complexity of the interactions and networking, differences in disciplinary outlooks, etc. Instead, current literature focuses on the simplified procedural steps and best practices that cannot embrace this complexity. In part, this approach can be explained by the traditions of classical inquiry that expects that results are to be stable, generalizable, and adhere to the principle of universality (Davis & Sumara, 2006; Horn, 2008). Yet, organizational and individual culture, personal expectations, communications among agents and other stakeholders, and other major and minor aspects of human dynamics are never stable across settings. There are too many variables that come into play, from a group composition (Cilliers, 1998; Hetherington, 2013; Martin et al., 2019). For example, we can envision a difference in outcomes for a program design for a team with three STEM professors and one coming from humanities than if only one faculty members has a STEM background. Indeed, in an educational setting, it is key to be aware of such complexity of relationships, interaction, and communication. Thus, it is paramount to be cognizant and view this collaboration

across faculty and staff coming from different disciplines as "a cooperative model, which given primacy to relationships and relies on contextual narratives and dialogue – communication…" (Levin, 1989), p. 110).

Interdisciplinary Communication as a Complex System: Theoretical Framework

It is common to view interdisciplinary approach as teamwork, and teamwork composition is interdisciplinary regardless of the settings due to the demand for collaborative and knowledge transfer and integration of skills by diverse faculty, incorporation of aspects of signature pedagogies (see Figure 1.1).

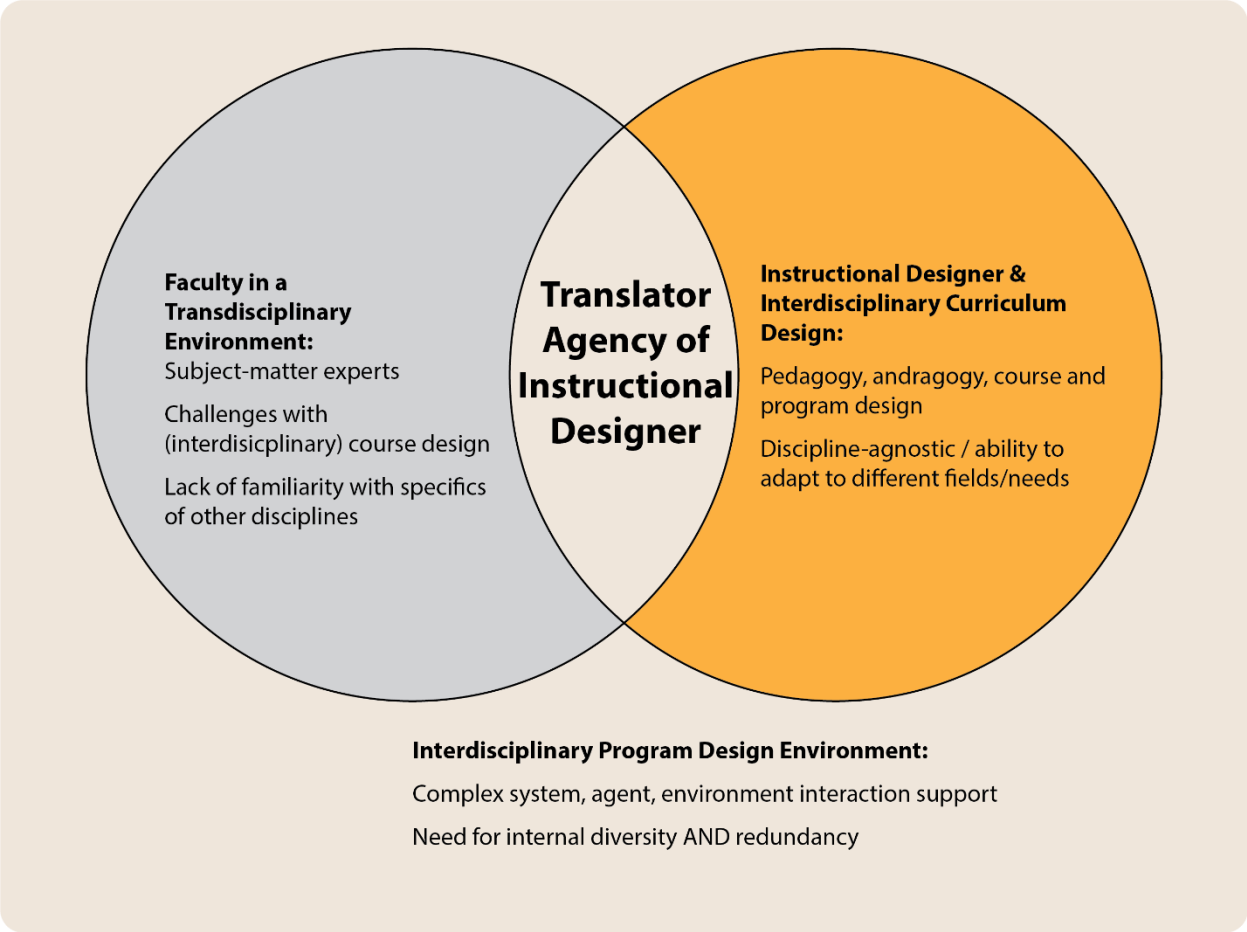

Figure 1.1 Interdisciplinary communication as a complex system

Yet, an important distinction of interdisciplinary teams is that they are complex systems (Klein, 2005). Complex systems are characterized as open and heterogenous due to the participants coming from different fields. Collaborations within complex systems emerge for multiple reasons, some because of personal interests, while others are the specific agenda (Davis & Sumara, 2006; Eoyang, 2007; Keeley & Benton-Short, 2020; Klein, 2005; Morrison, 2008; Wolf-Branigin, 2013). For example, each team member may have their own agenda to engage in an interdisciplinary project, team members with similar backgrounds may tend to cooperate more closely, and even physical boundaries (e.g., location of offices on different floors or even different parts of the same floor may become an obstacle to sharing knowledge, experience, and building a transdisciplinary environment.

Due to the lack of homogeneity, it is important to ensure that the communication across participants coming from different disciplinary backgrounds is translatable (Klein, 1996, 2005; Laursen & O'Rourke, 2019). However, communication can become problematic because, in order to be clear to all the parties, team members (who are often faculty) must be "bilingual" in terms of understanding the terminology and epistemology of different disciplines, thus requiring knowledge transfer across disciplinary borders (Klein, 1990; 2005). To support communication on interdisciplinary teams, we need to go beyond current recommendations described in the current literature (discussed earlier) and look for solutions suggested for working across knowledge borders in other fields, which aligns with the overall nature of this dissertation.

The idea of knowledge transfer as a movement of knowledge across disciplinary boundaries created by specialized, or siloed, disciplinary or knowledge domains is an important topic in the area of knowledge management and team sciences when related to an organizational development (Carlile & Rebentisch, 2003). After all, interdisciplinarity brings with it growth and innovation. However, knowledge is only as valuable as it is accurate and accessible for all involved (Karlsen & Gottschalk, 2004). Holden and von Kortzfleisch (2004) discuss knowledge transfer in terms of knowledge convertability – or the perceived usefulness of the shared knowledge and availability of experts (or "translators," who often come from the same domain but can overcome disciplinary boundaries) to help integrate knowledge that originates in different disciplines into a single schema. Such professionals can both filter the information and facilitate its transfer by making it accessible to all end users (e.g., faculty, administrators). Yet, even in the field of knowledge management, research on the practices on effective knowledge transfer across

boundaries is still limited (Carlile, 2004). In terms the fields of instructional design and education at large, this role is often overlooked.

The need for a knowledge translator on an interdisciplinary team can be further heightened by the diversity of this very teams. Harrison & Klein (2007) break up diversity, as in knowledge management and cross-disciplinary integration, into: separation (opinions, beliefs, values, and attitudes); variety (content expertise, professional/disciplinary backgrounds, experience, etc.); and disparity (income, prestige, status, authority, and power among others). Thus, for an interdisciplinary team to function it is important to overcome some issues of diversity before they tend to integrate their disciplinary knowledge. Even teams that are ready to communicate often focus on knowledge that is already common or shared, and not on the disciplinary difference that bring the desired synthesis known as transdisciplinary (Stasser et al., 1989). Consequently, a mediator would be helpful to address the differences and bring up attention and hopefully resolution to the underlying challenges.

Knowledge Boundaries

Those seeking to bring knowledge across disciplinary or knowledge boundaries face three types of boundaries – syntactic, semantic, and pragmatic (Carlile, 2004; see Figure 1.2). Syntactic boundaries that require knowledge transfer are manifested in the differences of the language used. But the border between terminology can be easily worked out, especially since the areas of knowledge are still neighboring and both parties are intent on making such a collaboration work. For example, the bursar office and departments might work closely together to develop technical documentation that is clear to both faculty and student.

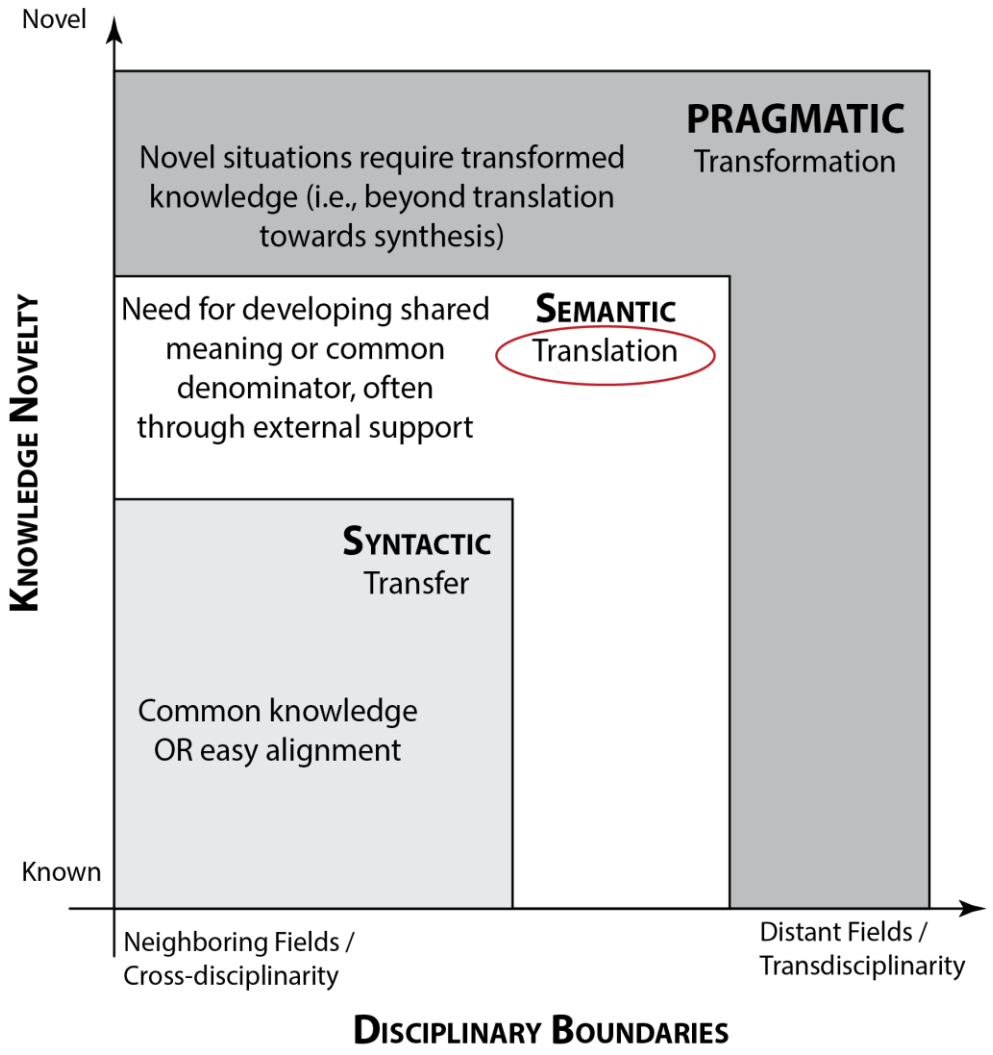

Figure 1.2 Need for translation on the continuum of knowledge novelty and disciplinary boundaries within an interdisciplinary environment (Adapted from Carlile, 2004)

To cross semantic boundaries, it is important to understand not only disciplinary terminology, but also to overcome individual perceptions and assumptions of what disciplinary terms may mean. Every team member has only a very high-level or general idea as to what another person may mean or assume. As a result, people "do not only know different things, but also know things differently" (Dougherty, 1992). Depending on their interests, background knowledge and education, we all can look at the same issue, but see different problems, opportunities, challenges, and tradeoffs.

Finally, pragmatic boundaries refer not only to differences in their lexicon, but also competing interests or agendas of individuals involved in a project. This would align with the highest level of interdisciplinarity, namely transdisciplinarity, and may be reached upon initial support of a translator and ability to become bilingual themselves (see Stages 9 and 10 as described by Sjölander (1985).

Research Philosophy

When contemplating my own research philosophy, I cannot help but agree with the words of Mervin Gordon, a friend of Alexander Fleming,

> *No research is ever quite complete. It is the glory of a good bit of work that it opens the way for something still better, and thus rapidly leads to its own eclipse. The object of research is the advancement, not of the investigator, but of knowledge (Hunter et al., 1995, p.18).*

Indeed, our goal is to better understand the world around us, and not to justify our own existence as researchers. But now, upon completing the PhD program, I would expand that new knowledge and new discoveries are also contextual and situational, in the true nature of post-modernism (Bloland, 1995; Kahraman, 2015). Additionally, research to me is inseparable from practice. I want to know why, how, and when something works – whether it is getting inspired by recent research and trying to implement and test it, or just seeing that something works and wanting to know why.

Prior to starting the PhD program, I already had some research experience including aspects of research design, working with the Institutional Review Board, data analysis, data presentation and visualization, and write-up of results. Most of the research was related to applied behavior analysis, which meant that my focus was on behavior or actions of a person that could be quantified, analyzed, compared, and hopefully, having statistical significance. People participating in the research were de-identified "subjects", and I should in no way interact with them beyond the protocol in order to not to influence the results.

The first projects as a PhD student that involved observations and field notes, encouragement to engage with students in the classroom whom we observed, and then qualitative data analysis were frame-breaking for me (a more detailed description of the experience is in Exter & Ashby, 2019). However, the more I learned and experienced, and the more engaged I became in the field of instructional design, the more I realized that for the learning to be effective, it needs

to be relevant and intrinsic to the learner, where an instructor supports learning rather than giving the rules. Each learner is different with their own culture, background, interests, abilities, and attitudes towards teaching and learning. With time, the spirit of post-modernism seemed to be more aligned with how I feel, as everyone – participants or learners that I engaged with in my research – has their own truth, which is rarely, if ever, objective. This belief has also helped me with my interest in interdisciplinary and competency-based education (CBE is discussed in Chapter 3). As such, I had to accept that for us as a learning society, "learning will need to be accepted as natural and endemic rather than as something which occurs as a result of discrete learning events or through following a curriculum" (Lester, 1996). Thus, I need to move from discrete observation and data collection to a move immersed research.

The more I learned about interdisciplinarity and complexity, the more connections I saw with postmodernism and the more it influenced my understanding and world outlook, as postmodernism does not expect predictability in life. Instead, it expects ongoing change. As a result, we all need to develop meta-strategies that should be flexible enough to face the change. I view learners and participants of my research as those who create their own niches and select and nurture their own roles within the society, who drop the idea of authority and rely on lifelong learning. But for them to fully take advantage of the situation, I, as a researcher and instructional designer, need to support learning that reflects individuality of learners, their voices and choices in my work.

Overview of Chapters

In this three-paper dissertation, I will explore the potential of engaging instructional designers on an interdisciplinary team both as designers and as mediators/translators (a buffer for cross-faculty communication and design efforts; see Fig. 1).

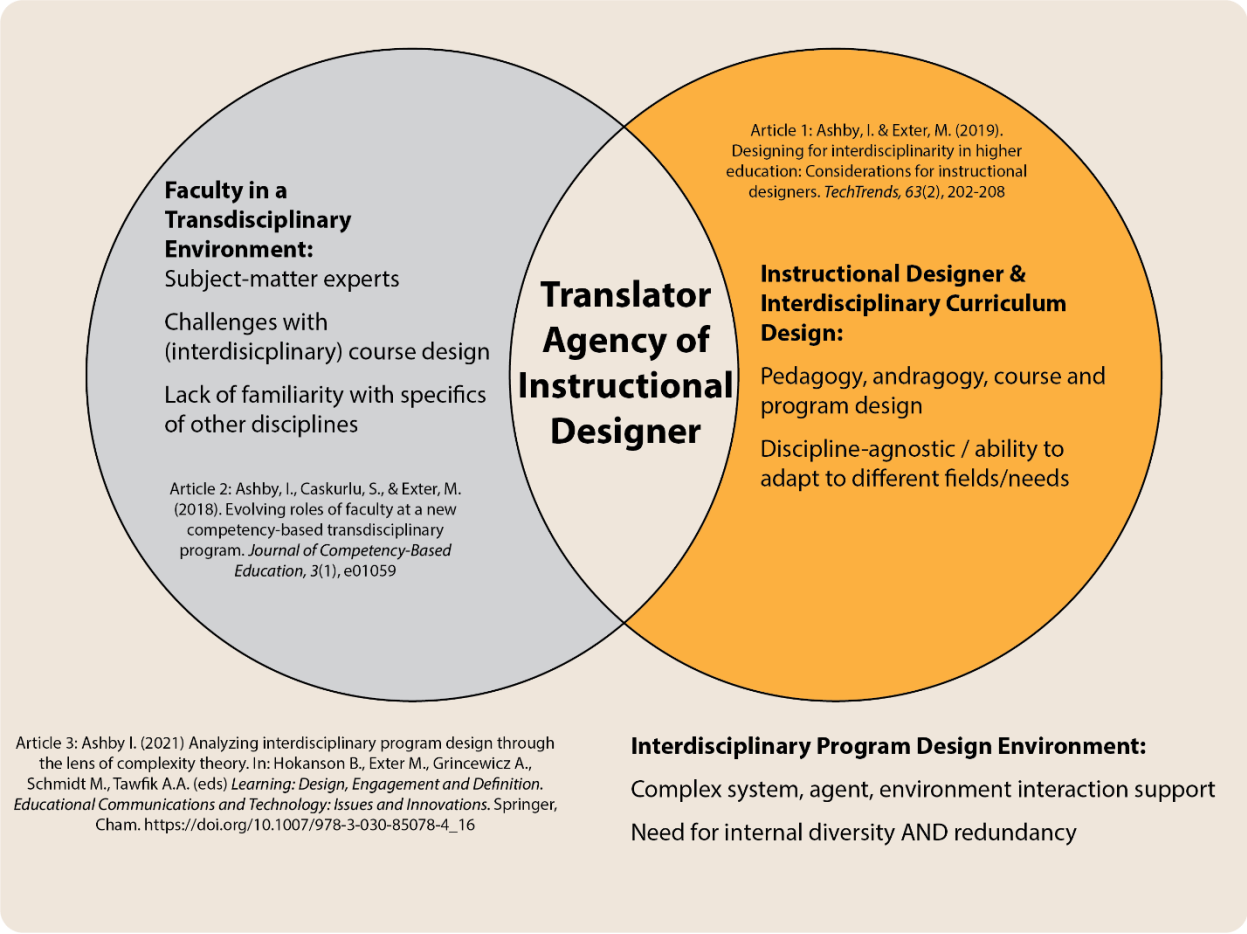

Figure 1.3 The interrelationship of three papers in the 3-paper dissertation

Overview of Chapter 2

This review of the literature is focused on reviewing the state of interdisciplinarity in higher education, as well as strategies and models that could be used in designing an interdisciplinary curriculum. The goal of the paper was to explore:

- Benefits of interdisciplinarity in higher education
- Challenges associated with its implementation
- Implications of benefits and challenges for instructional and curriculum designers.

The article chapter with giving a detailed review of the interdisciplinarity and its typology to set the basis for the dissertation, as well as examples of the interdisciplinary continuum or umbrella that includes cross-disciplinary, multi-disciplinary, and transdisciplinary education.

Several benefits are covered, including the focus on meta-learning and ability to develop critical thinking and problem solving that is approximated to real life. Challenges discussed in this chapter include pedagogical challenges, team teaching, course and program design, as well as assessment design and implementation. Finally, design considerations and process models were discussed to tool up instructional and curriculum designers in their efforts of interdisciplinary program design.

As the first author on this paper, I completed over 95% of work, including search for and review of literature on interdisciplinary curriculum design and collaboration efforts, synthesis of models and strategies across multiple fields that discuss how they embed interdisciplinary curriculum in their areas along with samples across domains; manuscript development and revisions that incorporated feedback from Dr. Exter, as well as the TechTrends peer review process. To date, the article has been cited 31 times per the statistics in Google Scholar (https://bit.ly/3ImFdRc).

Overview of Chapter 3

While Chapter 2 provides a review of literature on the aspects of interdisciplinary curriculum design and the role of an instructional designer in the process, Chapter 3 is a qualitative research that uses phenomenological techniques to study "lived experiences" (Jones et al., 2021; Patton, 2014) with the focus on perspectives, perceptions, understanding of a collaborative work, as well as the challenges and lessons learned by faculty members engaged in the actual process of designing of a competency-based (CBE) transdisciplinary (the highest level of cross-domain synthesis) undergraduate technology (polytechnic) program housed in a College of Technology, which was since renamed as Purdue Polytechnic Institute.

Seven faculty members involved in coteaching the first semester, of which five were engaged in the initial program design, were interviewed using a semi-structured protocols that helped capture the nature and essence of faculty experiences, while giving them an opportunity to reflect at their own pace (Patton, 2014). The protocol included 12 key questions as well as additional prompts and probing to gain deeper understanding of lived experiences. Each interview lasted 60-90 minutes, which was then transcribed verbatim, while removing identifiable information. NVivo 11 software was used for qualitative analysis.

The following key themes were identified as part of this research and discussed in this chapter:

- Program design and peer-to-peer faculty preparation, including program design and scale-up planning, as well as the needs and challenges of faculty onboarding
- Instruction and facilitation, including considerations for
    - design and implementation for individualization of learning experiences,
    - student onboarding and scaffolding of learning
    - student motivation and encouragement
    - ongoing self-evaluation by faculty to improve learning experiences for students
- Strategies and challenges for continuous assessment and feedback in a transdisciplinary CBE environment
- Additional faculty load on faculty doing career and academic mentoring, as well as the positive impact it has on students.

This research paper is rooted in a larger study led by Dr. Exter on a transdisciplinary program evolution at Purdue University. I was a member of the research team from the start, including active participation in research design, IRB application, and protocol development for faculty and student interviews. Since my interests have always focused on program design, competency-based and interdisciplinary education and as the first author on the article, I completed over 85% of the work, including developing the initial codes, coding of semi-structured interviews (initial and 2nd round based on the updated codebook), data analysis, and manuscript development and revision based on the feedback of co-authors and publication reviewers. The role of other contributors: Dr. Secil Caskurlu (then a fellow PhD student) – approximately 10% which included the role of a 2nd coder. She and I compared the results and negotiated any discrepancies in the code. Dr. Exter was one of the interviewers of the faculty team (which were conducted as part of the evaluation process for larger project) and also provided feedback on the article design and progression (approximately 5%). To date, the article has been cited 6 times (https://bit.ly/3ImFdRc).

Overview of Chapter 4

In taking a different conceptual approach, this chapter provides additional foundation for the idea of the translator agency that could be effectuated by instructional designers. Here, I explored the complexity of the system (e.g., faculty and staff designing an interdisciplinary

program) and the potential pathways for emerging dynamic across faculty on an interdisciplinary team, as well as the need for self-organization (faculty interested in design of such a program vs being told by the department chair) for an integrated and well-functioning interdisciplinary course design team to evolve. Yet, multiple challenges to the well-being of such a group are discussed (Axelrod & Cohen, 1999; Cilliers, 1998; Wolf-Branigin, 2013), including:

- Personal altruistic or pragmatic reasons for participating in an interdisciplinary program design and implementation;
- Internal (e.g., their own disciplinary culture) and external boundaries placed by the individual departments, colleges, and a university system as a whole; and
- Limitations or boundaries of physical (i.e., geographic or physical location) and conceptual (i.e., lack of understanding) among others.

This publication is part of a multi-tiered peer-reviewed process (written feedback – feedback on presentation-feedback on the updated chapter – editorial review) within the AECT Summer Research Symposium framework (for more information see (Hokanson, 2021).

Overview of Chapter 5

Finally, I summarize each manuscript and brought them together to highlight the consideration for the need of an instructional designer as a "translator" on an interdisciplinary team. I also discuss the potential directions for future research and practical applications of current findings discussed in this dissertation.

Potential Limitations

There are several potential limitations:

- *Contextual and Situational*: The role of an instructional designer and their use of translator agency may differ depending on the knowledge novelty and disciplinary boundary continuum (see Figure 1.2). The closer are the disciplinary fields, the more the focus of ID work will be on design vs translation.
- *Individual*: Just because there is an option for a translator agency, an instructional designer may or may not have the knowledge, skills, and disposition to execute them, which may reflect on their experience on an interdisciplinary team and the team acceptance of this role.

Definitions of Key Terms

Academic Discipline

Academic discipline refers to a body of knowledge that could be taught to others. It has its own background of education, methods, procedures, and content areas (Piaget, 1972). However, the division into specific disciplines within an institution of higher education is often done based on departments but does not equal an individual department (Becher & Trowler, 2001).

Agency of Instructional Designers

By virtue of working with faculty, students, institutions, and society in general, instructional designers are empowered to move beyond the technical implementation of work to serve as change agents who change not only immediate learning outcomes, but the very foundation of their immediate collaborators, learners, and society in general (Campbell, Schwier, & Kenny, 2009). They have the capacity (or agency) to have an impact at four levels: (1) interpersonal (i.e., collegial engagement, learner advocacy, self-efficacy of faculty and learners); (2) professional (i.e., providing professional support and instructional advice, support of leaning within communities of practice); (3) institutional (i.e., responsibility to align learning and collaboration activities with the

mission and vision of the institution they are in; cultural considerations and diversity); and (4) societal (i.e., ensuring the design contributes to a larger societal impact).

Complexity Theory

Complexity theory is a paradigm in educational research that originated as an interdisciplinary theory combining a number of fields that deal with complex systems, like biology, information technology, strategic management, and others (Cilliers, 1998; Davis & Sumara, 2006). Reductionist research traditionally looks at the cause-and-effect relationships, which requires reducing behaviors to foundational components. However, this approach would not work within an uncertain environment with unexpected outcomes, like human interactions (Morrison, 2002). In contrast complexity theory, views a system holistically and organically, as a single organism with complex behaviors (Hijmans & Wester, 2010).

Interdisciplinary Education

There is no single definition or categorization of interdisciplinary education. Moran (2010) describes it as a dialogue or interaction between two or more disciplines. More specifically, in this research, the categorization described in Holley (2017) will be used, where interdisciplinarity is viewed as an umbrella term that includes cross-disciplinary, multi-disciplinary, and transdisciplinary education.

Cross-disciplinary Education

Cross-disciplinary education refers to borrowing of tools, ideas, or theories mainly from neighboring fields. No blending of theories or methodologies takes place (Holley, 2017; Seel, 2012).

Multi-disciplinary Education

Like cross-disciplinary education, multi-disciplinary education refers to a combination of disciplines outside the major field of student utilized to inform it. The educational process is often represented by students from diverse fields of study who learn about each other fields through working together on a project (Holley, 2017; Seel, 2012).

Signature Pedagogy

A signature pedagogy (Shulman, 2005) refers to a set of pedagogical approaches traditionally utilized in a specific field (e.g., medical vs. law school). Schulman (2005) suggests that it includes three dimensions: (1) surface structure - actual teaching strategies and techniques utilized in the field; (2) deep structure - assumptions and beliefs about the disciplinary knowledge and know-how (this could also be seen in the assumptions of the "pure-applied and "soft-hard" continuum on Figure 4.2); and (3) implicit structure that includes professional attitudes, values, and dispositions that require enculturation.

Transdisciplinary Education

Unlike cross- and multi-disciplinary approaches, transdisciplinary education refers to a synthesis of two or more disciplinary areas to create new or shared frameworks (Klein, 2010; Rosenfield, 1992).

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CHAPTER 2: DESIGNING FOR INTERDISCIPLINARITY IN HIGHER EDUCATION: CONSIDERATIONS FOR INSTRUCTIONAL DESIGNERS

Ashby, I., & Exter, M. (2019). Designing for Interdisciplinarity in Higher Education: Considerations for Instructional Designers. TechTrends, 63, 202–208
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Abstract

Embedding interdisciplinarity into a higher educational curriculum allows students to develop competence in synthesizing and applying knowledge and skills from across multiple disciplines to address problems and find solutions that would not be possible if only a single disciplinary lens is used. This review of the literature focused on reviewing the state of interdisciplinarity, benefits and challenges of introducing interdisciplinary curriculum into a higher education environment, as well as strategies and models that could be used in designing an interdisciplinary curriculum. It provides a platform for instructional and curriculum designers for integration of interdisciplinary approaches into a curriculum design.

Introduction

Problems that exist in today's complex, globalized society "rarely arise within orderly disciplinary categories, and neither do their solutions" (Palmer, 2001, p. vii). Yet many graduates are not ready to synthesize multiple disciplines without substantial preparation. Interdisciplinary learning environments can provide students with the necessary tools to tackle ill-structured problems. Interdisciplinary education refers to the integration of knowledge drawn from diverse disciplines to address problems that cannot be solved by a single disciplinary perspective (Bridle et al., 2013; Holley, 2017; Repko, 2008). Therefore, introducing interdisciplinarity into academic and professional curricula provides a framework for preparing learners to make connections between seemingly fragmented or isolated knowledge and to apply that knowledge to real-world problems (Holley, 2017; Lyall & Meagher, 2012; Styron 2013).

Interdisciplinarity is often viewed as a way to instill creativity, innovation, and synergy through collaboration, teamwork, application, and blurring of disciplinary boundaries (Haynes 2017). It is often seen as a desirable element of higher education (Cooper, 2012), yet it is hard to

implement in academic settings, since pedagogical supports are often lacking (Klein, 2005). The goal of this paper is to explore the benefits of interdisciplinary education, the challenges associated with its implementation in higher education, and implications of these benefits and challenges for instructional and curriculum designers working in higher educational settings to implement interdisciplinary learning experiences.

Challenges of Disciplinarily

Discipline-based education has been at the heart of higher education for the better part of the 20th and 21st centuries, shaping boundaries for the experiences and education of students in terms of isolated subjects, concepts, models, and paradigms (Baker & Daumer, 2015; Klein, 2006). As Abbot (1988) noted, disciplinary scholarship focuses on building abstractions rather than solving specific problems. This approach is rooted in the need during the industrial era for specialization and diversification of labor to prepare professionals for work within specific domains. Even though disciplinary areas have evolved and produced new disciplines over time, the discipline-based structure of higher education has remained largely unchanged (Holley, 2017). The discipline-based approach lies in a 'system of power' (Klein, 2006, p. 11) that may range from the institutional structure or labor markets to the allocation of research funding, or faculty support and awards (Klein, 2006; O'Meara, 2005). Disciplines are also demarcated by a scientific community that builds the foundation of a discipline through peer review of research within specific domains (Aldrich, 2014). Indeed, disciplines instill analytic rigor (Sandefur, 2016) and serve as units of scientific knowledge (Aldrich, 2014). In contrast, interdisciplinarity serves as a form of communication between disciplines (Aldrich, 2014). This perception is also echoed by Holley (2017), who suggests that interdisciplinarity does not "diminish the role of the discipline in education" (p. 1) but rather recognizes the absence of boundaries in knowledge production, which allows that knowledge to extend beyond predetermined or normative silos.

Interdisciplinarity and its Typology

Interdisciplinarity is not a novel concept in education. It is closely linked with the concept of "integrative" learning, a pedagogical approach whose focus is on helping students make sense of knowledge across curricula. Integrative education has been particularly popular in

undergraduate general studies, in which students take an assortment of disciplinary courses and integrate a set of subjects across several disciplines into a framework that allows them to explore more complex issues from multiple points of view (Holley, 2017). However, it is also utilized in upper-level courses and professional training (e.g., Walshe et al., 2015). Yet, as Klein (2005) suggests, integrative learning is a broader concept than interdisciplinarity as it encompasses "structures, strategies, and activities that bridge numerous divides, such as high school and college, general education and the major, introductory and advanced levels, experiences inside and outside the classroom, theory and practice and disciplines and fields" (p. 8). In contrast, interdisciplinarity refers to a subset of such integrative learning where the focus is on the synthesis of disciplines. Though the term "interdisciplinary" in higher education may refer to any type of activity that traverses the boundaries of traditional disciplines, the degree of interaction among disciplines, knowledge integration, and the overarching vision or problem may vary significantly (Holley, 2017; Lattuca, 2001). The most common types of interdisciplinary programs may be described as cross-disciplinary, multi-disciplinary, and transdisciplinary.

The cross-disciplinary curriculum typically utilizes the borrowing of tools, ideas, or theories, mostly from neighboring fields, in order to explain specific phenomena (Holley, 2017; Klein, 2010; Lattuca et al., 2004). For example, a biology instructor may introduce chemistry concepts to explain the process of photosynthesis. A cross-disciplinary course may also be offered by two instructors from different disciplines or a single instructor who sought consultation from a professional from a different field. For example, in sharing her approaches to creating cross-disciplinary courses, Reynolds (2012) explained that she would either use input from a subject matter expert from a different discipline or would open the class to students from two different disciplines or with mixed experiences. However, the directional relationship among disciplines in these cases is often unilateral, leaving one field as a passive or even auxiliary contributor. Additionally, instructors from different disciplines maintain their own discourse and epistemology, without integrating or synthesizing the fields (Holley, 2017). This model is easier to embed into a curriculum, since it does not require significant curricular planning or changes. Students are often expected to integrate such knowledge, often received in individual courses, on their own (Reynolds, 2012; Tafa et al., 2011).

Multi-disciplinary teaching refers to an integration of many disciplines, although theories and approaches introduced continue to be tied to specific disciplines (Lattuca, Voight, & Fath,

2004). While students may learn many disciplinary perspectives on a given phenomenon, the perspectives are usually juxtaposed and present students with an "encyclopedic" view, without purposeful synthesis of the varying approaches (Holley, 2017; Klein, 2010). This model frequently has been utilized by instructors to create multi-disciplinary courses, in which students with different majors team up to learn about the other fields represented in the class and to gain experience working together on a project (e.g., Arsenault and Stevenson, 2012; Zhao, 2011). In this case, each instructor serves as a subject-matter expert who focuses on connecting their subject to an overarching theme (Drake, 1991). However, this represents a shared, rather than collaborative, relationship (Klein, 2010).

Transdisciplinarity refers to a synthesis of disciplinary areas to the extent that knowledge may no longer be attributable to a specific field; it may also include active involvement and collaboration with community and other stakeholders to co-construct knowledge (Choi & Pak, 2006; Holley, 2017; Lattuca et al., 2004). Unlike cross- or multi-disciplinary approaches, transdisciplinarity encourages the creation of new or shared conceptual frameworks, both in terms of methodology and theory, that transcend fields and integrate disciplinary perspectives (Klein, 2010; Rosenfield, 1992). In this case, an instructor serves as a guide who helps connect content to support overall goals (Drake, 1991). To design such interdisciplinary experiences, Ertas (2000) suggests that a learning experience should be built around a central element that is then surrounded by competencies rooted in various disciplines. However, what such a core includes may vary from program to program.

The move towards interdisciplinarity in higher education and professional preparation has resulted in hybrid fields such as behavioral medicine, bioinformatics, nanotechnology, and human-computer interaction, among others (e.g., Stokols et al., 2008). Interdisciplinary programs rooted in the humanities are more common than those rooted in the hard sciences. The integration of interdisciplinarity into higher education varies significantly and depends on institutional or organizational structures: For example, interdisciplinary may be incorporated as part of individual courses, as specializations within a department, or as autonomous programs (Holley, 2017).

Interdisciplinary Education: Benefits and Challenges

Interdisciplinary education provides students with knowledge and skills that allow them to look at the world through multiple lenses, synthesize disciplines to better understand the

phenomena they explore, see the interdependencies among disciplines or individual topics, and understand larger systems in which individual disciplines exist (Cotantino et al., 2010; Cruickshank, 2008; Fortuin et al., 2013; Styron, 2013). Interdisciplinary learning environments help engage students in critical thinking through appraisal and synthesis of disciplinary knowledge, problem solving, and creativity and innovation, and they help students develop collaboration and communication skills (Cotantino et al., 2010; Cowden and Santiago, 2016; Mobley et al. 2014; Styron 2013). More importantly, students have a chance to explore their own interests in an authentic environment and come to the realization that "knowledge in the real world is not applied in bits and pieces but in an integrated fashion" (Summers, 2005, p. 627).

Higher education institutions strongly support interdisciplinary collaboration (Friedow et al., 2012). Students enrolled in interdisciplinary programs benefit from seeing their instructors model interdisciplinary approaches and behaviors, including lifelong learning and exploration (Styron, 2013). Instructors also benefit, as an interdisciplinary perspective allows them to share teaching practices and to explore their own disciplines from new angles (Cruickshank, 2008). Yet, oftentimes, it is individual motivation that makes them cross boundaries and explore the richness other disciplines may add to the topics that interest them (Kandiko, 2012). However, instructors, instructional designers, and curriculum designers often are not well prepared to design interdisciplinary learning experiences, due to differences in discourses and epistemologies across disciplines (Baker & Daumer, 2015; Reynolds, 2012). For this reason, designers and instructors alike need a comprehensive understanding of interdisciplinarity and how it can be embedded into a higher education curriculum (Stefani, 2009).

Pedagogical Considerations

Teaching through an interdisciplinary lens requires pedagogical support (Augsburg et al., 2013). Yet there is no single pedagogy that facilitates interdisciplinary teaching and learning (Klein, 2005). Synthesis and meaning making are at the heart of interdisciplinary learning. Interdisciplinarity is constructivist in nature, focusing on application of knowledge and development of higher order critical thinking and reflexivity skills; in this paradigm, learners must pose meaningful questions about a complex problem, sift through and synthesize multiple sources of information and perspectives, see how they intersect, and develop a holistic framework to answer those questions (Klein, 1990, 2005). However, there are challenges with each of these steps.

For example, problem definition is often framed as a disciplinary process, which can later translate into challenges with identifying relevant bodies of knowledge external to the discipline being taught. Students' preparedness and prior educational and professional experiences impact and shape their interdisciplinary learning. As a result, students may experience the same kinds of challenges their instructors face in devising teaching methods and approaching epistemological divides (Bradbeer, 1999).

To enable learners to engage in such a critical review of disciplines, an interdisciplinary teaching approach requires "the blending of content and pedagogy into an understanding of how particular topics, problems, or issues are organized, represented, and adapted to the diverse interests and abilities of learners, and presented for instruction" (Shulman, 1987, p. 8). However, as Richards (1996) suggested, "team-taught courses often fail to achieve their objectives precisely because the individual members of the instructional team never really begin to understand their common concerns in a fashion that may be properly called interdisciplinary" (p. 16). Designing an interdisciplinary learning experience requires close collaboration, team planning, and co-teaching of subjects by faculty from different disciplines. It also provides opportunities to blend teaching techniques (Lefeber et al., 2013).

Another set of problems with designing an interdisciplinary curriculum stems from what Jacobs (1989) called potpourri and polarity problems. The Potpourri Problem refers to a quick sampling of multiple disciplines without addressing meaning making in depth. This can happen at a course level or program level, for example when a department adds courses to a degree program for breadth without fully accounting for the challenges associated with implementing and/or delivering interdisciplinary coursework (DeSanto, 1978). The Polarity Problem identifies the inherent conflict between interdisciplinary and disciplinary approaches, where those who teach individual disciplines may feel insecure and marginalized.

As an example, Gillis et al. (2017) reviewed 26 Canadian universities that together enroll just over 71% of all Canadian undergraduate and graduate students. Each of these universities offer interdisciplinary programs. However, many of interdisciplinary undergraduate programs focus on a single broad domain or a combination of up to three domains. In these cases, students learn about each domain separately through siloed courses or longer two-semester courses that cover objectives from two disciplinary courses. Most graduate programs reviewed allow students to choose their own learning path, taking courses from different disciplines without additional

scaffolding for synthesizing what they have learned. Such synthesis may occur while students work on their own research projects, but instructional support related to this synthesis typically is not included in graduate curricula.

Measuring Interdisciplinary Competence

Interdisciplinary thinking is a complex cognitive skill with a range of subskills (Van Merrienboer, 1997). Boix Mansilla (2010) outlined four cognitive processes that, when activated, may contribute to improved outcomes around interdisciplinary integration: 1) establishing purpose; 2) weighing disciplinary insights; 3) building leveraging integrations; and 4) maintaining a critical stance. In order to elicit these processes, students' work should engage both disciplinary and interdisciplinary insights. Some artifacts may be more representative of interdisciplinary cognitive processes than others, and it may take a significant amount of time for students to develop an adequate level of complexity in this process. It is also difficult to move from mere use of one discipline in support of another, characteristic of cross or multi-disciplinary approaches, towards the synthesis of disciplines constitutive of trans-disciplinarity (Spelt et al., 2009). Therefore, it is important to ensure that the assessment of interdisciplinary competence accounts for the complexity of the cognitive and metacognitive work comprising a truly transdisciplinary course or program.

However, as Boix Mansilla and Duraisingh (2007) observed in the evaluation of student work, instructors and evaluators often resort to considerations about the level or intensity of interdisciplinarity inclusion rather than focusing on the quality of work and effectiveness of integration of disciplines. To overcome this challenge, they devised an evaluation framework aimed at creating a culture of interdisciplinary evaluation. This framework includes three criteria important to measuring interdisciplinarity:

1. *Strong foundation or grounding in a discipline* to ensure the foundational insights and limitations of the discipline before attempting to integrate diverse disciplines.
2. *Advancement through integrating multiple disciplinary lenses*, where students can evoke epistemic frames of synthesized knowledge across disciplines and articulate their understanding.
3. *Critical awareness as to how to synthesize disciplinary knowledge*. At this point, students develop a meta-disciplinary understanding of their own work and are aligned with clear

goals and interdisciplinary framing of the issue at hand. This requires significant involvement in their work and judgment about why specific considerations were made.

Lattuca et al. (2013) developed a set of criteria to measure interdisciplinary competency in engineering students. It outlines eight major considerations that are aligned in part with the recommendations by Boix Mansilla & Duraisingh (2007):

1. *Awareness of disciplinarity*. A certain level of disciplinary knowledge is a cognitive apparatus that supports understanding of other disciplines. Additionally, understanding the social constructedness of disciplines may motivate learners to explore other disciplines.
2. *Appreciation of disciplinary perspective*. This refers to a process of moving from general understanding to more specific knowledge. Such appreciation requires seeing both the advantages of and challenges or gaps in individual disciplines.
3. *Appreciation of non-disciplinary perspectives*. Here, learners can demonstrate appreciating knowledge beyond their immediate discipline in order to address complex problems. Lattuca et al. (2013) also highlight the importance of working with stakeholders to understand a problem or issue from their point of view in order to embrace a non-disciplinary perspective.
4. *Recognition of disciplinary limitations*. Here, the focus is on a critical attitude towards and awareness of the limitations of individual disciplines and overcoming partiality to a specific field or discipline.
5. *Interdisciplinary evaluation*. Students should critically evaluate advantages and gaps or limitations of each discipline as part of interdisciplinary body of knowledge.
6. *Finding common ground*. Learners need to dynamically modify and adapt their perspectives in view of the information they collect from multiple disciplines and the viewpoints of others.
7. *Reflexivity*. Understanding the relationship between disciplines is a key part of their integration and synthesis, understanding one's own biases, and coming to a more complex or complete view of problems.
8. *Integrative skills*. This refers to the actual ability to integrate and synthesize disciplines by drawing insights from the relevant areas to devise a possible solution. Such solutions would be less complete if viewed through a single disciplinary lens (Newell 2001).

This range of components comprising interdisciplinary competence requires diverse assessment activities that reflect higher level cognitive processes, including critical thinking, problem solving, and integration of disciplines. Strategies include assessment of artifacts from collaborative project/ problem-based learning in an interdisciplinary environment, as this allows students to showcase their competence of higher-order skills (e.g., Biasutti & EL-Deghaidy, 2015); experiential or service learning opportunities that would allow students bring together knowledge across different fields (e.g., Rooks & Winkler, 2012); reflections and portfolios that encourage students to synthesize their knowledge across multiple subjects (e.g., Wang, 2009); and self and peer assessment (e.g., Hersam et al., 2004) to name a few.

Design Process Models and Considerations

Ensuring students' adoption of an interdisciplinary lens requires well-designed learning experiences that promote effective and efficient integration of disciplines and help students build their own holistic framework to explain a phenomenon. In designing an interdisciplinary experience, Yang (2009) suggests starting with two basic questions: *Why would we need to focus on interdisciplinary experiences in this particular course or program?* and *What outcomes can students achieve by taking such interdisciplinary courses?* Approaching a course through an outcome-based lens allows instructors and instructional designers to focus on what students can gain from it, why it might be important to them, and student output, thus ensuring their motivation and engagement.

Bigg's Model of Constructive Alignment (2003) is an outcome-based model and has been promoted as an effective framework for developing interdisciplinary learning experiences (Stefani, 2009; Yang, 2009). Bigg's model originated from a portfolio assessment of student work that reflected their thinking, integration of knowledge and experience, and self-representation as professionals. It is based on two main design principles: a) outcome-based and b) constructively aligned, and it consists of three main parts (Biggs & Tang, 2011):

a) *Intended learning outcomes* (ILOs) are central to the teaching and learning ecosystem and are to be designed first. ILOs can be designed at three levels, e.g., institutional (what graduates in general should be able to do); program (what graduates from specific majors should be able to do); and course (what course completers should be able to do). Each

ILO is designed to go beyond a topic and should include an activity. Such ILOs should reflect the interdisciplinarity of the program and its place within an institution.

b) *Teaching and learning activities* (TLA) embed active and collaborative learning and are aligned with ILOs; an instructor serves as a guide and facilitator of such learning.
c) *Assessment tasks* (AT) are assessable activities aligned with the ILOs (i.e., constructive alignment design principle). The focus of learning and assessment is on the quality or mastery of learning as outlined in outcomes and not on the accumulation of points. As such, learners are tasked with identifying their work that best reflects the ILOs and providing reflective statements that show how their artifacts meet ILOs. The latter serves as yet another point of connection and synthesis of disciplines.

Overall, the model offers a consistent approach to designing learning experiences that are rooted in interdisciplinarity and focused on students to ensure their learning. While originating as a framework for professional development, Biggs and Tang (2011) suggest that it could be applied to any college course. Additional research on using the theory in interdisciplinary teaching and learning is still needed (Gharaibeh et al., 2013).

The *Interdisciplinary Concept Model* (Jacobs and Borland, 1986) offers a framework for course development with interdisciplinarity at its core, where instructors and designers can brainstorm and evaluate topics and disciplines that might be included in an interdisciplinary course or program. The model includes several steps to help develop an interdisciplinary curriculum that allows students to remain aware of individual disciplines while making a deliberate effort to explore other disciplines:

1. *Select an organizing/core theme* that serves as a foundation for the interdisciplinary experience. An organizing theme should have a reasonable scope to ensure that students are able to explore and master topics.
2. *Brainstorm associations* with disciplines that treat the selected topic or theme, as well as subtopics within each discipline. Such associations should include a wide range of ideas, which later may be scoped down.
3. *Identify guiding questions to define the scope and outline topic sequence*. This step supports a balancing of discipline representation and ensures the class can deliver the proposed diversity of topics and discussions that might ensue from them.

4. *Identify and outline activities* to allow for an in-depth exploration of the topic/theme.

Ullrich et al. (2014) discussion of the Interdisciplinary Program in Neuroscience (IPN) at Georgetown University is an example of this model. This program strives to train well rounded neuroscientists and focuses on the development of professional identity. The core of the program embraces seven professional skill domains necessary for working in an interdisciplinary field such as neuroscience. These domains include leadership, oral and written communication, teaching, public outreach, ethics, collaboration, and mentorship. Learners are actively involved not only in theoretical discussions and synthesis of disciplines, but also in the practical application of co-constructed knowledge, including taking on leadership roles and writing grant proposals. Additionally, students are heavily engaged in the co-design of the program. While working on the program design, the faculty discovered that they did not always share assumptions about the perceptions and meanings of definitions for such professional skills.

Conclusions and Considerations

Engaging students in interdisciplinary experiences helps them develop higher-order metacognitive skills, such as critical thinking and the ability to view problems through diverse disciplinary lenses; it also guides students to synthesize disciplinary knowledge to devise innovative solutions (Cowden & Santiago, 2016; Holley, 2017). Yet the design and implementation of an interdisciplinary curriculum can be a challenge for instructors, instructional/curriculum designers, and students alike. These challenges may be due to differences in epistemological views, the existing constraints of the traditional higher education system, or a lack of pedagogical frameworks that support the introduction of interdisciplinary approaches (Baker & Daumer, 2015; Klein, 2005, 2006). The strategies and models discussed in the current paper may provide some insight into the ways that collaboration among co-instructors, potentially with the help of instructional designers, can support the creation of learning experiences that overcome the challenges of disciplinary language and epistemologies.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Ethical Approval This article does not contain any studies with human participants or animals performed by any of the authors.

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CHAPTER 3: EVOLVING ROLES OF FACULTY AT A NEW COMPETENCY-BASED TRANSDISCIPLINARY PROGRAM

Ashby, I., Caskurlu, S., & Exter, M. (2018). Evolving roles of faculty at a new competency-based transdisciplinary program. Journal of Competency-Based Education, 3(1), e01059 https://doi.org/10.1002/cbe2.1059

Abstract

Background: Faculty is inseparable from the design and implementation of competency-based programs. Yet prior research on competency-based education (CBE) has mainly focused on program design and implementation, paying less attention to the faculty roles and perception of their involvement.

Aims: This paper explores faculty perceptions of their own roles relating to the design and the pilot semester implementation of a new competency-based transdisciplinary program at a large Midwest research-intensive university.

Methods: Using a phenomenological approach, we conducted semi-structured interviews with faculty involved in the program design and implementation of the pilot semester in this program (n = 7) to gain an understanding of the varied demands and expectations, as well as their perceptions of such roles in the context of the program.

Results: Our findings showed a variety of faculty functions pertaining to their roles within our CBE environment. The faculty interviewed also tended to be actively engaged in terms of student onboarding, motivation, and encouragement, particularly earlier in the semester. Facilitation of students' learning and competency attainment at the prescribed level of mastery led to the need for ongoing review and feedback of students' work, and a higher workload than a traditional course. Yet, the faculty had positive responses to the program and their work, which in part may relate to their early buy-in into the program as part of their collaboration on the program design. Implications, limitations, and future research are discussed.

Introduction

The recent rapid growth in recognition of competency-based education (CBE) has provoked many discussions with the foci on effects it may have on students' learning path and

overall academic success; alignment of competencies with each other and the workplace, and place of competency-based education in a traditional college and how such programs can be set up (e.g., "Experimental sites concept paper," 2014; Koenen, Dochy, & Berghmans, 2015; Mancuso, 2001; Weise & Christensen, 2014). The changing higher educational arena raises the question whether the faculty role profile (or a set of roles with expected activities or functions; e.g., Kolb, Kolb, Passarelli, & Sharma, 2014) may be changing as well. The goal of this paper is to explore functions within their role profiles, as perceived by the faculty, within a new transdisciplinary hybrid CBE undergraduate program.

Literature Review

A key component of an organizational change and often the start for initiating such a change is a role, an intersection or interrelation between the person and the system (Krantz & Maltz, 1997). The roles within a faculty model and the faculty models themselves have evolved and morphed since the first universities in response to external drivers, like national and global economic changes and employment needs, spiraling costs, student access to higher education, or new types of institutions (Kezar, 2013; McCowan, 2017). The traditional full-time tenure-track faculty model that incorporated research, teaching, and service, and has been in place for almost hundred years is being challenged by other models that may be more responsive to the financial needs of the institutions of higher education, society in general, and students in particular (Finkelstein & Schuster, 2011; Kezar, 2013). A major direction in such changes is fueled by the idea of "unbundling," or going from bundled tasks and services offered by a single institution or individual to the distribution of these among multiple providers (Gehrke & Kezar, 2015; Kezar, 2013; McCowan, 2017). Unbundling can be conceptualized across multiple strata of higher education from the higher education as a system to institutions, courses, faculty and staff. Among the drivers of such systemic unbundling, McCowan (2017) suggested the need to enhance teaching and learning through personalization and better alignment with workplace demands, which can be represented by moving away from structured degrees to competencies.

Competency-based education: leveling the playground

Competency-based education (CBE) has been evolving as a strong player in the modern higher education field. As opposed to the credit-for-seat-time model of traditional higher education, the idea behind competency-based education is to evaluate and acknowledge the actual level of proficiency or mastery of competencies – knowledge, skills, abilities, and attitudes specified by the educational establishment ("Experimental sites concept paper," 2014; Silva, White, & Toch, 2015). While there is a range of CBE program models, for Federal purposes, CBE programs can be identified as directs assessment CBE programs (i.e., mastery of competencies that are not tied to a structured degree), credit-based CBE programs (i.e., where the majority of credits are offered through CBE), and hybrid direct assessment programs (Arthur & Musser, 2015; Higher Learning Commission, 2017). Regardless of the program type, the underlying ideas behind CBE are to: (a) create a flexible environment that supports personalized learning and engagement in the ongoing collaboration with mentors; (b) encourage students to learn outside of the traditional college environment and validate such learning (e.g. through prior learning assessment); and (c) ensure the transparency of educational experiences and measurability of expectations and outcomes. CBE programs also have the potential to make education more affordable and capable of meeting diverse learner needs ("Experimental sites concept paper," 2014; Koenen et al., 2015; Mancuso, 2001; Martinez-Mediano & Lord, 2012; U.S. Department of Education [U.S. DOE], n.d.; Weise & Christensen, 2014).

Reconsideration of faculty roles

The shift in the educational framework toward CBE naturally requires reconsidering the balance of the faculty roles, shifting the focus toward roles and practices that would support the core idea behind the competency-based approach. In CBE programs, faculty are typically actively involved in one or more of the following aspects: course design and competency alignment, design of formative and summative assessment tools and processes, engaging in assessment of student work personalization of learning and students' learning process, curation of resources, and/or building long-term relationships with students in order to provide ongoing support, motivation, and instructional and performance feedback (Hartman, Bann, Barton, & Pearce, 2015). To alleviate the burden on the faculty, some universities, particularly those that offer direct assessment

programs, unbundle, or deconstruct, faculty roles (Baker, 2015; U.S. DOE, 2015). In contrast, other programs believe in the so-called "all-hands-on-deck" approach to design and implement a CBE program to not only ensure that the program takes off the ground (Cleary, 2015), but also to increase buy-in through better understanding of CBE aspects and distinctive roles that faculty should play. However, it is important to note that most of this knowledge and understanding about faculty role profiles are represented by university documentation and white papers, with little empirical scholarly support.

Design and implementation of learning experiences

Strong engagement of faculty in diverse aspects of instruction could be divided into two main groups: (a) curriculum roles, including curriculum and assessment design, competency mapping, and (b) facilitation roles, e.g., facilitation for learning, support of onsite and/ or online instruction, student motivation in terms of learning and course-specific competency acquisition (Cleary, 2015; Tucker, Au, & Neely, 2015; Waldeck, 2006). Indeed, many of these functions have been fulfilled by individual faculty in a traditional higher educational environment. Yet, there is a strong difference. When designing a learning experience (e.g., course, service learning, etc.) in a CBE environment, faculty must go beyond the typical thought process about the course itself and what it may help students learn. They also must ensure the alignment with the overarching competencies (e.g., course-based CBE programs) to prevent undue repetitions and/or gaps; and/or to remove the dependence on the seat-time and allow students to progress at the speed they are comfortable with (e.g., direct assessment programs).

Additional curricular considerations may need to be made to ensure opportunities to attain mastery of skills that can be practiced in an authentic learning environment. For example, experiential learning opportunities would allow for more self-directed (Jiusto & Dibiasio, 2006) and confident (Simons et al., 2012) students, who actively collaborate with faculty (Retallick & Steiner, 2009) to improve their knowledge and skills. Such experiences may range from working on authentic problems, simulations, and case studies to field trips, service learning, or internships.

Formative and summative assessment

Assessment in a CBE environment is multidimensional and integrated into every aspect of learning (Schmitz, 1994). In this role faculty responsibilities include designing and developing both formative and summative assessment instruments or protocols, ensuring validity and reliability of the assessment tools and process, and conducting assessments (Cleary, 2015). Formative assessment and feedback (i.e., assessment for learning) are at the heart of such learning experiences. To be effective feedback must be timely, specific, effective, personalized, and engage students in self-regulated learning (Cramp, 2011; Nicol & Macfarlane-Dick, 2006; Orsmond, Maw, Park, Gomez, & Crook, 2013). Achieving the prescribed level of mastery may require multiple resubmissions of projects and assessments until evidence of mastery is provided (Ordonez, 2014). This in turn requires students to work closely with their instructors and mentors at each phase of their academic growth.

The multidimensionality of summative assessment may require diverse strategies and forms of assessment to evaluate the multifaceted aspects of a single competency, including peer and self-assessments, review of artifacts, and building opportunities for students to demonstrate competencies. To ensure the effectiveness of such assessments, assessments need to be carefully planned and aligned by the faculty at each stage of design and implementation of assessment.

Students: ongoing support, coaching, and mentoring needs

Faculty in this role are akin to mentors or thinking partners who guide students through the complexities of competency-based education, often beginning to work with a student before enrollment. They help students to understand their own role in the CBE-based program; follow process and milestones; help them to outline their goals; and regularly check in with students regarding their progress, challenges, and accomplishments. They often provide "at risk" support (e.g., emotional, psychological, academic, or practical) to students in need. Additionally, these faculty members may be actively engaged in recruitment and onboarding students into the program (Baker, 2015; Cleary, 2015; Tucker et al., 2015). This approach has already been found successful in integrative learning programs, where a faculty member helps not only with an academic career advice, but also build connections across discipline domains (Egan, 2015; Lowenstein, 2015). For example, Egan (2015) describes the process and purpose of advising as three I's: interdisciplinarity,

integrative, and intentional learning that can help students develop dispositions and skills to make their learning experiences intentional and meaningful.

However, active engagement of faculty in each aspect of course design and competency alignment, design of formative and summative assessment tools and processes, engaging in assessment of student work personalization of learning and students' learning process, curation of resources, as well as building long-term relationships with students in order to provide ongoing support, motivation, and instructional and performance feedback (Hartman et al., 2015) certainly increases faculty workload. This results in an ongoing conversation of potential unbundling or even re-bundling of faculty roles as discussed earlier.

Purpose statement

Different institutions implement CBE differently based on their CBE approach, student profile, and mission and vision statement, faculty roles might be different in such institutions (Cleary, 2015; Kelchen, 2015). However, there is a dearth of published scholarly work on the roles faculty play in CBE programs; although CBE is not a new approach, previous studies on the roles of faculty involved in the design and implementation of such programs is limited to either conceptual or white papers. More empirical research is needed on roles faculty play in various CBE programs and contexts (Cleary, 2015). Thus, the goal of this paper is to investigate faculty members' perceptions of their roles when involved in the design and implementation of one particular CBE program: a novel transdisciplinary, studio and seminar-based spiral model CBE program at a large research-intensive Midwest university, as well as their roles during the first semester of the implementation.

Methods

The current research study is part of a larger project that uses phenomenological techniques to explore "lived experiences" (Jones, Torres, & Arminio, 2014; Patton, 2004) of the of faculty engaged in teaching during the first semester of the newly established undergraduate program rooted in CBE within a large Midwestern, land-grant, research-intensive university. Due to the novelty of the program not only within the university but in the United States as a whole, the phenomenological approach is particularly valuable in allowing us to look deeply into the meaning,

structure, and essence of the experiences of a small group of faculty members, and their emotional and logical perceptions of these experiences, giving us a better picture of the entire phenomenon (Creswell, 2013; Patton, 2004). This decision allowed the research team to consider in detail perceptions, perspectives, and understanding of collaborative work, as well as antecedents, consequences, and foundations for such relationships of a small group of faculty members who taught during the semester. The study was approved by the Institutional Review Board.

Study context

The Transdisciplinary Studies in Technology undergraduate program within Purdue Polytechnic was initiated by a multidisciplinary team of 15 faculty members in Fall 2013 and was fully accredited in Spring 2016. The intent of the program is to support students' professional formation with a strong focus on the 21st century skills development, including communication, interpersonal and teamwork kills, critical thinking, problem solving, and lifelong learning, as well as incorporating a liberal education mindset. Domain specific and professional knowledge, skills, abilities, and attitudes are reflected by a set of global transdisciplinary competencies that meet the needs identified by today's employers.

In the initial program design, students enrolled in two major learning experiences each semester: Design Lab (equivalent of a four credit-hour design course that leveraged technical skills): an integration of direct teaching and learning-by-doing experiences within a studio framework. This hands-on course utilized adapted the studio model, relying heavily on a design process with formal and informal critique as a primary form of instruction and formative feedback. The course was cotaught by transdisciplinary faculty members from different departments on campus (e.g., Technology and Engineering, Liberal Arts). Seminar (equivalent of seven credit-hour English, communication, and information literacy course): a survey of a large range of topics with themes that crossed humanities and technical domains (Ashby, Exter, Matei, & Evans, 2016). Teaching and learning strategies (e.g., teamwork and social learning, faculty and peer critique) were a significant part of their experience. It was cotaught by instructors from the College of Liberal Arts, Engineering and Technology, and Library Sciences. In this class, the faculty intended to embody the core aspects of CBE, including encouraging students to work at their own place and allowing multiple submission and revisions.

The assessment of competencies was represented by "badges." A badge is a micro-credentialing unit that operationalizes a competency and contains metadata that validates its acquisition. Unlike traditional assessment, the focus of CBE is on mastery, as such, artifacts submitted toward badges may be returned multiple times until the required proficiency was achieved (Ashby et al., 2016). During the semester in question, a hybrid CBE model was used. Students were required to complete 20 badges in order to get credit for the design lab and studio classes. Those who did not complete the badges received an "incomplete" for the associated course. Students also could optionally complete up to 13 additional badges which aligned with domain-specific knowledge (e.g. programming or advanced Photoshop), which could be taken individually or used for course credit if a relevant set were completed. Badge submissions were assessed and accepted or feedback given by course instructors.

Additionally, all students were part of mentor groups, which included a mentor and five students on average. Although not all mentors were current instructors, all of the instructors served as mentors. The majority of instructors actively participated in program design and improvement, and all were involved at some level in the course design.

Participants

Participants included all transdisciplinary faculty members involved in coteaching the first semester (n = 7), as is recommended to explore cases that are rich with information (Patton, 2004). Five faculty members participated in the program design. Two interviewees joined the program closer to the beginning of the pilot semester due to reasons unrelated to the current research. No demographic information other than roles were collected to ensure participants' anonymity and confidentiality.

Instrumentation and procedures

Semi-structured interview protocols were developed to capture the nature and essence (Patton, 2004) of faculty experiences during the first semester of the new competency-based program. Using a semi-structured interview protocol allowed the research team to discuss the same points with each participant, while being flexible with the question order and prompts. This allowed participants to talk and reflect at their own pace and provided an in-depth picture of

participants' experiences in their own voices (Jones et al., 2014). Interviews were conducted by two faculty members who are part of the larger research team.

The faculty interview protocol included 12 questions that inquired into the interpretation of their individual experiences with the program and their work with students. Additionally, prompts and probing were used gain deep understanding of participants' lived experiences, while staying empathically neutral to maintain the rapport with interviewees (e.g., "How did you start in this program? How have you been involved in the process, and what key aspects you have been working on?", "Tell us about your mentoring process."; Jones et al., 2014). Each interview lasted between 60 and 90 min. Each interview was recorded and transcribed verbatim, while removing any identifiable information. NVivo 11 software was used for qualitative analysis.

Data analysis and credibility

Phenomenological studies focus not on individual experiences, but rather on the essence of the phenomena under investigation. The coding approach reflected this process (Jones et al., 2014). We first used open coding followed by axial coding to differentiate the descriptions into meaningful units to clarify the structure of the phenomena (Giorgi as cited in Jones et al., 2014; Saldana, 2009). Based on the initial review of the interviews by two coders, a codebook was developed, and the interviews were coded again. The results were then compared, and discrepancies negotiated. When interpreting results, much consideration was made to ensure that "all stakeholder views, perspectives, values, claims, concerns, and voices [are] apparent in the text" (Lincoln, Lynham, & Guba, 2011, p. 122). Post-negotiation intercoder reliability was 100%.

Findings

The analyses of the interviews allowed us to identify major themes that answer the research question and have the potential to explain the phenomenon in question and add to the current field of study (Yanchar, South, Williams, Allen, & Wilson, 2010). The themes fell into the following four main roles within a role profile: program design and peer-to-peer faculty preparation, instruction and facilitation, assessment and feedback, and career/academic mentoring within a range of functions within each of them. It is important to note that faculty reflections largely tended to view their roles through their perception of how students responded to them and the environment

they have created (i.e., roles as taken). This may create a less clear delineation of individual roles than would be the case when formally assigned by the institution (roles as given).

Program design and peer-to-peer faculty preparation

Program design and scale-up planning

From its onset, this program exercised the all-hands-on-deck approach during the initial design phase. As part of the design team, faculty members were involved in a variety of roles based on the needs of the program and their personal interests, including review of existing programs in other schools, determination of potential directions for the program and program design, global design of the learning experiences and curriculum, identification of competencies and construction of badges, working area layout design, and procurement of the resources needed to prepare the workspace for the learning experiences. Resources including books and visits by a professional coach were provided to aid in this process. One of the participants shared:

> *I guess retrospectively looking, I was involved with the brainstorming sessions in which we had some mentoring, coaching, workshops, […] learning and brainstorming with the whole group of faculty fellows. […][We] started soaking in all this information and sharing it with each other, and that was a good chunk of six-month heavy meetings, lots of discussions on what [this program will be like auth.]… In January [2014 – auth.], we had a retreat in which we decided what was going to be the architecture of the first year, which is what we're doing this semester, which was shaping what are going to be the experiences.*

Another participant confirmed that the roles completed varied based on the need of the group and program being developed:

> *I've been with [the program – auth.] since the very beginning. Since day one. In fact, day pre-one. And as far as roles go, I think I've kind of been a jack of all trades… I've been wearing a lot of different hats…*

While some of the team that initially designed the program left for a variety of reasons, a more tight-knit group continued to refine the program design all the way up to the launch of the pilot. As new faculty members joined in, they too became actively engaged in the process. In part, faculty members' dedication was due to the nurturing environment that was created and the openness of the faculty group to new ideas. Since the pilot has led to the development of a degree-granting

program, the faculty team continued with further program development and improvement, scaling up, and sustainability:

> *I think I was one of the later people to come in, and I think a lot of the core principles of [the program – auth.] were laid down. […] But that said, I feel like in every stage of the construction from when I entered I was very involved, especially number one, in terms of respect of opinion. I feel in every meeting it's completely open and comfortable to speak during those meetings, provide suggestions, provide feedback, and then, in the design of things.*

Faculty onboarding

While most participating faculty have been immersed in the program design from the onset of the program, the idea of the faculty onboarding into the core principles of CBE, particularly mentoring, was found challenging, yet helpful. As one participant shared, "They would be mentoring the mentors, really. So if it was to be held in the spring, the people in the fall would help coach the people that are going through things in the spring, and vice versa."

Instruction and facilitation

Instruction and facilitation include functions related to course-level curricular decisions, instruction, and facilitation of learning, as well as provision of diverse scaffolding and support needed to help students achieve mastery.

Facilitation: individualization of learning experiences

The idea of the individualization of instruction and supporting students on their learning pathway, while still providing them with enough challenge, has been a major concern of the participants. As one of the participants shared,

> *It really comes down to dealing with you, as a student, not with you, as one of 15 people who need to learn soldering. It comes down to you as a student. How do you learn soldering? In Design Lab, that might be about, "How do you learn soldering? What's going to work for you to learn this? Do you want to watch a video?" […] I tend to send students down that path first and like, "Why don't you just try something? […] Here's the idea. Try it, and then we can better respond to where you're frustrated."*

Such individualization is present not only in individual learning projects, but competency design as well, where students could address the badge challenge using individual projects and skills. As a faculty member described it,

> *Well, you don't care where the information [submitted toward badges auth.] comes from necessarily. It was one of the conversations we had when we were developing it. In other words, here's a challenge. Okay, you can demonstrate this either by an activity that you did in the seminar or an activity that you did in the design lab.*

Additionally, students were encouraged to use projects outside of their learning experiences in the classroom to further engage them in the transdisciplinarity and lifelong learning skills.

Ongoing self-evaluation to improve learning experiences

The faculty reflected and recognized challenges that come with the new design, admitting that it is an important part of the mutual growth:

> *Could we have done it better, in a way that was more supportive and caused a little less anxiety for some of them? Yes. I think definitely we could have, and we are still learning what those ways could have been.*

Indeed, any new courses bound to have "usability" and applicability issues, when not everything went as planned. This is even more true when an entirely new program, complete with multiple learning experiences, is introduced. As such, faculty had to be flexible and willing to step back, regroup, and try new approaches to ensure learning experiences for students:

> *[Students – auth.] are not blind to the fact that there are a lot of things that are mess. They're taking it in stride. […] We talk a lot about how we're trying stuff out. We are learning how to teach this way, while you're learning how to learn this way, and we're going to make mistakes.*

However, by the end of the semester, the ongoing changes took their toll on both faculty and students, bringing overall satisfaction down.

Student support: student onboarding and scaffolding of learning

Students coming from a traditional educational environment were challenged not only by the novelty of the college experience in general, but also by the program's unique learning experience setup and expectations. As such, faculty had to prepare them to fully engage in the coursework, complete badges to acquire competencies, and engage in self-regulated learning. As

one of the participants shared, the faculty had to adjust to students' actual abilities once the semester was underway.

> *[There are auth.] three parts to teaching: conditions, methods, and outcomes. You can't do the methods unless you know the conditions. We were wrong about the conditions. They were far less ready to handle the unstructured problems than we anticipated. Even though we knew they weren't going to be ready to handle the unstructured problems, they were […] far less ready for a classroom environment that was completely different than anything they'd experienced.*

However, the faculty members remained optimistic, "Getting into orbit is no small challenge. But to tell you the truth, they [students – auth.] are actually some of our best performers."

Student support: motivation and encouragement

The faculty participants often found themselves not only sharing their knowledge and facilitating learning, but also encouraging and motivating students to work toward gaining professional skills that students primarily interested in engineering and technology did not see as important or of interest (e.g., teamwork, communication). As one faculty member shared,

> *There's a seminar component in the morning and then the Design Lab in the afternoon. Many of the students were all dressed up because they had to do some kind of a presentation for Design Lab today [perceived as an unnecessary demand by students auth.]. It turned into about a five-minute mini kind of tutorial by me trying to convince them, and I think I did, that it's this set of skills that are really the most important.*

Another participant elaborated further as to how they try to encourage students and address challenges:

> *We've been trying to gently nudge, but not force a lot of [collaboration auth.]. […] Naturally, a few small cliques have formed, which we intentionally split apart from time to time. […] 'Hey, go work with some other folks' kind of thing.*

However, as admitted by the participants, 'selling' the idea may be an important first step towards recognition and adoption by students,

> *They don't find this communication thing […] very important right now. So we have to kind of keep selling that. Yeah, we'll probably do a few things a little bit differently. Maybe become a little bit more animated possibly. I know I'm equipped to do that. I have no problem doing that.*

Continuous assessment and feedback

Assessment for learning means that faculty are constantly in the process of providing feedback on in-class activities and work submitted as part of badges. In the pilot semester, students were given "soft" deadlines but not required to complete work at any specific time in order to allow students to work at their own place. However, the flexibility of soft deadlines led many students to submit project work toward badges as late as possible, which created a high load on faculty, particularly, closer to the end of the semester. This, in turn, resulted in less timely feedback to students, as well as overall confusion about what had been submitted to whom and whether individual revisions had been assessed. The electronic badge system also proved inadequate to support and fully represent multiple cycles submissions and feedback in a way that was easy to monitor. Altogether, this created a workload that was different from that typically seen by faculty, as one participant illustrated:

> *Because the flexibility in students doing things and turning things in and that sort of thing, it's really easy to lose sight of what's been submitted. […] Whereas in a traditional sense, well, 'The due date is this. Yes, there's a pile of papers there, but it's sitting right in front of you' kind of thing. So we are trying to get a grip around that.*

Career / academic mentoring

All interview participants combined both instructor and mentor roles. However, being with the students eight to 15 hr a week, many faculty felt that mentorship and coaching could be accomplished as part of feedback and classroom interactions. However, some students were assigned mentors who were not teaching during that semester and were not as frequently available to their mentees. Therefore, teaching faculty found themselves supporting not only students assigned but any student who asked for help or seemed to struggle:

> *… I have not looked at my mentor list since the first one came out in August. […] I have a lot of face time with all of the students […] and so than the subset of those students who would be on my mentor list, are in class with me, and I have a lot of face time with them. We are working so close to all of them. I am individually mentoring them during lunch, when we have our lunch break […], because I sit with them, and eat with them. We chat. We have advice things. And we kind of goof around.*

Faculty members found that they were called upon not only to answer questions about the course and the program, but also to provide emotional and psychological support related to students'

expectations and adjustment to the program, as well as their adaptation to life at the university and other personal issues.

> *I put the 'dad hat' on. So everything from careers to 'Why are you in college in the first place?' to the whole query of 'OK, what do you think you want to do? What do you think you'd be happy doing?' and that sort of thing.*

Another participant added,

> *"On occasion, we've backpedaled and said, 'Okay, obviously, there's some blowback going on in seminar. Let's [student and their mentor auth.] spend a few minutes talking about it.'"*

However, some faculty had concerns about combining instructor and mentor roles, since it may leave a student without a support, should an instructor-student relationship become strained:

> *I think there is an inherent conflict of interest that one of the mentors is with them eight hours a week in class, because then who do you go to if you have a problem with that instructor? […] That's probably why I […] and even other […] instructors maybe should not be mentors. Because there should be space and room for a student to express concern about their learning environment, and if the only person that person has to talk to is the person they're expressing concern about, that's a problem.*

Another participant shared the same feeling,

> *"It would be great if the mentors weren't the teachers. So whoever's instructing […] that semester, those shouldn't be the mentors. They should be separate faculty members."*

Multiple mentors were also suggested as a way for students to truly grow academically and professionally:

> *The best mentorship you can get is multiple mentors that have viewpoints that are different from each other. Because it gives you a wider view of what's going on. You are now no longer getting [a] solo mentoring data point. You are getting multiple ones, and sometimes they conflict. But that's where the questions happen, and that's where the person can make their own decisions as to which path they really agree with. Maybe it's a combination of both. I don't see a problem in that. I think it's actually healthier because if you ride with one mentor the entire time, that's greater likelihood that you'll just become a copy for that person. It's better to spread the gene pool out a little bit, spread the brain pool out a little bit. Get a couple of viewpoints and then make a real decision.*

Discussion

This study aimed to investigate faculty perceptions about a range of functions within faculty role profiles in a pilot transdisciplinary hybrid CBE environment. Interviews with the participants gave us an insight into the roles of the faculty involved. This program is the first program-wide competency-based undergraduate initiative on campus (Mili, 2014), which means program supports were not available to scaffold the process for the faculty, therefore a lot of situations encountered were in a way "first experiences."

Corresponding with the previous research, our results showed that faculty roles in CBE move beyond research, teaching, and service (Cleary, 2015; Tucker et al., 2015). In addition to research and service, the study showed that faculty role profiles in our newly established and piloted transdisciplinary CBE program include four main areas: program design and peer-to-peer faculty preparation, instruction and facilitation, assessment and feedback, and career/academic mentoring. It is important to note that while an institution outlines roles, each individual faculty member shapes their own role once on the job, based on how they understand the role, and how they see themselves it or, as Krantz and Maltz (1997) put it "role as given" and "role as taken." As we have encountered in our interviews, faculty often viewed their roles through the lens of students' engagement with the created environment and situations that arose from interactions with students. Additionally, while transdisciplinary approaches envision the co-existence of multiple viewpoints within the systemic collaboration needed to implement a program, faculty still bring mental models and their disciplinary identity and epistemic views into their individual roles (Senge, Lichtenstein, Kaeufr, & Bradbury, 2007; Vanasupa, McCormick, Stefanco, Herter, & McDonald, 2012). As such, the roles and their implementations should be viewed not only as expectations set forth by the institution, but also how they were perceived and implemented by faculty.

Program design and instruction/facilitation

While the role profile may show distinct areas and functions, they were tightly interconnected in their experiences. For example, the focus on competency attainment in a transdisciplinary environment requires of instructors to provide an all-encompassing support to their students with diverse needs, levels of preparedness, and academic and career interests and goals. This happened through engagement in diverse roles from the onset of the program, including

initial program and curriculum planning and course specific design, competency design and assessment, and activities during the program design that helped ensure better understanding of the process and activities involved in a CBE program, as well as ongoing self-evaluations at each point of the program design and development. However, CBE environments may look different depending on the type of the university, location, and specific path taken by their design team (Baker, 2015; U.S. DOE Federal Student Aid, 2014). Therefore, roles within their role profiles may differ as well. However, as our participants highlighted, it is key for faculty to support and mentor each other to ensure the shared understanding of CBE and its components.

Additionally, the novelty of the flexibility of the program intended to bring up learner creativity and engagement may have been rather unconventional for students who came from a traditional classroom experience. As such, faculty had to quickly readjust scaffolding to ensure positive learning experience for students (e.g., Baker, 2015). The faculty felt that they had to experiment a lot to pinpoint the design and implementation aspects that would work within the transdisciplinary learning environment that focuses on student mastery over grade. This is not uncommon for experiential or "hands-on" programs (Austin & Rust, 2015; Katula & Threnhauser, 1999). Donovan, Porter, and Stellar (2010) found that for an experiential program to be successful and accepted at a university, faculty needs to be part of the design and implementation: from planning and crafting learning goals to peer and external expert mentoring (Donovan et al., 2010).

Assessment and feedback

The focus on mastery of knowledge and skills within a competency along with the personalization of projects results in assessment for learning and regular in-class feedback are powerful tools that influence effective student learning (Hattie & Timperley, 2007; Sadler, 2010) that encourage students to pinpoint the direction for future studies along with review and detailed feedback of multiple iterations of artifacts submitted towards badges. This translates into a higher workload for the faculty in comparison with conventional classes, in addition to other roles and projects the faculty may be involved in. However, it does not mean an immediate dislike of the program. On the contrary, some of them shared their overall satisfaction. In part, this may be due to their early buy-in as a result of the participation in the design of the course and the program. In subsequent semesters, faculty began to feel the pressure of the sheer amount of time playing

multiple roles, although their belief in the underlying model has been maintained. Therefore, currently considerations are made regarding unbundling the roles and hiring expert assessors.

Mentoring

As highlighted in the CBE literature, one common function in CBE programs is career and academic mentoring not only within, but also outside of the classroom experience (Cleary, 2015; Klein-Collins, 2013). This role was also defined in our program, although many of the mentors were also instructors. Our results indicate that the role of a mentor embraces a broad spectrum of functions aimed at improving student experience, e.g., identifying competencies and gaps, determining a learning path, as well as psychological and emotional support and preparing students for CBE (Baker, 2015; Cleary, 2015; Tucker et al., 2015). This may require faculty to be familiar with courses and services available within and outside of the program, competencies adopted by the program, and how those competencies align with the needs of industry that a student is interested in. As could be seen, it is challenging for individual faculty members to take on diverse faculty roles at the depth required within a CBE program. For instance, two of the faculty members we interviewed explained that sharing instructor and mentor roles concurrently was at times difficult. In particular, faculty rarely separated teaching/ coaching within the context of the learning experience, and larger career mentoring, often focusing on immediate course issues and not a more complete or picture of students as a whole person. Here, we can find parallels with experiences of faculty and staff advisers working in integrated learning environments and with students in individualized major programs. They often serve as a guide to help students find parallels across their curriculum and knowledge they have amassed, the tie-in with their overarching career goals, and synthetizing and reflecting on how what they have done fit in into their global model (Egan, 2015; Lowenstein, 2015).

In this light, the suggestion shared by one of the faculty that students should have multiple mentors from different disciplinary backgrounds to provide more well-rounded guidance has a strong merit. Therefore, unbundling faculty roles as implemented by many CBE institutions, or at least separating the mentorship aspect into a separate role, seems to be a reasonable mechanism to ensure positive work balance for the faculty, while providing students with quality education. Yet, unbundling has been a sensitive topic for many faculty (e.g., Benton, 2005; Sammons & Ruth, 2007). As such, further investigation may be needed.

Conclusions

Prior research on competency-based education (CBE) has mainly focused on program design and implementation, paying less attention to the faculty roles and perception of their involvement. Yet, understanding the distribution of functions and how they meet the needs of students in a CBE environment is the key in ensuring the faculty's satisfaction and students' success. In this article, we have explored functions within role profiles of the faculty of a new transdisciplinary hybrid CBE program.

Even though some functions are similar to those played by teaching faculty in a traditional university, traditional faculty and CBE faculty may see a different distribution of weight of each function. The difference in allocation of time and effort across the role areas and functions may also evolve with the scale-up of the program and/or change with the changes in the program or the implementation of a CBE model. However, the awareness of what areas and functions within a role profile of faculty in a CBE environment will help faculty and administrators prepare and adjust accordingly, thus alleviating potential challenges. As such, it is important to continue evaluating faculty's role profiles and their perceptions of the program and the design and implementation processes behind it. As mentioned above, unbundling has the power to reduce workload. However, additional considerations of the process and its implications are needed.

Limitations and Future Research

This study purposely focused on a single program within one institution. Therefore, while all the faculty members involved in instruction were interviewed, the total number is still relatively small. Furthermore, because the data discussed in this paper were collected as part of a larger study with diverse foci, responses may not have reached the depth that they may have in a more targeted interview. It is also important to note that faculty were equally new at coteaching in the transdisciplinary program. This may have added challenges that impacted the overall perception of role functions and how well faculty were able to perform these functions beyond what may be seen for CBE programs within traditional disciplinary programs.

The current study is limited to the design phase and the first pilot semester of the program. However, with the establishment of a 4-year degree granting program last fall, faculty needs and perceptions may change. Subsequent interviews with faculty and students, as well as observations

of the ongoing design process, instruction, and mentor-mentee interactions have supported the role profiles as described in this document. Currently ongoing research focuses on the challenges perceived by the faculty in those roles and how they adapted to the changes, as well as the investigation of faculty roles across the first 4 years of implementation. To better understand role profiles across CBE environments, future research will look across institutions and models to identify key areas and functions, as well as the impact of role unbundling overall success and satisfaction of the faculty.

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Conflict of Interest Statement

No conflicts declared.

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CHAPTER 4: ANALYZING INTERDISCIPLINARY PROGRAM DESIGN THROUGH THE LENS OF COMPLEXITY THEORY

Ashby, I. (2021) Analyzing interdisciplinary program design through the lens of complexity theory. In: Hokanson B., Exter M., Grincewicz A., Schmidt M., Tawfik A.A. (eds) Learning: Design, Engagement and Definition. Educational Communications and Technology: Issues and Innovations. Springer, Cham. https://doi.org/10.1007/978-3-030-85078-4_16

Introduction

Practical publications on interdisciplinary program design often suggest that having dedicated faculty, proactive administrators, financial resources, and interested students would be sufficient for the success of an interdisciplinary program (e.g., Kelly, 2008). While these factors are important, cultural, structural, social, policy, pedagogical, curriculum, and visionary differences across structures and players of an education system end up being neglected (Jacobson et al., 2019; Marshall, 2006). In turn, these differences in systems and approaches result in the resilience of professionals and higher education institutions to change and in an intent to maintain the status quo, causing poor "survival" of interdisciplinary programs (Kester as cited in Cambridge University Press, 2020; Marshall, 2006).

To help administrators, program and instructional designers, as well as faculty interested in the design and implementation of interdisciplinary programs, I would like to review the importance of complexity theory in the interdisciplinary program design and how complexity theory is interwoven with an interdisciplinary approach.

Rising Popularity of Interdisciplinary Education

Today's graduates adopt a new career paradigm: frequently moving from job to job and acquiring new skills on-the-go. Even entering college is viewed as a "4-year career" that may or may not impact future job selection (Kamenetz, 2012). Eric Gentry, from the Institute for the Future, shares, "People are learning as they go and considering new avenues for their career in the process. This will have wide-ranging implications – on work and educational establishments" (Institute for the Future, 2018, p. 14). Attempts are made to flip classrooms, introduce technology, and apply problem-based learning, yet the challenge perseveres as the content is still delivered

using disciplinary approaches that, in a way, groom students for a predetermined career (Arvanitakis & Hornsby, 2016).

While there is a strong desire to maintain the century-old tradition of disciplinary-based education (Baker & Däumer, 2015; Klein, 2006), universities need to respond to technological advancement, globalization, changes in the economic and societal needs, as well as demands of the labor market in their effort to give their graduates a competitive advantage, and, thus, attract more diverse and engaged students (Arvanitakis & Hornsby, 2016; Denman, 2005; Whitaker, 2018). One such change for higher education is broader implementation of disruptive educational approaches, like interdisciplinarity, as a way to give students an edge in their future careers (Haynes, 2017). Indeed, integration of the arts, humanities, and STEMM (science, technology, engineering, mathematics, and medicine) fields has shown positive results in terms of increased critical thinking and problem-solving abilities, higher-order thinking, deeper learning, content mastery and enjoyment of learning, teamwork, adoption of new tools to address problems, and "soft" skills at both undergraduate and graduate levels. It also allows new graduates to have a wider choice of employment as well as become more active and informed citizens and lead more enriched lives (National Academies of Sciences, Engineering, and Medicine, 2018). As a result, the popularity of interdisciplinary programs has been growing. Since 2003, the increase in enrollment in such majors has grown by 37% across US institutions of higher education (Whitaker, 2018). In 2016, over 96,000 degrees were awarded to students in interdisciplinary majors (DataUSA, n.d.).

Complexity Considerations in Design of Interdisciplinary Programs

Whether we try to alleviate disparities in a community, address organizational issues, or design a new program, it is beneficial to engage people with diverse backgrounds. People coming together, finding a common ground for partnership and collaboration, working through issues, and growing together as they gain experience and feedback from each other and the surroundings introduce aspects of complexity theory, namely, self-organization and emergence (Wolf-Branigin, 2013). Complexity has been part of the discussion on interdisciplinarity for decades. In their paper, Klein and Newell described interdisciplinarity as "…a process of answering a question, solving a problem, or addressing a topic that is too broad or complex to be dealt with c by a single discipline or profession" (1997, p.3). Indeed, Newell (2001) theorized that complexity is an integral part of

interdisciplinarity (e.g., nonlinear knowledge that offers variable meanings under changing conditions). While there are different ways to explore interdisciplinarity, for the purpose of this paper, I subscribe to the categorization described in Holley (2017), where interdisciplinarity is viewed as an umbrella term that includes the following typological continuum (see Fig. 1; for more information on interdisciplinarity, typology, challenges, and process models, see Ashby & Exter, 2019):

- **Cross-disciplinarity**: Borrowing of tools, ideas, or theories mainly from neighboring fields.
- **Multidisciplinarity**: Integration of multiple disciplines but using a bird-view level of understanding.
- **Transdisciplinarity**: A synthesis of disciplines that allows creation of new conceptual frameworks and integrate disciplinary perspectives.

The first two types offer only slight discomfort when integrating in a traditional curriculum, mainly connected with the minor changes to the course design and potential co-teaching of some aspects of the course, while the onus is on the students to integrate such knowledge (Holley, 2017; Reynolds, 2012). Transdisciplinarity often requires a significant redesign that involves interprofessional and interdepartmental collaboration and may not fit into the boundaries of a traditional institution of higher education or departmental cultures and limitations (Exter et al., 2017; Holley, 2017).

While we may subscribe that the idea of interdisciplinary knowledge is complex, why would it impact an interdisciplinary program design? To better answer this question, let's start with its basic building blocks of interdisciplinarity – disciplines.

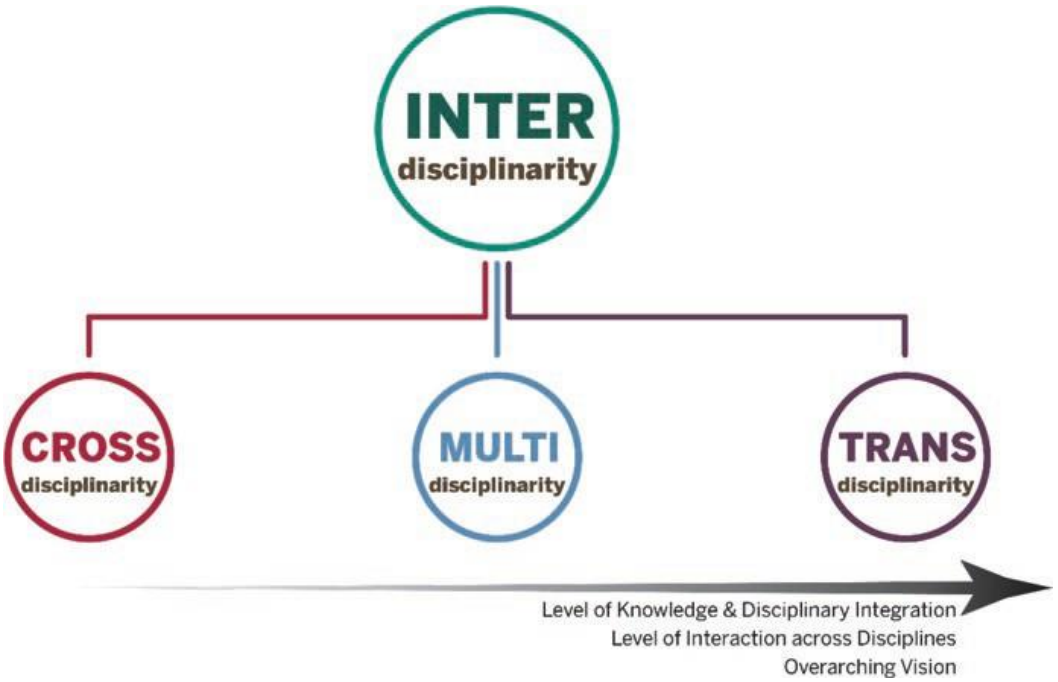

Figure 4.1 Interdisciplinary typology

A discipline is a product and is formed on multiple levels: institutional, economic, and societal (Moran, 2010), each representing not only subjects covered but even behaviors or cultures exhibited by its representatives (Becher & Trowler, 2001; Krishnan, 2009; Moran, 2010). For example, the Biglan (1973) classification scheme remains one of the most cited classification systems of academic disciplines across areas of research in higher education and still holds true for the general distribution of disciplines (Becher & Trowler, 2001; Krishnan, 2009; Simpson, 2017). The scheme groups disciplines on a continuum of "hard-soft" and "pure-applied" with a description of epistemic beliefs and know-how. The classification shows discipline demarcations within their own scientific communities setting directions for rigor and units of scientific knowledge through scholarship and peer review of research (Aldrich, 2014). While this classification does not necessarily clearly categorize the complexity of academic disciplines (Becher & Trowler, 2001), it assists in identifying potential dimensions to be observed and thus to better understand epistemic, cultural, and pragmatic differences and challenges faced by representatives of these disciplines when coming together to create an interdisciplinary program (Fig. 2).

To be able to build an interdisciplinary environment that allows interdepartmental collaboration, faculty needs to traverse their own academic "territories" and often go against the culture that they have been part of since the early days of their graduate preparation (Becher & Trowler, 2001). While some educators are eager to work outside of disciplinary silos, others may feel that it means a decrease in the offering of traditional courses that result in interdepartmental rivalries, yet others perceive it as a top-down approach that limits their freedom (Exter et al., 2017; Irani, 2018; Kandiko, 2012; Whitaker, 2018). Challenges exist on the institutional level as well – the traditional disciplinary-based environment is not friendly when it comes to disruptive innovations (Jacob, 2015).

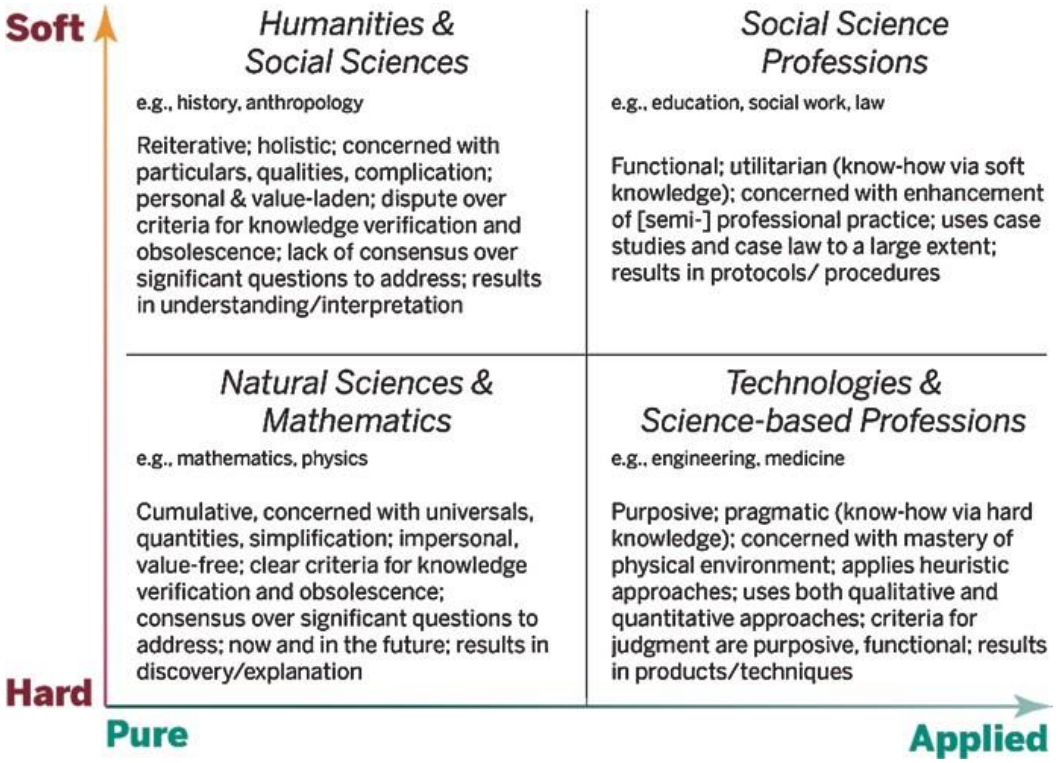

Figure 4.2 Discipline classification scheme. (Adapted from Biglan, 1973)

Elements of an Interdisciplinary Program Design Framework: Through the Lens of Complexity

Using the framework described in Harnessing Complexity: Organizational Implications of a Scientific Career (Axelrod & Cohen, 1999), let's identify the key elements of an interdisciplinary program design framework.

Agents These are the range of stakeholders involved in program design and implementation, including but not limited to administrators, faculty, curriculum designers, instructional designers, students, as well as a range of officers and clerks from across diverse university systems (e.g., registrar office, bursar office, secretaries). These agents are semi-independent. In other words, while they have free will, and they often act within the boundaries of their own departments, rules, traditions, and external expectations. In addition, agents have their own interests and reasons for the involvement in the design of an interdisciplinary program, views for such a program, and ability to learn and change depending on the external and internal boundaries. For example, in prior research, we observed that humanities faculty felt their field was subservient to STEM when building a transdisciplinary program, which certainly would not result in desired program design outcomes (Exter et al., 2015, 2017). Additionally, the reasons stakeholders may want to join an interdisciplinary program will vary as well – from altruistic desire to improve the outcomes for students to more pragmatic reasons of career development or a new research and funding strand. While no reason is better than another one, it consciously or subconsciously impacts the behaviors of stakeholders.

Populations and Systems Agents can be grouped into populations of similar types (e.g., faculty) with similar strategies or views. In turn, a system is formed of one or more populations of agents. Same agents can belong to different systems (e.g., while a bursar officer may interact with a team designing an interdisciplinary program and provide their input, he/she also belongs to one or more other systems in similar or different capacities). It is expected that there is a variety of agents of different types within a population or system, which is one of the key pillars of a complex system. Agents may go through a selection (or even self-selection) process that may increase or decrease the diversity, which can have a strong impact on the outcomes of the project (i.e., if the majority of faculty members represent the same discipline, we may end up with a cross-disciplinary program). Such processes align with team establishment and the sense of whether stakeholders feel comfortable with the team and diversity of opinions or feel stifled by other team

members. Additionally, it is important to note that the bottom-up emergence of such teams is preferable to a top-down administrative decision approach, which results in more positive outcomes (Cilliers, 1998; Wolf-Branigin, 2013).

Physical and Conceptual Space While agents may or may not be at the same location geographically or physically, it is the conceptual space (i.e., ways or strategies for agents to connect and interact) that may play a key role in interactions. The conceptual space is where I have seen most of the action happening: individual beliefs of faculty regarding the idea of interdisciplinarity, the impact of professional disciplinary background on pedagogies that could be used in teaching students, strong impact of signature pedagogies, and a lack of desire to step away and embrace other ways of problem-solving (e.g., Ashby et al., 2018; Exter et al., 2015, 2017).

Internal Diversity This pillar or condition for complexity is probably one of the most self-explanatory in terms of the benefit of which we can observe in any diverse team, like rich plentiful ideas, thinking outside the box, and many others. The diversity of members on an interdisciplinary program design team also makes a difference between a cross-disciplinary and transdisciplinary program. However, as discussed in the conceptual space section, the diversity without communication and co-construction of joint knowledge can be as harmful for program design.

Internal Redundancy This refers to duplications of some aspects and efforts needed for complex actions to allow for better interaction, more efficiency, broader perspectives, coverage of potential gaps, faster work completion (in some cases), and checks and balances. Lack of redundancy may result in poor adaptability and loss of robustness. For example, in one of the interviews with an interdisciplinary program coordinator, she mentioned that she is the driving force behind all the efforts of the program. When asked what will happen if she is not there, her response was sobering as she admitted that the program would probably fall apart as nobody else does what she does. However, it does not mean that a single person cannot design and implement a program (e.g., Lansiquot, 2016). The difference is that should this person no longer be there or have another person (even an administrative assistant) join in; it may have a significant impact (positive or negative) on the program outcome. Just like in a covered or timer-truss bridge, where the weight of a passing truck is distributed across all elements of the bridge, the weight of the program should also be distributed across many members.

Neighboring Interactions This refers to sharing ideas, queries, and approaches that are tightly connected with the notion of internal diversity and conceptual space. It is important to note,

though, that it is not important for all agents to be in constant communication with each other or have a full picture of what is happening. It is through the neighboring interactions that the system keeps evolving.

There is one more notion − **enabled constraints** − that is key for any system. Such constraints allow for maintaining a balance between coherence (i.e., focus or purpose of a system) and randomness (i.e., heterogeneity of systems that have to constantly adapt to the ever-changing environment). Davis and Sumara (2006) note that complex systems, like education, are bounded by heuristics and rules that may arise from the context, existing structures, settings, or participating agents. Some of these rules are created to maintain boundaries (e.g., mission and vision of an organization), while others are placed externally (e.g., study conduct rules set by the Institutional Review Boards). Such constraints can change an interdisciplinary program significantly. For example, one of our earlier publications explained how the initial program design focused on badges and nonlinear progression of courses to gain transdisciplinary experience. Yet, at the end of the first semester, a significant problem emerged when exploratory students wanted to join a different program and needed to have grades and class standing that are traditional for a higher education system (Exter et al., 2019).

Implications and Recommendations

Why would simple recommendations like dedicated faculty, proactive administrators, sufficient budget, and interested students be insufficient to address complex challenges? To answer this question, I would like to refer to Patton's (2011) scheme for developmental evaluation of programs through complexity theory that includes three levels:

Level 1: Simple – Refers to easy-to-follow instructions that will result in expected outcomes, like a time-tested recipe for a family night dinner.

Level 2: Complicated – Refers to more expanded and interconnected that require knowledge and balance, like an architectural blueprint, which if followed correctly will result in a structure that can withhold the adversaries.

Level 3: Complex – Where a combination of interconnected agents, nonlinear dynamics, added uncertainty may result in quite different outcomes. Look at any team, even if one person is replaced, the dynamics and the outcomes may shift significantly.

Recommendations like the above would fall somewhere between simple and complicated, but they envision a positive outcome each and every time it is applied. In my foray into interdisciplinary education, I have seen a clash of traditions and innovation, structural, cultural, and disciplinary silos, and strong intent of individual faculty to go outside the traditional disciplines, individual differences, preferences, and the need to respond to the market. This dissonance shows the delicate balance between faculty intent, reservations, and university support or lack thereof. There are eager faculty and staff across universities who want the best for their students, but still some programs succeed and prosper, while others terminate their existence.

In the past, we have explored models and best practices for interdisciplinary programs and ensuing collaboration (e.g., Ashby et al., 2018; Ashby & Exter, 2019; Exter et al., 2015, 2017). But the findings felt prescriptive and not necessarily comprehensive as they tend to apply a reductionist approach to boil down aspects of program design to foundational elements (Cilliers, 1998; Davis & Sumara, 2006). After all, even the best-laid plans often crash against the reality of human dynamics, learning and behavioral patterns, individual traits and characteristics, and directives of leadership. Additionally, in my earlier exploration of culture in an online environment (Ashby & Walker, 2015), I have explored how group engagement outcomes may change depending on the combination of people involved, perceived roles, and experiences. This can be true of any group, including faculty involved in designing a program. Thus, to gain a full understanding of why some programs may be more successful, while others may perish, it is important to consider this program from a holistic point of view that allows us to consider the roles played by diverse stakeholders, institutional and departmental cultures, and the environment – namely, complex level.

There are two key takeaways I would like to highlight:

When working in a complex system, we cannot expect that the recipe of success to be true for all. Even minor changes in the composition of a system (from stakeholder to strategy used) and external boundaries may result in completely different outcomes. However, we learn from the feedback we receive from each other and the environment and can adapt to the changes. Challenges met are not our mistakes, but rather learning opportunities to allow us to adapt. That is why it is important to accept them, embrace them, and adapt to them in order to develop new solutions.

To be successful, agents and the system itself need to be able to adapt. This can be achieved through promoting internal diversity but also internal redundancy. It is hard on a team if only one

person has the tacit knowledge about the program, internal and external networks, and other key ingredients of the program design. Yet, it is not effective for everybody to possess the same knowledge as it can lead to information overload. Balance the communication but also support the building of internal "buddy system," where no load is too big for just one person.

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CHAPTER 5: DISCUSSION AND CONCLUSION

Paraphrasing Donald Davidson and his classic essay On the Very Idea of a Conceptual Scheme (Davidson, 2001, reprint from1974), disciplines are words and not worlds apart. This means that communication in an interdisciplinary environment requires translatability (Holbrook, 2013). In this case, communication does not refer to interaction on an interpersonal level, but rather building understanding, mutual connections, and shared knowledge on the professional disciplinary level. To implement an interdisciplinary product (whether it is a course, program, research project, etc.), participants engaged in the design and operation (e.g., the faculty, staff, administrators, and other agents described in Chapter 4) need to move towards higher levels of conceptual synthesis (Fuller, 2004). The challenges highlighted across the three previous chapters support the idea that faculty-to-faculty interactions or communication within the interdisciplinary framework can be difficult, but paramount.

While the review of literature in Chapter 2 mainly focuses on design for effective interdisciplinary student learning outcomes, it touches on benefits and challenges of introducing interdisciplinary curricula into higher education. Thus, significant difficulties inherent in supporting equal engagement and synthesis of diverse disciplines needed for an interdisciplinary experience that goes beyond neighboring disciplines were discussed. This chapter provides a platform for instructional and curriculum designers for integration of interdisciplinary approaches into a curriculum design – a suggested role instructional designers should take upon themselves to be at the vanguard of changing educational environment.

Likewise, the findings discussed in Chapter 3 aligned with many of the challenges discussed in interdisciplinary literature, including peer-to-peer faculty preparation and onboarding; challenges of STEM faculty "sharing the floor" with disciplines rooted in humanities; and challenges in reconciliating pedagogical approaches used in each of these disciplines.

Chapter 4 offered a different theoretical approach to interaction and collaboration of faculty interested in the design of an interdisciplinary program, yet once again it highlighted the need for members of an interdisciplinary design team to share a conceptual framework. In an interdisciplinary environment, this framework is expected to more effectively combine philosophy and epistemology of disciplines that may be considered on the continuum of "soft-hard" and "pure-applied." Additional challenges may arise when the decision to create an interdisciplinary program

comes from the administration without the existing buy-in and positive energy from the faculty themselves, as in this case resistance may come not only from those involved, but even peers within their departments (Exter et al., 2017; Irani, 2018; Jacob, 2015; Kandiko, 2012; Whitaker, 2018),

The key feature of interdisciplinarity, particularly further down the interdisciplinary continuum (namely, cross-disciplinary – multi-disciplinary – transdisciplinary education, as defined in Chapter 2) is the need for integration of disciplines, or crossing over disciplinary boundaries, to identify and solve problems with a multi-faceted approach (e.g., as can see in a transdisciplinary environment). This is in contrast with trying to find multiple solutions using different disciplines as a lens for problem-solving approaches (e.g., cross-disciplinary education). Yet, each faculty member that joins an interdisciplinary design or teaching team bring in their own terminology, discipline-specific epistemology, and culture, which impacts both their own behavior and their beliefs about how students should be taught, as discussed both in Chapters 2 and 4, as well as other research (Ashby, Exter, Matei, & Evans, 2016; Debs, Miller, Ashby, & Exter, 2018; M. Exter, Ashby, & Shaurette, 2015; M. Exter et al., 2017; Gillis et al., 2017; Klein, 1996, 2005; Shulman, 2005; van Epps et al., 2016). Indeed, design and implementation of an interdisciplinary program in higher education requires an integration beyond a single discipline. As such, a common language for both building and running the program should be built to span beyond one discipline and is understood and used across diverse faculty (Holbrook, 2013; Klein, 2005). Undoubtedly, this sounds like a common-sense solution, as it should. Speaking the same language is the foundational piece for our survival and existence as human beings, as well as our progression as researchers and educations. However, communication is what makes the solution complex. As discussed in Chapters 2 and 4, academic disciplines have been evolving for centuries through the selection of directions, terminology, and how its representatives define themselves as part of the larger disciplinary culture. Whether it is the attire or the language, a representative of a specific discipline is expected to stand out among other disciplines yet be like those within their own field. However, with the move towards the interdisciplinarity, we are asking this long-term disciplinary evolution to look for commonalities (while enjoying the diversity, of course). Chiseling out what took years to bring up is hard. Yet, it becomes paramount when considering today's society, its needs, and the direction of globalization and collective knowledge, or knowledge distributed across different networks – from organizations to communities and beyond (Hecker, 2012).

The importance of being able to develop a collective understanding of concepts, or share a conceptual space, has been highlighted across the three chapters of this dissertation. Likewise, the challenges associated with such communication as faculty joins from different fields and disciplinary cultures have been brought up as well. Communication happens more easily when the boundaries are less obvious, like neighboring disciplines, or where one discipline is dominant while the other brought in to explain some concepts (i.e., cross-disciplinary environment). The real challenge emerges when a program is designed to be transdisciplinary and thus requiring a more heterogeneous mix of disciplines.

Disciplinary bilingualism is an inherent desire and a common metaphor in for professionals engaging in an interdisciplinary collaboration; yet it rarely occurs (Klein, 1996, 2005; Laursen & O'Rourke, 2019). Faculty become team experts representing their disciplines instead of trying to build mutual understanding. They also bring excess disciplinary baggage, including their perceptions of other disciplines, status (i.e., tenured faculty vs staff vs adjunct instructors) and the power it brings, and preconceived notions of their own role (Klein, 2005). Communication, knowledge integration and transfer, become challenging unless these obstacles can be overcome. The ten stages of communication in an interdisciplinary team offered by Sjölander (1985) demonstrate why these obstacles are often insurmountable and therefore, interdisciplinary collaborations often do not meet the desired outcomes (as discussed in Chapter 1).

Knowledge has value only when it is accurate and accessible (Cranefield & Yoong, 2007b). Considering the type of boundaries that need to be crossed to bringing knowledge across disciplines as show on Figure 1.2 (namely, syntactic, semantic, and pragmatic; Carlile, 2004), it is paramount to identify a best person for the role of the translator, and leverage their strengths to build common terminology, knowledge, or even highlight the points where differences may be occuring because of the nuances in the terminology. Translators are responsible not only for codifying or adapting the language for the interdisciplinary team, but also for interpreting the meaning using application examples, e.g., commonalities and differences in the process of teaching across different disciplines and how this can be brought together in an interdisciplinary program. The evolution of a translator role and their support of an interdisciplinary team in a public sector project as described in Cranefield & Yoong (2007a) had additional positive impact that will certainly be of help for higher education. The Model of Inter-organizational Knowledge Transfer (Cranefield & Yoong, 2007a), has six phases:

1. *Engaging*: A translator filters and simplifies disciplinary knowledge that may be new to the team to tailor it to the current needs. This is an earlier stage of learning about the fields currently represented within the team to initiate the engagement and cannot be equated to Stage 9 "Getting to Know the Enemy" (Sjölander, 1985), as a translator as well as other team members may not have sufficient knowledge of roles and disciplines.
2. *Defining*: An interdisciplinary translator serves as a mediator to survey team members to learn more about their fields, as well as unique issues and problems. The challenge of this phase is in adapting abstract ideas to specific context. In other words, a translator needs to search for application examples of commonalities and differences.
3. *Seeking*: A translator helps their team to actively seek solutions and acquire new knowledge to address issues identified in Phase 2 including both explicit and tacit knowledge and their interpretation for common understanding. The focus of a translator is on simplifying and adapting new sources and discipline-specific information.
4. *Articulating*: At this phase, a translator adapts information, examples, and models to ensure their fit to the needs of an interdisciplinary team/project. This is the phase, where the language that is common to all the members is adopted and recorded for onboarding needs of future participants. The additional benefit is that the translator becomes an expert in this interdisciplinary environment that can also be used in building the program recognition, as well as the transfer to other programs or projects.
5. *Integrating*: The integration of new knowledge and existing knowledge. A translator/expert helps smooth the process. This may happen simultaneously with Phase 6.
6. *Disseminating*: A translator/expert becomes a storyteller, champion, or advocate for the interdisciplinary team and program. They can help inform the organization as a whole, any interdisciplinary projects that may follow the completed one, or a community (e.g., presentations, white papers, or an in-depth write-up of results).

While this model can serve as a prescriptive discussion of a role of a translator, it is still very important for a translator to reflect on communication differences and challenges and how to turn those to benefit the project.

Competencies for Instructional Designers as Translators

Several characteristics of a translator have been identified in the literature, including that an interdisciplinary translator should:

- Have a different discipline/culture than those within the team (Hauschildt & Schewe, 2000)
- Work across disciplinary and role boundaries to monitor external resources and internal interactions; to establish communication and collaboration networks (Hernandez et al, 2004 as cited in Cranefield & Yoong, 2007)
- Be capable to bridging discipline-specific terminology and disciplinary cultures together (Hernandez et al, 2004 as cited in Cranefield & Yoong, 2007)
- Ready to help establish a community of practice for existing and new members of the interdisciplinary program design team (Carlile, 2004).

Considering these desired characteristics, the type of training and experience instructional designers bring in, they are a strong fit for this role. Furthermore, taking into account the diverse capacity (or agencies) owned by instructional designers, it is possible to describe professionals in this field as those who:

- Possess experience in evidence-based teaching and learning across different disciplines and can help evaluate gaps and help build a resource repository (professional agency),
- Take the point of view of both students and faculty to help determine the commonalties and build their self-efficacy (interpersonal agency),
- Understand the disciplinary and institutional cultures to interweave the program within the institution (institutional agency), and finally,
- Help build program that can meet larger goals for future graduates in terms of academic education and practical experiences (societal agency).

It is important to note though that this will not be yet a fully new capacity (or agency) for an instructional designer, but rather an addendum or expanded agency across the four ones identified by Campbell et al. (2005, 2009). All in all, the translation capabilities inherently span across the existing change agencies, including providing professional support and development services (professional agency), instructional designers often serve as advocates not only for students, but also faculty to build community, promote their self-efficacy, and help develop skills

that ultimately help learners (interpersonal agency). Instructional designers are sensitive to institutional culture, have to navigate the often-tough terrain of academic "tribes" (institutional agency), and address larger cultural and ethical issues when working on domestic and international projects (societal agency). In other words, they possess qualities and skills that enable them to serve as a communication and project mediator (or translator, as I will discuss next) not only between faculty and student, but also faculty and faculty, faculty and administrator, and faculty and external stakeholders.

Barriers for Instructional Designers as Translators

I can envision several potential barriers to instructional designers serving as translators for a faculty team, based on prior research:

1. *Lack of understanding and appreciation of the role and qualifications of instructional designers and resulting power imbalance* (Richardson et al., 2018). Knowledge translation may often require the need to create new consensus or agreement and hold team members accountable to it, which requires gaining buy-in and trust of the faculty (Carlile, 2004; J. Klein, 1996, 2005). However, if faculty is unaware of the role of an instructional designer, have strong opinions about the power or hierarchy within such teams, or yet higher qualification/degree (e.g., PhD for faculty vs master's for instructional designers), it may cause additional strain due to the power imbalance. As a result, an instructional designers may need to take significant time to gain the trust needed, especially considering Sjölander's "Everybody on the other side is an idiot" stage (see Chapter 1) and potential questioning of the depth of knowledge of an instructional designer to fully appreciate individual disciplines; as well as whether an instructional designer is empowered to tell faculty what to do. This may be even a bigger challenge.
2. *Instructional designer joining too late*. From personal experience and experiences of instructional designers with whom I have interacted, it is common that instructional designers are brought to the team at the point of course development. In part, this is caused by the lack of understanding of the role and professional capacities of an instructional designer. Likewise, it may also be due to the power play of letting faculty decide what to do and how.

3. *Time, effort, and commitment of an instructional designer as a translator:* While the importance of translation on an interdisciplinary team has been highlighted in organizational and team science, current research is limited in terms of the specifics of the role or the time it takes to complete it (Cranefield & Yoong, 2007a). Though, this can become an advantage, as an instructional designer can then shape the role and functions that are of the most benefit to the team.
4. *Ability to take an open-minded approach, work across disciplines, and engage in continuous lifelong learning*: Instructional designers come from different disciplines (and therefore, disciplinary cultures), and therefore have different personalities, biases, processes, goals, and vision for the boundaries of their own work which may help with the translation on an interdisciplinary team or may further hinder it (Ashby & Walker, 2015; Richardson et al., 2018). Additionally, they may or may not be open to ongoing learning beyond what is immediately needed for the job (Exter & Ashby, 2021).

Directions for Future Research

Taken together, the dissertation offers directions for future research across the following areas:

1. *Interdisciplinary team formation and management in higher education*: Chapter 4 provided an initial insight into interdisciplinary teams as complex systems that are open and usually formed up from bottom-up. Such complex systems are sensitive to changes in the composition of agents, communication and interaction networks, as well as external rules and boundaries (e.g., institutional settings). While there is some theoretical and conceptual research on the topic of interdisciplinary teams a complex system, it has not yet been studied in more detail to provide support for effective implementation of interdisciplinary teams.
2. *Role of instructional designers on interdisciplinary teams*: As shown across Chapters 2, 3, and 4, communication and sharing a conceptual space is challenging on an interdisciplinary team due to differences in disciplinary cultures; perceptions of roles and expertise of peers from other domains; one's own expectations, departmental culture, expectations, and resources; the actual and perceived relationships between departments within he institution; and the overall culture of the institution (Becher & Trowler, 2001; Klein & Kelly, 2018; Richardson et al., 2018; Ritzhaupt & Kumar, 2015). Indeed, it is naïve to consider that the

ability to communicate successfully equates to a desire to do so. While instructional designers have the capabilities and expertise to serve as translators of knowledge across the teams there are multiple challenges that may be experienced. The listed challenges are based on conclusions drawn from research on often individual collaboration of instructional designers with faculty. However, the dynamics will be quite different on an interdisciplinary team with multiple faculty members.

3. *Supports for effective interdisciplinary program design teams by instructional designers*: Chapters 2 and 3 highlighted common challenges experienced by faculty designing and co-teaching interdisciplinary courses and programs, including the lack of a common pedagogy, lack of shared understanding of goals and expectations, and lack of faculty support on integrating interdisciplinarity into a course or program. Further research investigating roles and supports offered by instructional designers working in a capacity of a translator is important.
4. *Design for and implementation of the interdisciplinarity in higher education*: As discussed in Chapter 2, there is a lack of evidence-based strategies on design and development of interdisciplinary courses and programs, as well how to teach in an interdisciplinary environment with particular focus on higher level of synthesis, like transdisciplinarity. Steps and supports needed to design a transdisciplinary program, as well as the involvement an instructional designer will have require a more in-depth view and comparison (e.g., meta-analysis) across multiple programs.
5. *Agent-based modeling (ABM) application for outcome simulations*. In exploring the complexity theory and its application in program design, I got rather interested in using the ABM modeling technique to predict outcomes of whether an interdisciplinary team may emerge and how it may happen in a non-centralized (top-down) environment. Such a model includes a collection of agents (e.g., faculty, staff, administrators) that are autonomous, can have different characteristics, goals, and make independent decisions. They also have relationships with each other, which also impacts their behaviors and decisions. Yet, they all behave within the system parameters, which represents an environment. ABM will allow to (1) capture the emergent phenomena of the system (e.g., program design and creation); (2) represent a natural description of a system; and (3) be flexible in ways similar to that of a natural environment (Secchi & Neumann, 2016). It

These directions will inform my future research endeavors in order to understand communication as well as other variables that may play into it.

Practical Implications for Educational Programs

Based on the opportunities and barriers discussed above, there are several implications for educational programs that prepare instructional designers:

1. Explore in more details such topics as the typology of interdisciplinarity (Chapter 2) and interdisciplinary environments as complex systems (Chapter 4); ten stages of interdisciplinary communication to envision challenges and pitfalls of interdisciplinary collaboration (Sjölander, 1985; as discussed in Chapter 1); as well as the Model of Inter0Organizational Knowledge Transfer (Cranefield & Yoong, 2007 as discussed in Chapter 5).
2. Embed opportunities for exploring signature pedagogies and specific approaches used by instructors across different fields within soft-pure, soft-applied, hard-pure, and hard-applied disciplines. This will help graduates familiarize themselves with and start synthesizing the specifics of the disciplines, strategies for teaching and learning, and expectations for students in those disciplines. Additionally, it could be helpful to add application activities to design for a combination of such approaches.
3. Create interdisciplinary opportunities though combined courses that would welcome students from different (non-neighboring) majors and where instructional design students will have to use design and translation skills to help reach consensus within their teams. For example, during my career as a PhD student, I worked with my advisor Dr. Marisa Exter on re-design and co-teaching of a graduate-level course on educational software development. The course welcomed students from across disciplines, including but not limited to instructional design, human-computer technology, computer graphics, teacher-training programs, and others interested in the process that leads to a hi-fidelity software design. Though embedding additional opportunities for the role of a translator will be beneficial both for instructional design students wanting to try out this role, but also for students from other fields to get a fuller immersion in an interdisciplinary environment.

Practical Implications for Instructional Designers in Higher Education

As a practicing instructional designer working with diverse faculty across universities, I fully realize the need for evidence-based strategies that could help me support faculty working on interdisciplinary courses. As such, one of my underlying goals for this dissertation is to better understand the underlying obstacles in working with faculty members and strategies on supporting them both for effective and productive relationship and positive results of the students. Thus, there are several implications I would like to highlight:

1. Take your time to learn more about the disciplinary culture of faculty members to inform your relationship and strategies you will employ. Pitfalls that are common for an interdisciplinary team communication are undoubtedly similar to the ones you may experience in your daily practice, since faculty members will not necessarily have the background and experience you have.
2. Become disciplinary bilingual, or better yet multilingual. As a professional translator and instructional designer, I can attest that the words you select to translate the idea can make or break the negotiations; can help people feel comfortable and in control or push them outside of their normal environment.
3. Explore pitfalls of interdisciplinary communication (as described in Chapter 1) and how can you support a program or course by serving as a translator on the project (see chapter 5). You can plan ahead on how to mediate these challenges at and between meetings to minimize potential fallouts and move the project forward.
4. Empower yourself with learning more and practicing change agencies, including interpersonal, professional, institutional, and societal agencies (Campbell et al., 2005) and as discussed in Chapters 1 and 5. Remembering these agencies when you work on a project next time will help you balance the power better in your relationships with subject-matter experts and universities in general.

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