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Exploring Interdisciplinary Identity Development Using Possible Selves: An Exploratory Study

Jessica R. Deters, Maya Menon, Marie C. Paretti, and Margaret Webb
Virginia Tech Department of Engineering Education
jdeters@vt.edu

ABSTRACT

CONTEXT

This exploratory study focuses on an interdisciplinary graduate program in the United States that brings students from science, engineering, technology, or mathematics (STEM) programs together with students in business, policy and governance, natural resources, and other fields to address disaster resilience and risk management. Given the complexity of interdisciplinary collaboration and the need to work across disciplinary boundaries it is increasingly important to develop interdisciplinary capacity in STEM graduate students.

PURPOSE OR GOAL

The purpose of this exploratory study was to explore how participants conceptualize a possible identity as an interdisciplinary scholar over time in order to characterize the structural and individual factors that might prevent one from developing an interdisciplinary identity.

APPROACH OR METHODOLOGY/METHODS

This exploratory study draws on identity-based motivation, using the possible identities framework to understand two qualitatively different development trajectories for two STEM graduate students in the interdisciplinary program. We draw on longitudinal semi-structured interviews over three years with two participants who exhibited markedly different identity development trajectories. Data were analysed using the possible identities framework, which allows us to investigate how participants' desire to be an interdisciplinary scholar changes over time because of their experiences in the interdisciplinary program.

ACTUAL OR ANTICIPATED OUTCOMES

Preliminary analysis indicates that participation in the program does not guarantee that students will desire or develop an identity as an interdisciplinary scholar. Students participate in interdisciplinary programs based on a variety of internal and external factors, and similarly, their identity development depends on multiple factors, including students' backgrounds and their perspectives on the goals of doctoral study.

CONCLUSIONS/RECOMMENDATIONS/SUMMARY

We find that interdisciplinary identity development is an individual process that can be constrained or enabled by several structural factors. Interdisciplinary graduate programs can facilitate interdisciplinary identity development, only if structural and individual factors are addressed in tandem. These exploratory findings suggests that interdisciplinary programs may sit at a complex intersection of students' personal goals and orientation and the structural constraints of the institutions. These intersections must be understood more fully in order to develop effective interdisciplinary programs that foster interdisciplinary identity development.

KEYWORDS

Interdisciplinary, Graduate, Identity

Introduction

In response to calls from both universities and government agencies in recent decades, schools have seen a marked increase in interdisciplinary graduate programs that educate students to think across boundaries. The U.S. National Science Foundation (NSF) has funded interdisciplinary training programs for graduate students since 1998, first through the Integrative Graduate Education and Research Traineeship (IGERT) and now through the NSF Research Traineeship (NRT) program (NSF, 2019). In 2014, representatives from graduate institutions across 14 countries issued a joint statement establishing the importance of interdisciplinary graduate education and research (McCarthy & Woolfrey-Fahey, 2014). Such calls are further supported by educational research highlighting the need to train interdisciplinary scholars, who can move between disciplines and take on the perspectives of different disciplines (Borrego & Cutler, 2010; Newswander & Borrego, 2009).

In response to these calls, interdisciplinary graduate programs have emerged across the U.S. and elsewhere. However, both structural and individual barriers to successful implementation of interdisciplinary programs persist (Boden et al., 2011). One challenge lies in the fact that current university systems are organized around disciplines. This structure creates barriers such as resource allocations, incentive structures, and course credit issues. Moreover, the siloed nature of universities can lead to interdisciplinary programs in which learning is simply structured as a disconnected set of modules from different disciplines (Foley, 2016).

In addition to structural barriers, however, interdisciplinary graduate programs face individualized challenges in helping students simultaneously develop competencies in their home disciplines and those that enable them to work across disciplines (Lattuca et al., 2017). This challenge is compounded by the ways in which students see themselves – the identity (or identities) they assume and are granted across their educational experience. At an undergraduate level, students tend to view themselves through the lens of their individual disciplines (Entwistle, 2009). A graduate degree enhances this "reflection of a disciplinary identity" (Holley, 2017, p. 1), but in doing so can "[produce] over-specialized, disciplinary-based researchers who struggle to adapt to industrial and professional workplaces" (Mathunga et al., 2006, p. 307). As a result, if the goal is to train graduate students to take on interdisciplinary perspectives in both their graduate work and their future careers, programs must not only give students interdisciplinary skills, but also build interdisciplinarity into their professional identities in ways that support sustained engagement. Work in identity-based motivation is particularly relevant here in that it links the ways in which individuals see themselves, in the present and in the future, to their current motivation and actions. Further, in the context of disaster resilience, interdisciplinary identity development is increasingly necessary as the complexity and frequency of disasters increases.

Theoretical Framework

The established links between identity and motivation raise questions about how graduate students see their own identities as both disciplinary and interdisciplinary scholars, and how their perceptions influence their professional development and engagement in interdisciplinary programs. To begin to explore these questions, we draw on the concept of possible identities (also referred to as possible selves) to understand the ways in which graduate students in the interdisciplinary Disaster Resilience and Risk Management (DRRM) program perceive their present and future identities. Possible identities represent "working theories of who one may become, based in current assessments of one's own strengths, weaknesses, talents, and characteristics, as well as assessments of what is possible for people like oneself" (Oyserman & James, 2011, p. 119). Beginning with the work of Markus and Nurius (1986), and later taken up by Oyserman and others, researchers have examined the ways in which both hoped-for and feared possible selves influence individuals' current actions, including academic choices and outcomes. Research in this area suggests that a

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future identity is most likely to positively influence current actions when it is "congruent with other aspects and goals of the current self, be connected to the present self, and be possible to attain" (Kajfez et al., 2016, p. 22). These criteria are defined in Table 1.

Table 1: Dimensions of Possible Selves Needed to Influence Present Actions

Dimension	Definition
Connected	The possible identity is aligned with the person's values and core sense of self; it is an extension of the current self and feels closely connected to one's present.
Congruent	The actions needed to attain the possible identity are aligned with the person's current self.
Possible to Attain	The person believes that the future identity is possible to attain through appropriate action, and that difficulties that may arise can be overcome. (Notably, if an individual believes that the future identity is easy to obtain and requires little or no action, they are as unlikely to take action as if they believe it is too difficult.)

Possible identities as a framework, then, provides a lens to explore how students see themselves relative to a given interdisciplinary context, which in turn can help guide program development. As a first step toward such actions, this exploratory case study examines the development trajectories for two STEM graduate students in an interdisciplinary graduate program, focusing on two research questions:

1. In what qualitatively different ways do graduate students' conceptions of future possible selves shape their development as interdisciplinary scholars?
2. In what ways do university structures constrain or enable interdisciplinary identities among graduate students?

To address our research questions, we adopt a constructivist approach, focusing on how participants perceive interdisciplinarity as a possible identity. Subsequent work will examine longitudinal data for all participants in the interdisciplinary program, both in STEM and non-STEM disciplines, to consider changes in students' perceptions over time and corresponding actions they take or do not take relative to developing an interdisciplinary identity.

Methods

This exploratory case study (Yin, 2018) draws on longitudinal semi-structured interviews with two STEM graduate students who have completed at least two years in the interdisciplinary DRRM program. Each student is considered a case and their trajectories are compared to develop an initial framework for understanding interdisciplinary identity development across participants in the program. We employ an a priori coding scheme grounded in possible selves to analyze the data (Miles, Huberman, & Saldana, 2019). Moreover, we posit that the use of possible identities and longitudinal data could be transferred to other interdisciplinary contexts to understand interdisciplinary identity development in other interdisciplinary programs.

Research Site: Disaster Resilience and Risk Management (DRRM) Program

The study context is an interdisciplinary graduate program at a large land-grant university in the mid-Atlantic region of the United States. Built on an earlier iteration funded internally by the university, the current program is funded through the National Science Foundation (NSF) Research Traineeship (NRT) program, with plans to ensure long-term sustainability through both internal and external funding. The graduate program focuses on disaster resilience and risk management and brings together students and faculty from engineering, business, the sciences, and planning and governance. All students and faculty are associated with a

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disciplinary department; the interdisciplinary program grants a graduate certificate but not graduate degrees. Participants' advisors are required to engage in the interdisciplinary program, and participants must have at least one committee member from outside of their discipline who is associated with the program. While interdisciplinary committee members can give input throughout the process, participants' degree-progress is dictated by their discipline and advisor.

While the program's courses are open to graduate students across levels, funding is allocated primarily for doctoral students. Funded students as well as students completing the program's graduate certificate complete at least 12 hours of DRRM coursework (typically 4 courses), along with a 1-credit interdisciplinary seminar each semester, in addition to their core, disciplinary coursework (typically 30 hours or 10 courses). Most students can count the DRRM coursework toward their departmental degree requirements, but for some students the additional coursework itself is a barrier. The required program coursework provides students with interdisciplinary grounding in issues related to DRRM, while the seminar offers a space for students to develop a community of practice and learn what it means to be an interdisciplinary scholar in this area. Participants in this study had participated in at least the first two years of DRRM coursework (their exact point in the program at the time of analysis is masked to maintain participant anonymity), including four semesters of the seminar and an interdisciplinary foundational course.

Data Collection

This study draws on semi-structured, hour-long interviews with participants at the conclusion of each year in the program. All interviews were conducted by two of the program's graduate research assistants, who are both educational researchers who have observed the introductory course as well as the seminar and thus have built significant rapport with the participants over time prior to data collection. The interviews were audio-recorded and transcribed by a professional transcription service. While the interviews covered a broad range of topics, this paper draws primarily from participants' responses to the following interview question:

> Do you consider yourself an interdisciplinary scholar/practitioner? Why or why not?
>
> *Follow-up prompts:*
>
> a. To what extent do you view yourself as an interdisciplinary scholar?
> b. To what extent do you want to view yourself as an interdisciplinary scholar?
> c. To what extent have you been able to practice being an interdisciplinary scholar?
> d. What experiences could help you get there?

This research was approved by the Institutional Review Board at the authors' institution, and the participants in this paper consented to the research study.

Participants

To select participants for this exploratory case study, we set two inclusion criteria: 1) participated in at least two annual interviews and 2) pursuing a PhD in a STEM-discipline. Moreover, since this is an exploratory study, for those meeting the inclusion criteria, we used maximum variation as the sampling criterion; that is, we select two participants (Students A and B) whose identity trajectories were most different from one another. Because the DRRM program is small, we mask demographic characteristics in order to maintain participants' anonymity.

Data Analysis

To understand students' development as interdisciplinary scholars, we first used a priori coding (Miles, Huberman, & Saldana, 2019) based on the possible identities framework to examine the extent to which participants considered an interdisciplinary identity as connected

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to their current identity, congruent with their current identity, and possible to attain. Using a holistic approach to each transcript, participants were placed in one of three categories for each dimension: Yes, Unsure, or No (e.g. connected, unsure, not connected). Participants' desire to become an interdisciplinary scholar was analyzed based on their responses to follow-up prompt b in the interview protocol ("To what extent do you want to view yourself as an interdisciplinary scholar?"), with responses coded as Want to Be, Do Not Want to Be, or Unsure.

Author 2 conducted an initial round of coding, reviewing responses to the questions about being an interdisciplinary scholar holistically to assign each participant to one of the three subcodes for each dimension. Author 1 reviewed the initial coding and indicated agreement or disagreement. The authors agreed on all of the codes, so no negotiation to consensus was required.

Positionality

The research team for this study consists of four scholars who are all engineering education researchers embedded within the interdisciplinary program. Deters is a Ph.D. candidate in Engineering Education and has worked as a graduate research assistant with the DRRM program since 2018. Menon is a Ph.D. student in Engineering Education who began working with the DRRM program in 2020. Paretti is a Professor in Engineering Education and leads the educational arm of the DRRM program, teaching the core program course and leading educational assessment efforts. Webb is a Ph.D. student in Engineering Education who began working with the interdisciplinary program in 2021. Deters, Menon, and Webb are funded participants in the interdisciplinary program and have developed rapport with the other student participants.

Limitations

The data for this study come from one context-specific interdisciplinary program within a single institution; as a result, the findings are not intended to be generalizable to other programs or institutions. Moreover, they present perceptions of a limited number of participants. However, as an exploratory study, the findings highlight several potential issues that can help inform program development and this research may be applicable to other programs. Further, the approach to understanding interdisciplinary identity used in this study provides the basis for longitudinal work across a broader sample of students in order to understand both actions taken and changes in perception over time.

Results

As noted, the two participants in our exploratory analysis illustrate contrasting conceptions of participants' futures as interdisciplinary scholars. Through their experiences and words, we can see the ways in which participants did or did not perceive interdisciplinarity as congruent, connected, and possible to attain relative to their present self. Further, we can identify structural aspects of their experience that constrained and enabled their identity development.

Student A: "Become an Expert in My Discipline First"

Student A recognized the importance and value of interdisciplinary collaborations from their experiences prior to pursuing a PhD but remained highly invested in developing their disciplinary expertise throughout their doctorate program. In their year one interview, Student A perceived a future interdisciplinary identity as connected but not congruent – an interdisciplinary identity aligned with their values (i.e., connected) but the actions needed to attain that identity did not align with their goals for their graduate program (i.e., not congruent). Student A could see themselves attaining an interdisciplinary identity in the

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distant future, after completing their PhD. That is, being an interdisciplinary scholar was not the primary goal for Student A during their PhD program. This student noted:

> *But as a PhD student, it's a kind of [about doing] independent research […] 100 percent collaboration research is not […] a good thing [for] a PhD student.*

The interdisciplinary graduate program provided Student A with funding to pursue their research interest and collaborate across disciplines with others who are working in a similar domain. By the time the year two interview was conducted, Student A's actions were congruent to achieving an interdisciplinary identity. However, their focus on gaining disciplinary knowledge and expertise did not waiver. In the second interview, the student expressed:

> *As a student, we need to become expert in our discipline first, and then [collaborating] or working with other disciplines should be the second step.*

What changed for Student A from the first year to the second was the definition of *interdisciplinary*. While navigating through interdisciplinary research and collaborating across other STEM fields, the student wrestled with the idea of what qualifies as interdisciplinary. Student A explained their confusion:

> *I'm a little bit confused of my identity sometimes because I'm in [STEM discipline A - hidden for anonymity], but my research seems like related to more in [STEM discipline B] field sometimes. So, most of the papers I'm reading is related to [STEM discipline B] journals. So am I in [STEM discipline A] and working for [STEM discipline B]? Those kinds of things. But that means I'm an interdisciplinary researcher so, I would say yes.*

While Student A's collaborations with other faculty and students during their time in the program indicates congruency to an interdisciplinary identity, they found it difficult to differentiate between what counts as disciplinary and interdisciplinary when disciplines overlap. Overall, Student A was more connected to their discipline and more committed to acquiring disciplinary expertise throughout the duration of their program. Furthermore, they admitted to being confused as to whether they identify as an interdisciplinary scholar or even want to, in the future, but saw it as a possibility upon completion of their PhD.

Student B: "Interdisciplinary scholar - that is the one thing I need to be"

Student B, in contrast, was very clear about their interdisciplinary identity and goals from the beginning of their PhD journey. Motivated to pursue a PhD because they felt that they didn't know enough to effectively collaborate at the firm they worked for, they felt disconnected to their discipline and more connected to the interdisciplinary program. In their year one interview, Student B felt connected to a future interdisciplinary identity – it aligned with their values, and they even noted that "[an interdisciplinary scholar] is the one thing I need to be."

To Student B, an interdisciplinary scholar is an individual who can bring together different knowledge areas. An interdisciplinary scholar, according to Student B, does not have to have deep disciplinary expertise, but rather focuses on facilitating connections between disciplines. Student B further explained their definition of an interdisciplinary scholar in their year one interview:

> *I think it means that I have the liberty to solve applied problems, applied complex problems in real time, like modern problems. I think that you can't be so specialized in something so obscure. You can't be too deep into something so tiny in order to solve these really, really big problems. I think some people need to have that really, really fine disciplinary expertise, but I think you also need to have some people that can bring all that together somehow and link it together or understand how it links together, like have more of a systems perspective that's not so entrenched [in a single discipline].*

Although Student B did not think they could call themselves an interdisciplinary researcher at the time of the year one interview, they were very clear about their desire to be interdisciplinary as they acknowledged that real-world problems are not bounded by a discipline:

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> *Mother Nature does not construct her problems with a disciplinary lens. So, a lot of the really people focused problem-solving classes tend to be kind of interdisciplinary.*

Student B believed that an interdisciplinary identity was attainable and expected the interdisciplinary graduate program to provide them with opportunities that were congruent to their goal. Over their time in the program, Student B worked across disciplines and collaborated with a number of different people from various fields. The program gave them the platform to communicate to different disciplines about their research, and they reported gaining confidence through such courses and research project presentations and collaborations. However, they felt constrained and limited by the academic setting and expectations of their advisor and department. Their research interests seemed to span over different disciplines, which, from comments they received from their advisor and others, may not be the ideal situation for a PhD student. The advisor and others felt that the student did not have the deep knowledge and expertise in their discipline, which led them to lack a sense of belonging in their department. As a result, despite an interdisciplinary identity being connected, congruent, and attainable throughout their time in the interdisciplinary program, they struggled with confidence and imposter syndrome. In their year two interview, Student B said:

> *I think because of these [kinds of] identity struggles about like whether I'm a good researcher, am I a good researcher? Um, these identity struggles kind of stem from maybe being an interdisciplinary student and not feeling like I have a place has not helped me with any sort of like confidence or imposter syndrome sort of like alleviating that. It only exacerbates that. Because you look around at, you know, your fellow students. And I told you that I try not to compare myself to other people in my department. I do that on purpose because I feel like I lack the knowledge base to be a researcher in that field. So being an interdisciplinary student is challenging for that reason where you think that you kind of have to justify your existence sometimes because maybe you don't have as deep of a knowledge base as the people in your department. You just have a different knowledge base. So yeah, that, that, that kind of insecurity about not feeling like I am sufficient in a certain department for a while um, impeded my ability to see myself as a PhD researcher.*

By the end of the program, Student B felt the need to be a part of a different environment in order to continue their primary goal of being an interdisciplinary scholar.

The Role of University Structures

Throughout their interviews, the students discussed different university structures that enabled and constrained their identity development, including the design of their doctoral program, their advisor's approach to interdisciplinarity, and the siloed nature of departments at the university. First, Students A and B had very differently constrained doctoral programs. Student A's program had a large number of required courses, requiring them to take the majority of their courses within their discipline, while Student B's program had a small number of required courses, allowing them to take many courses in other disciplines. Moreover, Students A and B's advisors offered different guidance about and support for interdisciplinary work at different stages of their Ph.D., which was in part informed by how they perceived expectations for dissertations within their department. The students navigated different disciplinary structures and advising styles, but both experienced tensions between their interdisciplinary program and the disciplinary silos of academia. Student A was more comfortable with a disciplinary focus, and while they collaborated across other related STEM disciplines, they did not identify this work as interdisciplinary. However, Student B, for whom interdisciplinarity was congruent, connected, and possible to attain relative to their present self, felt limited by the siloed nature of academia. While both Students A and B valued interdisciplinarity in their research, the role of university structures affected them differently because of their contrasting relationship with their future self and interdisciplinary identity development.

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Discussion & Conclusion

Both participants discussed navigating structural challenges associated with interdisciplinary education, similar to those barriers noted in Lattuca et al. (2017), including challenges balancing their efforts between their disciplinary degree-granting program and their interdisciplinary graduate certificate. The two participants in this study both discussed how their experiences were shaped and constrained by these existing university structures, and each participant responded differently. Student A chose to focus primarily on their discipline, seeing interdisciplinary work as something that could happen in the distant future. Because an interdisciplinary scholar identity was a distant possible self, their responses about whether this identity was connected, congruent, and possible to attain oscillated. On the other hand, Student B chose to focus primarily on interdisciplinary work, and felt that they did not fit into the structures of their discipline. While this student fully embraced 'interdisciplinary scholar' as a future possible self, they struggled to navigate the strict boundaries of their discipline.

The experiences and trajectories of Students A and B through their disciplinary and interdisciplinary programs raises questions about how we design interdisciplinary programs. Tensions between university structures, like disciplinary silos, reward structures, and even the layout of physical buildings, and interdisciplinary programs are longstanding (Boden, Borrego, & Newswander, 2011; Gardner et al., 2012; Holley, 2009; Lattuca, 2001). These barriers existed in the previous iteration of nationally funded interdisciplinary programs (IGERTs) and still exist today with NRTs. As Student A and B's stories show, the continued prevalence of structural barriers impacts how students navigate their possible identities and ultimately impacts the success of these taxpayer funded interdisciplinary programs. This work reinforces the need to account not only for the structure of universities, but also for the orientations students bring (i.e., towards disciplinary expertise or towards interdisciplinary expertise), and to foreground both the alignments and the tensions that exist as students navigate these structural barriers. That is, students may wish to build disciplinary expertise but be funded through an interdisciplinary program, or they may seek interdisciplinary expertise, but be constrained by departmental expectations.

These exploratory findings suggests that interdisciplinary programs may sit at a complex intersection of students' personal goals and orientation and the structural constraints of the institutions. We need to understand those intersections more fully as we think about the future of interdisciplinary education. Accordingly, more work is needed to expand this exploratory study into a larger study that looks across more participants and more interdisciplinary programs.

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