Identifying Asymmetries in Web-based Transfer Student Information that is "Believed to be Correct" using Fully Integrated Mixed Methods

David P. Reeping

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David B. Knight, Chair
Jacob R. Grohs
Matthew W. Ohland
Kenneth J. Reid

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ABSTRACT

Transfer between community colleges and four-year institutions has become more common as student mobility increases. Accordingly, the higher education system has coped with the fluidity by establishing articulation agreements that facilitate pathways from one institution to another. The forward-facing policies and guides to inform students on those pathways are known to be complicated, leading to the development of web-based tools like Transferology to help students navigate the system. Still, credit loss is common, whether through misunderstandings, lack of awareness, or changing degree plans. A proliferation of literature examines the experiences of transfer students and other agents in the process like community college advisors, but few pieces interrogate the underlying website structures that facilitate those experiences as the unit of analysis.

Information related to facilitating transfer from one institution to another is often fragmented across multiple webpages or policies and uses language not optimal for communicating with students – creating what are called "information asymmetries" between the students and institutions. The premise of an exchange having information asymmetries is that one or more parties in the exchange have more or better information than the others, leading to an imbalance in power. In the case of higher education, transfer students – and their advisors by extension – can be subjected to manipulation by the invisible hands of the four-year institutions through language gaps and scattered

sources of information. Accordingly, this dissertation explored four-year university websites, a major point of contact students have with information on transfer, to address the following main research question: “How are information asymmetries in curricular policies/procedures apparent for engineering students on institutional webpages in terms of language and fragmentation?” The subsequent research question synthesized the results of the first question: “Looking across information asymmetry measures, what are the different narratives of information asymmetry that integrate themes of language and fragmentation across institutions?”

A fully integrated mixed methods design using all existing data was employed to address the two research questions. A stratified random sample was taken with respect to institution size based on their Carnegie classifications (n = 38). The collection of relevant public webpages based on a set of keywords from the sampled institutions was transformed into three network measures - hierarchy, centrality, and nonlinear – that were used in cluster analyses to group the institutions based on their information structures. Sequential mixed methods sampling was used to choose institutions purposefully from each cluster based on notable features recorded during the first stage of data collection. Two-cycle coding followed the cluster analysis by elaborating on the networks formed during data collection. I used joint displays to organize the networks and In-Vivo codes in the same picture and develop themes related to fragmentation and language simultaneously.

K-means and K-medoids cluster methods both produced the same four cluster solution illustrating one aspect of information asymmetries through fragmentation. The clustering solution highlighted four major network patterns, plus one cluster mixing two

of the patterns: 1) linear browsing, 2) centralized expansive browsing, 3) branched browsing, and 4) mixed browsing. Further qualitative analysis of the sampled institutions revealed several types of missteps where information is obscured through language or dispersed in the network. I explored a subset of 16 institutions and identified four themes related to fragmentation (unlinked divergence, progressive disclosure, lack of uniformity, and neighborhood linking) and six themes related to language (hedging transferability and applicability, legalese handwaving, building rapport, exclusivity, deviance from common practice, and defining terms). The missteps were contextualized further using six narratives with institutional examples.

This work characterized the information design for transfer students as a messy web of loosely connected structures with language that complicates understanding. Integrated narratives illustrate a landscape of loosely coupled information structures that become more expansive as state initiatives interact with already existing local agreements. Moreover, institutional websites describing transfer processes use communication strategies similar to private companies writing online privacy policies. In light of the themes of information asymmetries, opportunities for supporting transfer were highlighted. For example, institutions are encouraged to create visual representations of the transfer credit process, ensure terms are defined upfront while minimizing jargon, and avoid linking to information that is easily summarizable on the current page.

This research would be of interest to institutions looking to improve the presentation of their transfer information by critically examining their designs for the missteps described here. In addition, engineering education practitioners and researchers

studying transfer student pathways and experiences will find the results of interest – especially in considering how to support the students despite the large information gaps. Finally, those looking to implement a fully integrated mixed methods design or use existing/archival data in their own context will find the use of mixing strategies of interest.

Identifying Asymmetries in Web-based Transfer Student Information that is "Believed to be Correct" using Fully Integrated Mixed Methods

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GENERAL AUDIENCE ABSTRACT

Transfer between community colleges and four-year institutions has become more common as student mobility increases, especially for engineering. Institutions have coped with this inter-institutional movement by establishing agreements with each other that facilitate pathways between programs. The forward-facing policies and guides to inform students on such pathways are known to be complicated, leading to the development of web-based tools like Transferology to help students navigate the system. Despite these advances, transfer students continue to struggle in their information search.

The purpose of this dissertation was to describe the extent to which information for engineering transfer students is scattered across multiple web-based sources and written in a manner not conducive to understanding. I used a fully integrated mixed methods design to create narratives capturing the interactions between the more quantitative idea of scatter using network analysis and the more qualitative aspect of language-use using visually based two-cycle coding across 38 U.S. four-year institutions. All data was readily available online, which were transformed and combined using several mixing strategies to form integrated stories of information asymmetries.

The resulting narratives characterized the information design for transfer students as a messy web of loosely connected structures with language that complicates understanding. Moreover, institutional websites describing transfer processes use

communication strategies similar to private companies writing online privacy policies. In light of the themes of information asymmetries, opportunities for supporting transfer were highlighted. This work will be of interest to those interested in engineering transfer student experiences and pathways. Also, those looking to implement fully integrated mixed methods approaches or make extensive use of existing data, especially mixing during analysis, will see strategies applicable in their own work.

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CHAPTER 1. INTRODUCTION

"Missing information flows is one of the most common causes of system malfunction. Adding or restoring information can be a powerful intervention."

(Meadows, 2008, p. 157)

1.1 Introduction

Used cars with mechanical problems lurking under their hoods are peddled at lots across the country to unsuspecting customers who only realize sometime after signing on the dotted line that they had been sold a dreaded "lemon." Akerlof (1970) demonstrates the effect of such *information asymmetry*, akin to not disclosing the problems with a car, in the context of the used car market in his seminal piece "The Market for Lemons"—asymmetries can lead to market failure. Market failures are not financial collapses, as the name might imply; rather, market failures occur when the allocation of goods and services are not efficient in the microeconomic sense, leading to suboptimal performance of the overall system. Information asymmetry is said to exist in a transaction if one party has better or more information than the other party or parties (Milgrom & Roberts, 1992). All sectors are susceptible to information asymmetry in some sense, far beyond predatory used car lots, and education is rife with asymmetries across the system between all stakeholders.

In higher education, information asymmetries have risen to become ever-present in how institutions and their stakeholders interact with one another (Dill & Soo, 2004; Kivistö & Hölttä, 2008), especially with respect to policy. Once students matriculate, if they cannot find the information needed regarding higher education processes and

procedures, they often face difficulties answering questions regarding their next steps to progress through their degree programs (Nodine, Jaeger, Venezia, & Bracco, 2012; Van Noy, Trimble, Jenkins, Barnett, & Wachen, 2016). More difficulties emerge when existing information is poorly presented or organized (Jagger & Fletcher, 2014), and higher education is teeming with information differentials that affect all students across a variety of backgrounds. When asymmetric information is prevalent – imposed through a combination of bureaucratic constraints, strained resources at home or school, and insufficient parental, advisor, or peer guidance – students from underrepresented backgrounds, in particular, have been shown to be disproportionately affected in the number of asymmetries they can face (Plank & Jordan, 2001).

Transfer students, in particular, must navigate an array of asymmetries, perhaps even more so than first-time-in-college students, as they must navigate how to bridge two different university environments. Transferring from one institution to another is a highly demanding process for students to undertake (Crisp & Nuñez, 2014; Dougherty & Kienzl, 2006). Having access to clear information and guidance for transfer is essential, as information access and guidance positively relate to enrollment in a four-year institution relative to enrolling in a two-year institution (Laanan, Starobin, & Eggleston, 2010). When asymmetries exist, transfer students can be affected in a manner that can disrupt their degree progress because losing credits is an indicator for a decrease in the likelihood of graduation (Monagham & Attewell, 2015).

Transfer students who have access to accurate and clear information concerning their degree requirements and transfer procedures have the potential to navigate the system more successfully. The information sources for requirements all start with the

policies and procedures as they are codified, which are then read and disseminated. Accordingly, this dissertation seeks to characterize the current information structures for transfer engineering students from one specific angle through the webpages they come into contact within their information search. Such information sources are the valuable places that transfer students learn about degree requirements and transfer procedures (Grote, Lee, Knight, Erwin, & Watford, 2019; Lukszo & Hayes, 2019).

1.2 Problem Statement

This dissertation concerns information asymmetries in higher education (Kivistö & Hölttä, 2008) – with attention to how the asymmetries specifically affect undergraduate engineering transfer students. The value of studying information asymmetry lies within its importance in the theory of "market structure" in higher education. The presence of information asymmetries introduces the potential for market failure – i.e., inefficiencies in the system that negatively affect students, faculty, and staff (Kivistö & Hölttä, 2008). In a perfect world, administrative structures would not have a significant negative bearing on educational processes. Yet, transfer students have come to experience the effects of administrative decisions in a multitude of forms through their transitions directly and indirectly (Messacar, 2015). This dissertation seeks to identify some of the different types of information asymmetry bred by higher education processes on their websites.

Information asymmetries impact organizational performance if not directly, then indirectly – much like the legal backdrop in society and its influences on human behavior. Using a microeconomic framework to analyze organizational processes prefers the condition of perfect competition, where all purchasers have complete information

such that rational choices can be made and Pareto optimality is achieved (Dill, 1997). Pareto optimality refers to the most efficient allocation of resources – all investments are appropriate given the market conditions. However, in the presence of asymmetric information, a "market failure" occurs where the allocation is no longer efficient. Breneman (1981) assessed the nature of the higher education market and argued no information could be considered complete since a "college education" as a good is most often purchased once in a lifetime. Beyond the pure economic formulation of "performance," it is an unavoidable reality that the presence of asymmetries affects the performance of a system. As Meadows (2008, p. 157) explains, "missing information flows is one of the most common causes of system malfunction. Adding or restoring information can be a powerful intervention." Pareto optimality is not practically achievable in the market structure of higher education, but information structures can be built to get as close as possible.

The type of asymmetry explored in this dissertation concerns policies meant to outline student-facing processes and procedures within the university for transfer students. Considering the processes involved in navigating an education program to degree completion, students must interact with policies during the consumption of the good, leading to critical decisions in their journey to completion. Behavioral biases in decision making can occur if information asymmetries are present when consuming information (Castleman, Baum, & Schwartz, 2015), which are flaws in rationality. For example, students may act upon the first piece of information they find or delay difficult decisions to the last possible moment. Clarity in the policies is vital, as easy-to-follow

procedures streamline the experience for all stakeholders in the system including students, parents, and advisors (Pretlow & Patteson, 2015).

Academic advisors act as one form of university intermediary between students and policies to make decisions regarding their pathway through the program, and the call to increase the number of counselors at the secondary and post-secondary level is never-ending (Edwards J. , 2011). Ideally, students would have access to an advisor who could walk them through the intricacies of their pathways through higher education, but personalized advising is not financially feasible for even the wealthiest departments. The situation is dire in the case of community colleges; most community colleges only have enough resources to staff advisors to maintain a ratio of 800:1 or 1200:1 (Gallagher, 2011; Grubb, 2006; Rosenbaum, Deil-Amen, & Person, 2006), and many of those advisors are not discipline-specific (Kirkner & Levinson, 2013). The lack of satisfactory advising experiences is evidenced by students who report informational setbacks, including misinformation, because of poor or non-existent advising (Packard, Gagnon, & Senas, 2012). Thus, even when support structures are in place through advising, information asymmetry issues regarding policies and procedures persist.

This situation causes transfer students to fall to an alternate intermediary; university websites are primary information sources within higher education, as effectively organized web pages can contain a wealth of information for transfer students and staff alike (Grote et al., 2019). Students rely on university webpages for information during their college search (Tucciarone, 2009), and the Center for Community College Student Engagement (2018) found 11 percent of community college students depend upon websites as their single, primary source of information for advising specifically, and

community college personnel make use of university websites frequently (Schuddle, Bradley, & Absher, 2018). Moreover, Grote et al. (2019) reported that the university website was the most frequently used source of information for faculty and advisors in their qualitative study of information asymmetries in the transfer process. However, the organization and presentation of information on websites have a large room for improvement. Moreover, policies such as articulation agreements, often available on websites, are generally written above the average adult reading level (Taylor, 2019); community college websites vary in their usefulness and can be fragmented across multiple pages (Schuddle et al., 2018). Lukszo and Hayes (2019) highlight in their case study that several students had difficulty navigating their university's website, noting that asymmetries would become apparent after admission – like discovering a math placement exam was needed for a certain course – even in cases where the information was helpful. Given the importance of this communication mechanism, my dissertation focuses on the information asymmetry conveyed via university websites, caused by the design of information in policies and the website infrastructure connecting the disparate pieces of policy together.

1.3 Research Questions and Approach

I employed a fully integrated mixed methods design (Creamer, 2018a) for the purpose of complementarity, which involved the collection of qualitative and quantitative data to explore information asymmetries in transfer information and to construct a more holistic understanding of its various facets. The research questions guiding this dissertation included two explicit mixing questions. To promote methodological transparency, each question was appended by the type of inquiry employed to address the

question and the type of analytical procedure to be used. The research questions are shown in Figure 1. Note the research questions are not implying a complete evaluation of the webpages. Instead, the questions involve eliciting themes of information asymmetry from the webpages used as data.

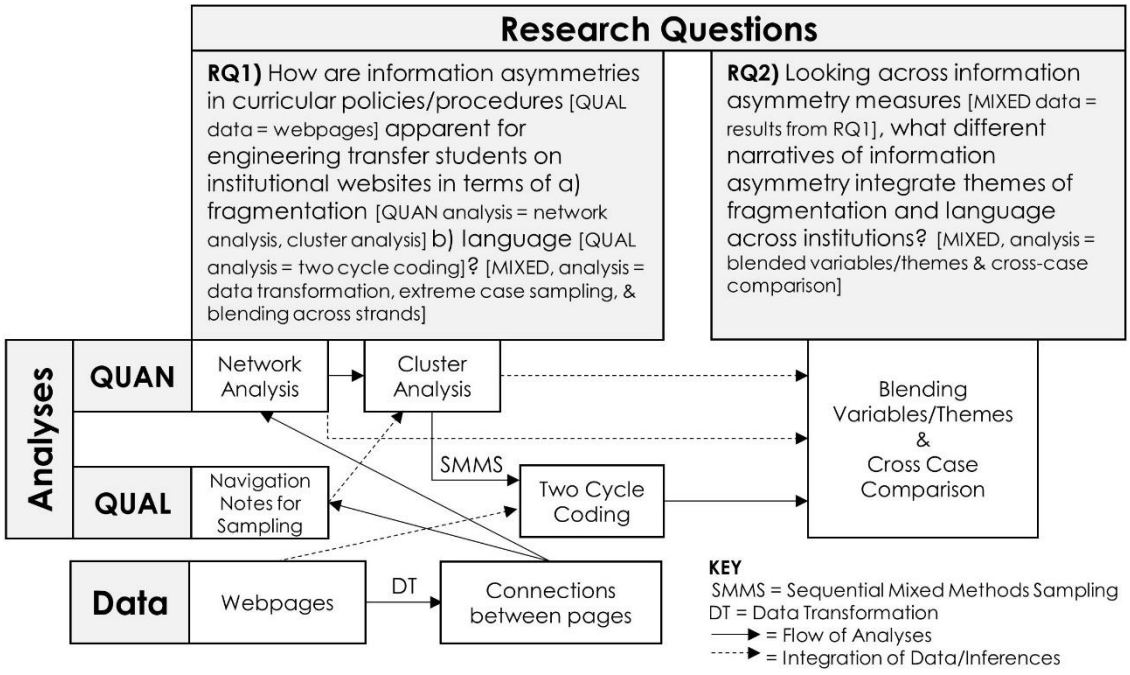


Figure 1. Research questions and corresponding analyses to demonstrate their mixed nature

1.4 Implications for Research

The contributions of this work extend the engineering education and higher education fields methodologically in four main areas: the use of existing data, mixed methods analysis strategies, graph/network theory to evaluate the design of information, and in studying information asymmetries generally.

Too often in engineering education research, potential data remain untapped, but such data present enormous potential for the field to leverage for research purposes. Existing data enable collaboration across disciplines, institutions, and national boundaries through diverse and potentially international data sets. Perhaps most compellingly, examining historical events or long-term longitudinal patterns may only be possible by leveraging existing data, and many datasets often are noteworthy in either sample representation (e.g., an extensive collection of data surrounding one subpopulation) or type of dataset (e.g., common text database for training semantic models). Singleton and Straits (2010) add that numerous publicly available data sources, such as enrollment data or facility usage reports (Knight, et al., 2018) can be "nonreactive" in the sense that the participants do not know they are being studied or observed, which counters the issue of participant self-censorship in social science. Other datasets are simply large conglomerates of various items; for instance, institutions collect several artifacts from students – course assignments, surveys, building usage – but the analysis can often only be surface deep. To demonstrate the potential of freely available university data, this dissertation leveraged institutional websites as existing data. By digging deeper into data that already exists, we can generate inferences that can provide tangible impacts by exploring our own digital infrastructure.

We often think of existing data only at the data collection stage, but opportunities exist beyond our typical approach as a field. Engineering education has made some use of archival data, but there is room for improvement to leverage existing sets of quantitative and qualitative data sets fully. More specifically, typical approaches examine the data separately and do not employ mixed methods procedures. For example, Verleger (2015)

leveraged existing qualitative data through class assignments collected as part of his dissertation work. Using these data, Verleger (2015) developed a classification scheme for student responses to open-ended problems. Brown and Knight (2014) offer an example of drawing from existing quantitative data in their investigation of external influences on course planning. Their study sampled survey data from two separate studies in the United States and Australia which, despite being conducted independently and scoped differently, revealed broader indicators of the influences sought within the posed research question. Separately, archival approaches using existing qualitative or quantitative data sets provide efficient and effective mechanisms to explore research questions. However, mixed methods can weave together qualitative and quantitative existing data to arrive at inferences that would not have been possible if the data were analyzed separately, which are called meta-inferences (Teddlie & Tashakkori, 2009). Jones (2010, p. 1013) hints at the creative potential of consolidating existing sets of "seemingly intractable mixes of qualitative and quantitative data." Integrating existing quantitative and qualitative data sets offer an opportunity for creativity in engineering education research. Accordingly, this dissertation made use of a data transformation to derive another strand of data from the webpages – uncovering the quantitative structure of relationships between pages as a network. Mixing strategies were used to create visualizations of the networks, integrating the qualitative contents of the webpage in the network representation to contextualize the asymmetries within them fully.

By weaving together multiple strands of data, this dissertation also can provide an impact in research concerning mixed methods analysis strategies. A mixed methods analysis strategy is done to compare and consolidate the results of multiple strands of

data (Creamer, 2018a). The approach is done during the analysis stage of a research design where more than one source of data is considered (Bazely, 2012), or both quantitative and qualitative perspectives are used simultaneously (Small, 2011). No formal procedures for mixing during analysis exist (Creamer, 2018a), which may be a product of the few publications using such strategies (Caracelli & Greene, 1993; O'Cathain, Murphy, & Nicholl, 2007; Bryman, 2006). In fact, in Caracelli and Greene's (1993) review of 57 publications regarding mixed methods program evaluation, they found that only five studies – about nine percent – mixed during data analysis. The lack of examples is understandable considering the analysis stage is said to be the most challenging stage to integrate the qualitative and quantitative strands (Yin, 2006). This dissertation seeks to apply Creamer's (2018a) mixed methods analysis strategies with a level of methodological transparency such that others can find applications of the strategies in their work like those demonstrated in Reeping, Taylor, Knight, and Edwards (2019).

Finally, the use of graph theory to discuss the design of information built upon previous studies of web design for academic information (Van Noy, Trimble, Jenkins, Barnett, & Wachen, 2016; Schuddle, Bradley, & Absher, 2018) and the prior application of graph theory to describe the connections between web pages in the Internet as a whole (Broder, et al., 2000). In social science, the concept of social network analysis is perhaps the most common use of graph-theoretic concepts to study phenomena like how rumors spread through social networks (Liu & Chen, 2011), inclusion (Pearson, Major, Godwin, & Kirn, 2018), and faculty connections (Middleton, et al., 2018). Using graph theory to

operationalize information asymmetry, specifically the fragmentation of information related to undergraduates' curricular policies, had not been tried visibly to date.

Finally, this dissertation builds upon the initial work on information asymmetries in higher education (Kivistö & Hölttä, 2008) and in transfer specifically (Grote et al., 2019; Messacar, 2015; Schuddle et al., 2018) with specific attention to the engineering context. Information asymmetries were operationalized as separate but intimately related constructs, fragmentation and language, which enabled the study of institutional websites from a new perspective. I found that information asymmetries in transfer information can be described in terms of the two constructs and as one construct emerging as a function of the other. Future work examining asymmetries in transfer information can benefit from such an operationalization in both qualitative, qualitative, and mixed methods approaches to understanding the information search component of the transfer student experience.

1.5 Implications for Practice and Policy in Engineering

This study describes information asymmetries in higher education processes within the context of engineering education, specifically within the information design of institutional websites and policies for transfer students. For institutions with policies that contain high levels of fragmentation and unapproachable language, the students they aim to serve can be dissuaded to enroll or find themselves at a significant disadvantage because of the ripple effect of a potentially simple misunderstanding. Through this dissertation, the sources of information asymmetry were uncovered in a traceable fashion when designing information for students and advisors. The engineering departments can understand the nature of their information design, and the consumers of the design can then benefit from reframing the delivery of information into a more purposeful design.

Policy-consumers, such as advisors, will also have the language to identify pain points in the design using the themes from this dissertation.

Engineering is a particularly prohibitive major for transfer students. Students experience transfer shock, a decline in the first semester GPA upon enrolling at the new institution (Hill, 1965), which is often found to be more severe in science and engineering (Arnold, 2001; Mattis & Sislin, 2005). Moreover, understanding how transfer credits are applied is further complicated by considerable variation in the matriculation practices of engineering departments (Chen, Brawner, Ohland, & Orr, 2013) and content of introductory engineering courses (Reid, Reeping, & Spingola, 2018). The curriculum itself is generally more complex than other majors in the arts and sciences (Slim, Kozlick, Heileman, & Abdallah, 2014), forcing students to take multiple prerequisite courses for the engineering major – as most of the general education courses have been fulfilled via transfer credits. Information asymmetries related to transferring into engineering could be uncovered through this dissertation's research design, which has a specific impact for the field of engineering education and work on transfer students in that space.

I refined themes of information asymmetries for transfer students from previous work (Van Noy et al., 2016; Schuddle et al., 2018; Messacar, 2015) to provide practitioners with tangible items to search for in their information designs in terms of how pages connect to one another. The recommendations in this work were framed in terms of the causal links between information rather than the technical feature of the site which would otherwise go unnoticed or be overlooked as outside the scope of a traditional evaluation. I created six broad narratives from four themes of fragmentation and six themes of language that can be identified in webpage design. I then provided

recommendations based on webpage design guidelines to combat the common issues. In general, institutions are encouraged to create visual representations of the transfer credit process, ensure terms are defined upfront while minimizing jargon, and avoid linking to information that is easily summarizable on the current page.

Note that the recommendations can extend beyond the context of transfer. Any individual can evaluate their webpage design for communicating any type of information that can be naturally fragmented or contain language the complicated understanding. For example, an engineering college could rework their webpage design for transfer and curricular information to bridge gaps between information at the institutional level and at the college level. Even an individual engineering faculty member can use the themes to rethink their course website organization and, with some tweaks to the themes, language-use.

1.6 Scope and Limitations

This dissertation intends to be a methodological contribution to the literature in addition to what is known about transfer for engineering students, hence the focus on the integration of quantitative and qualitative methods. The design makes use of mixed methods analysis techniques with existing data, which is a central feature of the work from a methodological perspective. The data collection stresses the use of existing data, web pages and policies in this case, to generate new inferences before creating a research design necessitating the additional data collection. I argue engineering education as a field often collects data for each new research question instead of finding convergence in interests or curiosities to leverage an existing dataset or freely available social artifacts.

Accordingly, this dissertation places the scope of work with a spotlight on the methods employed in addressing the research questions.

The study is bound by scoping constraints that lead to a set of limitations. First, this work does not intend to define what is the "best" way to organize and display information. The system at the center of this study is sociotechnical since the information design requires interpretation by a human, which then impacts the conditions in the institution. Attempting to optimize the technical side without the social or the social without the technical is a failure to recognize the totality of the system (Donaldson, 2017). I needed to make a compromise in mapping out the information structures by beginning with a landing page and navigating through the site – limiting the ability to search. Therefore, this dissertation serves as an ignition to first understand and characterize the technical side of the information system followed by a comprehensive exploration of the system dynamics with the human element – students, advisors, and administrators. Improvements to the information design will come through interactions with the information consumers after this study to survey the landscape of what can be gleaned from existing data.

Finally, a glaring limitation of the work resulting from the scope is the exclusion of the human element of the system. This work opts for emphasis on a positive analysis rather than a normative analysis, meaning the technical component of the sociotechnical system can only be described "as is" with the artifacts available to the public. An attempt was made to determine what is "better" or "optimal" by drawing from common best practices of webpage design in higher education. However, the analysis only captures the intentions of policies as they are codified, not understood. The quantitative and

qualitative measures used only provide a preliminary attempt to characterize and compare existing policies and information designs as they exist to enable a movement toward the question of what is understood from the conveyed information.

1.7 Definitions of Keywords

The following keywords appear consistently throughout the dissertation and are defined in-text upon their first use. For ease of reading, the alphabetized key terms are defined here as well for reference.

- *Adverse Selection:* Adverse selection is a result of information asymmetry where the selling party has more or better information than the buyer, usually about product quality, which leads to suboptimal decisions.
- *Betweenness Centrality:* One of the variables used in the network analysis. This variable measures the flow of information between nodes in the network; that is, how many times a node serves as the shortest path between two other arbitrary nodes in the network.
- *Blended Theme:* In this dissertation, a blended theme is a theme created by consolidating a qualitatively oriented theme with a quantitatively oriented theme.
- *Blended Variables/Themes:* A variable/theme that is created by combining qualitative or quantitative data or inferences to create a composite variable/theme.
- *Blending Variables/Themes Across Strands*: A mixing strategy where a quantitative variable is tested using qualitative data. Similarly, a qualitative theme can be tested using quantitative data.
- *Cluster (Groupings):* A cluster or grouping refers to a grouping derived from an application of cluster analysis.

- *Construct:* Construct refers to the major components of this study, fragmentation and language.
- *Cross-case comparison:* A mixing strategy wherein quantitative and qualitative data/inferences are consolidated into holistic profiles to enable comparisons.
- *Data Transformation (Qualitizing):* A mixing strategy where quantitative data/inferences are transformed into qualitative data.
- *Data Transformation (Quantitizing):* A mixing strategy where qualitative data/inferences are transformed into quantitative data.
- *Detouring language*: A phrase that references other information not on the page like "for more information…" and "see more…" which directs the user to move to another point in the network.
- *Formative Joint Display:* A formative joint display is a visualization that integrates quantitative and qualitative data or inferences for the purposes of initiating another step of analyses.
- *Fragmentation (Information Asymmetry):* Information asymmetry caused by fragmentation refers to a difference in the quality or quantity of information attributable to the dispersion of said information across multiple channels (e.g., webpages, individuals, documents).
- *Fully integrated mixed methods:* A methodological approach for conducting mixed methods research designs wherein mixing occurs at every stage of the research process.
- *Hierarchy:* One of the variables used in the network analysis. This variable measures the extent to which the network was splintered off into pockets of

information using a single value – i.e., the degree to which a network is hierarchical. Hierarchy is the exponent in the exponential fit on the degree distribution of the network.

- *Information Asymmetry:* Information asymmetry occurs when a difference in the quality or quantity of information exists between one or more stakeholders in an economic transaction.
- *Information Design/Structure:* The information design/structure refers to the way in which pages are connected and how information is laid out on a webpage.
- *Language (Information Asymmetry):* Information asymmetry caused by language refers to a difference in the quality or quantity of information attributable to an issue with vocabulary, sentence structure, or communicative strategy employed by one or more stakeholders.
- *Meta-inference:* An inference that could not have been achieved by using quantitative or qualitative inquiry alone.
- *Mixed Priority:* A mixed methods design that prioritizes mixed analyses and inferences rather than the individual quantitative or qualitative analyses – distinct from an equal priority design.
- *Moral Hazard:* Moral hazard is a result of information asymmetry where one party changes their behavior after entering into a contract. Moral hazard often refers to a party engaging in riskier behavior knowing the cost of their mistakes is incurred by a different party.
- *Narrative:* A narrative in this dissertation was a result of the cross-case comparison mixing strategy, which is a description of how themes, blended

themes, and other data came together to tell a short story.

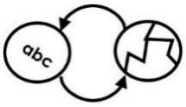
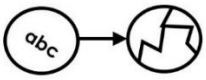
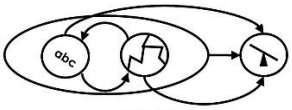
- *Network Elaboration:* A coding scheme used in this dissertation that was designed to add context to plots of the connections between webpages and prepare them for secondary analyses.
- *Nonlinear:* One of the variables used in the network analysis. This variable assigns networks without loops a value of 1 and with loops a value of -1.
- *Priority:* Priority refers to the emphasis placed on quantitative inquiry or qualitative inquiry or their individual inferences in a mixed methods design.
- *Theme:* A theme, in this dissertation, refers to an inference of some pattern in qualitative or quantitative data.

1.8 Definitions of Icons

This dissertation makes use of the icons displayed in Table 1 to organize the different constructs and their interactions. The icons appear in section headings and in figures as appropriate.

Table 1

Summary of icons used in this dissertation

Icon	Meaning
	Fragmentation-focus
	Language-focus
	Information Asymmetries
	Integration of Fragmentation and Language
	Fragmentation Caused by Language
	Integration of Fragmentation and Language to Describe Information Asymmetries
	Pertains to the first research question
	Pertains to the second research question

CHAPTER 2. LITERATURE REVIEW

2.1 Overview of Literature Review

This literature review outlines the target population and the phenomenon of information asymmetry. I review the effects of asymmetric information from a behavioral economics perspective. Next, the constructs of language and fragmentation are discussed. Finally, I review types of information asymmetries related to engineering transfer students and how prior research has operationalized such asymmetries.

2.2 Engineering Transfer Students as the Target Population

Transfer is not a rare occurrence in higher education. The National Student Clearinghouse (2017) reports that 49 percent of students who completed a bachelor's degree at a four-year university in the 2015-2016 academic year also had enrolled at a community college (two-year institution) for at least one semester in the previous ten years. Several states like Texas, California, Kansas, Wyoming, and Florida have populations of students where more than half graduated having attended a community college in the past. Texas is a standout with 75 percent of the bachelor's degree earners having attended a community college at some point.

Students can perform a horizontal (lateral) transfer from one four-year institution to another or from one two-year institution to another. For STEM students, Eagan and colleagues (2014) found 13 percent of students laterally transferred during their pursuit of a bachelor's degree. Alternately, vertical transfer is the movement from a two-year to a four-year institution (Kirk-Kuwaye & Kirk-Kuwaye, 2007). Melguizo and Dowd (2009) estimate the vertical transfer rate as 25 percent nationally, the most common pattern across all types (Buchwitz, 2015).

This dissertation is relevant to students who move vertically because they are the most likely to interact with policies outlining transfer procedures. Community colleges serve as a point of access for underrepresented minorities from a variety of backgrounds (Kasper, 2003), many of whom transfer into engineering (Sullivan, et al., 2012). Community colleges are still more likely to enroll part-time students who are often non-traditional (Ma & Baum, 2016). The definition of a "non-traditional" student has promoted a hearty discussion in the literature but being older than twenty-four has classically been a prevailing factor (Bean & Metzner, 1985). Because a community college is a point of access, two-year colleges serve lower-income populations who also are characterized by a large portion of first-generation college students (Ma & Baum, 2016). Considering this demographic composition, vertical transfer students are likely to have difficulties navigating the transfer system because of their lack of familiarity with higher education.

Even for students who move laterally, several barriers impede transfer students from attaining the intended time to degree and influencing attrition, such as unawarded (or misawarded) transfer credit (Packard, Gagnon, & Senas, 2012). Institutions often collaborate to ease the process by outlining transfer policies between one another in formal partnerships called articulation agreements (Anderson, Sun, & Alfonso, 2006). Such agreements, however, are generally unreadable by the population they intend to help (Taylor, 2019). Taylor's finding may not be too surprising considering the agreements are contracts and tend to use legal language to outline the institutional relationships. However, articulation agreements are only one element of the transfer process – and are not the only confusing or unclear element either (Messacar, 2015).

Without sufficient guidance, students are left to decipher a plethora of web-based policies and academic language outlining how they will academically integrate into their new environment.

The ease in which a student transfers from one institution to another is influenced by transfer student capital (Laanan, Starobin, & Eggleston, 2010; Laanan, 2004; Laanan, 2007), or the set of knowledge and skills community college students gain from engaging in the transfer process. Laanan, Starobin, and Eggleston (2010) hypothesized that the more transfer student capital a community college student acquires, the more likely the student will be able to persist and graduate. Considering how transfer student capital is operationalized, an accumulation of skills and knowledge will diminish the effect of information asymmetry. Although transfer student capital was not measured in this dissertation, it is a practical variable to consider when evaluating the effects of organization and language-use in transfer information.

Considering the number of students who transfer into engineering programs after attending a community college (Sullivan, et al., 2012), we cannot ignore the structural factors impeding transfer pathways. In my study, structural factors are the information designs of institutional websites, a commonly used information source for transfer students (Schuddle et al., 2018; Grote et al., 2019) The policies and information design for transfer students need to be clear to ensure institutions are transparent in outlining students' trajectories toward graduation. Otherwise, gaps in information called information asymmetries can occur.

2.3 Theoretical Framework

This work was guided by the concept of information asymmetry (Akerlof, 1970), a situation where at least one party has more or better information than other parties in an economic transaction. This framing for my project intends to build off an application of information asymmetry to transfer student literacy (Messacar, 2015). Information asymmetry as a topic originates from contract theory and economics, highlighted by Akerlof's (1970) famous paper "The Market for Lemons" in which he demonstrated the idea through the used car market. In Akerlof's (1970) example, the sellers have more information than the buyers in the used car market because the sellers know the history of the vehicle from the previous owner. Perhaps this particular example is dated since companies like Carfax, Inc. now exist as third parties to provide detailed information about vehicles upon request, thereby resolving the asymmetry. However, not all markets are safe from asymmetries, and the consequences of persistent asymmetries can be costly to any party in the transaction.

Two common problems occur in transactions with asymmetric information: adverse selection and moral hazard (Akerlof, 1970). To illustrate, suppose a contract is being negotiated between two individuals with different levels of information, meaning asymmetric information is present. Adverse selection refers to the situation where the asymmetric information related to the product or contract itself, like the quality of a used car, exists between the parties. Adverse selection typically refers to the situation where the seller has better information than the buyer. In the case where asymmetries emerge after the contract is entered, like a change in behavior of one or more parties, moral hazard can occur. For example, someone who takes out insurance on their smartphone may become careless with their device because the contract will cover the cost of

replacing the phone if it is damaged. The insurer experiences asymmetry because the insurer is not certain if the individual will continue to treat the device with care, considering the insurance covers the cost of a new device if it is damaged. Modern contract theory simplifies the difference between the two concepts in terms of the timing of the asymmetries (Bolton & Dewatripont, 2005; Laffont & Martimort, 2002). Adverse selection refers to the asymmetries before the contract is written, and moral hazard concerns asymmetries that emerge after the contract is written but were not there before writing.

An obvious example within higher education of a "contract" is how students are admitted. Students submit their information through an application, which provides the institution with some idea of how the student will perform if enrolled – the institution tries to determine if the student is a "good fit" for the institution. However, the "contract" here is not made with perfect information since the situation contains unresolvable asymmetries. For instance, the student does not necessarily know what exactly the university staff is looking for in their application. Therefore, adverse selection can occur. On the student side, "fit" cannot be perfectly assessed based on the single data point at entry. First, students may not have access to adequate information to know how well they "fit" at that time. Second, how well someone will do academically and socially on campus can only be known longitudinally, and the students will only know the extent to which they "fit" in real-time – this example demonstrates moral hazard.

The process of transferring from one institution to another has a similar framing. Simply change the "contract" to evaluating transfer credit in addition to the application, and more asymmetries appear, such as course equivalency. The situations with

asymmetric information for transfer students expand beyond the admit phase and bleed into the search phase before students apply. Transfer students carry the additional burden of making sure their coursework taken at a community college or through advanced placement credit is not lost. Students are expected to interact with actors and information sources, such as websites and policies, if they want to minimize the chances of experiencing difficulties in transferring. To provide accurate information to students, advisors similarly must interact with the information on institutional websites and policies. However, the information designs on the websites leave much to be desired as evidenced by prior work (Schuddle, Bradley, & Absher, 2018; Van Noy, Trimble, Jenkins, Barnett, & Wachen, 2016), which creates another situation with asymmetric information.

One potential remedy for asymmetric information is to build in high degrees of structure and perhaps limited choice as a result. In the case of transfer, the "structure hypothesis" provides elaboration. The structure hypothesis was put forth by Rosenbaum, Deil-Amen, and Person (2006) and further explained by Scott-Clayton (2015), who likened the pathway to a degree through a community college as a "shapeless river" (p. 102). The hypothesis asserts students are more likely to succeed in tightly structured programs (with perfect information) with little room to deviate from the plan of study and completion as well as when there are fewer bureaucratic constraints in place (Scott-Clayton, 2015). In contrast to this structure, community colleges tend to offer a "laissez-faire" curricular structure (Fronte, 1997), and benefits certainly exist to support such an approach (e.g., the ability to explore different fields or flexibility with outside work or family commitments). In an unstructured system, both in form and information, it is

sensible to assume students believe they are making progress by amassing credits. For potential transfer students who do not have special knowledge about the bureaucratic processes associated with postsecondary education, students' true progress to a degree is likely much different (Rosenbaum & Diel-Amen, 2003). Here, information asymmetry is not being used to make suggestions for improvement or verify the structure hypothesis; rather, it is used as a framing device to describe the current state of institutional web-based information design of their transfer information and policies.

Information asymmetry was explored in this work through two perspectives: fragmentation and language. Fragmentation captures the degree to which the information needed to make an optimal decision or action is localized – if it is all in one place or "fragmented" into pieces across several policies or pages. Language here refers to the linguistic characteristics of the information presented in the webpages. The framework is summarized in Figure 2.

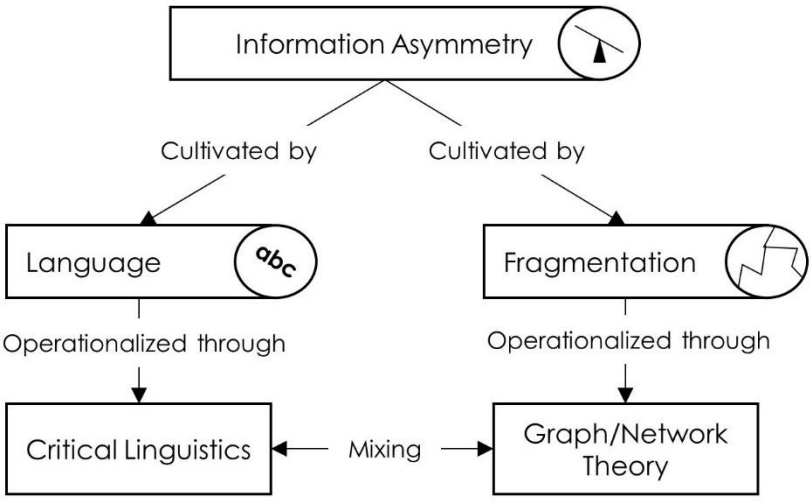


Figure 2. Theoretical framework as operationalized in this study

The icons associated with language and fragmentation are used throughout the text to signal which construct is addressed in a particular phase of the study. The icons also are used with arrows to signify integration at different stages of the design.

2.4 Information Asymmetries 

Information asymmetries are drivers of an imbalance of power between stakeholders. Asymmetric information occurs at any point when one stakeholder or stakeholders have better or more information than other stakeholders in a transaction (Milgrom & Roberts, 1992). Ben-Ner and van Hoomissen (1991) describe the three main situations where information asymmetries disadvantage stakeholders: (1) a lag exists between purchase and consumption, (2) the purchaser and consumer are different individuals or entities, and (3) the good or service consumed is challenging to evaluate by the stakeholders. Kivistö & Hölttä (2008) argue all three situations can occur in the case of higher education, as summarized in Table 2.

Table 2

General Causes of Information Asymmetries and the Relationship to Higher Education (see Kivistö & Hölttä, 2008)

Cause of Asymmetry	Relevance in Higher Education
A lag exists between purchase and consumption	Higher education is consumed over a period of time, and payments cease before higher education is fully consumed.
The purchaser and consumer are different individuals or entities	Not all students pay for their own education, nor are they sole purchaser. Subsidies guarantee a public stake in the consumers' education; parents may also provide funds.
The good or service consumed is challenging to evaluate by the stakeholders	The notion of a quality education can be difficult to express quantitatively (e.g., in dollars) or qualitatively (e.g., comparing the expected outcomes of attending one institution or another).

Information asymmetries occur because of a mix of intentional and unintentional gaps in communication between stakeholders, so increasing the transparency during exchanges can decrease needless asymmetries. Transparency is vital from an economic perspective, as clarity on the quality of a product allows the producer to improve their products and compete more efficiently in the market (Dill & Soo, 2004).

Jones (2004) outlines two main types of information asymmetry, which describe two axes along which information can be distorted or lost: 1) vertical differentiation, and 2) horizontal differentiation (see Figure 3). Vertical differentiation concerns the loss of information as it travels down the organizational hierarchy and horizontal differentiation concerns loss of information within or between units. In the vertical direction, the more layers between the actors, the more likely information in the form of bad news will be lost. On the other hand, the positive news is embellished because the information is filtered through several interpretations and judged by several individuals as to what needs to be reported (Kivistö, 2007; Mintzberg, 1983). Next, the separation of organizational units causes horizontal differentiation. As individual academic units become more specialized, horizontal differentiation increases (Kivistö & Hölttä, 2008). The growth in differentiation occurs because forming social and academic connections outside the unit becomes more challenging for those inside and outside the unit (Blau, 1973). As is the case with vertical differentiation, horizontal differentiation causes information to be distorted and lost because of differences in language, norms, and communication processes stemming from highly stratified disciplinary foci. My work primarily concerns vertical differentiation because the research questions are aimed at characterizing information asymmetry in institutional websites for students. However, horizontal

differentiation was pertinent when comparing information sources between different units in the same institution.

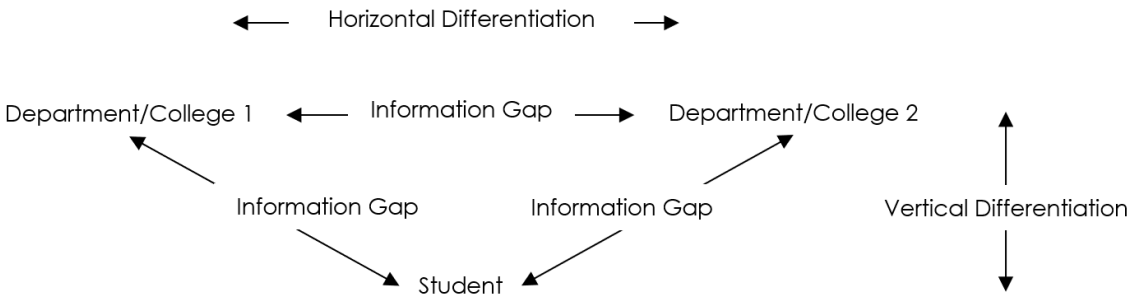


Figure 3. Example of Horizontal and Vertical Differentiation

2.4.1 Examples of Information Asymmetry in Higher Education

Higher education as a system contains several examples of asymmetric information, and administrators actively seek strategies to restore the balance of information. Before examining the specific type of asymmetric information in this work, a few examples of general information differentials are worth noting. Examples in higher education of transparency and reducing horizontal differentiation can be most saliently drawn from the case management literature, relating to the unit in higher education responsible for the safety of students by providing them with services to suit a variety of needs. The literature on case management is relevant in this work as an example of asymmetries mitigated through policy. Case management solidified as a tangible unit in higher education in response to the events at Virginia Tech on April 16th, 2007 (Adams, Hazelwood, & Hayden, 2014) and previously acted as a type of service industry based on social work (Solomon, 2000). The case managers within the unit act as "human links" between the students in need and the larger institutional infrastructure (Intagliata, 1982; Schmidt-Posner & Jerrell, 1998), as there were some parts of the institution that provide services that may have been unknown to students. In case management, the managers act

as “de-fragmenters” who connect students with the resources they need – reducing asymmetries resulting from the way institutions operate.

One case management model, called the broker model, is invaluable from the perspective of reducing information asymmetry. The dispersive nature of student services is a prime example of horizontal differentiation, like the stratification of academic disciplines across several units. From a student’s perspective, navigating a large number of different offices tailored to one facet of student life on campus can be challenging. Under the broker model, the case manager does not provide direct services (Bedell, Cohen, & Sullivan, 2000; Schmidt-Posner & Jerrell, 1998); rather, the manager makes referrals to different units and agencies on the students’ behalf (Hepworth, Rooney, Rooney, Strom-Gottfried, & Larsen, 2013). Certain offices or centers, like a Women’s Center on campus, can operate in such a fashion. The broker model serves as an integration point of information that students may not even know exists for them on campus, thereby reducing the horizontal differentiation.

Information asymmetry is observable across the organization of higher education beyond the institutions themselves. A popular example is the Free Application for Federal Student Aid (FAFSA), which can be more complicated than some students’ income tax returns (Dynarski & Scott-Clayton, 2006). The literature reveals that many students do not complete the FASFA because of its length and complicated format (Davidson, 2015). Moreover, Rosenbaum, Deli-Amen, and Person (2006) remark that students find difficulty in completing the forms and are provided with little to no assistance from universities. Even small bits of assistance could help, as text message reminders and assistance were found to increase sophomore re-enrollment rates by about

12 percent (Castleman & Page, 2016). Linking this scenario to the notion of information asymmetry, young adults are more likely to suffer from cognitive overload and make mistakes in financial planning because of their lack of experience (Agarwal, Driscoll, Gabaix, & Laibson, 2008; Lusardi & Mitchell, 2007). Since students are especially susceptible to making mistakes in such a critical area of their education, scaffolds are needed to facilitate the successful completion of the paperwork. The most successful financial aid programs are well-publicized and simple (Cornwell, Mustard, & Sridhar, 2006; Dynarski, 2002), so reform toward a simpler set of financial aid procedures from the student perspective would be ideal for mitigating the asymmetries resulting from complicated financial documents like the FAFSA.

Another example of information asymmetry can be found in the availability of information on sexual assault. Lund and Thomas (2015) reviewed sexual assault information availability, location, and content in the context of 102 university and college websites. They found about 90 percent of institutions had some kind of information available, but what was available often did not elaborate on issues of victim-blaming (only 35 percent) and affirmative consent (only 30 percent). Studies of information asymmetries tend to focus on the general availability of information or its clarity, such as Lund and Thomas (2015) and Schuddle et al. (2018), but more comprehensive evaluations appear to be rare.

The previous examples were broad instances of asymmetric information in higher education. In all cases, methods of reducing the asymmetries were also presented, including increasing transparency and simplicity of the information. My dissertation concerns two ways in which policies and information design can strike an imbalance in

information, through fragmentation and language, within the context of transfer student information sources on websites.

2.5 Asymmetry through Fragmentation 

Consider a "choose your own adventure" book in which each decision the reader makes affects which page is read next. In such books, the choice is often binary and generally easy to follow; however, the scenario can be complicated by assuming the book is part of a more extensive collection and not binary. At any point, the decision can take the reader into a different book in the series – meaning the story is scattered in pieces across the various books. The hypothetical collection illustrates the concept of information fragmentation (Karger & Jones, 2006), where a single decision could depend on information from a variety of sources that are likely decentralized (or not in a single book, in the context of the metaphor).

In its most benign form, information fragmentation is merely a nuisance – like the book collection example or the way a user chooses to organize their files on a computer. However, fragmentation can be fatal in situations such as patients in hospitals lacking complete medical records in emergency care (Bourgeois, Olson, & Mandl, 2010). Within a higher education context, university websites are examples of common media with high degrees of information fragmentation across numerous drop-down menus on an institution's home page. The multiple objectives of institutions lend themselves to highly fragmented website organization. Policies can display a similar type of fragmentation and often are integrated into the websites themselves. For example, if a student intends to transfer credits into a program and only refers to the general policy rather than the

department policy, the student could potentially lose a substantial number of credits because the department has its own rules for what can be applied toward certain majors. In such cases, fragmented policies across websites could potentially extend a student's time to degree if suboptimal curricular decisions are made.

The literature on quantifying university web pages or policies under the framework of fragmentation is less mature than readability studies, but evaluating policies and websites has been attempted using qualitative inquiry (Schuddle et al., 2018). A close line of literature concerns the evaluation of university websites for accessibility and usability, inside and outside of the United States, often using rubrics (Al-Khalifa, 2014; Astani & Elhindi, 2008; Gordon & Berhow, 2009; Hasan, 2013; Toleva-Stoimenova & Christozov, 2013; Mentes & Turan, 2012; Pinto, Guerrero, Fernández-Ramos, & Doucet, 2009; Yoo & Jin, 2005). Accessibility and quality of the information design differ from institution to institution (Jagger & Fletcher, 2014; Khlasiang, 2017). For example, Astani and Elhindi (2008) used Tarafdar and Zhang's (2005) characteristics of successful website design by rating 50 university websites based on information content, navigation, usability, customization, download speed, and security and found average ratings between 3 and 4.3 out of 5 across the characteristics. Astani and Elhindi (2008) called for improving the usability, navigation, and information content of the university websites based on their findings because of their lower scores in the sample.

The navigation and usability issues extend to the transfer student context. Schuddle et al. (2018) purposively sampled 20 community college websites based on transfer-out and bachelor's degree completion rates. The study was composed of

interviews with community college personnel including advisors and administrators on barriers to vertical transfer. Then, Schuddle et al. (2018) turned to review websites based on two constructs: ease of access and usefulness. Schuddle et al.'s (2018) constructs were based on Van Noy et al.'s (2016) "access to information" construct in a separate but similar study. "Ease of access" was operationalized based on the number of clicks needed to arrive at the desired information, whether the information was accessible through the home page, and if the information was findable using search tools. "Usefulness" was defined in terms of clarity, organization, and accuracy. The researchers found variation in their results. Most community college websites had at least some information that could be easily located; low scores on usefulness tended to appear more often than for ease of access. However, recall that usefulness was defined by Schuddle et al.'s (2018) regarding clarity and organization, a parallel to language and fragmentation as defined in this study. Of most concern was the community college personnel's reliance on the web pages to advise students and their difficulty in locating information. One advisor in particular needed to "dig through several sites to get to the information" despite her wealth of experience (Schuddle et al., 2018, p. 22). If advisors cannot easily find the necessary information to aid their students, their ability to advise becomes hindered. The authors suggested posting transfer guides for institutions with which the community colleges hold transfer agreements, or a curricular "roadmap" for example (p. 28), as a means to reduce asymmetries between the community colleges and the four-year institutions.

2.6 Asymmetry through Language

The premise of language barriers in readability underlies the idea of "asymmetry through language." Examples of asymmetry through language can be seen in the literature, most notably with different types of legal documentation. Specific types of policies have been the target for evaluation to improve readability and transparency, as evidenced in Cude's (2005) work in insurance policies and Jensen & Potts' (2004) and Pollach's (2005) work in privacy policies. In the legal profession, lawyers' use of English, affectionately known as "legalese" or Legal English, has been criticized repeatedly for the seemingly deliberate attempt to confuse the reader. Butt (2001) offers three points in defense for the wordy prose found in many legal documents: inertia, necessity, and insecurity. Legal English persists because it has merely been the norm as it better safeguards the writer from unintended loopholes that nefarious readers may try to construct.

In the context of transferring institutions, for example, partnerships between universities surrounding transfer credit – articulation agreements – also take the form of legalese-styled contracts signed by highly ranked administrators at the collaborating institutions. University policies are not safe from language issues either, as the same three rationales offered by Butt (2001) hold since, like any institution or business, the writers want to avoid loopholes and litigation. As a general question, if policies surrounding academic decisions, such as transfer and course-taking, are written in such a way that cannot be understood by its target audience, how can a student appropriately use the information? Moreover, if a piece of written text is outside of one's "reading grade level" or reading proficiency, how likely is it that the person will be able to comprehend the

policy's logical consequences and long-term effects fully? Although this dissertation does not address these questions directly, understanding the composition of the information design presented by institutions can begin to narrow down the issues in the use of language.

One method of exploring the use of language in policies employs text analysis formulas and algorithms. Language can be operationalized in terms of readability – or more specifically in this context as text easability (McNamara, Graesser, McCarthy, & Cai, 2014). The implication of focusing on language as one form of asymmetry is a characterization of an issue in the information gathering process – under the umbrella of information processing. Some text analysis of transfer information has been done. For example, Taylor (2019) explored the readability of 100 randomly sampled articulation agreements and found 93 of the 100 documents to be unreadable by the transfer student population. The sample size needed to conduct text analysis with sufficient statistical power is outside the scope of this dissertation, however.

Instead of text analysis, constructs to describe the "legalese" used in official documentation exist and can aid in characterizing information asymmetry caused by language. Various communicative strategies can be taken in the writing of policies to hedge, obscure agency, and appeal to commonalities. For example, Pollach (2005) created a typology of such strategies for privacy policies to describe how companies would use language that could potentially mislead their readers. Whether intentional or unintentional, the strategies can confuse or deceive the reader, and policy writers need to be more aware of how their linguistic choices affect the individuals their policies intend to serve. Although the issue of Legal English and contracts may only significantly affect

those entangled in some form of litigation, the classroom has seemingly moved toward the courthouse. One such example is presented each first-day-of-classes with the dissemination of the course syllabus that Wasley (2008) joked as reading like a prenuptial agreement. Whether such strategies discussed in Pollach (2005) exist in higher education policies beyond the syllabi had yet to be determined formally beyond preliminary investigations.

2.7 Consuming Information in Higher Education

The constructs of language and fragmentation as facets of information asymmetry can be seen in practice, which can lead to issues in consumption called behavioral biases. The time and patience needed to comb through web pages and documentation from the university carefully, understand the implications of the information, and make an optimal decision are not feasible for most college students – instead, the care to engage in the search is won out by their psychology. Consider the phenomenon of "availability bias" (Tversky & Kahneman, 1974; Kahneman, 2011). The premise of availability bias is the inclination to base decisions on information that is readily available, which is perhaps the case for students since Begg, Banthan and Taylor (2008) reported finding that students in their sample did little to search for information when choosing their major. Students may resort to "anchoring," or basing their decisions on the first piece of information that becomes available to them (Castleman, Baum, & Schwartz, 2015). Alternately, students also appear to collect information through "taking courses almost at random" (Grubb, 2006, p. 197). In the case of transfer students, Rosenbaum, Deli-Amen, and Person (2006) found that students in their interviews felt they did not have information to make

decisions about degree requirements. Even more alarming, 26 percent of the students did not know which courses counted toward their degrees (2006, p. 104).

One example of a significant decision in academic life subject to asymmetries is choosing a major. Deciding on which major to pursue requires copious amounts of information to weigh the options properly. Beggs, Bantham, and Taylor (2008) identified six factors in major selection: information search, match with interests, psychosocial benefits, job characteristics, financial considerations, and major attributes. Information search is of particular interest in this work, as examining the asymmetries in the information design are the centerpiece of the study. One component of the information search is the social capital of the student, specifically how it scopes their major interests, and parental occupation and socioeconomic status have been found to have an impact on students' choices (Chung, Loeb, & Gonzo, 1996; Keillor, Bush, & Bush, 1995). Generally, family and peers are influential in the student's major selection (Halaby, 2003; Song & Glick, 2004), and the impact of the expectations or suggestions from such groups can even trump a student's own interests (Kaynama & Smith, 1996). For example, students with fathers in executive positions were found to be more likely to major in a STEM discipline (Leppel, Williams, & Waldauer, 2001). Gender roles are still at play and can be reinforced through student decisions as well, hence the tendency of women to choose disciplines such as education and nursing (Lackland & De Lisi, 2001). However, women are also more likely to pursue male-dominated professions if their fathers are employed in high-level occupations like engineering (Betz & Fitzgerald, 1987). Parental influence can be tied back to information sources; parents who participated in higher education have the "college knowledge" to pass onto their children. The differential

information at home, although influential in students' decisions, is outside the scope of this work. However, the influences underscore how imperfect information can lead to poor or suboptimal decision-making.

Students may also tend to fall victim to "present bias" (Laibson, 1997), which is the delay of unpleasant or costly actions until a time in the future - choosing a major, for example. Assuming a student stays in general education for as long as possible, the student forgoes opportunities to enroll in courses leading to a specific major's requirements. Other issues can arise in the opposite case, such as choosing a major too early. Once the decision is made, the student may still be unsatisfied with their choice – especially when the student is still doubtful, and the decision is critical to make (Heitmann, Lehmann, & Herrmann, 2007; Botti & Iyengar, 2006). Highly structured programs like engineering (Slim, Kozlick, Heileman, & Abdallah, 2014) can make it difficult for students to switch majors and graduate in four years, so providing enough information for students to make a satisfactory major decision early in their program is vital, like through common introductory courses (Brawner, Chen, Ohland, & Orr, 2013). Reducing asymmetries in students' information consumption in terms of policies and procedures is one method of enabling better decision-making, which can be as simple as improving the information design on the institution's website.

2.8 Asymmetries and Information Consumption for Transfer Students

Considering the proliferation of transfer, the design of information and policies for the population of students moving between institutions is not trivial. For institutions with transfer policies that contain high levels of unapproachable language and dispersion of information, the students they aim to serve can be dissuaded to enroll or find

themselves at a significant disadvantage in terms of time wasted and money spent because of the ripple effect of a potentially simple misunderstanding. Messacar (2015) characterized the ways in which the transfer process contains information asymmetry including: the evaluation of credits, the application process and required documentation, the credit transfer portfolio (which include the location, unit[s] and personnel involved), how GPA is calculated, prerequisites (called reach backs in the original Canadian context), the degree and program requirements, the variations in structure of the institution and program type, and the policies and associated terminology. Ideally, all the information should be provided through publicly available channels, specifically the university website; yet, issues persist with information availability. Transfer students who Messacar (2015) interviewed in semi-structured focus groups noted that locating the information was a challenge. Misunderstanding or being unaware of policies outlining pertinent information like GPA calculation and evaluation of credits can result in unfavorable outcomes that are detrimental to students' progress to degree in terms of time and money, resulting in instances of retaking courses, for example.

Information asymmetries could lead to a common issue in transfer: credit loss. Although significant dips in performance leading to a decrease in the probability of graduating is not a typical outcome for students with two years' worth of credits, the outright loss of credits is an indicator for a decrease in the likelihood of graduation (Monagham & Attewell, 2015). A potential pitfall for students is a situation in which the students attempt to exchange credit for a course but only receive the equivalent of inert credits – nameless elective credit – that do not count toward the students' degrees, what Kadlec and Gupta (2014, p. 7) eloquently describe as an "academic graveyard where

students essentially bury all those courses that transfer but do not meet any specific requirements in the new institution." Simone (2014) notes the large losses may be a function of transfer students not reporting previous coursework, which could simply be a misunderstanding – perhaps influenced by an information asymmetry – by students on what "counts" for credit. For students who began college in 2003-2004, 39.4 percent had no credits that transferred, and those who have a portion successfully transferred lose an average of 13 credits (Simone, 2014).

The literature does have some explanation as to why students may be losing so many credits, which are rooted in asymmetries. For instance, Hodara and colleagues (2016) claim degree program credit loss for transfer students occurs for two reasons: (1) uncertainty about major and/or destination, and (2) a poor capacity of advisors and institutions to offer support. Since advisors are consumers of transfer information, the poor capacity is perhaps influenced by the asymmetry in information (Schuddle et al., 2018). Advising has been found to be beneficial to students in achieving their goals (Bahr, 2008), but the residual asymmetry potentially not rectifiable is in the design of degree pathways. Transfer policies assume that students have selected a major and destination institution early enough to complete the correct combination of courses to have a seamless transfer, but such policies do not reflect reality.

What is more troublesome is that, unbeknownst to transfer students, even general education courses may not be applicable to their degree requirements (Hodara, Martinez-Wenzl, Stevens, & Mazzeo, 2016), and prerequisites might change over time (Packard, Gagnon, & Senas, 2012). Developmental and remedial programs are two of the many functions of the community college, yet the credits often do not "count" if students try to

transfer them into their new institution. Since more than half of community college students have developmental credits in at least one subject upon entering the receiving institution (Bailey, Jeong, & Cho, 2010; Bailey, 2009), the surge in credit loss can be at least partially explained.

How well the details are communicated and whether students know the difference between the credits relate back to Messacar's (2015) themes and ties back to the guiding framework of the study, information asymmetry. This dissertation sought to begin interrogating the policies outlining transfer credit by using the framework of information asymmetry through the constructs of fragmentation and language. In fact, I provide a step toward what Bahr (2013) calls a "deconstructive approach" to studying student pathways. I shifted from a linear input-output style of analyses to one engaging institutional policies and procedures by embracing their nonlinearities, including a qualitative perspective. Bahr specifically calls for more qualitative deconstructive work, which comprises a disproportionality small part of the literature compared to the body of quantitative work on student pathways (Bahr, 2013).

2.9 Chapter Summary

This chapter reviewed the concept of information asymmetry and its applications in higher education. Information asymmetry was parsed into two types of interest: asymmetries through fragmentation and asymmetries through language. Although the literature is rich with examples of policy work in higher education, studies evaluating how institutions convey information are less pronounced. Previous work has been done to evaluate the ease of access to information for students with respect to transfer (Schuddle et al, 2018; Van Noy et al., 2016) and general website design (Astani & Elhindi, 2008),

but examples of comprehensive analyses to test a framework for information asymmetries are absent. Therefore, this effort extends the previous work on the accessibility of information for academic decision-making and situates it within the economic conceptual framework of asymmetric information.

CHAPTER 3. RESEARCH DESIGN

3.1 Overview of Research Design

I employed a fully integrated mixed methods approach (Creamer, 2018a) to frame this study's research design and address two explicitly mixed research questions. Following Plano Clark and Badiee's (2010) blended research question approach, I embedded the data and analyses in the following research questions to highlight the necessity for a mixed methods design:

> **RQ1:** How are information asymmetries in curricular policies/procedures [QUAL data = webpages] apparent for engineering transfer students on institutional websites in terms of a) fragmentation [QUAN analysis = network analysis, cluster analysis], and b) language [QUAL analysis = two cycle coding]? [MIXED, analysis = data transformation & blending across strands]
>
> **RQ2:** Looking across information asymmetry measures [MIXED data = results from RQ1], what different narratives of information asymmetry integrate themes of fragmentation and language across institutions? [MIXED, analysis = blended variables/themes & cross-case comparison]

The design uses multiple mixing strategies throughout the analyses to construct the narratives desired in RQ2 from the inferences ascertained in RQ1.

3.2 Methodology

The approach to this study was fully integrated mixed methods as articulated by Creamer (2018a). The fundamental principle of mixed methods research is that the researcher must use a variety, or "mixture," of complementary methods with strengths offsetting the weaknesses of each other to achieve a quality meta-inference (Johnson & Turner, Data collection strategies in mixed methods research, 2003). A meta-inference is

a defining feature of a mixed methods investigation, as it is an inference that could not have been achieved if without mixing (Tashakkori & Teddlie, 2008).

I selected mixed methods as the mode of inquiry for purposes of complementarity and development (Greene, Caracelli, & Graham, 1989). Complementary, seeking a more comprehensive understanding to generate and test a theory, was desired because the nature of the constructs necessitated both qualitative and quantitative inquiry. The perspective of quantitative inquiry addresses fragmentation of information, which was a question of the structure of information across websites – a distinctly quantitative idea. Qualitative inquiry was most appropriate to contextualize the construct of language. Moreover, the interaction of the two constructs – such as how fragmentation can be caused by language – provided an opportunity for mixing to occur. The developmental purpose of the design was to explore the landscape of information related to transfer in a non-intrusive manner using existing data to inform future research that could interact with students directly.

Creating profiles across a range of measures and themes required an interplay between inductive and deductive processes, which was accomplished through full integration. The "fully integrated" phrase refers to the intentional calibration of qualitative and quantitative inquiry across multiple stages of the study: design, data collection, analysis, and inferences. Full integration across quantitative and qualitative data strands facilitated more comprehensive inferences to generate a meta-inference (Creamer, 2018a). Moreover, I argue the fully integrated design was not equal in priority, where qualitative and quantitative strands are given equal weight in constructing inferences. Instead, the design is what Creamer (2018a) describes to be mixed priority,

which can be achieved through mixing throughout the logic and implementation of analysis procedures. I have shown the operationalization of the constructs, fragmentation and language, necessitated the use of mixed methods. Moreover, my use of mixing strategies throughout the design generated tightly coupled inferences depending on both quantitative and qualitative evidence, as shown in Table 3, which is indicative of mixed priority design.

Table 3 summarizes the research design with respect to the rationale/purpose for mixed methods, the priority of the different strands in the design, the timing of data collection and analyses, and stages of mixing through the design. Limitations of the approach close the discussion on the research design.

Table 3

Summary of mixed methods characteristics for the study

Design Feature	Description	
Rationale/Purpose	Complementarity and Development – Mixed methods enabled a more comprehensive understanding of the phenomenon of information asymmetry in the dissemination of academic information and policy. The developmental component referred to the creation of themes of information asymmetry to explore in future work with students.	
Priority	Mixed Priority (Creamer, 2018a) – Both QUAN (transformed from QUAL) and QUAL data and analyses were of equal importance in constructing the narratives and are interwoven through multiple mixed analytical procedures. The inferences were dependent upon mixing.	
Timing of Data Collection	Sequential – QUAL → QUAN → QUAL (Sequential Mixed Methods Sampling)	
Timing of Data Analysis	Sequential and Concurrent – QUAN(qual) → QUAL(quan) → MIXED	
Stages Where Mixing Occurs	Design (Research Questions)	Explicitly labeled mixed methods research questions were posed in the design. Constructs necessitated mixing to analyze them completely.
	Data collection	Sequential mixed methods sampling was done with respect to quantitative data to sample institutions to explore deeply. Qualitative data were transformed from qualitative data using the converting mixing strategy as a form of data collection.
	Data analysis	Network analysis complemented coding procedures to elaborate on the connections between webpages to address RQ1, blending across strands. Multiple mixed analysis strategies were used to explore variation in the sample to address RQ2.
	Inferences	Inferences were drawn from profiles resulting from the cross-case comparison mixing strategy. QUAN and QUAL themes were integrated in four different ways.

3.2.1 Reflexivity Statement

Mixed methods inquiry is compatible with a variety of paradigms. The research questions and data collection centered around existing data are design choices most aligned with pragmatism – see Johnson and Onwuegbuzie (2004) for a list of assumptions such a paradigm adopts. I place value on gaining new insights from exploring existing information in this study using methods in different ways. Strauss and Corbin (1998) describe the spirit of this dissertation with the following quote: "Researchers in the human and social sciences are operational pragmatists. The more flexibility scientists work or are allowed to work, the more creative their research is apt to be" (p. 30). I leave it to the reader to determine how creative my approach was, but nevertheless the choices I made in conducting this work were operationally pragmatic – from choosing available data sources to abandoning commercial data analysis software in favor of PowerPoint to code my data.

The focus on available data is not intended to minimize what could be learned by talking with stakeholders. The lack of communication with participants like students or advisors is a choice of scoping the design. I value using existing data and unobtrusive methods for studying social systems. My work critically engages webpages containing transfer and curricular information, as those sources are artifacts with which students interact to make substantive decisions about their educational careers. I believe that what we can learn from the institutional environment, both physical and latent, tells us a wealth of information about the institutional infrastructure that may go unspoken – the loquacious nonverbal communication of the research arena.

Because the data are existing, this work is derived from my conceptions of the phenomenon guided by the literature to structure my observations. I recognize that my

perceptions of the transfer student information come from a specific position. I did not attend a community college, nor did I transfer from one institution to another. My experience with transfer has been second-hand through co-teaching an introductory engineering course for transfer students and knowing others who have transferred from a community college or from another four-year university. Their sharing of lived experiences motivated this work.

I tend to favor quantitative approaches to research within mixed methods designs. Quantitative research does not necessarily mean inferential statistics, as I prefer quantitative descriptions of structure that highlight interconnectivity. Therefore, post-positivist inclinations can be seen in the quantitative formulation of the design, but I do not subscribe to the paradigm in this study. The measure of fragmentation here is not meant to be a "true" representation. The use of graph-theoretic approaches to assign values to asymmetries through fragmentation signal a proclivity for measurement, which is a reductionist approach indicative of post-positivism. However, the measurements were done to select institutions for further analysis pragmatically as a decision-making framework – internal validity and relative measurements were more valuable than making broad generalized claims. Moreover, the research questions are worded such that the work is open to the generation of understanding the phenomenon of information asymmetry through the inclusion of a qualitative perspective.

3.3 Operationalizing the Constructs of Fragmentation and Language

This section outlines how the constructs of this study, fragmentation and language, were operationalized during analysis. Fragmentation is described first, followed by language.

3.3.1 Operationalizing Fragmentation 

I used graph theory, also called network theory, to explore the concept of fragmentation, which was operationalized using three variables: 1) hierarchy, 2) betweenness centrality, and 3) nonlinear. One additional intermediary variable, girth, was used to define nonlinear.

University websites can be thought of as being a set of pages (nodes or vertices). The links between pages can then be considered edges, the technical name for the lines connecting the nodes. For the sake of scoping with respect to the website, a subset of nodes and edges can be taken to omit completely unrelated components of the website – forming a subgraph. The subgraph would then be a quantitative representation of the way transfer student information is organized on an institutional website. One fundamental assumption of treating the website as a network is that students will take a "walk" across the nodes and edges to find the information they need. The idea of a walk asserts the pages are connected through a hyperlink and navigated sequentially from some starting page like in Figure 4. However, a walk does not capture the students' ability to use a search feature to jump to different locations in the network then navigate from where their search takes them. The representation desired in this dissertation mapped out the information structure, not necessarily every student's path through the network. Accordingly, the measures taken on the network reflect the arrangement of the pages and the connections between them. I describe the limitations of this approach at the close of the chapter.

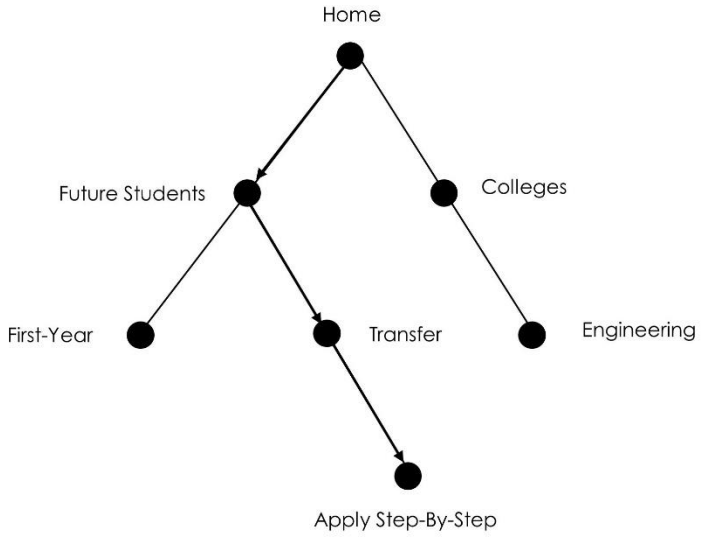


Figure 4. Example of a graph and walk using web pages as vertices and page transitions as edges

3.3.1.1 Hierarchy

One measure to compare networks was hierarchy, which quantitatively captures the extent to which the network splinters into pockets of information using a single value (Ducruet & Rodrigue, 2019). The practical implication of the variable in relation to the idea of fragmentation was the existence of multiple landing pages that may or may not be connected. Most networks tend to have a couple of influential nodes and several nodes with few connections. If the frequency of nodes with degree *d*, $f(d)$, are plotted against *d*, then the distribution looks like a decaying exponential. Alternately, if the networks have several highly connected nodes and a handful of low connected nodes, then the distribution would look more like exponential growth:

$$f(d) = cd^h$$

where *c* is a free constant and *h* is the hierarchy value. Hierarchy is found by plotting the degree of the nodes and their frequencies on a log-log plot with a linear function fitting

the points. The slope of the line in the log-log plot of *f*, *h*, provides an indicator of how strongly hierarchical the website is. Figure 5 displays what hierarchy looks like with the exponential fit in gray for a highly dispersive website with a single landing page and many links.

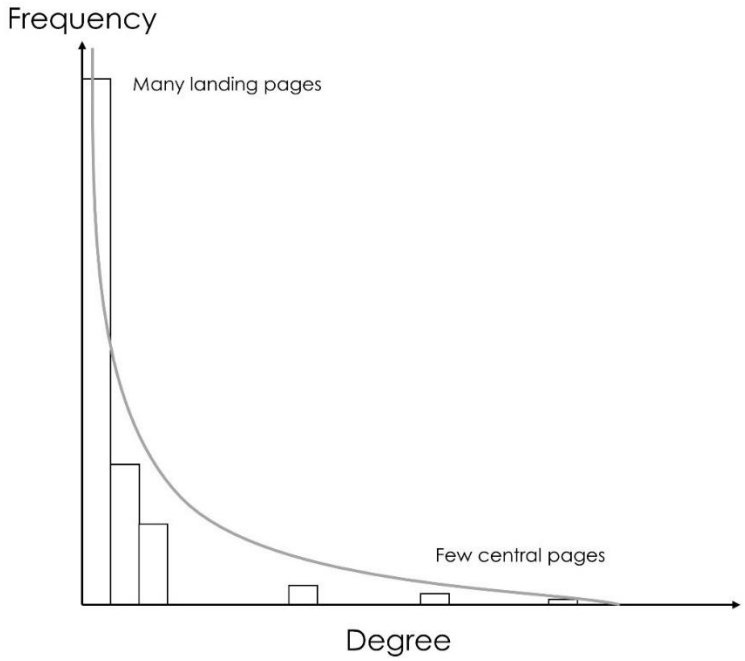


Figure 5. Example of a dispersive website that has numerous stand-alone pages with few central pages, hierarchy exponential fit in gray

Because most networks tend to have negative values of hierarchy – many nodes with a few connections, and few nodes with many connections – we can reverse the sign on the result to simplify the discussion. As a result, high positive values of hierarchy indicate stronger hierarchical structures. In sum, hierarchy captures the dispersion of information across pages, which creates hierarchical structures that *h* intends to measure.

3.3.1.2 Betweenness Centrality

Another visually striking structural feature of the graphs was their apparent "center." The center could correspond to a centralized location for information that disperses into other areas, which made it a pragmatic choice for measurement. Some networks contained strong central hubs of pages, but others did not appear to have clear, visually identifiable centers – as shown in Figure 6. A network-level centrality measure allowed for an alternative perspective on structure – focusing less on order and more on how one can flow through the network.

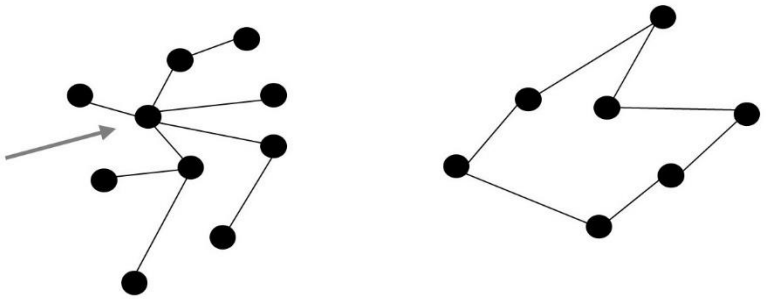


Figure 6. Example of a network with a central hub (denoted with the arrow) and one without a central hub

To derive network-level centrality, the first step was to determine the betweenness centrality, C_B, which describes the network's "centeredness." Betweenness centrality measures the number of times a node functions as a shortcut between pairs of nodes (Ducruet & Rodrigue, 2019) and is calculated as follows:

$$C_B(v_k) = \sum_{i \neq j \neq k} \frac{\sigma_{ij}(v_k)}{\sigma_{ij}}$$

where σ_{ij} is the total number of shortest paths between vertices i and j, and $\sigma_{ij}(v_k)$ is the number of the shortest paths containing the kth node v_k. The network-level centrality sums the residuals of the betweenness centrality of the individual nodes and the maximum between centrality as follows:

$$C_B(G) = \sum_{v \in V} \left(\max_{u \in V} \{C_B(u)\} - C_B(v) \right)$$

In other words, the network-level centrality attempts to form a measure of how strong of a center the network has relative to all the other nodes.

3.3.1.3 Nonlinear

The previous two variables, hierarchy and centrality, cannot necessarily identify the type of browsing associated with completely linear networks that contain no links back to home pages or any other landing page. In such a setting, browsing would only go deeper and deeper into the network. Moreover, the calculation of centrality does not always correspond to a predictable graphical representation. By the definition of betweenness centrality, a long straight network has a "center" at or adjacent to the midpoint of the line depending on if there are an even or odd number of vertices. The center of the line receives a considerable amount of traffic as nodes on either side use the center to reach one another, so its centrality is high. However, that scenario runs counter to the rationale of selecting centrality as a proxy for fragmentation because completely straight networks could possibly have the same value as one with a moderately defined center. Therefore, an additional variable was necessary to split more circular networks from more linear networks, which I derived in this study in an iterative manner as I tried to sort networks into meaningful groups.

Linearity was operationalized using an existing variable in the igraph package called girth. To describe girth, let c be an undirected cycle described by the sequence of the links and pages $c = \{v_0, e_1, v_1, \dots, v_n\}$ and $C(G)$ be the set of undirected cycles in G. The girth of the graph, g, is the smallest undirected cycle, the shortest walk, in the graph. The length of the cycle is denoted by $|c|$, and the girth is calculated as:

$$g = \begin{cases} 0, & C(G) = \emptyset \\ \min\limits_{c \in G(G)} \{|c|\}, & else \end{cases}$$

The dichotomous variable I created was called "nonlinear," L. "Nonlinear" used girth, g, to operationalize strictly linear browsing behavior – no loops containing a family of pages. The variable *L* takes a value of 1 when the girth is nonzero and -1 if the girth is zero. I chose 1 and -1 to associate the linear and nonlinear networks with specific parts of the coordinate plane – linear networks would be reflected over hierarchy's axis.

$$L = \begin{cases} 1, g > 0 \\ -1, g = 0 \end{cases}$$

As an example of girth and nonlinear, review Figure 6 once more as we did for betweenness centrality. Note that the network on the left has no cycles, it is composed of all branches. This would imply the network has a girth of zero and a nonlinear value of -1. The network on the right is a cycle with seven nodes, so it has a girth of seven and a nonlinear value of 1.

3.3.2 Operationalizing Language

Language was operationalized in two ways. Each operationalization was introduced into the design at different stages of the analysis as appropriate to the goal of the particular approach.

First, I captured the ways information was dispersed on webpages and through the concept of detouring language, or phrases used to divert a reader to another page or document. Detouring language is defined in this work as a phrase that references other information not on the page like “for more information…” and “see more…” which directs the user to move to another point in the network.

The second way to operationalize language involved examining text on webpages using a critical linguistics lens (Fowler & Kress, 1979; Fowler, 1985; Kress, 1985; Hodge & Kress, 1993), which examines language from the perspective of specific choices in grammar and diction (Fowler & Kress, 1979; Hodge & Kress, 1993). Critical linguistics provides a method of highlighting latent messaging (Kress, 1985) – especially in attempts to deceive the reader (Hodge & Kress, 1993). Fowler (1985) provides a list of suggestions that serve as constructs in critical linguistic analyses (see Table 4). These constructs provide a mechanism by which one can develop codes and themes; I did not directly map observations onto its elements as a final product.

Table 4

Summary of Critical Linguistics features suggested by Fowler (1985)

Construct	Description
Lexical Processes	Refers to the use of vocabulary. Are certain words being used more than others? Does the text use metaphors or euphemisms?
Transitivity	Concerns the process types in verbs and relationships between the participants in the processes. How is the passive voice used? How are verbs and the parties the verbs concern connected?
Syntactical Transformations	Involves concepts like nominalization, using words as a noun which are not nouns. Can include passive voice. How are syntactical transformations used to disguise processes or agency?
Modality	Refers to the authors' evaluations of events or people and their attitudes. How are hedging words like "may" used? How are processes negated using "not?"
Speech Acts	Refers to the functions the utterances are posited to perform. How does the text assign roles to different parties? What questioning techniques are used, like rhetorical questions?
Implicature	What are the inferences readers can draw if they dig deeper into the text? (Reading between the lines)
Personal address/references	Refers to the text's formality. How are pronouns used? Are there first or second-person pronouns like "I," "we," and "you?"

Note: Recreated as a table from a passage in "A Typology of Communicative Strategies in Online Privacy Policies: Ethics, Power and Informed Consent," by Pollach, I. (2005)

3.3.3 Summary of Operationalization

To summarize, two types of information asymmetry were operationalized in this section. The asymmetries created through fragmentation were captured using parameters used in graph/network theory, and the asymmetries created through language have been described using constructs from critical linguistics. The measures of fragmentation comprised the basis for the strictly quantitative perspective of this work, which was integrated within the qualitative and mixed analyses using the emergent themes and the existing coding scheme.

3.4 Data Collection

This section outlines the data collection procedures, including the definition of the population and the sampling design. Institutional research board approval was not necessary because no human subjects were involved in data collection. All data were publicly available webpages. The remaining information included publicly available institutional data from the Integrated Postsecondary Education Data System (National Center for Education Statistics, 2013-2018).

3.4.1 Population

The institutional population were U.S. four-year institutions that offer engineering as a program of study, as categorized by the American Society of Engineering Education's (ASEE) online database (N = 296) of college profiles (American Society for Engineering Education, 2018). The population was chosen purposively because ASEE maintains the database with the requirement that all participating schools have at least one four-year, ABET-accredited engineering program. Moreover, the database had a mix of public and private schools of varying sizes that are spread across the United States. Some institutions were undergraduate only, whereas others had both undergraduate and graduate programs. The diversity of institutions enabled a broad representation of universities for analysis.

3.4.2 Sampling Design

Institutions were chosen using mixed methods sampling procedures by combining random and purposive sampling as recommended by Creamer (2018a). The ASEE's webpage of college profiles was scraped and downloaded and cleaned to remove unnecessary information from scraping the text from the webpage. Institutions that had

engineering technology programs but not engineering undergraduate programs and institutions with only engineering graduate programs were removed, leaving 289 observations to be considered. The data set also contained Canadian institutions and for-profit institutions, which were also removed. The omissions left 279 institutions in the sampling frame.

The Carnegie Classifications for small, medium, and large institutions and the control – public or private – were used to describe the institutions (Carnegie Foundation for the Advancement of Teaching, 2018). I aggregated "very small" with the "small" category because there were so few "very small" institutions to consider.

The design of this study did not employ inferential statistics and used two variables (i.e., adjusted centrality (betweenness centrality times nonlinear) and hierarchy) in the exploratory quantitative dominant analysis. Cluster analysis, subsequently described, generally does not have a minimum sample size as most of its techniques are computationally driven rather than statistical. Formann (1984) does provide one rule-of-thumb, 2^v at minimum with preference to $5(2^v)$, where *v* is the number of variables. Alternatively, Qiu and Joe (2006) recommend a linear estimate of 10*vk* for the sample size, where *k* is the number of clusters. A simulation study by Dolnicar et al. (2014) led the authors to advocate for a more conservative sample size estimate of 70*v*. The recommendations are aimed at generalizability, which requires a considerably large sample as described by the authors I reviewed. However, strict generalizability was not intended in this case.

Onwuegbuzie and Collins (2007) remind researchers that sample size is a function of the study's purpose, which becomes tricky to manage because mixing sampling

designs can often be caught between qualitative and quantitative traditions. A sample size of at least 50 units (i.e., institutions in my study's instance) is recommended for a probability sample to be representative, and a purposive sample typically includes less than 30 units (Teddlie & Tashakkori, 2009). Moreover, Castro et al. (2010) recommend a range of 20 to 40 observations for integrated mixed analyses to satisfy statistical constraints. This work did not employ cluster analysis to understand the "true" latent structure of the relationships between the institutions, nor were statistical procedures used. Instead, clustering was applied pragmatically to segment institutions for purposeful sampling. Description of the quantitative data was prioritized rather than making statistical inferences, which resulted in a representative stratified random sample of 38 institutions – balanced between the purposeful and probability sample recommendations (Teddlie & Tashakkori, 2009). Institutions were sampled using the "stratified" function in Rstudio's "splitstackshape" package (Mahto, 2018) so that the sample was representative of the population across two strata: 1) institution control (i.e., public versus private), and 2) size of the institution (i.e., small, medium, large). A random seed was set so that the sample can be reproduced.

Other institutional characteristics were not considered in the strata - like Carnegie Classifications for research activity, Historically Black Colleges and Universities, and other special designations – because defining the strata too finely created too many categories. Such variables were examined for the sample once it was selected. Note the "Large Public" category is the most notably overrepresented because adjustments to the bin sizes were needed to ensure "Small Public" institutions would be sampled. If left unaltered, no "Small Public" institutions would have been included. Table 5 displays the

characteristics of the sample relative to the population. A subset of 16 institutions was selected using sequential mixed methods sampling (Teddlie & Yu, 2007) in the second stage of the process, which is explained in full in the context of the design.

Table 5

Sample as compared to the population based on the strata

Strata	% Sample	% Population
Large Private	13.1	11.4
Large Public	65.8	50.2
Medium Private	21.1	16.1
Medium Public	13.2	11.8
Small Private	10.5	8.2
Small Public	2.6	2.1

3.5 Overview of Analyses

The design contains several mixed methods analytical procedures, which are analytical strategies incorporating more than one type of data (Plano Clark & Badiee, 2010). In fact, all of Creamer's (2018a) mixing strategies were used in some form in the analytical procedures – indicative of a mixed priority design. Figure 7 illustrates the major structure of the analyses with respect to the two main strands related to the constructs used in this study, fragmentation and language. Consider Figure 7 to be a roadmap of the design to see where different components of the analyses interrelated. The fragmentation strand concerned data, analyses, and inferences exclusively related to fragmentation. The language strand provides the same information, but for the language construct. Another goal of Figure 7 is to communicate the design was mixed in priority by outlining the stages of the design, hence the several steps of analyses taking place in the *mixed* strand.

The design was divided into four phases, noted by the horizontal lines dividing the picture after the sampling. Each significant step in the analysis was appended by the

research question it addressed as well as which construct it relates to (i.e., fragmentation or language). These additional details are shown in an alternative version of the figure in Appendix C as Figure C.1. RQ1 was addressed through the initial strands of fragmentation and language by characterizing the asymmetric information induced by fragmentation and language through the network analysis followed by two-cycle mixed coding. RQ2 was addressed by forming holistic profiles consolidating the qualitative and quantitative results into the mixed strand to enable more comprehensive comparisons. The analyses are described in the subsequent sections in the order in which they were conducted to illustrate the timing of the mixing.

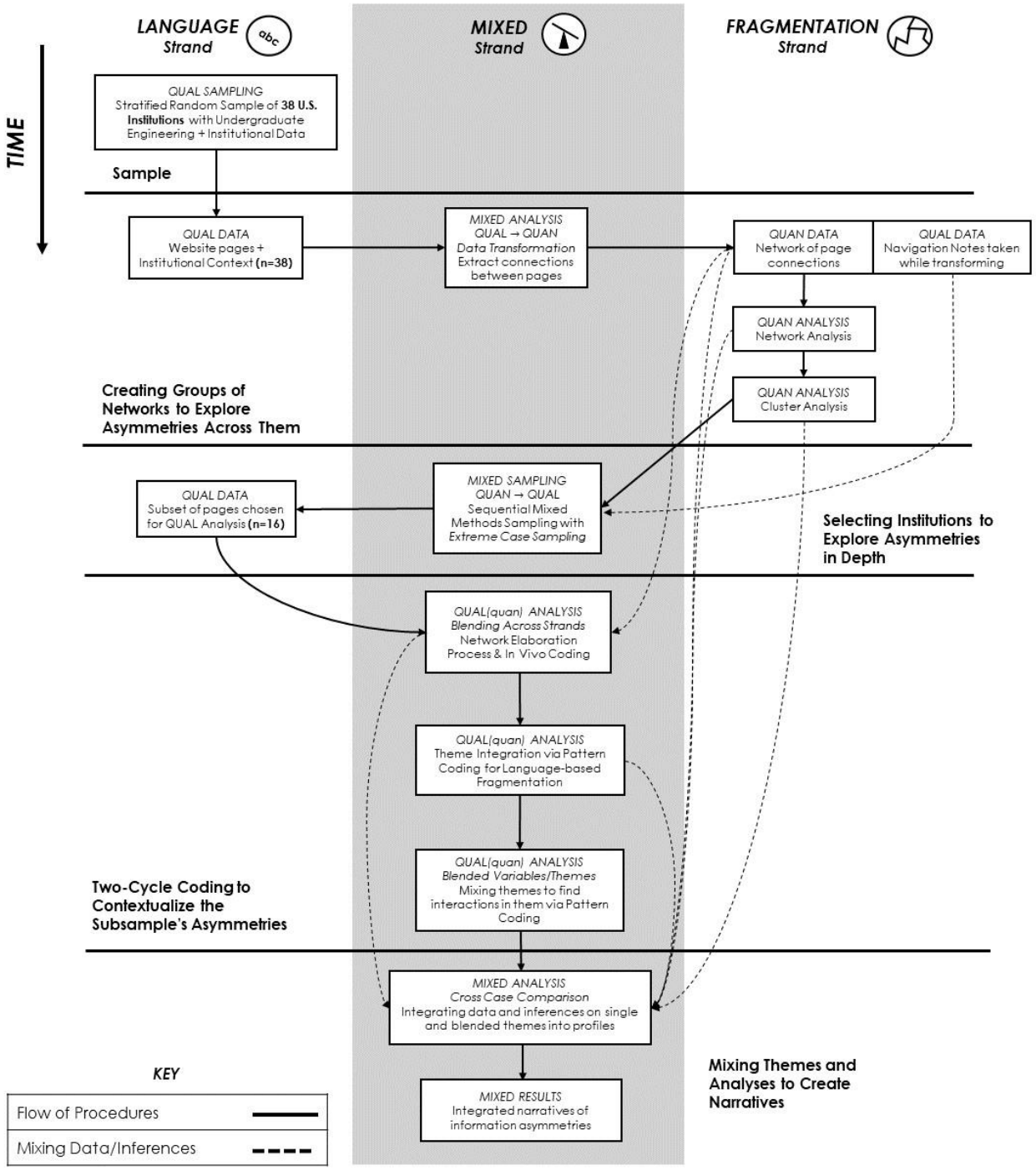


Figure 7. Diagram of analyses and where mixing occurs between the two strands throughout the design to illustrate the mixed priority of the approach

3.6 Creating Groups of Networks to Explore Asymmetries Across Them

The first stage of this work involved creating groups of institutions from which a subset of institutions could be sampled for further analysis. The quantitative data in this study was created from the language strand, webpages, through the mixing strategy of *data transformation*. The transformed data then were analyzed using network analysis. The variables from the network analysis were used in a cluster analysis to form groups.

3.6.1 Extracting the Quantitative Data and Making Notes for Sampling

The mixing strategy of *data transformation* was used to pull out the quantitative structure underlying the qualitative data (Greene, 2007), the collection of webpages. As described in the operationalization of fragmentation previously, the webpages were connected by the links steering a user from one page to another. The keywords in Table 6 were used as markers to scope appropriate web pages for identifying a sample. The set of preliminary keywords was based on themes from Messacar (2015). A problem in sampling from large networks is obtaining a representative subgraph much like how a sample should be representative of the population of interest (Leskovec & Faloutsos, 2006); however, a representative sub-graph is not necessary here because the research questions do *not* concern the structure of the entire website.

Table 6

Base keywords for sampling webpages

Curriculum	Courses	Program Requirement
Plan of study	Documentation	Degree Requirement
Credit	GPA	Articulation
Transfer	Prerequisite	Equivalency

The data collection procedure was formulated to mimic a webcrawler done manually by the researcher. Normally such a task would be pragmatically infeasible as

well because creating a network requires specifying what is called an adjacency matrix. Alternatively, a list of connections – typically called an edge list – were written to outline which nodes are connected to others, which R parsed into a graph format through functions in the igraph package (Csárdi & Nepusz, 2006). The edge list was deemed to be a more intuitive and less time-intensive process for generating graphs, but compiling the list was the remaining step. Therefore, I documented my path through the network using a text file. The procedure, shown in Figure 8, manifested itself as an R script designed to take a text file listing the URLs visited in real-time as an input and parse the URLs into an edge list, and plotting the graph using the plotting function in the igraph package (Csárdi & Nepusz, 2006).

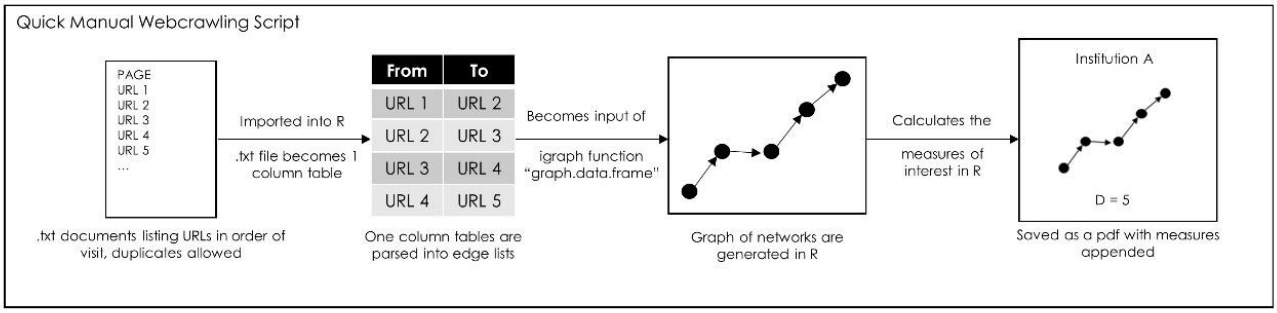


Figure 8. Illustration of R script functionality in creating the networks representing the researcher's navigation

The text document, i.e., the edge list, represented my navigation in real-time because the URLs were copied into the text document as navigation occurred. The quantitative data were collected naturally as comments were made regarding the website's general usefulness and ease of access, constructs from a website evaluation study for community colleges (Schuddle et al., 2018) – the comments were the *navigation notes* for that website.

The navigation notes centered around the constructs of fragmentation and language with additional inspiration from the constructs of "ease of access" and "usefulness" from Schuddle, Bradley, and Absher's (2018) (see Table 7). The organizing notes used for selecting a subsample for the next round of analyses considered those five noteworthy elements as well as the sampling strata and the average transfer-in for the institution between 2013 and 2017 (data available from IPEDS).

Table 7

Mapping of noteworthy elements for sampling mapped back to literature

Noteworthy Element	Criteria from Schuddle, Bradley, and Absher (2018)
Broken Links	"Information present, but full of broken links that make it impossible to find adequate and accurate information"
Language	"Policies or processes necessary to guide student through transfer present, but could be more detailed; flow of information moves from simple to complex;" "Simple language used to define transfer process"
Structure	"The information was far removed from the home page, but could be found by gradually clicking through several pages, with some backtracking"; "flow of information moves from simple to complex, but requires some backtracking to help students determine transfer process and requirements"
No Transfer	"No information regarding transfer"
Transferology	"Transfer options (e.g., transfer plans for partner institution) clearly presented" Note that Transferology is a free tool that helps students search for courses that will transfer from one institution to another.

3.6.2 Network Analysis to Measure Elements of the Browsing

Once the graphs were constructed by converting the set of webpages to a network, each node's measures were calculated to explore the *fragmentation* of the information design with respect to RQ1 using centrality, hierarchy, and nonlinear, as previously

described. The open-source programming environment and statistical software, R (R Core Team, 2019), and the igraph package (Csárdi & Nepusz, 2006) were used to compute graph-theoretic measures associated with the connections between transfer student information webpages. The data were then prepped for the next analysis.

3.6.3 Data Cleaning and Processing before Finding Groups

The next step in the procedure was to use the analyses from the network analyses to find groups. However, the data needed to be cleaned and standardized before being used in the algorithm to enable meaningful clusters to be formed.

I consolidated centrality and nonlinear into adjusted centrality – which is justified in Appendix A – then standardization was performed. Note that the composite variable of betweenness centrality times nonlinear is called *adjusted centrality* from this point. The standardization was done to ensure large and small values of *x* respective to its mean did not dominate the calculations in the cluster analysis algorithms. The analyses rely on distances between observations to calculate the objective function, so distant unstandardized observations needlessly inflate the size of the feature space and introduce bias. The variables adjusted centrality and hierarchy used for the cluster analysis procedures were standardized using a min-max transformation to the interval [0,1] so both variables were clustered in the first quadrant. The min-max transformation was as follows:

$$x_{standard} = \frac{x - x_{min}}{x_{max} - x_{min}}$$

Where *x* is the value of the variable, x_{min} is the minimum value of the variable, and x_{max} is the maximum value of the variable.

The last step of data cleaning involved screening the variables for outliers that could bias the clustering algorithms. The main method of screening involved using box plots. The sample size for the cluster analysis was 36 after removing two outliers.

3.6.4 Cluster Analysis to Form Groups from the Network Analysis

The method of finding groups to begin work on narratives of information asymmetries across institutions was cluster analysis, which seeks to form groups of similar observations. Several methods to conduct cluster analysis exist, but the most commonly used approach is *K*-means. *K*-means cluster analysis classifies *q* observations into *K* categories, called clusters. The clusters are centered at their mean such that the within-cluster sum of squares is minimized (Jain, 2010). RStudio uses Hartigan and Wong's (1979) algorithm, which is a common implementation of *K*-means. The clustering procedures are summarized in Figure 9.

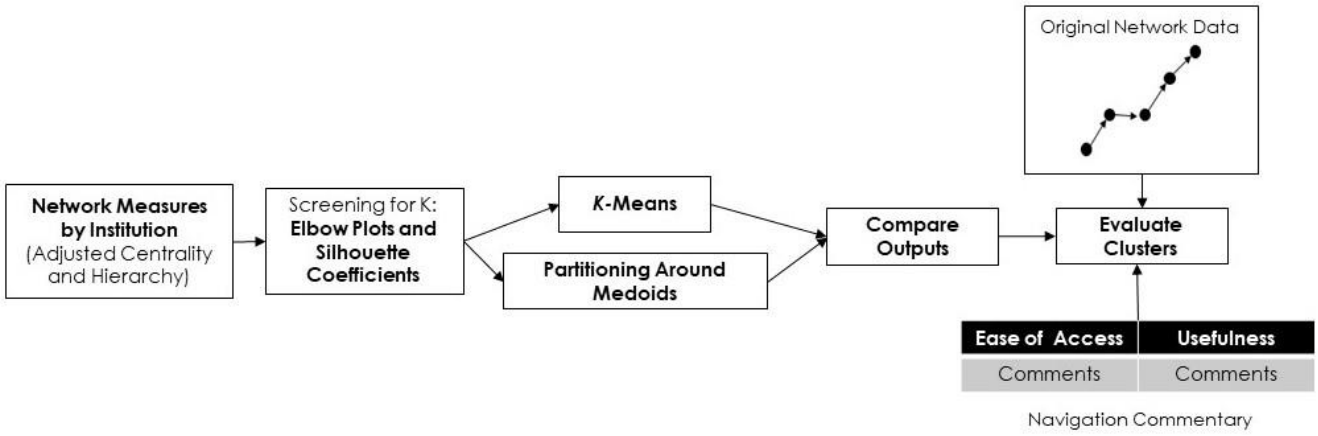


Figure 9. Summary of Clustering Procedures

The goal of this stage of the analysis was to create groupings of similar browsing behavior for further analyses based on the three variables. Both *K*-means cluster analysis and Partitioning around Medoids (PAM) – implemented from the "cluster" package

(Rousseeuw, et al., 2019) – were used as the means to derive the initial groupings for refinement in the later phases of the design. I used the Elbow Method (Kodinariya & Makwana, 2013) and the Silhouette Method (Rousseeuw, 1987) to pick the number of clusters to extract – the value *K* in *K*-Means and PAM. A more detailed description of the clustering procedures is given in Appendix B for reference

The clustering solutions from both methods, K-Means and PAM, were compared for consistency in grouping data points. Because no explicit class labels were available for this application, qualitative investigations of cluster validity needed to be approached with a mixed perspective. Revisiting the complete data was done to visually inspect how the algorithms sorted the networks into the groups. This process involved creating a grid of the network structures sorted into their appropriate clusters and visually assessing the similarity in their structure within and between clusters. Moreover, the navigation commentary written during data collection was used to further examine the clusters for themes in their network structure.

3.7 Selecting Institutions to Explore Asymmetries in Depth

Using sequential mixed methods sampling (Teddlie & Yu, 2007), a subset of 16 institutions were identified for a mixed analysis based on the results of the cluster analyses and navigation notes to explore the variation using a new strand of data. The sampling was based upon the navigation notes centered around the constructs of fragmentation and language as mapped to the constructs of “ease of access” and “usefulness” from Schuddle et al. (2018). The organizing notes to resample an institution for the next round of analyses concerned: (1) if broken links were encountered, (2) if there were instances of language worth revisiting in detail, (3) if there were instances of

structural issues worth revisiting in detail, (4) if the institution claimed to not have a transfer program, (5) if Transferology (a free tool that helps students search for courses that will transfer from one institution to another) was mentioned, (6) the strata, and (7) the average transfer-in for the institution between 2013 and 2017 (Data available from IPEDS). If a note was made on the first (5) constructs during the screening navigation, a mark was appended to the institution. The number of marks per institution was totaled to form a "score" for that institution. Institutions were chosen to include a range of transfer-in rates, balance in the strata, and combinations of the marks in the five categories.

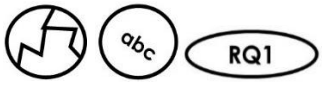
A formative joint display, a figure synthesizing qualitative and quantitative data for purposes of making decisions for further analysis (Creamer & Edwards, 2019; Edwards & Creamer, 2019), was used to evaluate the balance of institutions picked for the next stage of analysis. To maximize variation for creating narrative comparisons at the end of the analyses, purposive sampling was used as a means of *extreme case sampling* in the last step of the analysis. The extreme cases included an institution with no marks as well as an institution with the maximum number of marks.

3.8 Two-Cycle Coding to Contextualize the Subsample's Asymmetries

The qualitative dominant analyses followed the network and cluster analyses. The goal of this phase was to discover specific ways in which asymmetries could be manifested. This section provides an overview of the coding procedures by describing how mixing occurs during coding then outlines the first and second cycle coding methods.

3.8.1 Overview of Coding Procedures

A subset of 16 institutions was identified for a mixed analysis based on the results of the quantitative analyses for this stage of the design using sequential mixed methods sampling (Teddlie & Yu, 2007). This section outlines the coding procedure and highlights the mixing occurring in this stage to the extent it could be deemed a type of mixed methods coding. The emergent themes led to the construction of profiles of information asymmetry to address RQ2 since each policy document or webpage is characterized by the level of the organization it concerns (i.e., department or institution). Coding was dependent on the quantitative strand of data, which presented an opportunity for mixing. Fragmentation could not be coded page by page in isolation because fragmentation involved the dispersion of information by definition. To code for fragmentation, other sources of evidence within the document or page's proximity needed to be considered. Policies are connected when they reference one another. If one page was being coded for its information content, the paths to how one would reach the other page should be considered, as captured by Schuddle, Bradley, and Absher's (2018) constructs. The symbiotic relationship between the strands exemplified why a mixed approach was not optional. Ignoring the connections between sources would have weakened the qualitative inquiry, which was not ideal.

3.9.2 Cycle One, Contextualizing the Networks 

The first cycle coding procedure was an explicit mixed methods coding protocol. The set of coding procedures as an approach was collectively called *network elaboration*, a variant of process coding to refine the *fragmentation* measures calculated in the network analyses to incorporate how *language* fragments the information design for RQ1

by appending “In Vivo” codes directly taken from the webpage. Accordingly, the first cycle coding was the implementation of the mixing strategy *blending across stands,* where the constructs used in the quantitative analyses were expanded upon using qualitative data (Creamer, 2018a).

The coding scheme was devised as an integrated application of simultaneous coding, the assignment of more than one code to a segment of data (Saldaña, 2016), to cope with challenges of coding for the interaction of structural and linguistic elements in the data. Glesne (2011) argues that simultaneous coding is defensible when the data appear to exhibit several interpretations, necessitating the use of multiple codes to capture the different dimensions. Commercially available qualitative and mixed methods coding platforms were generally unhelpful in the meaning-making process, so I used PowerPoint to illustrate the *network elaboration* codes. My approach ensured I could faithfully capture the relationships between the individual pages as one unit without sacrificing the structural complexity rather than loading the pages individually into a commercial qualitative or mixed methods data analysis software. There were two components to scheme: (1) organizing the interdependence of the webpages, and (2) capturing the content of the pages themselves.

The first component of the code captured the structure of the webpages. Nooraie, Sale, Marin, and Ross (2018) claim that networks can be considered to be qualitative data considering the network is a raw visual representation of the data. I argue the networks were primarily quantitative in this phase because I was more concerned with structure rather than the visual characteristics. Capturing the underlying connections between the pages, the structure, was a crucial element of the design to ensure congruence with the

previous stage of the analyses and properly code how one could flow through the network.

The journeys through the networks were created based on finding pages related to transfer admissions, the evaluation of credits, prerequisites, degree/program requirements, and policies (specifically articulation agreements) – which was drawn from Messacar's (2015) work. Process coding captures actions and is usually applied to uncover routines in the behavior of a phenomenon, but the method can be used in almost any qualitative study (Saldaña, 2016). Gerund phrases are typically used to describe an action taken by the individual (Charmaz, 2002). In this case, the process coding recorded the process by which I was guided through the network, noting which vertex in the network the page links to next. Gerund phrases in the conventional form of process coding were replaced by detouring language phrases that sent the user between pages. The phrases were appended to the arrows connecting the pages.

Because information fragmentation was the unit of study, finding phrases acting as detours to other pages, departments, or other websites was useful as a step in first cycle coding. The set of key phrases was chosen after reading the webpages first to gain a general understanding of what constituted a "detouring phrase" from the first stage of the design (see Table 8 and Figure 10 for an example).

Table 8

Base keywords for coding detouring language

"(Please) see"…	"(Please) visit" …	"For more information"…
"Can be found"…	"(Please) make sure"…	"(Please) review"...
"(Please) follow" …	"(Please) consult"	"(Please) go to"…
"(Please) look for" …	"(Please) use"…	"(Please) contact"…

As an example of detouring language in the network, Figure 10 shows the detouring language "should be directed" applied to a link from a College of Engineering page to University Admissions. The detouring language captured the direction of the flow through the network, hence the directional arrow from the College of Engineering page to University Admissions page. Detouring language was underlined to distinguish it from other phrases in the sentence(s).

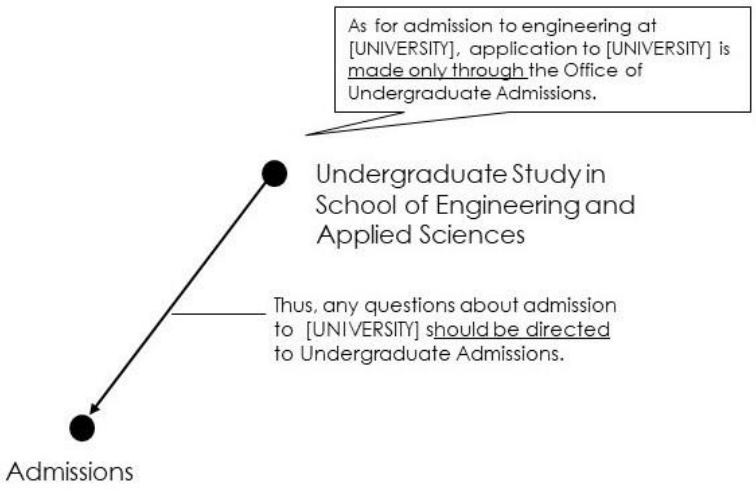


Figure 10. Example of a Detouring Language Code

Next, I used "In Vivo" coding to contextualize the contents of the individual nodes in the network. In this case, the "In Vivo" codes were direct quotes from the webpages; I followed the "verbatim principle," using words exactly as they appear in the data, to avoid obscuring their meaning (Stringer, 2014, p. 140). The "In Vivo" codes were appended to the nodes as speech bubbles, and to prep for analyses related to language-based information asymmetries, words used to hedge, imply doubt or uncertainty, and definitiveness were underlined (see Figure 11 for an example).

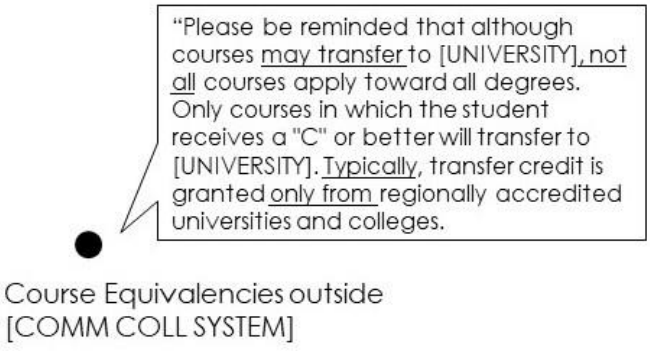


Figure 11. Example of an "In Vivo" style code combined with language-based codes

The network itself was not the only visual element to capture in this cycle. When the visual representation or organization of the page was deemed necessary to illustrate, the node was replaced with either a screen-capture of the relevant part of the page or a mockup of its structure. Figure 12 shows an example of both cases.

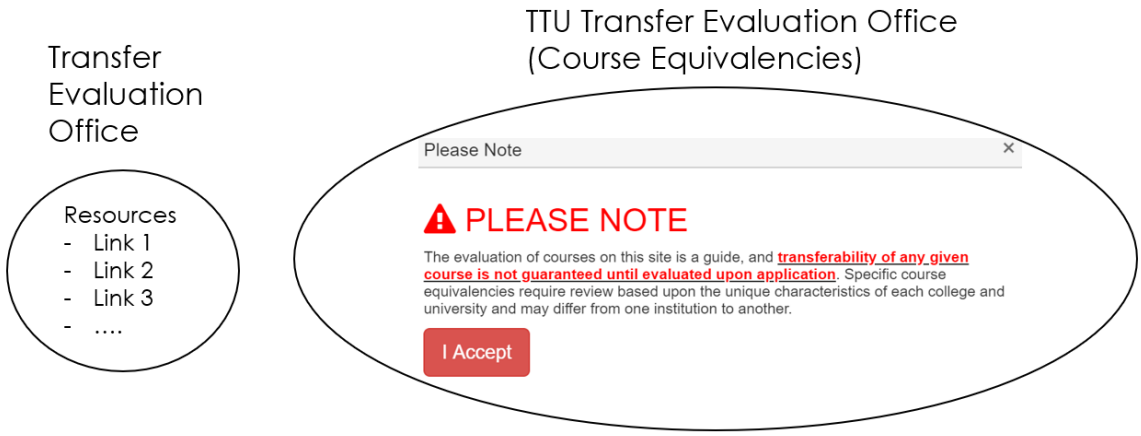
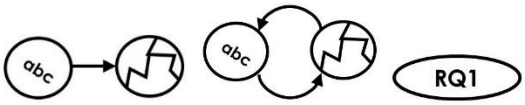


Figure 12. Example of visual elements of webpages incorporated into the first cycle

Once the first cycle was completed, the network elaboration codes were synthesized to establish preliminary themes, as recommended by Saldaña (2016). The themes were a set of common quantitative structures in the network and qualitative

elements from the detouring language and “In Vivo” snippets from the webpages. The purposefully organized codes and themes then entered into the second cycle.

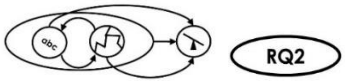
3.9.2 Cycle Two, Blending the Themes



An appropriate second cycle coding protocol to continue work on RQ1 was pattern coding. Miles, Huberman, and Saldaña (2014) describe the method as appropriate for establishing grounds to conduct cross-case analyses by creating themes across different instances by consolidating large sections of data into smaller units. Pattern coding was deemed to be especially congruent with the overall research design because of the multiple dimensions captured in the first cycle codes. Synthesizing common structures in the networks for fragmentation in relation to the detouring language for the language component was the goal of the second cycle. Therefore, the slides illustrating the network elaboration codes were reviewed to pull broader themes from the networks noting their context in the network.

After integrating the themes of detouring language into the fragmentation, a more general synthesis of themes was conducted using the same process. The analysis strategy is referred to as blending themes (Creamer, 2018a), as the quantitatively focused themes from fragmentation and qualitatively focused language themes were intermingled as mixed themes. More generally, the process of bringing quantitative and qualitative data together during analysis here would be called embedding (Catallo, Jack, Ciliska, & MacMillian, 2013). The narratives were then created from the synthesis.

3.9 Mixing Themes and Analyses to Create Narratives



The last phase of the design involved leveraging the results of the previous phases to construct narratives of common asymmetries in the institutions' websites. Although mixing occurs throughout the analyses, the conclusion of the analysis phase was an explicit mixed analysis that combined the results of the two strands. RQ2 was addressed using the mixing strategy cross-case comparison to consolidate the results of the previous analyses to characterize both *fragmentation and language*. The result was a more complete description of the *information asymmetries* present in the webpages.

Cross-case comparison involves the creation of internally consistent holistic profiles – narratives in this case – of qualitative and quantitative data to enable the researcher to begin comparing broad patterns (Creamer, 2018a). The narratives were derived by integrating the results of the network analysis clusters and the two-cycle mixed coding by weaving the fragmentation and language themes together. Therefore, the narratives can be understood, in part, as a qualitization (Teddlie & Tashakkori, 2009; Sandelowski, 2001; Sandelowski, Voils, & Knafl, 2009) of the quantitative data because of the quantitative priority network structures and themes associated with the structure were described in textual form.

Both convergence and divergence were explored in the profiles, meaning the strategy was not meant to be an effort of triangulation nor was lack of convergence meant to be a sign of poor quality (Creamer, 2018b). Brief narratives were written to describe the variation and lack of variation found in the institutional clusters concerning the three data sources used to form them: network analysis clusters, the two-cycle mixed coding, and the network representations of the information design.

3.10 Limitations

The design choices in this work introduce a series of limitations and caveats about the extent to which results can be deemed generalizable or transferable. The limitations can be explained in terms of the perspective taken to conduct the design, the operationalization of the constructs, and the interpretation of results.

3.10.1 Limitations in the Economic-based Perspective

Although this research was cast with an economic lens, an element of the information processing approach to college choice was included because of the process of collecting information for students' academic decision-making. Still, the choice of using an economic perspective privileges one approach to understanding how students navigate higher education over others more grounded in sociological influences. The implications of binding the study in terms of information asymmetry was backed by a driving assumption that the student experience is marred by asymmetric information as defined, which in turn affects how the student experiences the process of earning a degree. The design decision also implied the policies and documentation were dense enough such that "availability bias" (Tversky & Kahneman, 1974; Kahneman, 2011) and "anchoring" would cause students to make sub-optimal decisions and complicate their experience. More work is needed beyond this design to make causal connections.

The lack of the sociological perspective was most apparent in the choice of data. The positioning of university websites and policies available online as the data sources carried assumptions about how students consume information and whether the policies are up to date and online. The sources of data assume students have access to the internet, which was a strong claim. Nine in ten families are connected to the internet in some way,

but about one-quarter of lower-income families below the median income level and one third below the poverty level only have internet access through a mobile device (Rideout & Katz, 2016). More specifically, the choice of data can appear to make the assumption that students rely exclusively on what is available through the university and not the proliferation of external sources of information students have access to (Grote et al., 2019), but the inferences from the design do not attempt to make that claim .

3.10.2 Limitations in the Operationalizations

A few consequences arose from the graph theory and linguistic driven formulation. Under a graph theory perspective, the relevant information was assumed to all be available in a website, ignoring the other sources of information a transfer student may use (Park & Hossler, 2014; Grote, Lee, Knight, Erwin, & Watford, 2019). The decision obscured the idea of usability by only considering the organization of the website's architecture and dispersion of information, but the construct was intentionally formulated to be measurable and compatible with the constructs in the language operationalization - a post-positivist inclination.

Context still matters in interpreting the measures, and using indices from graph theory can only provide a decontextualized view on the information design by ignoring features of the sites and policies not tractable by any of the measures. The weaknesses of the measures were offset in part by the qualitative analyses, but the metrics cannot provide causal inferences regarding the impact of the information designs on student outcomes by themselves – even with the additional qualitative approach. The design did not include any analyses on student decision-making. Therefore, the effect of the values of each measure on a student's major or curricula cannot be determined. Other methods

would be necessary to explore the effects of the information design on key individuals like other students and advisors. Future efforts can serve to integrate the results into the human element of the system of information design.

The first limitation of the networks themselves was that they assume a top-down style of search as opposed to a bottom-up approach using keywords from the question guiding the browsing. A top-down style of searching could be possible with a transfer student not familiar with university processes or information, as less experienced searchers tend to employ top-down strategies more frequently before switching to a bottom-up strategy later in the search (Navarro-Prieto & Rogers, 1999). More experienced users tend to use a combination of the two strategies.

A glaring limitation of the operationalization in a top-down fashion was that the networks ignore the presence of a search bar. The ability to switch to any node in the network instantaneously regardless of the starting position or current node was a credible threat to the method. However, Katz and Byrne (2003) report that only a small percentage of users will search first. Moreover, users eventually have to navigate through a subset of pages to find the right piece of information after searching. Search results are dependent upon the keywords chosen by the user and the power of the search engine. The choice of keywords could return irrelevant results, send the user to a page deep in the network that is relevant but does not directly answer the original question, or place the user somewhere in a chain of information where nuance or caveats on preceding pages are missed. Thus, although I acknowledged limitations of the graph-theoretic approach tied to the ability to search, I argue that understanding how information is spread across pages is still pertinent for users who first search for a keyword, particularly if key pieces of

information build across pages. In that sense, my research could suggest that users who begin searching with keywords might actually miss essential information. Incorporating search in a clickstream-based design serves as an avenue for future work.

The process of generating the network structures made a compromise in its completeness considering the design of university webpages. The webpages themselves were to be collected using a set of keywords relevant to the information students would need to access. A webcrawler in the R package "Rcrawler" (Khalil, 2018) was able to use the keywords to scrape relevant webpages and their related pages to a specified degree of separation. However, a webcrawler was deemed infeasible in early attempts to collect the network structure of the transfer information because the flat degree distribution guaranteed nearly all pages on the website would be sampled. Technical issues did not end with the generous sampling done by the webcrawler, as it was also desired for the webcrawler to scrape the content of the pages it traversed. Sampling the text also could not happen because of the diversity of the webpage designs both within and between universities was more than current generation webcrawlers could manage. On reflection, the webcrawler also suffered from being an impersonal quantitative method of interacting with the data which was incongruent with the fully integrated design. For the previous reasons specified, the webcrawler was deemed to be pragmatically and methodologically inconsistent with the design. Moreover, universities were found to have considerable high connectivity in trial data collection processes, so seeking to make all the appropriate connections between pages did not provide any added value. Forfeiting graph completeness leads to a different interpretation of the networks, which limits generalizability.

3.10.3 Limitations in the Interpreting Results

The first main limitation of results interpretation concerns the representativeness of the sample. The sampling design was constructed such that the institutions chosen for the larger thirty-eight observation group was as congruent with the population as possible. However, the goal of this design was not to apply results to specific institutions. Broad patterns in information asymmetry that could manifest in institutional websites were desired. Therefore, I cannot make claims such as, "institutions that are small and private tend to have this issue." I cannot make generalized claims about the clusters themselves either. The relationships described in the results should be interpreted as suggestive, not with high confidence in causality based on group membership.

A second unavoidable limitation was that websites are not static. Websites are constantly under construction, and it is possible a website in this sample was just about to be redesigned when these analyses were conducted. Such a limitation does not necessarily invalidate a finding or theme, as the theme was observed in other institutions.

Finally, it is entirely possible pages with information related to transfer were not found based on the nature of the data collection and analysis. Specific guiding keywords and questions were used, but the approach does not guarantee all information was collected. This limitation might have been mitigated by a robust webcrawler, but technical barriers invalidated the automated approach. Again, I concede the networks are not intended to be complete representations of the information design. The networks are limited to the constraints of the protocol used to construct them.

CHAPTER 4. RESULTS

4.1 Overview of Results

This chapter describes the complete analyses at each step of mixing. It begins with a discussion of the results of the network generation process, followed by the cluster analysis of the network structures, purposeful sampling of institutions for the next stage of analyses, and two-cycle coding of the sampled institution webpages. It concludes with the integration of themes across strands as well as the narratives of extreme cases.

4.2 Creating Groups of Networks to Explore Asymmetries Across Them

This section presents the results of the network analysis and cluster analysis for the first stage of the design.

4.2.1 Network Analysis to Measure Elements of the Browsing 

Table 9 displays the network level summary statistics for the standardized and unstandardized variables used in the cluster analysis. The dichotomous "Nonlinear" variable that was created from the girth of the graph to describe networks with loops and without loops had 9 instances of -1 (linear network) and 31 instances of 1 (not linear).

Table 9

Summary statistics for variables from the network analysis

Variable	Mean	SD	Minimum	Maximum	Skew	Kurtosis	SE
Hierarchy	0.62	0.81	-2.26	2.80	0.45	3.21	0.13
Centrality	0.41	0.20	0.14	0.78	0.26	-1.42	0.03
Hierarchy[a]	0.57	0.16	0	1	-0.45	3.21	0.03
Adjusted Centrality[a,b]	0.62	0.27	0	1	-0.57	-0.87	0.04

Note: [a] Variable is standardized using max-min transformation. [b] Adjusted Centrality is multiplied by Nonlinear before being standardized.

Cluster analysis does not require normality in the variables. However, outliers should be attended to for the *K*-means method because the solution can be highly influenced by substantive outliers, and accordingly, two extreme values for Hierarchy and Adjusted Centrality were dropped. These values were reintroduced later after the clustering procedures based on their proximity to the nearest cluster.

4.2.2 Data Cleaning and Processing before Finding Groups, Screening for Values of K for Cluster Analysis

The Elbow Plot shown in Figure 13 displays the total within sum of squares (WSS) for the clusters indexed by the value of *K*. The goal of the method is to find the point at which the successive reductions in the WSS are not worth increasing the number of clusters. Figure 14 shows productive reductions in the total WSS until $K = 4$. After $K = 4$, the reductions from $K = 5$ to $K = 10$ do little to decrease the total WSS. Therefore, and consistent with using the elbow plot approach, a four-cluster solution was preferred.

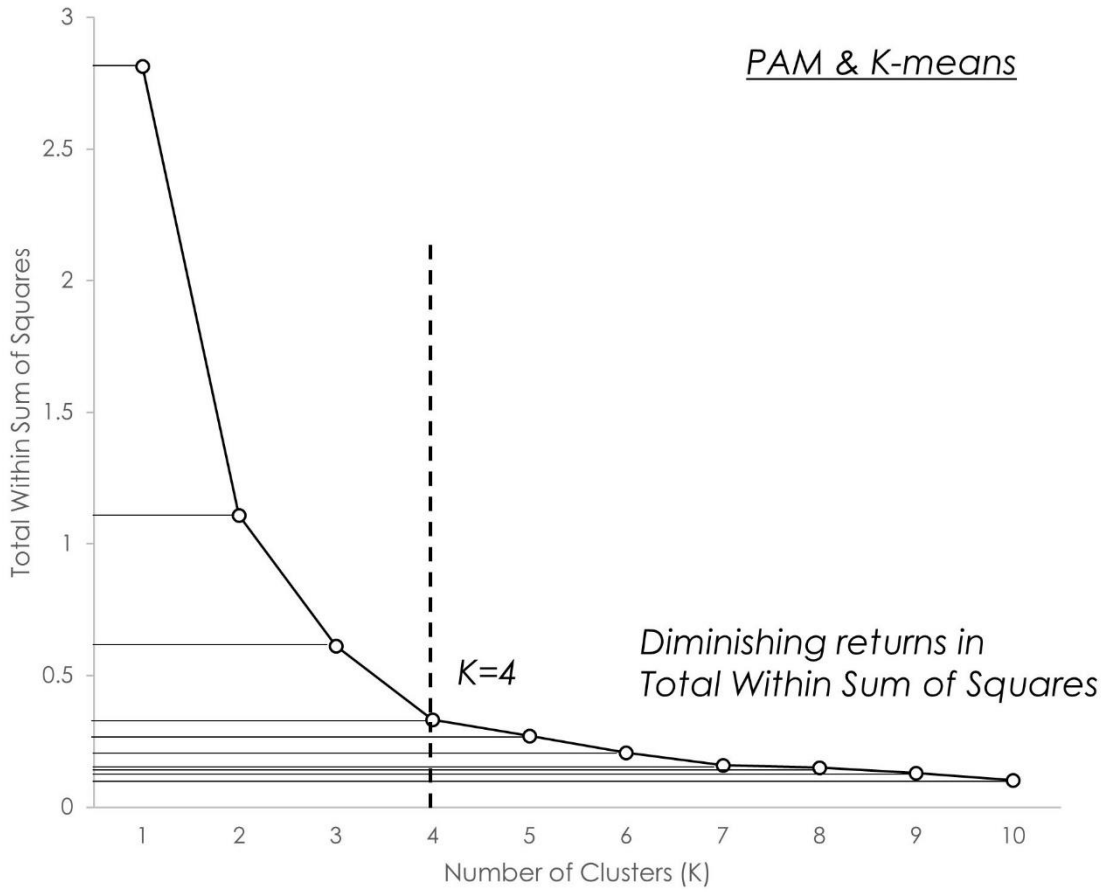


Figure 13. Elbow plot for PAM indicating the choice for *K*, *K*-means version was similar

The silhouette plot was also examined for K-means and PAM in Figures 13 and 14 respectively. Although the two cluster solution is empirically the "best" in PAM, I evaluated the opportunity cost of choosing $K = 4$ on the average silhouette coefficient. The difference between the average silhouette value for $K = 2$ and $K = 4$ was only a decrease of 0.05. The decrease was seen as a negligible trade-off to corroborate the Elbow Method.

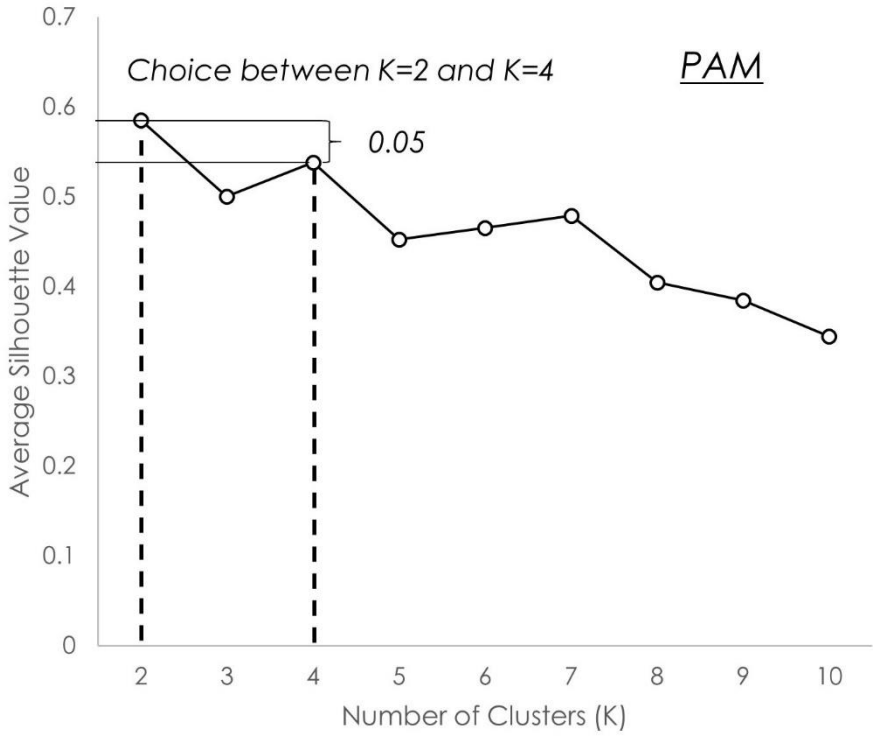


Figure 14. Average Silhouette Width for PAM, choice between $K = 2$ and $K = 4$ has minimal effect on average silhouette

In addition, the maximum average silhouette value for *K*-means was also found at $K = 4$ in Figure 15, further adding support to the choice of $K = 4$.

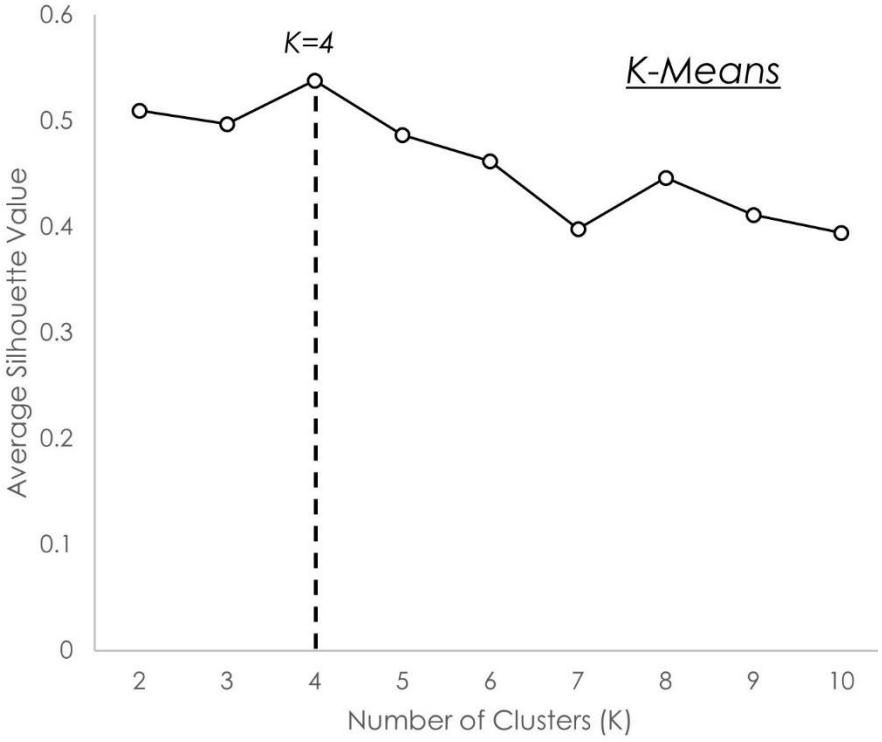


Figure 15. Average Silhouette Width for *K*-Means, maximum value of average silhouette width at *K = 4* corroborates results from Elbow Method for *K*-Means and *PAM*

4.2.3 Cluster Analysis to Form Groups from the Network Analysis

The solution with approximate cluster outlines is shown in Figure 16. What can be seen is that the composite variable of adjusted centrality (i.e., betweenness centrality with nonlinear) provided the most information in distinguishing clusters from one another, with hierarchy providing some distinction in the third cluster with its skinnier vertical range. Hierarchy sorted out a set of outliers not closely related to clusters 2 or 3 by forming cluster 4, which consists of a small set of networks with high values of hierarchy.

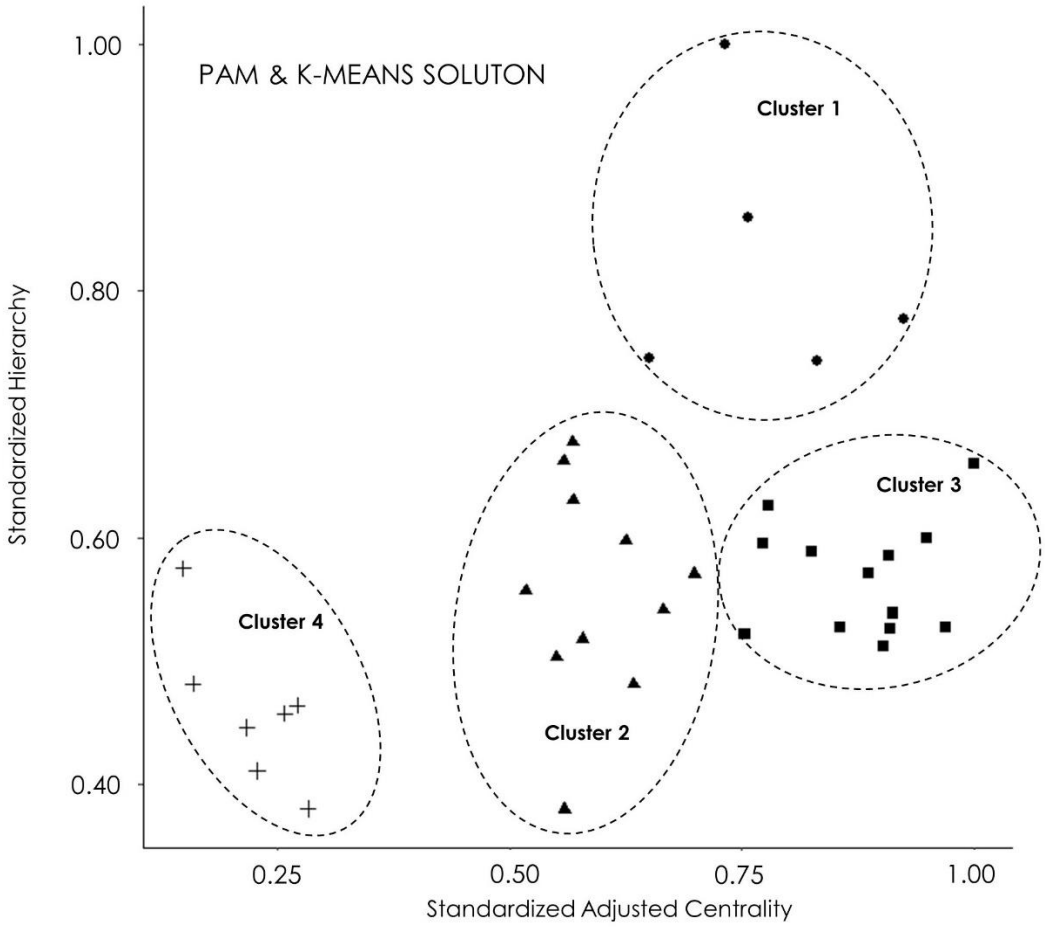


Figure 16. Results of PAM and K-means with $K = 4$

A solution with $K = 3$ was also attempted because of its proximity to $K = 4$ and as an attempt to step back in overfitting the data. Figure 17 displays the common solution for both *K*-means and PAM. Note that 31 of the 36 observations clustered as they did in the four cluster solution. The only discrepancies are in the upper right portion of the space, which exhibited weak cohesion because of the points' separation relative to the other clusters. Given the increase in the within-sum of squares and a decrease in overall silhouette coefficient indicated by the initial screening for *K*, the three cluster solution was rejected.

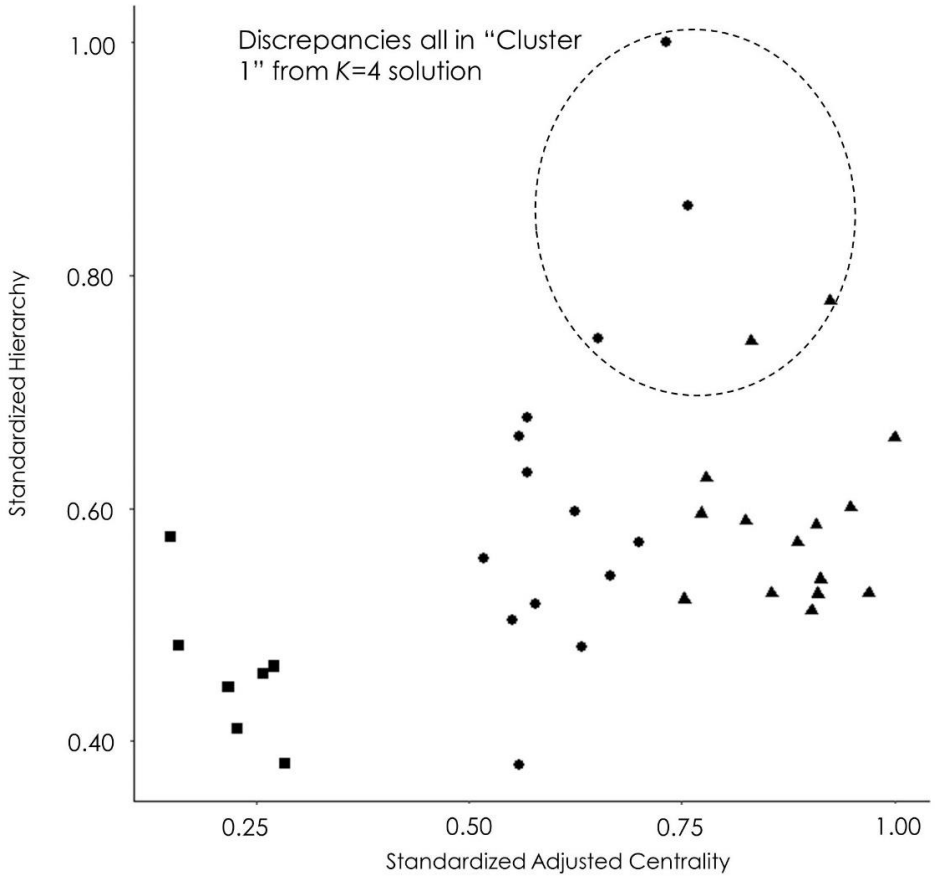


Figure 17. Results of PAM and *K*-means with *K = 3,* discrepancies between *K = 4* and *K = 3* circled. Solutions are fundamentally the same

The K = 4 solution had WSS and silhouette values generally classified as good. The total WSS of the clustering was 0.33, the between sum of squares (BSS) was 2.48, and the total sum of squares (TSS) was 2.81. Therefore, the ratio of the BSS to the TSS was 0.88 – indicating good fit. Examining the silhouette values across the solution revealed reasonable structure for clusters 2 and 3 with average values of 0.52 and 0.56 respectively. Cluster 4 had a strong structure as indicated by its average silhouette value of 0.75. Cluster 1, however, exhibited a weaker cohesion with an average value of 0.22. The set of clusters had reasonable structure, an overall average silhouette coefficient of 0.54.

4.2.3.1 Mixing to Evaluate the Clustering Solution 

Assessing the final PAM and *K*-Means solution was done with a mixed perspective. First, reintroducing the original network structure from which the features were derived allowed for a recontextualization of the data. Second, the navigation notes taken during data collection, while browsing the webpages, added an additional layer of description to the clusters. Finally, the strata used to sample the institutions from the sampling frame were appended to the data to add context for institutional control (public or private) and size (small, medium, large). The previous steps were incorporated into a visual called a formative joint display, a figure synthesizing qualitative and quantitative data for purposes of making decisions for further analysis (Creamer & Edwards, 2019; Edwards & Creamer, 2019).

Figure 18 presents a formative joint display (Edwards & Creamer, 2019) of the visual representations for the networks appended to the clusters relative to their position in the feature space. The size of each cluster, its center, and navigation commentary are added to further contextualize the clusters. The formative joint display here was used to understand the pictorial representations of the clusters – i.e., to see what a typical network looked like in each cluster relative to its metrics.

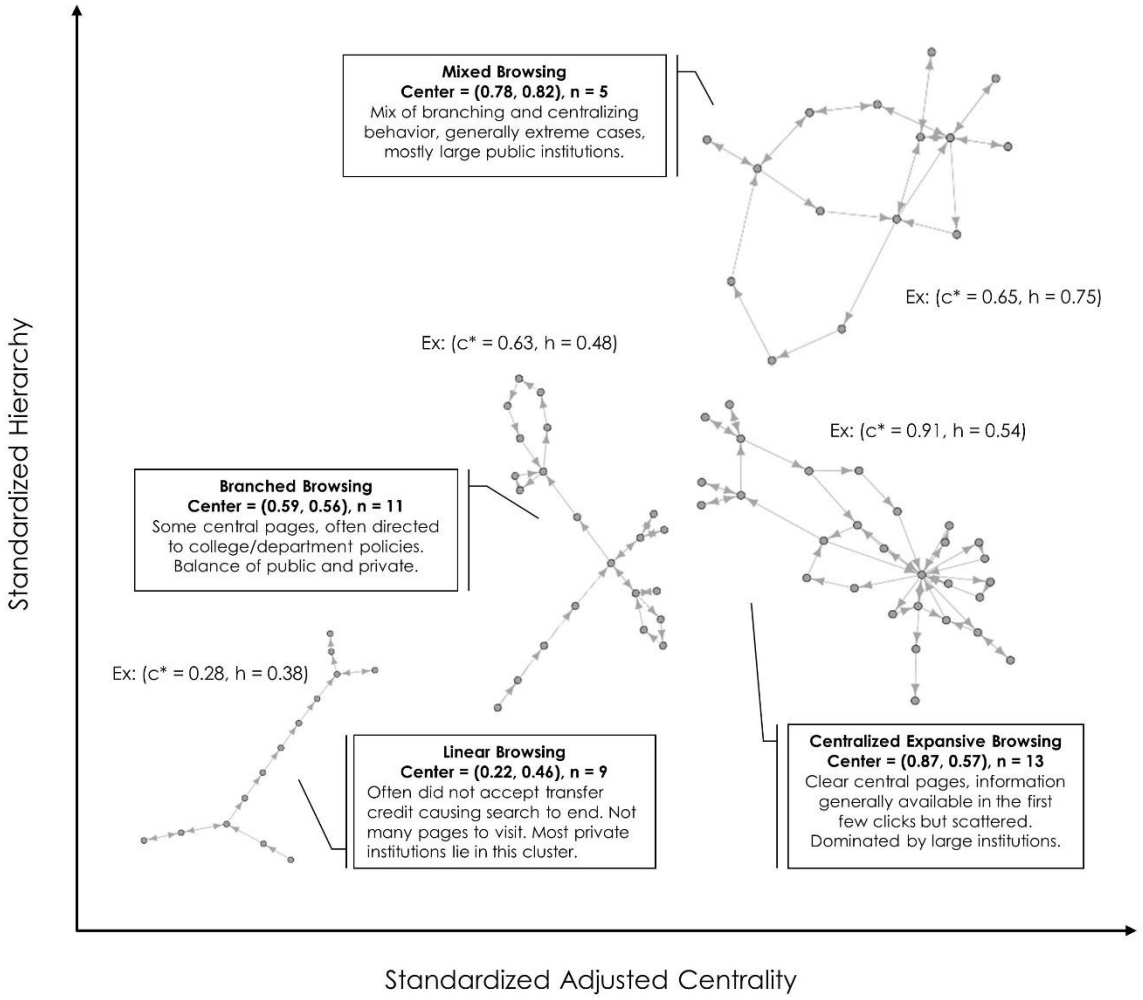


Figure 18. Visualizing mixed clustering structure by region in the feature space, navigation commentary and cluster centers appended

Table 10 displays cross-tabulations of the clusters based on the strata. Branched browsing behavior with clear pockets of information was seen in small, medium, and large schools with a balance between public and private institutions. Expansive browsing patterns with a clear center and multiple outward directions were almost exclusively represented in larger institutions, and no institutions falling within this cluster were small.

Most small and medium schools were clustered based on linear or branched browsing behavior.

Table 10

Cross-tabulations of clusters by strata

Cluster	Small	Medium	Large	Total
Mixed		1	4	5
Branched	2	2	7	11
Centralized expansive		1	12	13
Linear	3	3	3	9
Total	5	7	26	38

4.3 Selecting Institutions to Explore Asymmetries in Depth

Following the cluster analyses, a subset of institutions was chosen to explore in more detail based on my navigation notes and the school's transfer-in rate. The organizing notes to resample the institution for the next round of analyses concerned: (1) if broken links were encountered, (2) if there were instances of diction or linguistic choices worth revisiting in detail (i.e., language), (3) if there were instances of structural issues worth revisiting in detail (i.e., fragmentation), (4) if the institution claimed to not have a formal transfer process but still supported transfer, (5) if Transferology was mentioned as a tool, (6) the strata, and (7) the average transfer-in for the institution between 2013 and 2017 (Data available from IPEDS). If a note was made on the first (5) constructs during the screening navigation (based on work by Schuddle et al., 2018), the institution was given a "mark" in the respective category.

At this stage, institutions were anonymized using a standard naming convention to capture their size and control. Institutional pseudonyms were given as [SIZE] [CONTROL] [NUMBER] such as SPub2. The size was either small (S), medium (M), or

large (L), and control was public (Pub) or private (Priv). The number was solely a function of the order in which they appeared in an alphabetized list. The purpose of the blinding was to help readers at other institutions imagine themselves as one of the institutions being discussed.

Institutions were chosen based on the number of marks they received while attempting to balance the strata and average five-year transfer-in rate. Extreme cases of institutions with zero marks and the maximum number of recorded marks – which happened to be 3 in this work – also were chosen to explore why they received no or several marks. The remaining institutions had one or two marks. A range of transfer-in rates was sought as well – even including MPriv4 with zero transfer students over the five years to maximize variation as an extreme case.

A formative joint display (Figure 19) was created by taking the number of marks per institution and plotting them against the average five-year transfer-in rate – a value for how much of the total undergraduate population is composed of transfer students. The shape of the data points denotes cluster membership, and the marks associated with the chosen institutions are appended to each data point via the horizontal lines. For example, the institution selected from the three-mark line had three marks from the data transformation stage: broken links, language, and Transferology. The selected institutions (colored in red) were then used as the sample for the coding stage.

Figure 19 intends to illustrate the balance sought in sampling for the next stage of analysis. Two extreme cases were sampled above and below with 0 and 3 marks respectively to explore why so many or so few marks were assigned to the institution during data collection. Across the marks, an equal number of structure and language

marks were selected - nine each. Finally, cluster representation was taken into account. Approximately the same percentage of each cluster was purposefully sampled for the next stage of analysis. The figure I used to argue the sample was balanced across the criteria of interest can be found in Appendix C as Figure C.2.

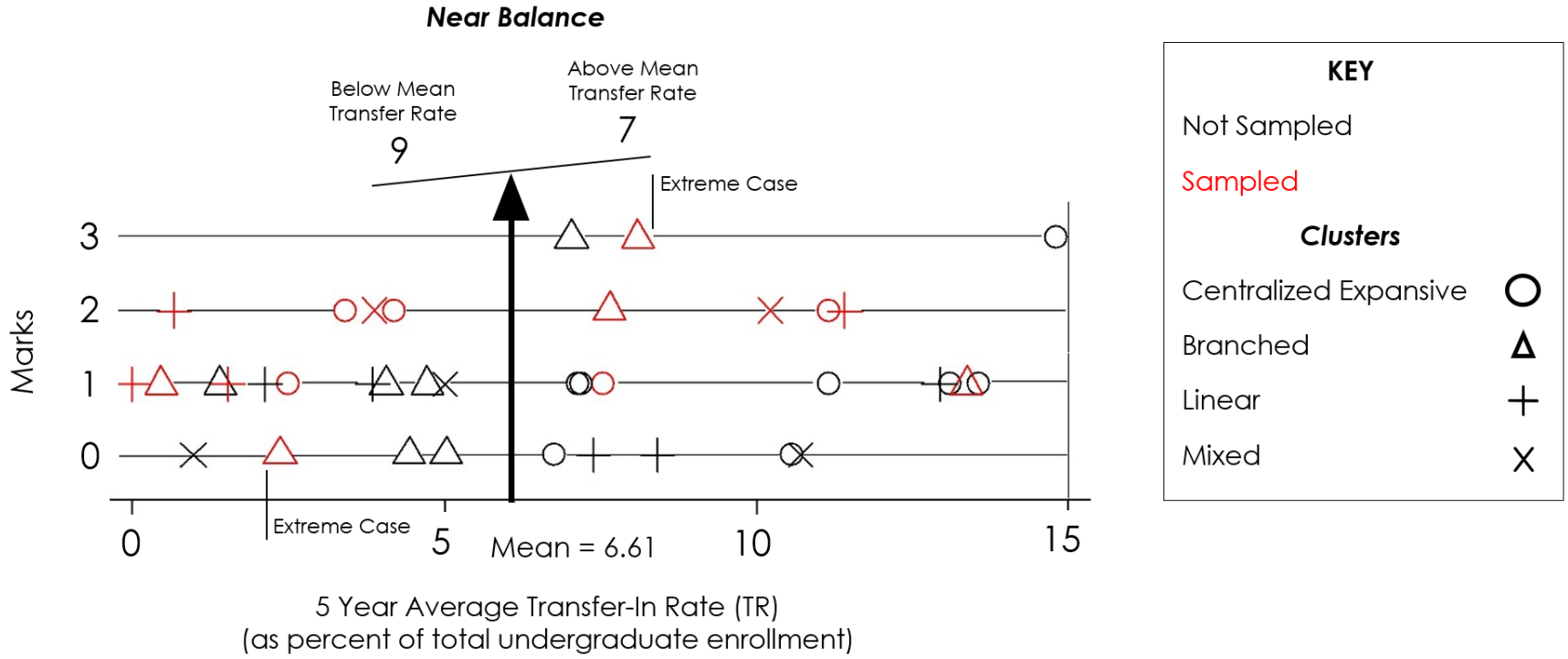


Figure 19. Sequential Mixed Methods Sampling Formative Joint Display, Variation Across Clusters, Transfer-In Rate, and Marks Received

4.4 Cycle One, Contextualizing the Networks

The results of this analysis are split into three parts. The first part presents the results of the network elaboration themes for fragmentation, followed by the language themes. Finally, the mixing of the qualitative and quantitative themes is presented last as an introduction to the resulting narratives of information asymmetry.

4.4.1 Themes for Fragmentation 

The network elaboration themes for fragmentation across clusters concerned structure, making them primarily quantitative themes, but this imbalanced priority did not ignore the qualitative context. In fact, the themes could not exist without considering the text associated with each node. The themes for the network elaboration process resulted in four overarching themes that are described in the following sections: *unlinked divergence, neighborhood linking, lack of uniformity, and progressive disclosure*.

4.4.1.1 Unlinked Divergence

The theme of *unlinked divergence* occurs when pages refer to other pages or documents but do not provide explicit links to find them, which was observed in 10 institutions. This theme can be seen in MPub1's network in three places, pictured in Figure 20. The articulation agreement is referenced in the requirements for transfer students in the leftmost gray oval, but no link is provided to that agreement – it is located under a different set of pages. Moreover, several FAQs exist in the network related to admissions and transfer but do not refer to one another – shown in the middle gray oval. Trying to reconcile the different FAQs places unnecessary work on the transfer students, especially in understanding which FAQ to deem trustworthy or applicable to them.

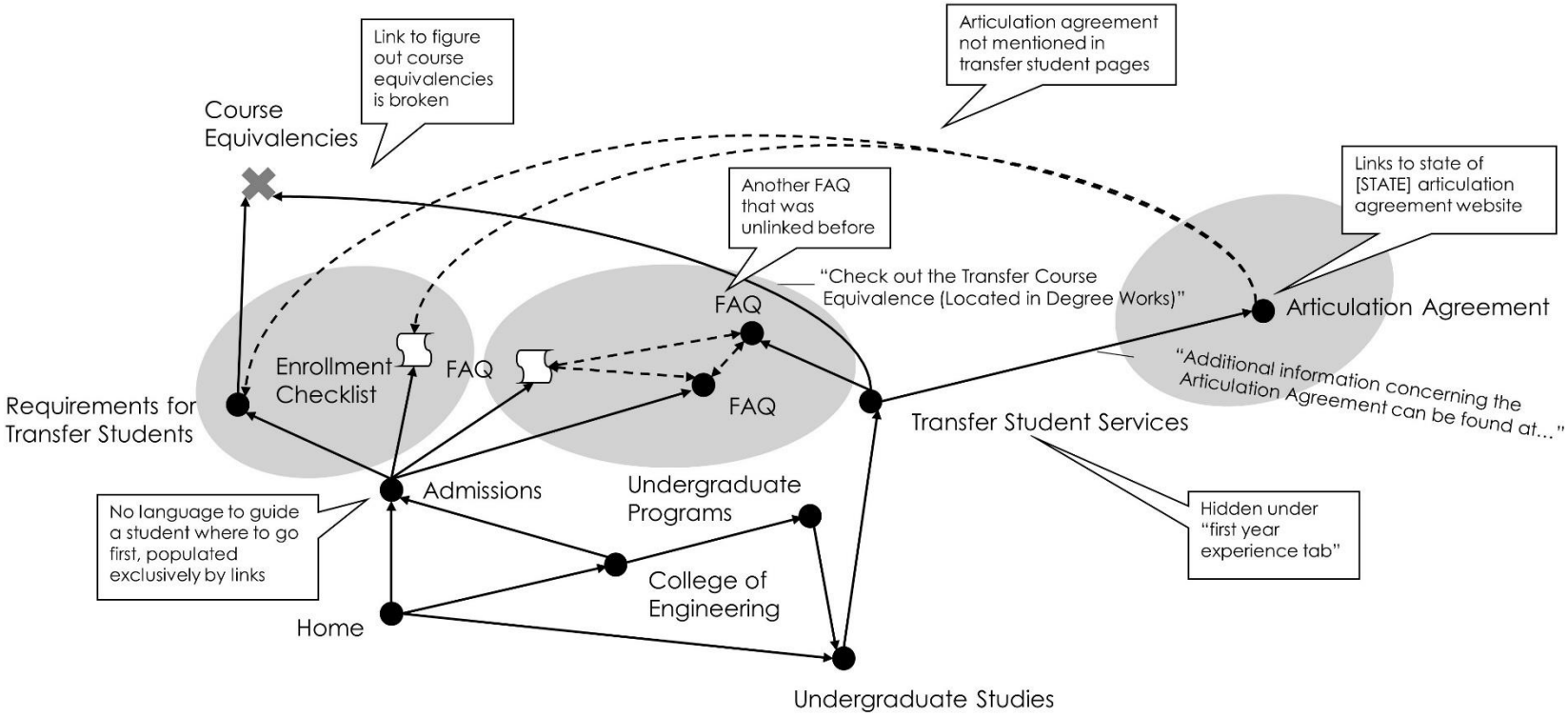


Figure 20. Example of Unlinked Divergence (MPub1)

4.4.1.2 Progressive Disclosure

I used the theme *progressive disclosure* whenever details were seemingly withheld only to be explained on the following page, which occurred in 7 institutions. Often this arrangement revealed inconsistencies in information with the previous page. For example, as shown in Figure 21, LPub2 outlines the GPA requirements for students seeking different majors in the gray oval. The discussion centers on overall and technical GPA. However, if the student clicks on the link to learn about how to calculate technical GPA, the student would find it is not the overall GPA nor the technical GPA that is used for admission, but it is the *combo* GPA. The use of combo GPA is not disclosed in the previous page, despite being a critical piece of information for transfer students. Also, note that the "future engineers" page is buried two layers deep in the header.

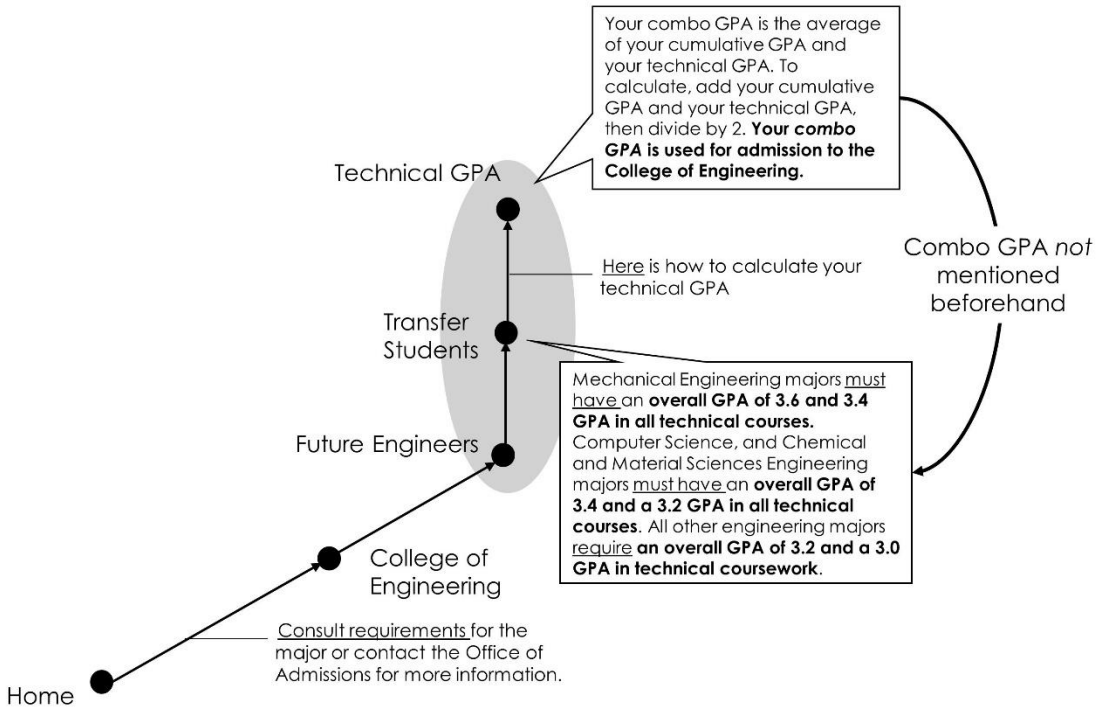


Figure 21. Example of Progressive Disclosure

4.4.1.3 Neighborhood Linking

The *neighborhood linking* theme referred to an instance when a page would redirect the user to another page or document through a link as a means of elaboration, but the page the user was sent to is an intermediary, more general page. I observed *neighborhood linking* in 4 institutions. *Neighborhood linking* differs from *progressive disclosure* in that the "bus stop" page is not where the user wanted to go. *Progressive disclosure* involves sending the user to the correct destination. The practice of *neighborhood linking* is sensible from a technical perspective. Because university websites are so expansive and can change regularly, a link to a specific page across units can quickly become unusable. However, by not linking directly to the page one is referencing, the users have to conduct additional labor to find what they need. Figure 22 from the LPub5 provides an example of this practice in two ways. First, the transfer student requirements page refers to different admissions standards depending on the college in which the student wants to enroll. Clicking on the link for the college of engineering takes the user to the general transfer student page rather than the admissions page it intended to reference. The second example of *neighborhood linking* was seen in the same network. In the other oval, the transfer credit page references a credit requirement that is described in the Engineering Bulletin but does not link directly to the requirement.

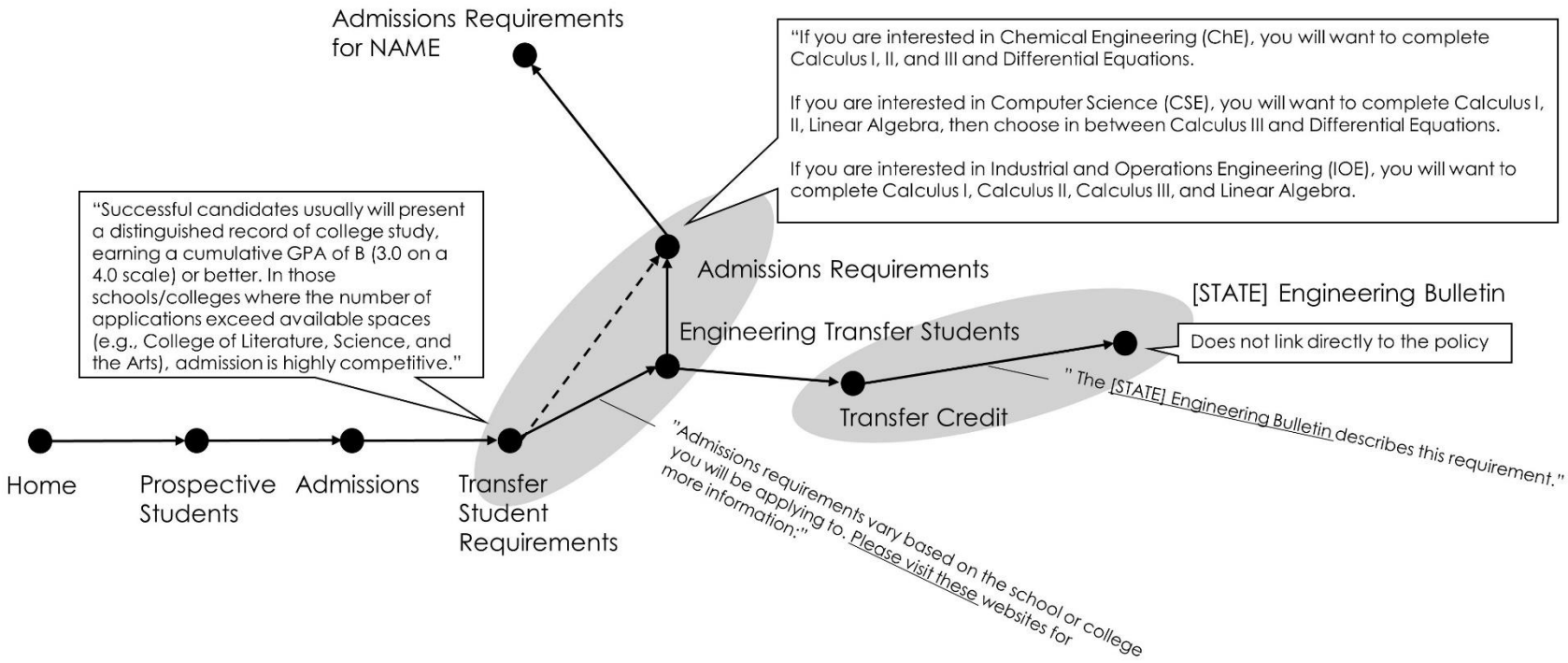


Figure 22. Examples of Neighborhood Linking

4.4.1.4 Lack of Uniformity

The theme *Lack of Uniformity* referred to a lack of consistency in linking to a set of pages or documents, which was observed in 7 institutions. An example of where this may occur is listing articulation agreements with specific community colleges. In Figure 23, LPriv2 links to three specific community colleges but leaves the remaining twenty-two unlinked. The site instructs students to ask for copies of the articulation agreement rather than explicitly linking to them.

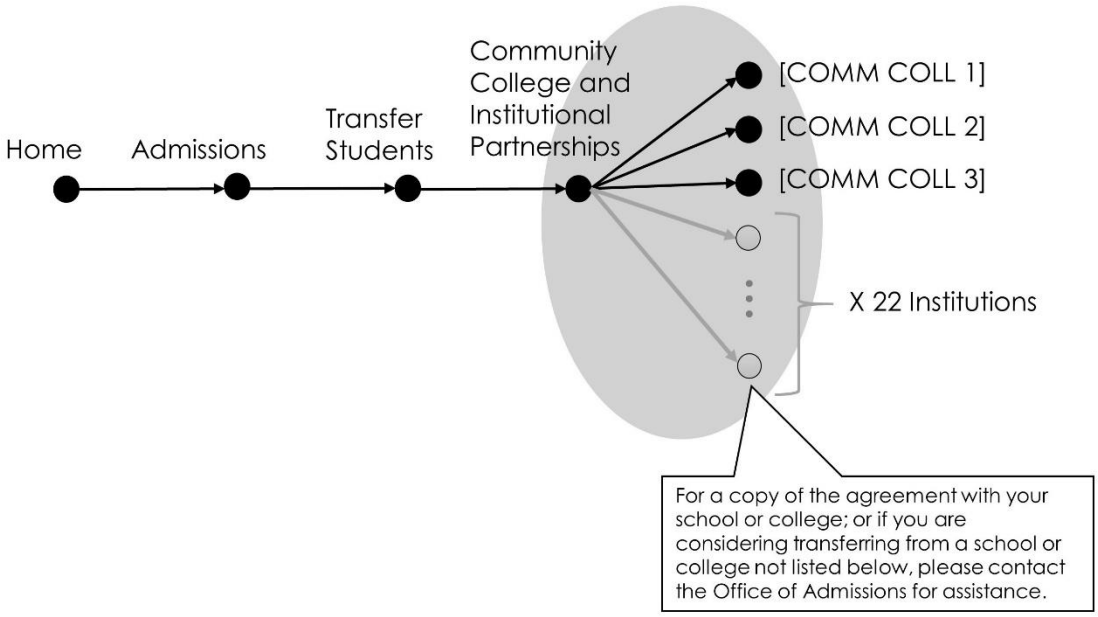
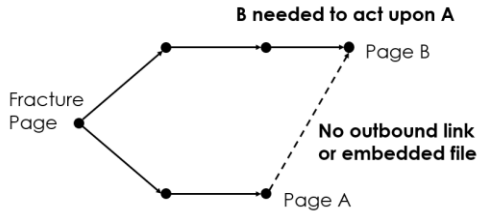
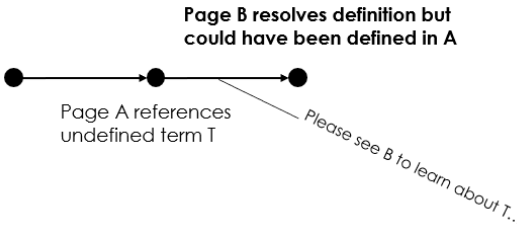
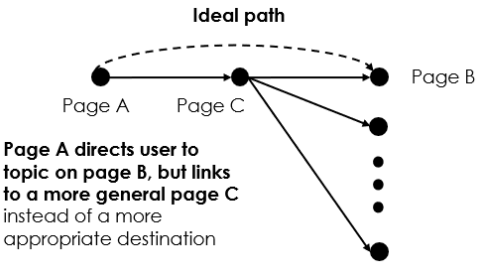
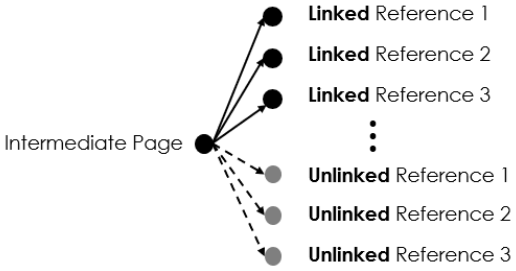


Figure 23. Example of Lack of Uniformity

The themes of fragmentation elicited in the first cycle of coding converged to four common themes: unlinked divergence, progressive disclosure, neighborhood linking, and lack of uniformity. A summary of the fragmentation themes and their prevalence is summarized in Table 11. The themes did not appear to have an intrinsic relationship with transfer-in rates or control – all institutions were susceptible. One exception was neighborhood linking, which appeared in larger institutions.

Table 11

Themes related to fragmentation

Theme (# Institutions)	Characteristics	Network Realization
Unlinked Divergence **(10)**	Page A contains some bit of information, but information from page B is needed to act upon what is seen in A. This code could also be applied if the pages should be linked or combined but are not. For example, page A references a form that is needed for approval of transfer course credit but provides no link to complete the form on page B.	
Progressive Disclosure **(7)**	Page A refers to an undefined term and prompts the user to visit page B to clarify what is meant on A. This theme can apply more generally where details are seemingly withheld unless a user digs deeper into the network, Page B could also reveal information that elaborates on A that is not necessarily specified as needing explanation. For example, a university could define a course credit differently and prompt the user to visit a glossary to read on how the institution defines their credits.	
Neighborhood Linking **(4)**	Page A refers or directs the user to page B though a link. However, page A links to some intermediary page C that is more general. For example, page A refers to a math requirement for all entering students and links to the form, but the link takes the user to the math department's homepage, page C, rather than the page describing the requirement, page B.	
Lack of Uniformity **(7)**	An intermediate page links to several other pages but does not link to similar pages in the same context. Or the linked pages may not be consistent. For example, the intermediate page could house all the articulation agreements, but only link to a subset of them. Also, an institution may have a list of links for courses, some of which may be broken, lead to a different platform, or have different level of information available.	

4.4.2 Themes for Language 

The themes for language primarily examined the content of the webpages. Accordingly, these themes have a qualitative priority. Themes that emerged from the data, described in the subsequent sections, included: *hedging transferability and applicability, legalese handwaving, building rapport, defining terms, deviance from common practice,* and *exclusivity*. I mapped the themes onto the analytical suggestions from critical linguistics to demonstrate how the In Vivo quotes were interpreted for purposes of methodological transparency.

4.4.2.1 Hedging Transferability and Applicability

One of the most common themes across all the institutions sampled is the *hedging of transferability and applicability*. The prevalence of this theme was to be expected, as institutions cannot make any promises about the transferability of credits. The theme took several forms, but the effect of instilling doubt in the utility of credits was shared among all instances. For example, the hedging could take the following form: “Please be reminded that although courses may transfer to LPub19, not all courses apply toward all degrees. Only courses in which the student receives a “C” or better will transfer to LPub19. Typically, transfer credit is granted only from regionally accredited universities and colleges.”

This theme was developed from examining the use of lexical processes and modality from the critical linguistics framework. The use of the word “may” and words to convey lack of frequency were prevalent, especially in explaining how credits would be transferred into the institution and specific programs.

4.4.2.2 Legalese Handwaving

The theme *legalese handwaving* builds upon the previous theme of *hedging of transferability and applicability* and was observed in 11 institutions. However, the handwaving is done to place the institution at a relative advantage compared to students by yielding to an "invisible hand" for inaccuracies or point to another unit to make determinations. This theme can be seen in course articulation systems, where the information is doubted, such as the following: "information displayed in this Transfer Guide is believed to be correct." Then, the responsibility for the information is absolved, as it continues: "however, the university reserves the right to make corrections and revisions." The responsibility for decisions may also be placed on other units in the institution: "Transfer credit policies vary, depending on the LPriv2 school/college to which you apply."

This theme referred to the use of language to obscure agency in the critical linguistics framework. Therefore, the deference of agency was indicative of transitivity from the critical linguistics dimensions. The use of transitive language was especially common because pages would refer to the institution as a monolith able to change policies at its whim rather than the individual unit whose page the user visits.

4.4.2.3 Building Rapport

Seven institutions would occasionally switch perspectives to address the reader in the second person: "our guide to Transfer Credit Evaluations will help you find credit equivalencies for commonly transferred courses," or in the first person, "Will my courses transfer?" The theme of *building rapport* refers to language that would likely appeal to students, like "get the credits you deserve," especially if it is framed from the students'

perspectives. Such statements are personal addresses or references lessening the formality of the text – which is consistent with the critical linguistics framework.

4.4.2.4 Defining Terms

The act of *defining terms* occurred whenever the institution explicitly defined a term related to transfer or a term that is institution-specific. I observed four institutions with this theme. *Defining terms* relates to lexical processes because it establishes a shared reality with the reader – demystifying the academic language. An institution could clarify the difference between applicability and transfer: “But here is an important distinction between transferability and applicability of transfer credits. Transferability means the credit hours earned from another school will be added to your LPub13 transcript. Applicability means the transfer credits posted to your LPub13 transcript fulfill requirements toward your degree.” An example of defining an institution-specific term or practice is as follows: “SPriv3 uses the semester-course-credit unit of credit -- one course at SPriv3 is normally worth one SPriv3 credit, with 32 semester-course-credits required for the BA.” Defining institution-specific terms like how course credits are based on the course itself and not based on contact hours is vital to ensure a shared communication between the institution and the student – relationship-building language.

4.4.2.5 Deviance from Common Practice

Another theme that appeared for two private institutions and one public institution was the lack of a transfer system. When institutions or units within the institution seemed to differentiate themselves from other institutional practices, the theme of *deviance of common practice* was applied. For example, “Technically, SPriv3 doesn't transfer credit. We award credit for work done elsewhere, and we casually call this transfer credit.” The

use of the word “casually” here suggests a reality for SPriv3 that is uncertain – lifting responsibility for exact terms using transitive language, consistent with the critical linguistics framework.

4.4.2.6 Exclusivity

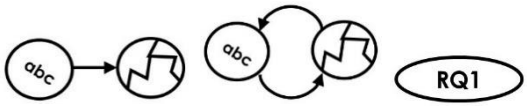
The *exclusivity* theme was applied to instances where institutions appeared to flex their status, often by proxy of their exclusivity. I observed this theme in four institutions. For example, institutions may say something along the lines of “as competitive as the admissions process is for freshmen, the transfer process is even more so” and “we typically admit fewer than 10 percent of the applicants for transfer admission each year.” The *exclusivity* is often extraneous information or is said in contrast to the inclusive statements universities make - sometimes in the same utterance. The *Exclusivity* theme involves personal addresses, as they warn the reader by using specific vocabulary to communicate the uncertainty students would even be admitted.

Table 12 summarizes the themes related to language-use and their prevalence by institution. The table outlines the characteristics of the themes, how often they occurred, the critical linguistic features they are most congruent with, and an example quote to illustrate their meaning in context. The themes of *hedging transferability and applicability*, *legalese handwaving*, *building rapport,* and *defining terms* did not appear to have clear relationships with transfer-in rates or control. However, *deviance from common practice* was observed almost exclusively in smaller private institutions. Likewise, *exclusivity* was observed most often in large private institutions. These private institutions also tended to have transfer-in rates below the sample mean.

Table 12

Themes related to language-use

Theme related to Language (# Institutions)	Characteristics	Critical Linguistic Features Underlying the Theme	Examples Quote
Hedging Transferability and Applicability **(16)**	Uses language to instill doubt about the transferability or applicability of student credits.	**Modality**, use of the word "may" and negation, which occurred frequently (**Lexical processes**)	**Generally**, departmental requirements for majors and certificate programs **may not be** fulfilled through transfer credit."
Legalese Handwaving **(11)**	Explicitly hedges to benefit the institution by absolving institutional responsibility for inaccuracies, defers authority to other units.	**Transitivity** and **modality**, passing of responsibility using certain diction	Information displayed in this Transfer Guide is **believed to be correct.** However, the **university reserves the right** to make corrections and revisions.
Building Rapport **(7)**	Uses terminology that might resonate with students, switches to student perspective.	**Personal addresses / references**, less formal language used to build relationships with readers	One of the most common questions is **"Will my credits transfer?"**
Defining Terms **(4)**	Terminology unique to the institution (university course credits) or general terms used in transfer (articulation) are defined.	**Lexical processes**, help the reader understand the transfer process or overuse of institution-specific terms	**But there is an important distinction between transferability and applicability of transfer credits.** Transferability means the credit hours earned from another school will be added to your LPub13. Applicability means the transfer credits posted to your LPub13 transcript fulfill requirements toward your degree"
Deviance from Common Practice **(3)**	Claims the institution does not engage in transfer agreements or transfer credit itself. A unit may also deviate significantly from the institution's usual transfer practices.	**Transitivity** and **Lexical processes**, responsibility is lifted for transfer using negation (the word 'not') or diction that handwaves.	**Technically,** SPriv3 doesn't transfer credit. We award credit for work done elsewhere, and **we casually call this transfer credit**.
Exclusivity **(4)**	Makes claims that do not add relevant information for the transfer student, rather, it downplays their fit.	**Lexical processes** and **personal addresses/references**, uses specific diction to cast a certain image of transfer fit. Could personally address students using 'you' or talks from the student perspective.	**As competitive as the admissions process is** for freshmen, the **transfer process is even more so**. … Given the competitive nature of the transfer admissions process, **candidates should have compelling reasons for attending** LPriv1 and **should think carefully about whether LPriv1 is the right fit for them.**

4.5 Cycle Two, Integrating the Themes 

During the construction of the fragmentation themes, the language on the pages was a driver in how the webpages were traversed – which formed the fragmentation themes. Moreover, pieces of language encountered that did not detour the journey through the network were appended to individual nodes as snippets of text, direct screen captures, or abstracted visuals of the structure where screen captures would have been infeasible. Therefore, primarily qualitative language themes do possess an element of quantitative context. This stage of the analysis concerned how the fragmentation and language themes could be mixed to create blended themes.

Blended themes were created by using the fragmentation themes (Table 11) to situate the language themes (Table 12) in the network. For example, the placement of the language themes in the network has meaning. Consider *defining terms* as an example. The theme of *defining terms* can be particularly helpful for a first-generation student who may not have the social capital to fully engage with the vocabulary used by institutions. Without a grasp on the terminology used in the documents, it is possible for details to be obscured. Therefore, clarifying language not done upfront is considerably less effective than if it is buried in later pages. Moreover, having a list of terms and definitions somewhere is unhelpful as it requires the users to seek the language out for themselves. Transparency requires spelling out special terminology, otherwise information asymmetries may be created in later interpretations of policy.

The example can be extended further because the spatial relation in the network of “early” versus “late” use of *defining terms* allows for meaningful crosses between the

fragmentation and language themes. An instance could occur where a dictionary of terms exists but is not readily linkable from the early pages where a student would need them – this scenario would be a blended theme of *early unlinked divergence in defining terms*. Similarly, a later page could instruct the student to consult a university handbook by linking to a pdf but may not provide a page or section number – this example is the blended theme of *late neighborhood linking in defining terms.* Where the theme appears in the network can also be highlighted as a supplement or as its own theme. If the first page of transfer information is marked with a theme of *defining terms*, then it is *early defining terms* relative to the remaining nodes in the network. Alternatively, the theme could be *late defining terms* if the page holding the theme appears later in the network relative to the first instance of transfer information or the home page – whichever is defined as the "root" of the network.

Figure 24 shows a formative joint display used to make sense of the mixing between the network elaboration themes and the language themes. Note that the blended themes in Figure 24 constitute specific instances in an institution created to demonstrate how themes could occur at the same time. In other words, the blended themes were chosen purposefully to create the integrated narratives of information asymmetry. An institution could have more blended themes than reported in the narrative but were not considered because of the purposeful selection.

The interactions between the themes are supplemented by where they appear in the networks – early, late, or early/late. A theme appearing late meant it was found after a subordinate page of transfer information from a main transfer page. For example, suppose there is a page "Transfer Applicants" that links to "Transfer Credit." If "Transfer Credit"

then guides the user to a university policy, that would be considered “late” in the network. No value judgment is made on whether a theme occurring late is necessarily good or bad.

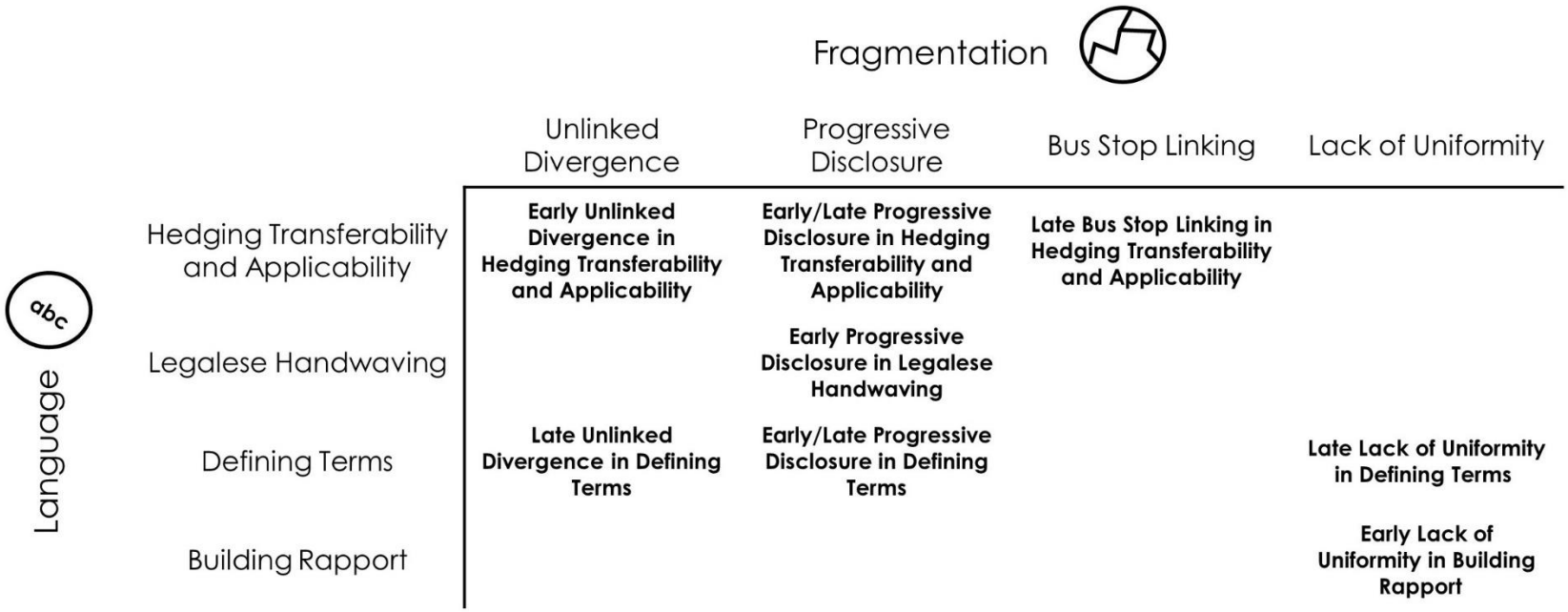
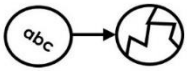
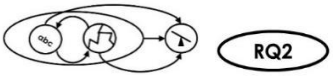


Figure 24. Formative joint display to show the creation of blended themes used in the narratives, other blends were possible but were either not observed or not included in the narratives

4.5.1 Fragmentation through Language based on Time 

One theme of fragmentation through language that did not arise from detouring language built into the network elaboration step of the coding procedures was rooted in time. Institutions like LPriv1 and LPriv3 indicated on websites they would not perform any form of credit evaluations prior to admission. Two examples uncovered in the first cycle were: “LPriv1 will not perform credit evaluations prior to admission.” and “Please note that transfer credit evaluation occurs only at the time of acceptance. We cannot review transcripts and/or courses for transfer before a candidate submits an application.” This type of asymmetry did not relate to the network structures. Instead, it was a policy-based asymmetry that created a theme of *time-based fragmentation.* Students are only able to act upon the information that they have available in terms of articulation agreements, course articulation systems, and Transferology to estimate how much credit will transfer and apply. The students are then forced to wait until they have had enough contact with the institution to receive the true value of their credits in the institution. This lag time creates an asymmetry based in time, *fragmenting* the complete picture of what credit will count once an official review is conducted.

4.6 Mixing Themes and Analyses to Create Narratives 

After consolidating the data into a formative joint display, the networks, network elaboration themes, and language-based themes – narratives were constructed from the data. This section presents the six overarching narratives that emerged from various combinations of the blended themes and network analyses results. These narratives

served to integrate the inferences made in the previous stages of the design and illustrate what became the meta-inference of the emergence of information asymmetries that depend upon on fragmentation and language issues occurring simultaneously. Each narrative begins with a summary of the blended themes which were used to construct it.

4.6.1 Missed Opportunities for Support

This narrative contained three institutions and three blended themes from three clusters. The narrative strand is shown in Figure 25.

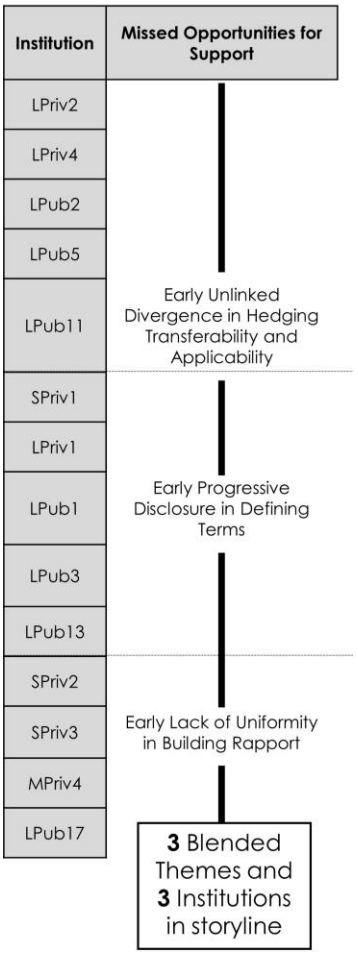


Figure 25. Narrative strand of blended themes for Missed Opportunities for Support

LPub11 has among the highest transfer-in rate in the sample. It also belongs to a state with transfer-friendly policies, including a transferable core of lower-division courses, a common course numbering system across the state, statewide guaranteed transfer for associate degrees, and statewide reverse transfer. The institution was placed in the Centralized Expansive Browsing cluster in the first stage of the analyses. Examining the network structure as compared to others in the sample revealed a structure visually unlike all 37 structures – containing long branches that circle back to a clear central node (Figure 26). The clear central node defined LPub11 as a member of the Centralized Expansive browsing cluster, but the long circling branches indicated deep searches for information. Because of the institution's long chains of pages when searching for transfer information, it was chosen for the next stage of analysis to explore what was responsible for the long paths in its structure.

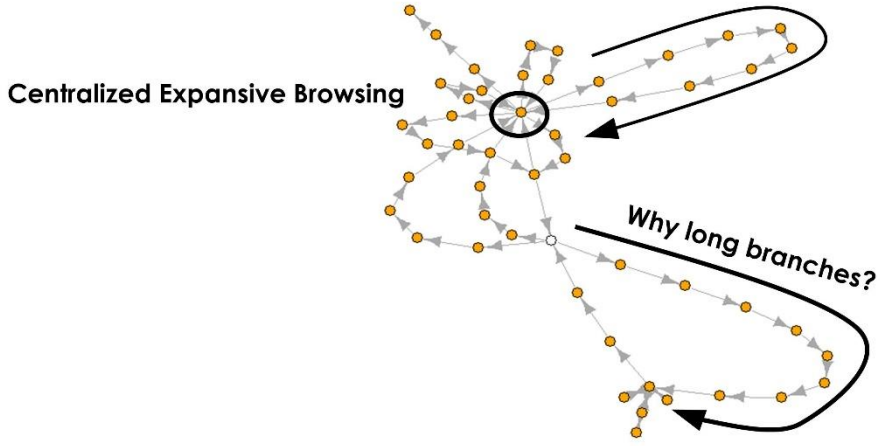


Figure 26. Researcher's browsing pattern for the LPub11, home page is colored white

Upon revisiting the LPub11 website in the next stage, the blended theme *Early Unlinked Divergence in Hedging Transferability and Applicability* emerged. The display

illustrating the network for LPub11 is shown in Figure 27, with the subject of the first theme highlighted by an opaque oval. Attempting to navigate the University's Admissions pages in the left oval for transfer credit information proved to be fruitless. Browsing in the University Studies oval, however, revealed the source of information a transfer student would need related to transfer credits. In fact, the University has its own Office of Transfer Student Success. The issue here is that two gray circles in Figure 26 do not have obvious links between the information pages for transfer students seeking admission, hence the theme of *Unlinked Divergence*, which is further compounded by a broken link to the Office. If a transfer student were to follow the links specifically targeted for them, they would find the following detouring language: "The Office of Transfer Student Success advisors can answer pre-transfer questions, preliminary credit review, explore degree programs or advise on a change of major," in the form of an embedded link. This detouring language does not lead to the Office as promised. Instead, following the path returns the typical page indicating a broken link. However, taking a different path through the units on campus via "departments" connects the student to the Office of Transfer Student Success.

For an institution with such a high transfer-in population within a state that has the explicit infrastructure to support them, it is unusual that the Office of Transfer Student success is not prominently placed in the admissions information specifically targeted to transfer students. Considering not all institutions have an office dedicated to supporting transfer students, the current information design is a missed opportunity to highlight the value LPub11 places on its transfer student population. Although the institution has a high transfer-in rate, we do not know what the individual students'

outcomes are with the system without additional data. Students may successfully transfer into the institution, but they may be losing credits along the way.

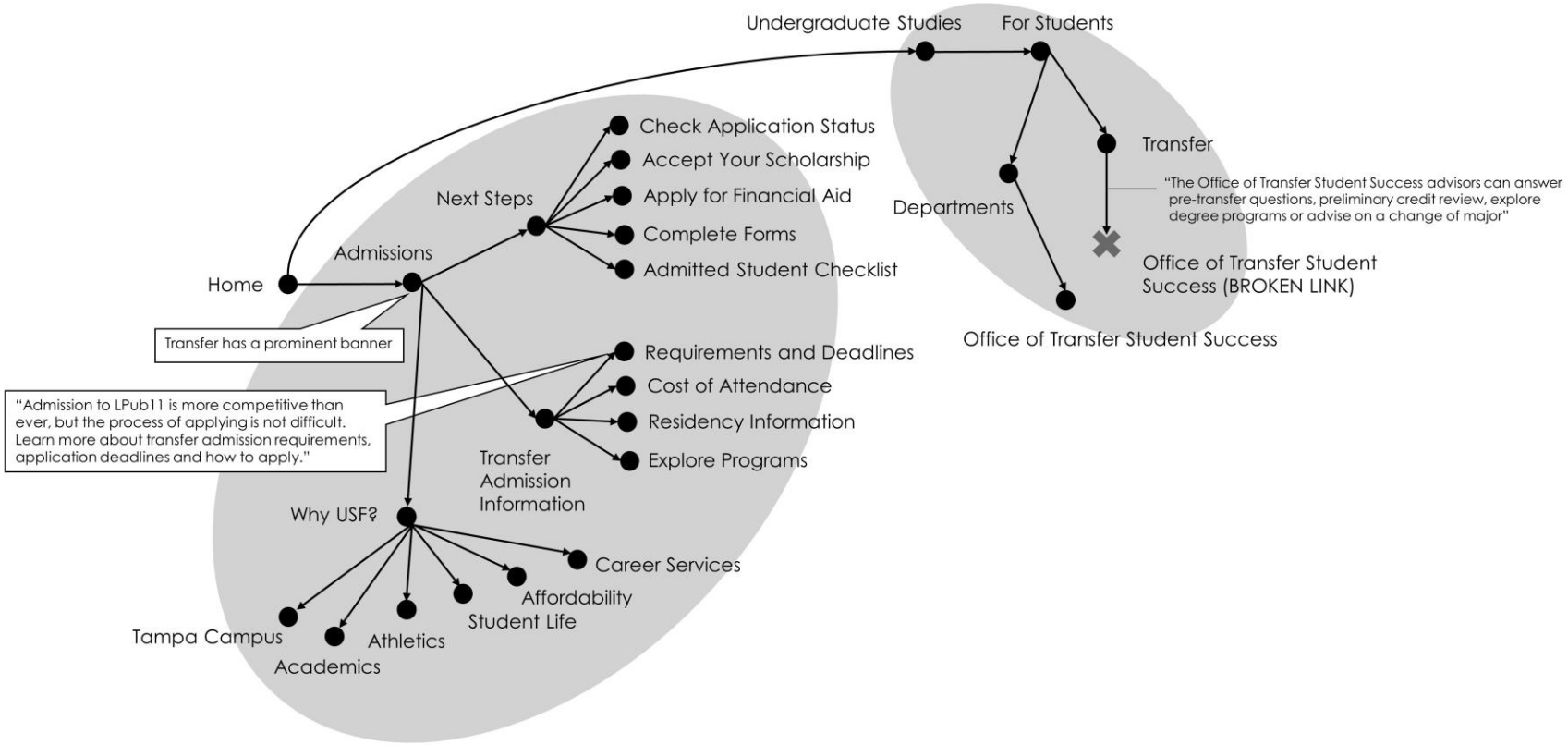


Figure 27. Display for LPub11 highlighting *Early Unlinked Divergence in Hedging Transferability and Applicability*

Similar practices occur in presenting information at the admissions level. The values of adjusted centrality and hierarchy placed SPriv3 in the linear browsing cluster, as shown in Figure 28. SPriv3 was an outlier in terms of hierarchy as displayed in the scale.

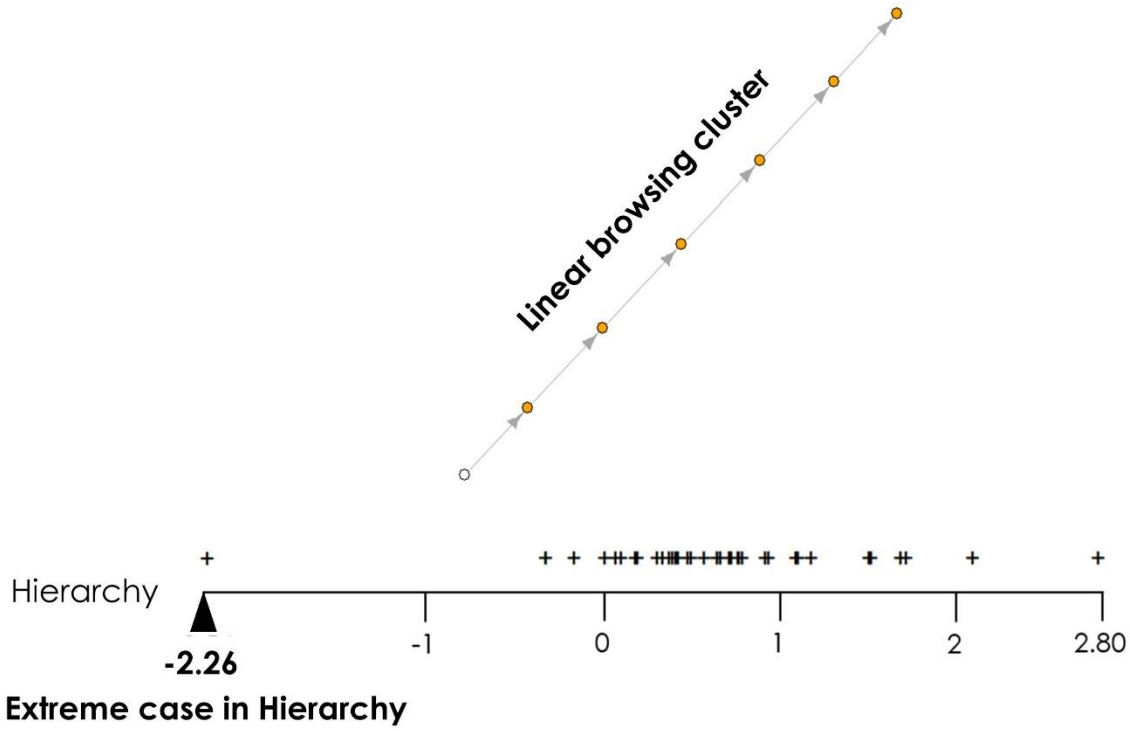


Figure 28. Researcher's browsing pattern for SPriv3, home page is colored white

Early in the network when visiting SPriv3's site, there was an admissions blog that could potentially have advice for transfer students. Upon reviewing the admissions blog, it appeared to be a potential wealth of information to students – related to the theme of *building rapport*. However, the *lack of uniformity* in its design could present challenges for students attempting to use the blog pieces as an information source. Specifically, the blog pieces are not organized by topic. Instead, the pieces are ordered in terms of publication date. Moreover, the types of posts vary considerably. Some posts are

more immediately useful than others for incoming students generally, which is captured in the network elaboration theme in Figure 29. A post of "What I wish I knew before orientation" in an admissions context may be more useful than a post on indoor golf depending on who you are. The design of the page itself did not allow for seamless searching for specific topics, making it a missed opportunity to provide information for transfer students in a structured manner.

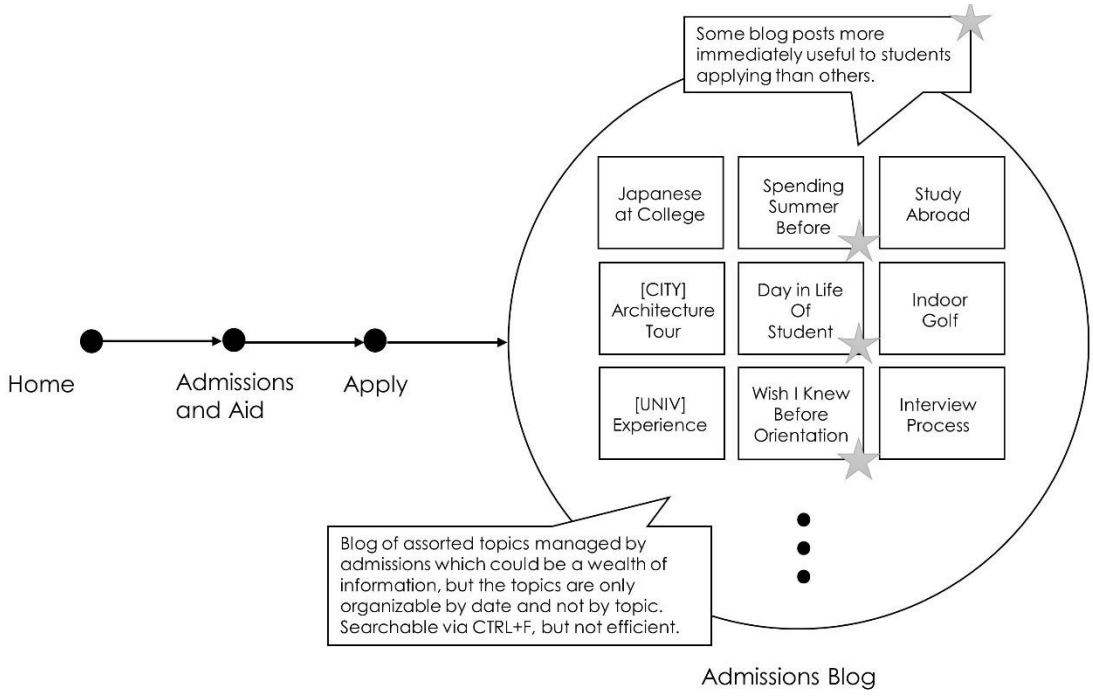


Figure 29. Display for SPriv3 highlighting *Early Lack of Uniformity in Building Rapport*

Finally, the institution or state-specific language may make certain pages look irrelevant or less helpful even when they are quite helpful. An example of this is LPub1 and the [Mascot] Promise, a community college partnership program for transfer students, as shown in Figure 30. On the general transfer student page, a link to [Mascot] Promise is provided. However, no prompting as to what the promise involves is provided. Looking further into the [Mascot] Promise reveals that the promise is only extended to

those who apply, not as a broad program to all transfer students – *Progressive Disclosure in Defining Terms*. The Promise also hedges that "The [Mascot] Promise program does not guarantee admission to a specific major or program." Local jargon should not be assumed to be known by all visitors to the site. Language that is highly localized can create an information asymmetry that needs to be resolved by clicking down the appropriate path to determine how the program or policy relates to the user.

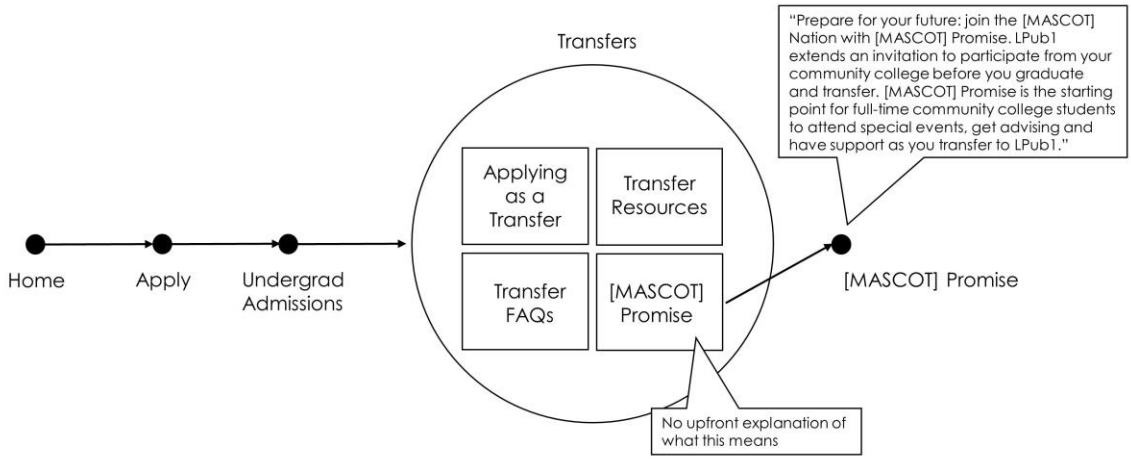


Figure 30. LPub1 "[Mascot] Promise" in a menu as an example of *Early Progressive Disclosure in Defining Terms*

4.6.2 Absolving Responsibility

This narrative contained four institutions and five blended themes from three clusters. The narrative strand is shown in Figure 31.

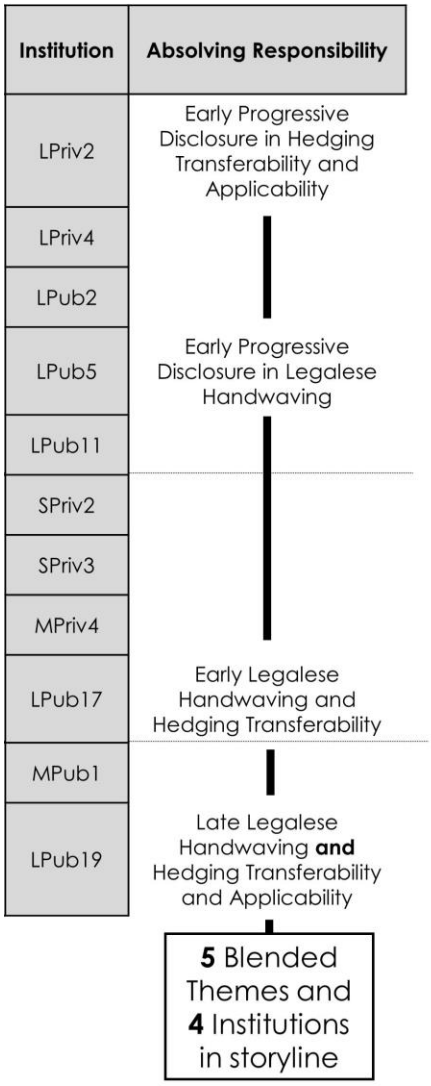


Figure 31. Narrative strand of blended themes for Absolving Responsibility

The theme of institutions leveraging their legal power is perhaps best highlighted by the phrasing of LPub19's course articulation system disclaimer – as shown in Figure 32. When institutions choose to use language that intends to absolve themselves of responsibility for the accuracy of their information, they place students in an awkward position. In the case of LPub19, the power that institutions can exert on students in their curricular experiences is encapsulated by their course articulation disclaimer *late* in the

network demonstrating *Legalese Handwaving*: “Information displayed in this Transfer Guide is believed to be correct. However, the university reserves the right to make corrections and revisions.” LPub17 makes a similar claim *early* in the network with less uncertainty than LPub19, “Course transferability and equivalencies are subject to change. An official evaluation of transfer courses will be available to each student at the time of their admission to the university.” Information published by an institution hedged by a phrase like “believed to be correct” instills doubt – *Hedging Transferability and Applicability*. Delays in updating a website happen frequently, but such phrasing leaves the student at the mercy of such delays.

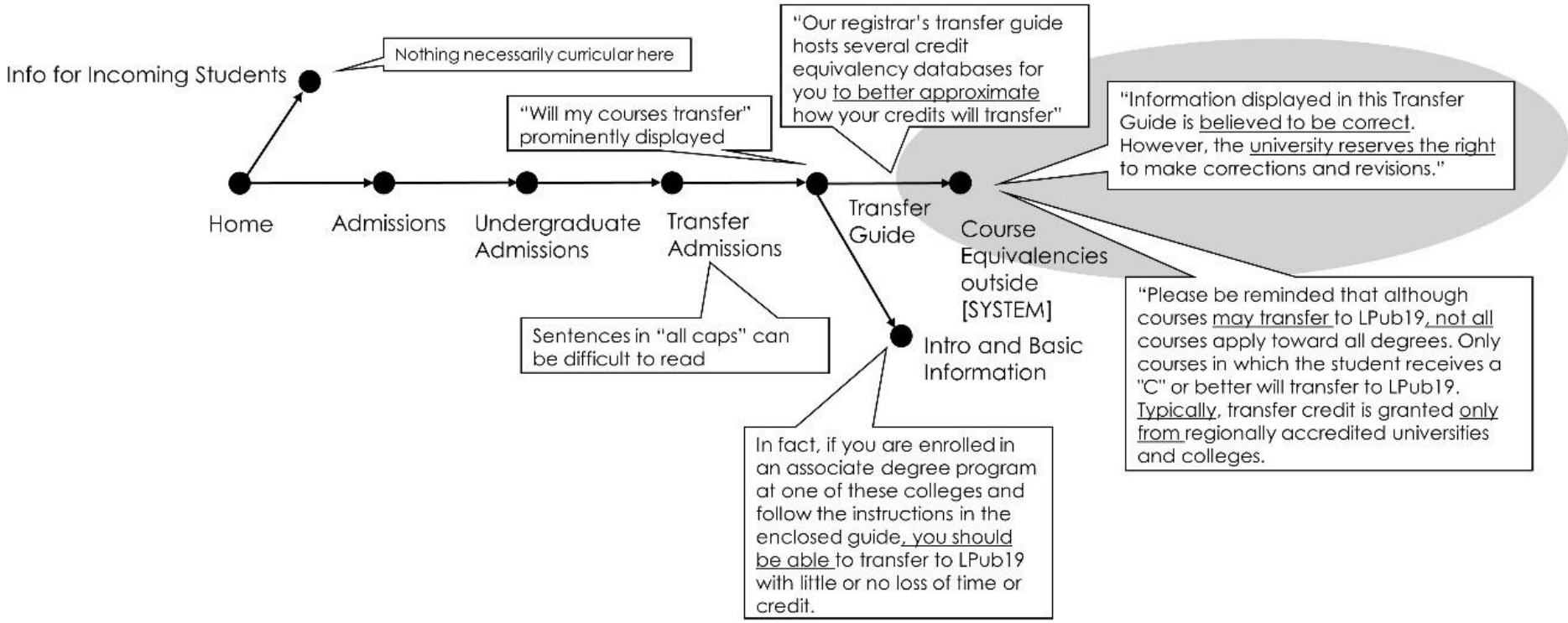


Figure 32. LPub19's use of *Late Legalese Handwaving and Hedging Transferability and Applicability*

Another aspect of absolving responsibility is how decisions are deferred to different units in the organization. Pages in admissions will often hedge and defer authority to the college or department with respect to admissions to specific programs or transferring credits. LPub5 provides an example of this practice in its network, which was one of the networks with one of the highest adjusted centrality (0.72) – making it a member of the centralized expansive browsing cluster. The network is shown in Figure 33.

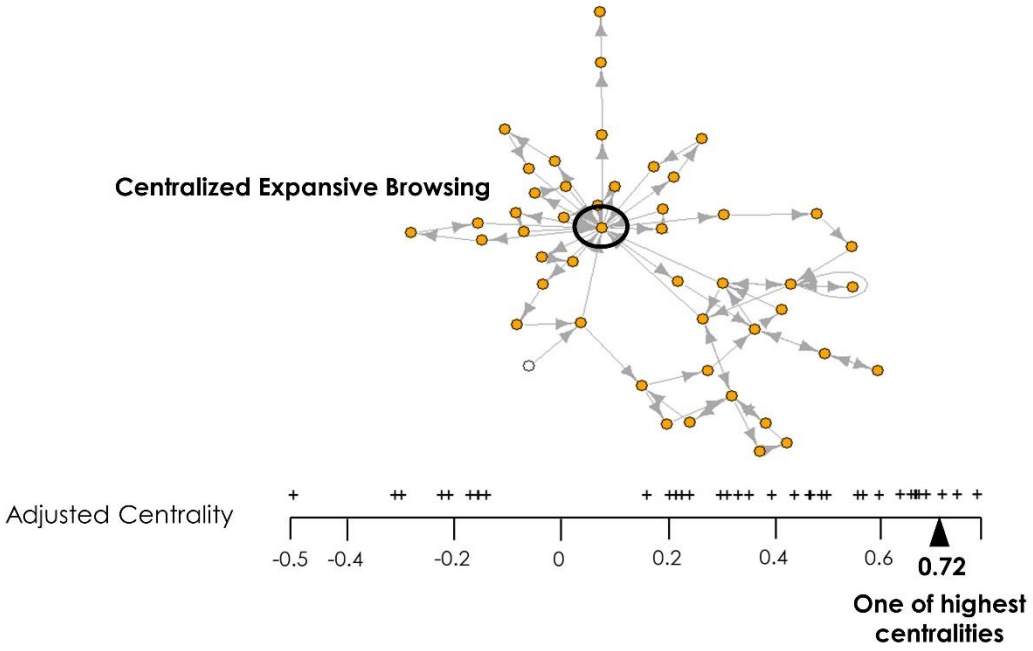


Figure 33. Researcher's browsing pattern for LPub5, home page is colored white

The journey through the network was prompted by needing to visit individual departments in response to the following claim *early* in the network, "Transfer credit is awarded using the guidelines and rules established by each academic department within each of our Schools and Colleges on campus. Each student's academic record is looked at

individually because students will have different factors involved in the evaluation of their credit (previous coursework, school or college enrolled, academic major/minor elected, AP/IB credit, etc.). All of these factors are considered as our Credit Evaluation Team reviews the coursework to determine if and how transfer credit can be awarded." LPriv2 contains a similar statement *early* in the network: "LPriv2 grants credit for courses you successfully completed at other accredited institutions. Transfer credit policies vary, depending on the LPriv2 school/college to which you apply." Such statements constitute *Progressive Disclosure* because students need to dig deeper into the network at the college or department level to understand how their credits will flow into the program of their choice. Students not recognizing how credits change in value by department can be a severe misstep, causing credits to be relegated to elective categories rather than being applied toward a specific program.

4.6.3 Subtle Differences and Unfinished Bridges

This narrative contained six institutions and seven blended themes from three clusters. The narrative strand is shown in Figure 34.

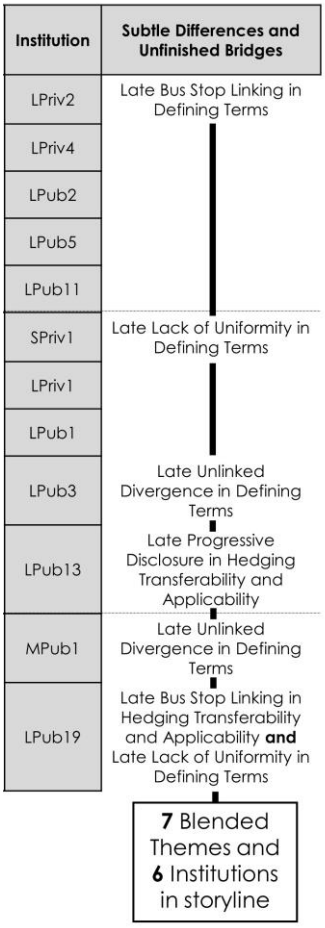


Figure 34. Narrative strand of blended themes for Subtle Differences and Unfinished Bridges

When networks are expansive and requirements are distributed across different units, the chance for information to be incongruent increases, which is a classic form of information asymmetry. The branched browsing cluster seemed to be particularly susceptible to fragmented requirements because institutions in the cluster have pockets of information separated by a chain of pages. Take LPub3, for example, as shown in Figure 35—the University is in the branchy browsing cluster, characterized by the different groups of pages.

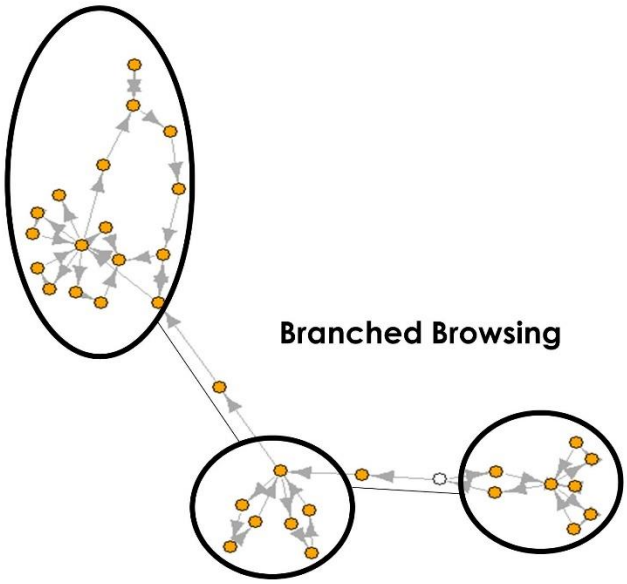


Figure 35. Researcher's browsing pattern for LPub3, home page is colored white

A narrative drawn from this kind of structure highlights the need for cross-checks across organizational units – *and* within. A critical piece of information transfer students need to find is admissions requirements. Going through the admissions pathway in the network, one would find a PDF of GPA requirements broken down by college as shown in Figure 36. The college of engineering outlines five different types of GPA used in admissions decisions. Along the college of engineering's pathway, two sets of GPA requirement pages were found. However, small details appear to change based on which document is being viewed. Some differences are subtle, like the use of "non-remedial" qualifier on English course attempted, whereas the admissions PDF does not specify "non-remedial" in the same heading. Perhaps more apparent are the differences in course numbers listed in the "courses that must be completed" category – both documents in the college of engineering. Other features that are apparent are how multiple attempts at the same course are treated. In the requirements page, it is revealed that all attempts are

counted into the GPA, which is not disclosed in the other pages. These slight differences reveal the potential for anchoring, where the first piece of information available is given greater weight in making a decision than other information sources. Such situations create a sense of doubt with respect to which information source is correct, which may be difficult to ascertain for students not familiar with the system.

Other unfinished paths in the network can be described using the *late neighborhood linking in hedging transferability and applicability* blended theme in LPub19's network. When looking to see which associate's degrees transfer into the college of engineering, the link takes the user to a generic search for "engineering" on the Community College System website. A curated list would display more care in transfer student pathways.

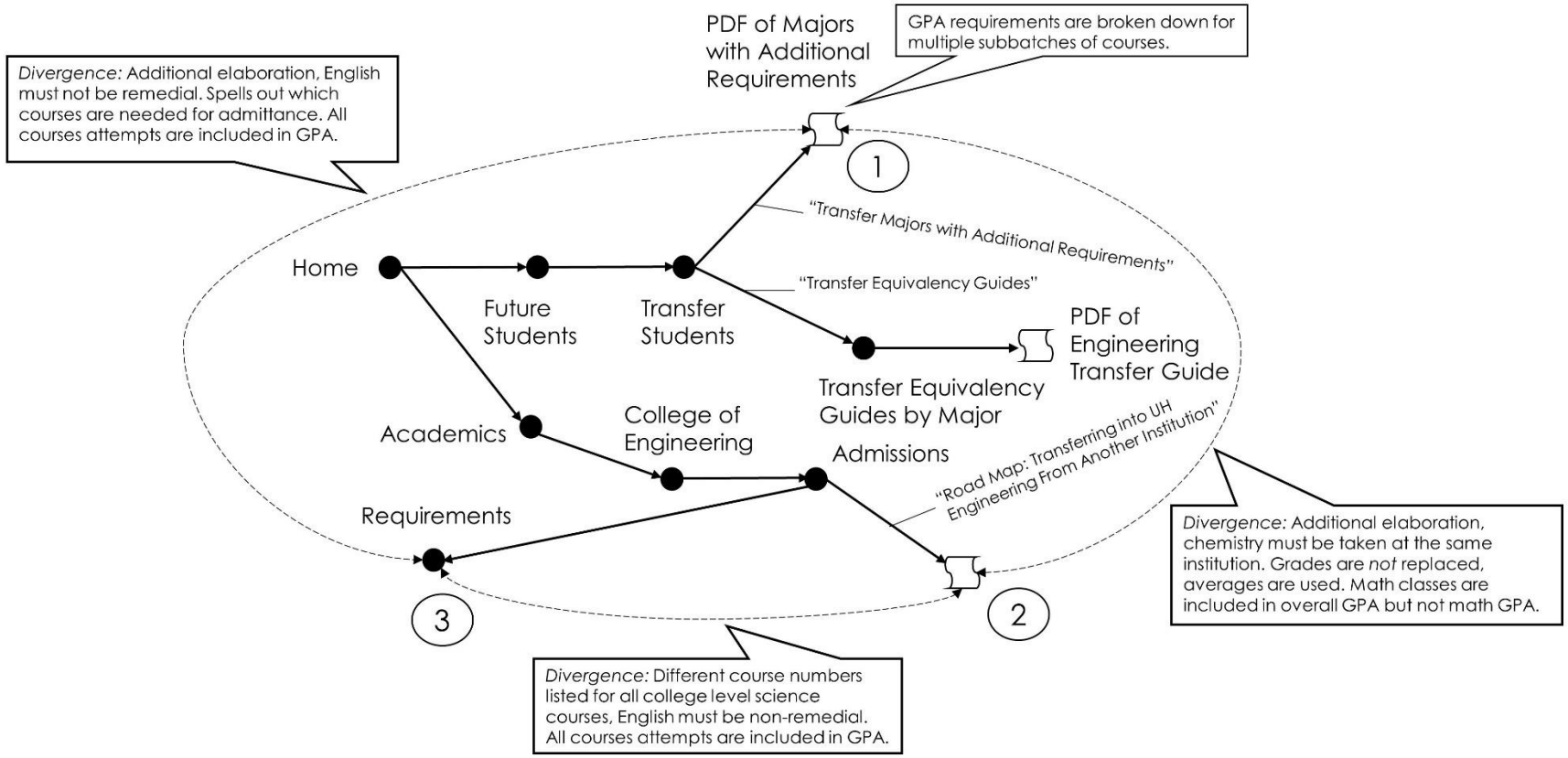


Figure 36. LPub3's divergence in admissions GPA requirements across three areas in the network (numbered)

Although this arrangement shows that policy-makers seemingly care about the success of community college students matriculating into four-year institutions, the multiple information sources increase the chance for divergence. For instance, one state in the sample has statewide transfer initiatives to support community college students' transitions from the community college to a four-year institution. One institution chosen for its use of the Transferology service and state-wide initiative to pave explicit pathways for students was LPub13 University. Like LPub3, it also was sorted into the "branchy" cluster. Figure 37 shows the researcher's browsing pattern through the transfer information. The fragmentation of information is similar in this case.

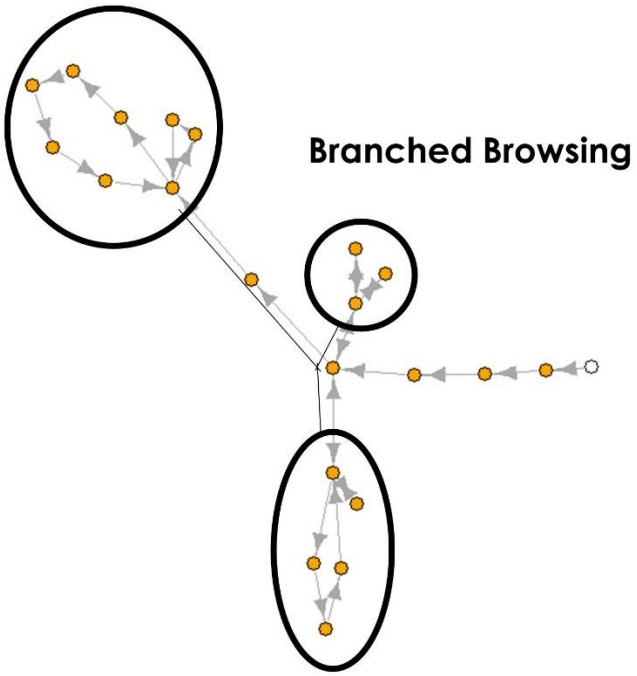


Figure 37. Researcher's browsing pattern for LPub13, home page is colored white

Figure 38 shows a subset of the possible pages one could visit when searching for transfer information. Paths from the Community College Pathways page could take the student to the articulation agreements, Transferology, or the state-initiative pages. The divergence provides

an example of *late progressive disclosure in hedging transferability and applicability*. In the transfer assurance guide course reporting system, it is hedged that local and bilateral agreements are not reflected in the reporting system – forcing students to dig deeper by re-examining the website for the institution or visit Transferology.

The fragmentation is exacerbated by the state of the transfer initiative's system, as shown in the network elaboration theme in Figure 39. The pathways intend to package a set of courses that will transfer regardless of which public institution in the state a student will attend. Upon attempting to find the pathways for engineering disciplines, an "under construction" page was presented. Visiting the other engineering discipline pages brought no clarity, as all seemed to be incomplete.

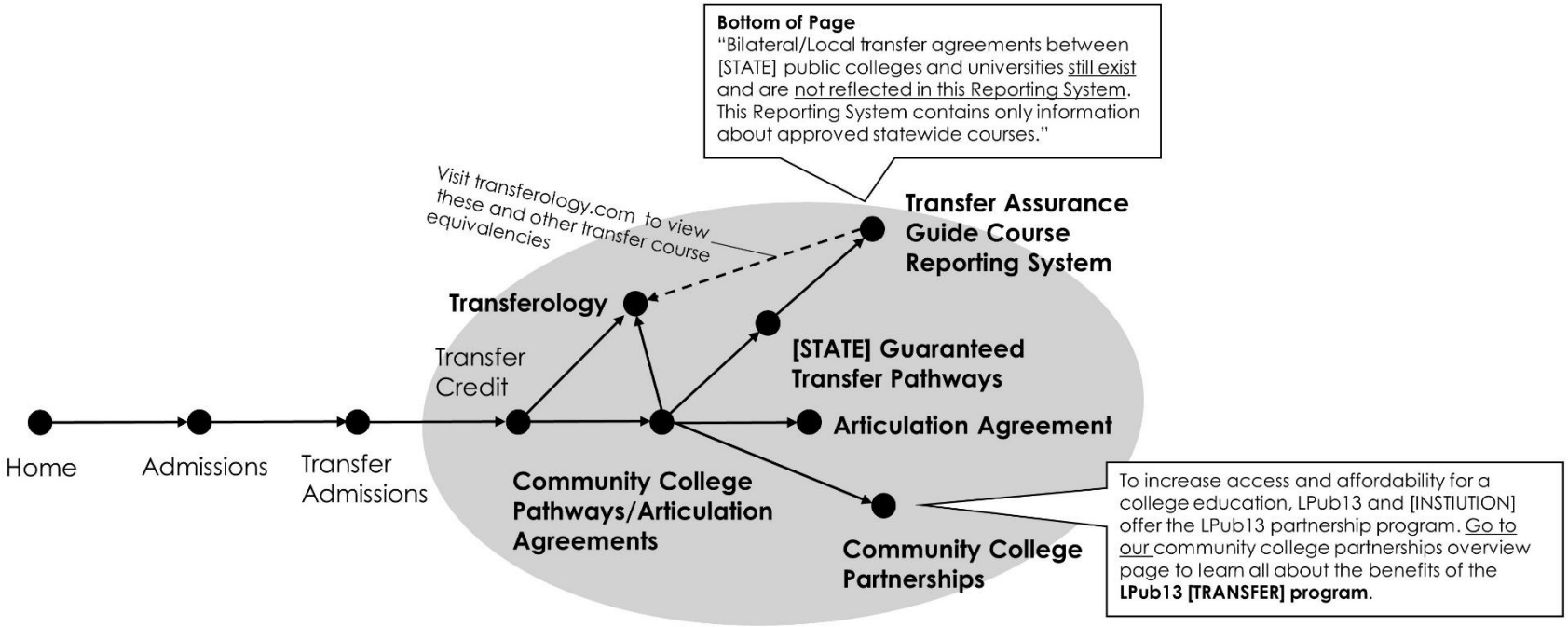


Figure 38. LPub13 and the multiple areas a student could look for transfer information

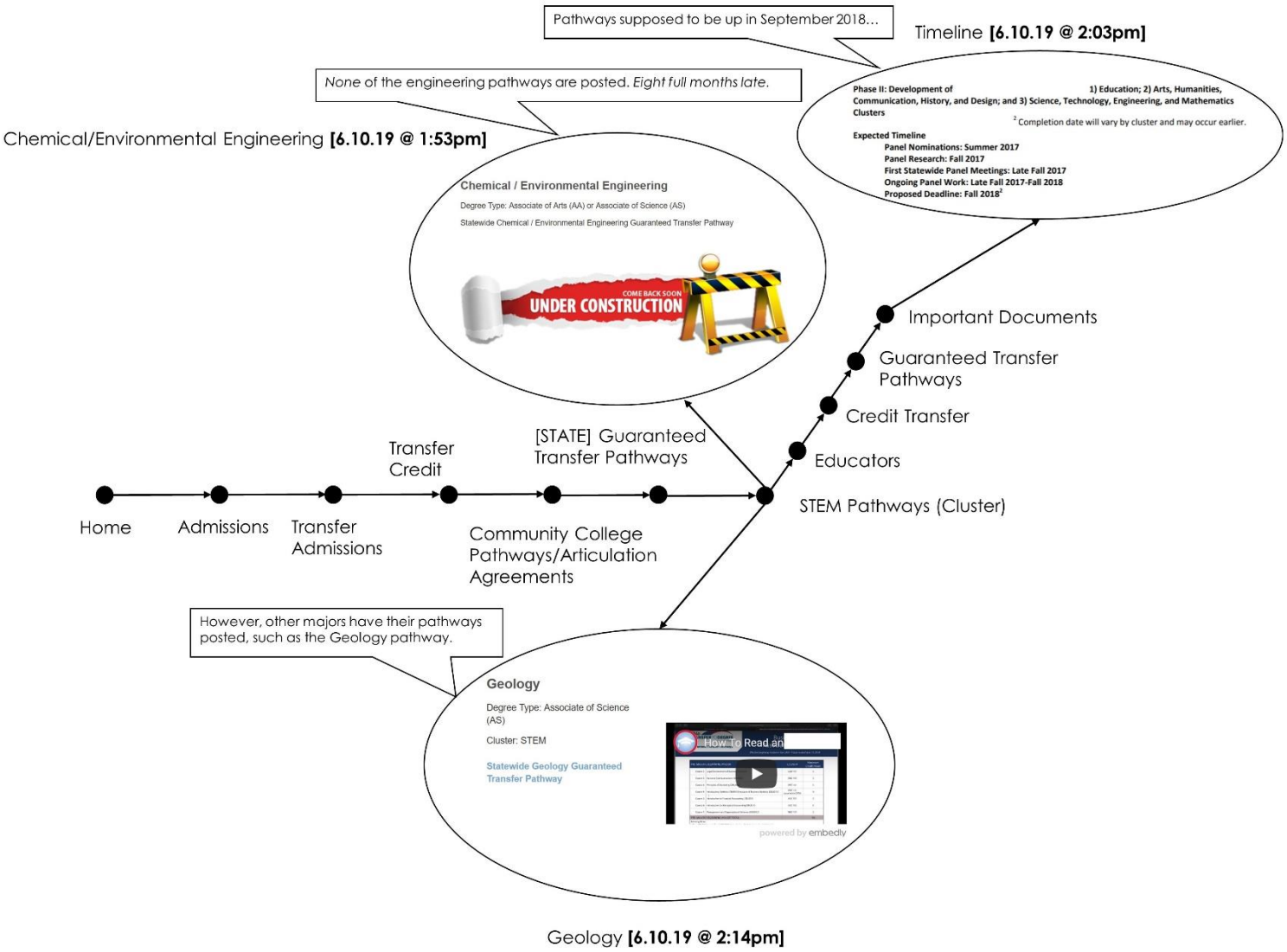


Figure 39. LPub13 and the state initiative pages

The problem of fragmentation does not exclusively occur in larger networks or the branched browsing cluster. Take MPub1, for example. The network was clustered into the mixed category. The network is shown in Figure 40. Even though the mixed browsing cluster has networks with a small number of pages relative to those clustered in the centralized expansive or branched browsing categories, fragmentation was still possible.

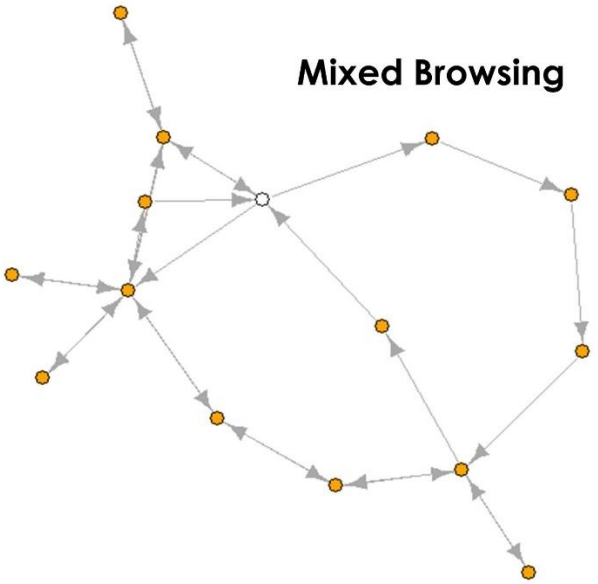


Figure 40. Researcher's browsing pattern for MPub1, home page is colored white

Elaborating on the network in the first cycle of coding revealed multiple FAQs related to admissions and transfer that did not appear to link to one another. The three ovals in Figure 41 all relate to information for transfer credit in some way but are distributed elsewhere in the network. The FAQs are particularly fragmented, as some do not ask the same questions as others. This dispersion forces the student to collect all of them to find the question they need to be answered – *late unlinked divergence in defining terms*. Sometimes documents may not even be readily provided. For example, SPriv1 has a page of community college partnerships *called*

"articulation agreements," but does not link to any of them. Therefore, SPriv1 one had demonstrated *late lack of uniformity in defining terms*.

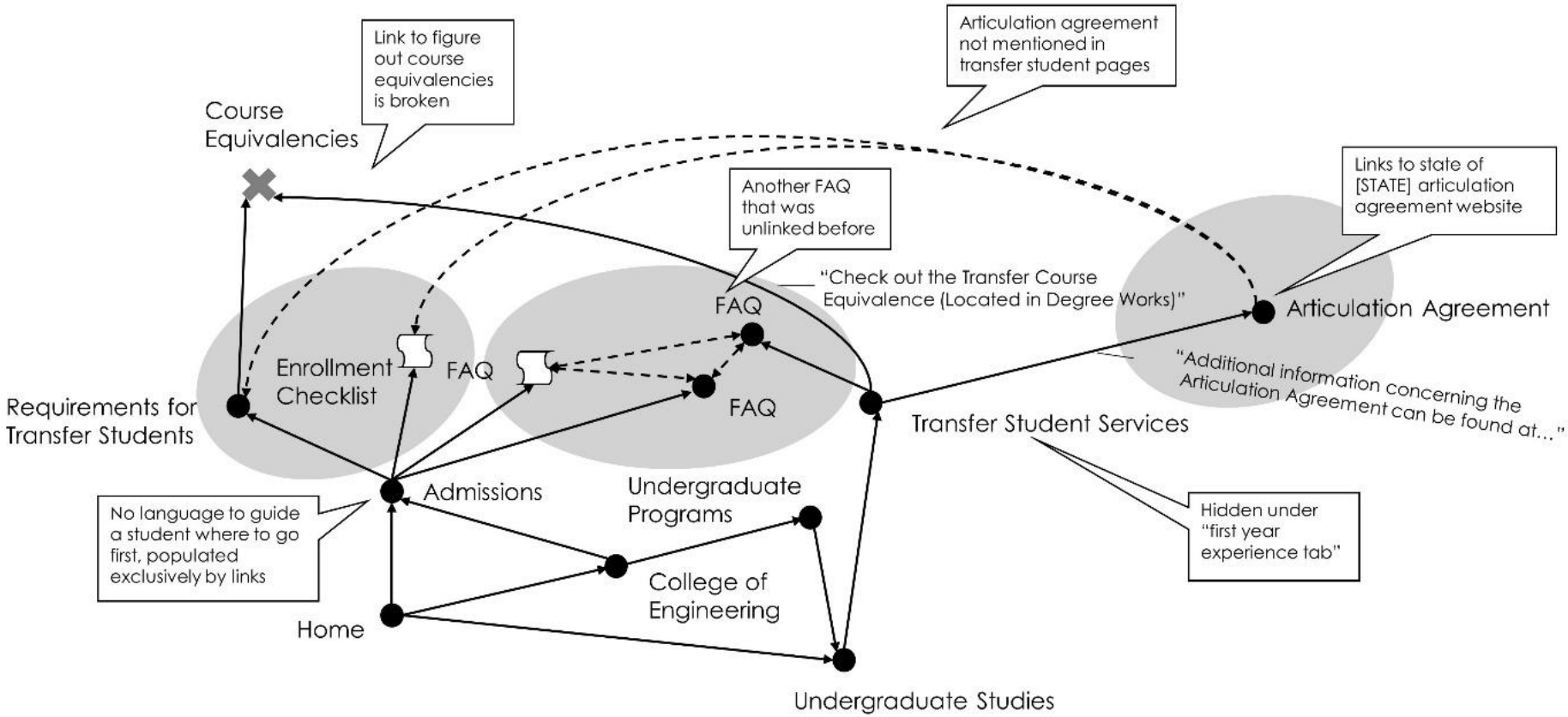


Figure 41. MPub1 and its multiple unlinked FAQs

4.6.4 Early Discouraged Fit

This narrative contained five institutions and five blended themes from three clusters. The narrative strand is shown in Figure 42.

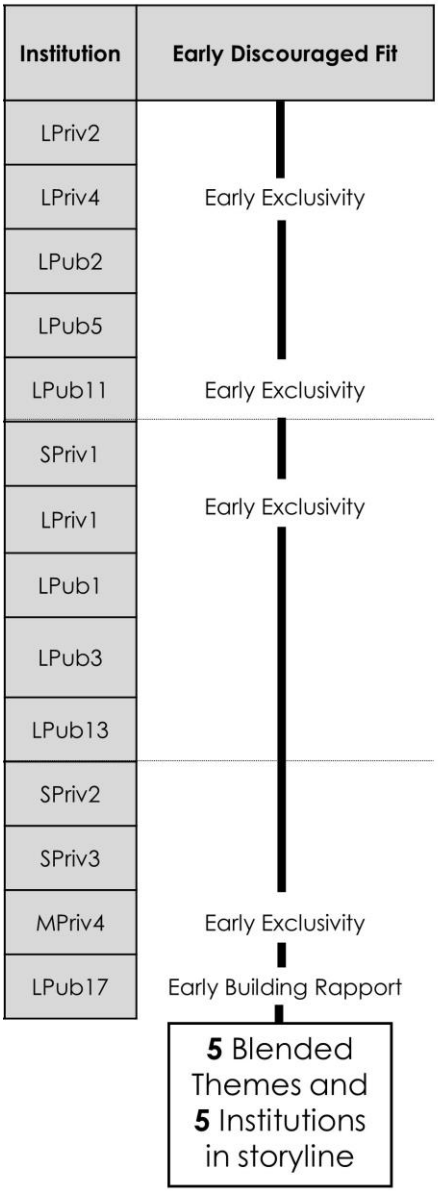


Figure 42. Narrative strand of blended themes for Early Discouraged Fit

Use of language emerging from the data involved how institutions talked about proxies for their level of prestige, specifically their exclusivity. Generally, this narrative is not about asymmetries, but the intentions of the institution can be viewed in a negative light as a result. On

LPub11's "Requirements and Deadlines" page, LPub11 claims "admission to LPub11 is more competitive than ever, but the process of applying is not difficult." The phrasing can be interpreted as bluntly providing evidence of the institution's prestige or as a reality check to students as to the demand of the institution. Adding prestige-based language may be viewed as condescending, exclusionary, or uniquely honest – regardless, the theme *Exclusivity* is applied. LPriv1's statement on their transfer student application page makes a similar statement: "As competitive as the admissions process is for freshmen, the transfer process is even more so. LPriv1 receives more than 1,000 transfer applications each year, with spaces for only 20 to 30 students. Given the competitive nature of the transfer admissions process, candidates should have compelling reasons for attending LPriv1 and should think carefully about whether LPriv1 is the right fit for them." LPriv1 has one of the lowest transfer-in populations in the sample, which is sensible based on the admitted limited space. LPriv4 also makes similar claims, "Each year, we admit a small group of transfer students to LPriv4 College and LPriv4 Engineering. Because space in the sophomore and junior classes is limited, admission is highly competitive. We typically admit fewer than 10 percent of the applicants for transfer admission each year." All of the examples given here were *early acts of prestige*.

However, is the theme *Exclusivity* necessarily good or bad? Making that evaluation cannot be claimed from the data here, but arguments can be made from either perspective. Students might enjoy applying to a university that claims to be highly exclusive and are not bothered by the *Exclusivity*. Other students may be dissuaded from applying or may be apprehensive about applying – especially if the language appears early in the information targeted to them. In fact, this theme can weave into the network structure itself based upon the positioning and visibility of the claim itself. In the case of LPriv1, the positioning of the

Exclusivity is not only on the first transfer student page, but the claim is in a larger font and featured prominently at the top of the page (Figure 43).

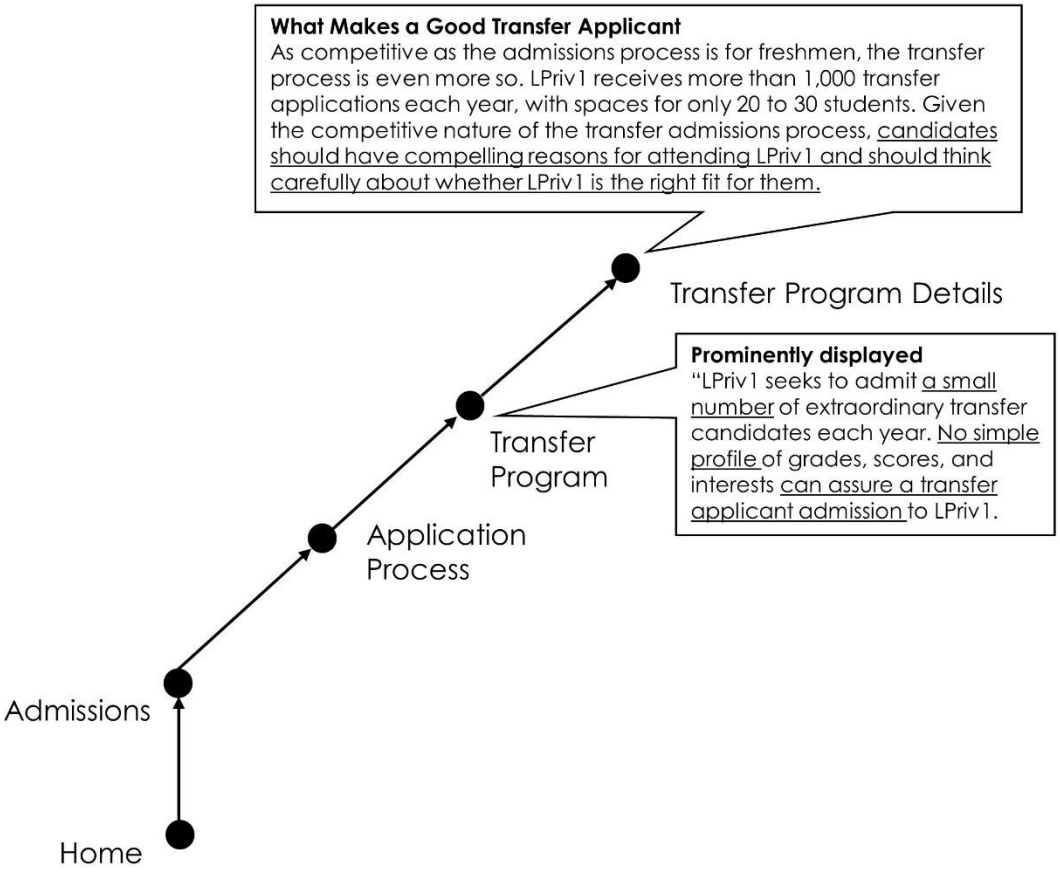


Figure 43. Display for LPriv1 highlighting the *Early Exclusivity* theme.

MPriv4's network contains a similar sentiment – shown in Figure 44. The University claims to look for a "small group of exceptionally well-prepared students," which speaks to the exclusivity aspect of the institution's prestige, but in the same sentence, the site also encourages community college students from underrepresented backgrounds to apply. Consider what happens when we remove the *Exclusivity*: "MPriv4's Transfer program looks for students from a range of backgrounds, and we particularly encourage applications from students from low-income backgrounds, community college students, and U.S. military veterans." Without the

"small group of exceptionally well-prepared students," the sentence now reads like a general statement of inclusion. Contrast these with LPub17's language, "Ready to take the next step in your education? LPub17 welcomes nearly 4,000 new transfer students each year" – *early building rapport.* Considering the existence of transfer student stigma (Laanan, Starobin, & Eggleston, 2010; Shaw, Spink, & Chin-Newman, 2019) and attitudes of first-generation college students, claiming that getting into the institution *will* be difficult is not the best welcome. A less transfer-receptive framing in tandem with asymmetries from other narratives can position the institution's messaging as appearing adversarial from the perspectives of prospective transfer students. Although the asymmetries themselves are not changed, a specific intent to their presence can be ascribed by students.

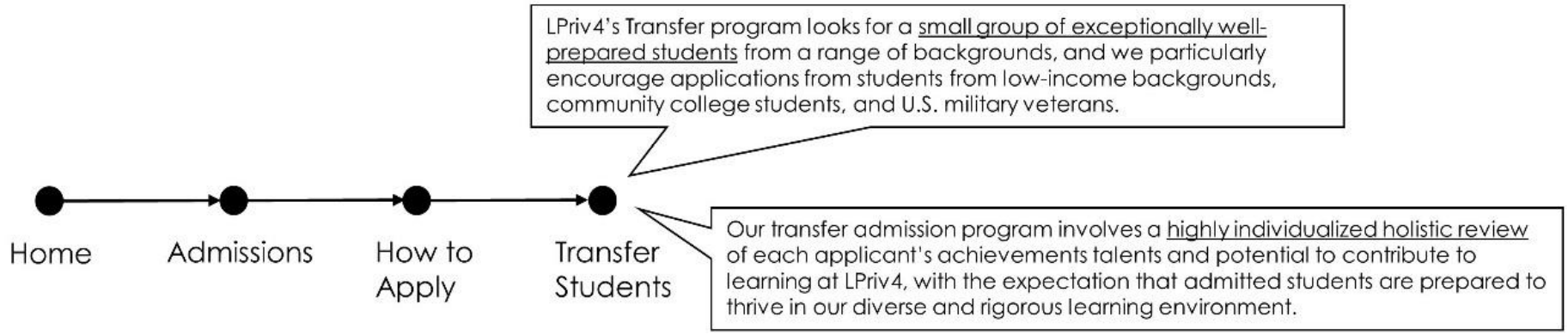


Figure 44. Display for MPriv4 highlighting the Early Exclusivity theme

4.6.5 Transferring versus Applying Credit

This narrative contained six institutions and six blended themes from three clusters. The narrative strand is shown in Figure 45.

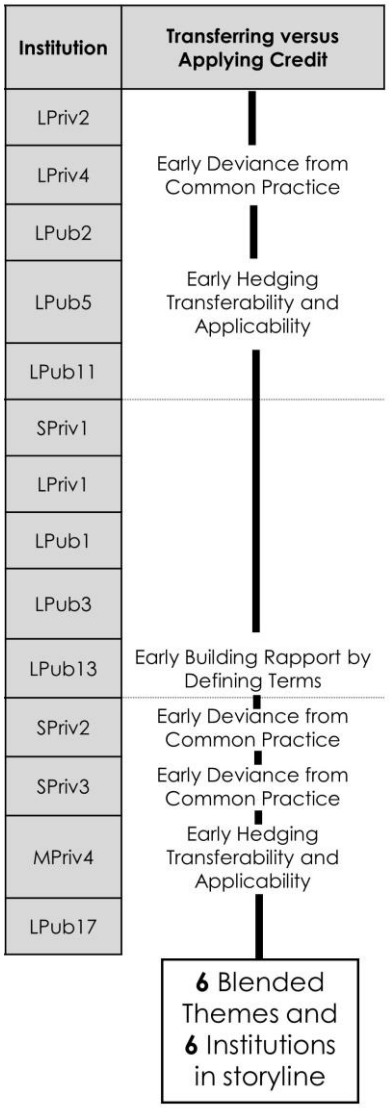


Figure 45. Narrative strand of blended themes for Transferring versus Applying Credit

An actionable narrative thread emergent from the data is the need to be transparent with students on the difference between transferability and applicability. This subtlety is often woven into statements to hedge the information provided by course articulation systems. For example,

the Community College System's articulation tool for one state on the state's higher education relegating body's website makes the following claim: "Course equivalents should not be used as an indicator of how a course applies toward a student's program of study or four-year institutional graduation requirements. Students should confer with their academic adviser or the four-year institution to determine a course sequence that maximizes the acceptance and application of credits toward degree and institutional graduation requirements." This situation places the responsibility back on the student to "maximize the acceptance *and* application" of credits toward a certain set of institutional requirements while simultaneously placing doubt in the usefulness of the articulation system.

Institutions do not typically provide students with explicit definitions of the academic terminology surrounding credits, creating asymmetries regarding the credits' "market value." What it means for a credit to be an elective or major elective, a general education course, or, most critical for transfer students, the difference between a credit being transferred and applied is embedded into the subtle distinctions. LPub13's defied the norm of not defining academic terms on the first transfer credit page, as shown in Figure 46 – an example of *early building rapport by defining terms*. The page, in part, reads "One of the most common questions is "Will my credits transfer?" But there is a nontrivial distinction between transferability and applicability of transfer credits. Transferability means the credit hours earned from another school will be added to your LPub13 transcript. Applicability means the transfer credits posted to your LPub13 transcript fulfill requirements toward your degree." This kind of intervention early in the information search process helps reframe the types of questions students should be asking.

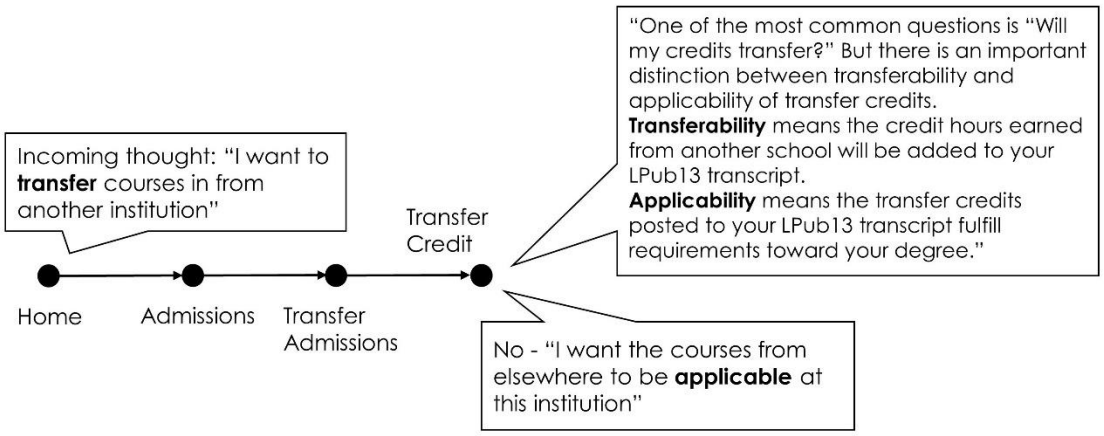


Figure 46. LPub13 outlining the difference between applicability and transferability, reframing student perspectives

The lack of applicability of credits may result in a considerable number of student credits that will become buried in the "academic graveyard" of elective credit that Kadlec and Gupta (2014, p. 7) describe. In writing about what can be transferred and applied, the language can often be unclear. For example, LPriv4 does not "give credit" for any course taught online, even partially. Upon the first reading, this appears to refer to transferability. However, it is said in the following sentence that the credit will be transferred in as general degree credit – a problem with applicability. Some institutions give the impression that they participate in transfer credit programs via the *early deviance from common practice* theme: "Technically, SPriv3 doesn't transfer credit. We award credit for work done elsewhere, and we casually call this transfer credit" but the website also claims, "SPriv3 does not establish transfer articulation agreements (automatic transfer credit agreements) with any school." The fuzziness in language can create confusion, potentially creating more asymmetries.

It can be more difficult to discern what will transfer or apply when multiple types of credit are possible. For example, LPub5 outlines four types of credit in Figure 47 - equivalent,

inter-department, department, and elective – intermixed with qualifying adjectives like applicable and transferable. How credits are repackaged at an institution after transferring them in can be unpredictable, blurring the line between transferability and applicability. Additional terminology only muddies the waters further.

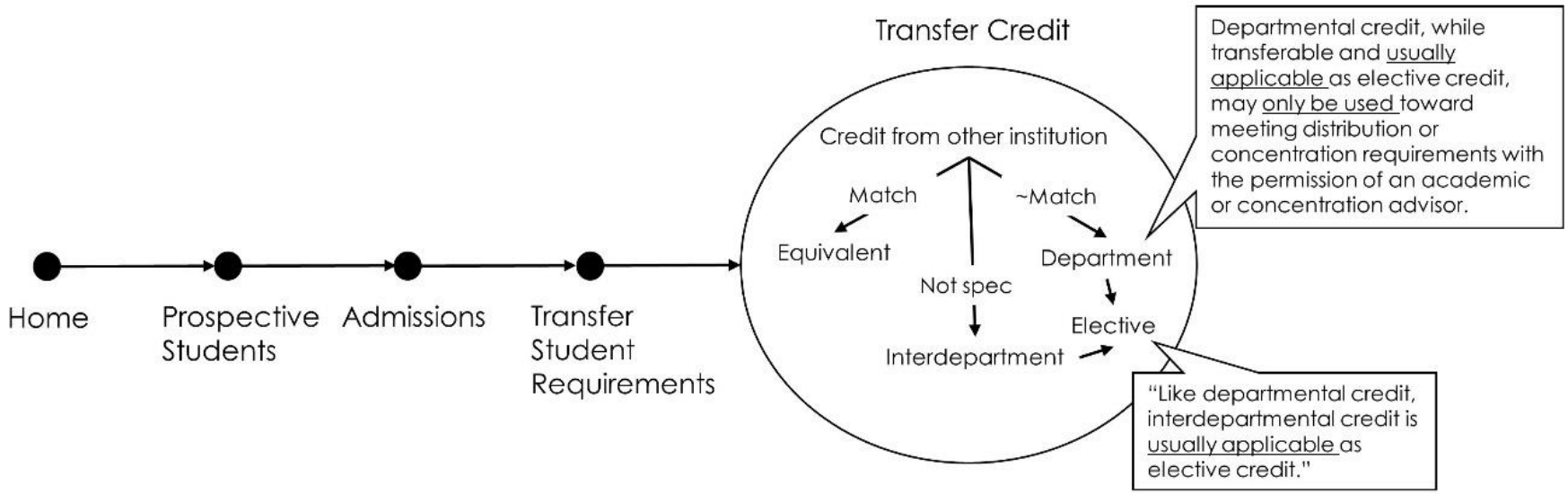


Figure 47. LPub5 and the multiple types of credits awarded, *Early Hedging Transferability and Applicability in Defining Terms*

4.6.6 Making Connections

This narrative contained two institutions and two blended themes. The narrative strand is shown in Figure 48.

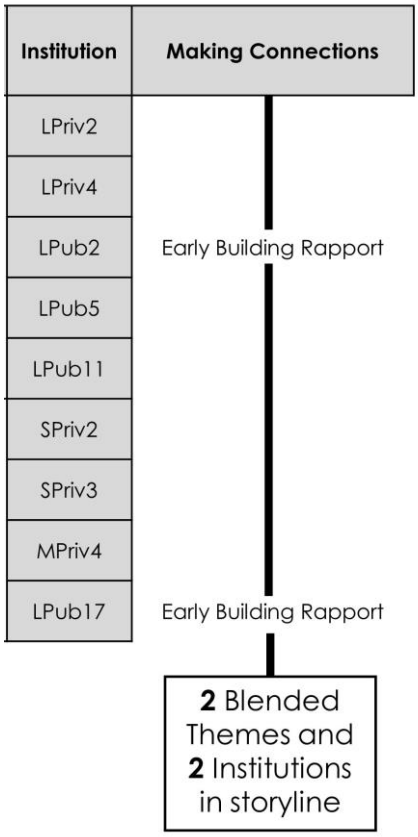


Figure 48. Narrative strand of blended themes for Making Connections

Explicit examples of welcoming transfer students and speaking with the type of language that would likely resonate with them were noticed in some institutions, explicit instances of *early building rapport*. The most vivid example was at LPub2, as shown in Figure 49. The transfer applicants page outlines three stages of applying, one of which is "before you apply." Clicking along that path leads the student to the next page, "before you apply" which displays a particular phrase that would resonate with students – "get the credits you *deserve*." Deserve is a powerful word to use in this context, considering the kinds of emotions it evokes related to feeling

accomplished. The perspective is also explicated via the shift to second person in “getting the credits you deserve” and “review everything we’ll need from you.” More informal, emphatic language could be a mechanism to lower the amount of academic jargon used in the transfer student pages.

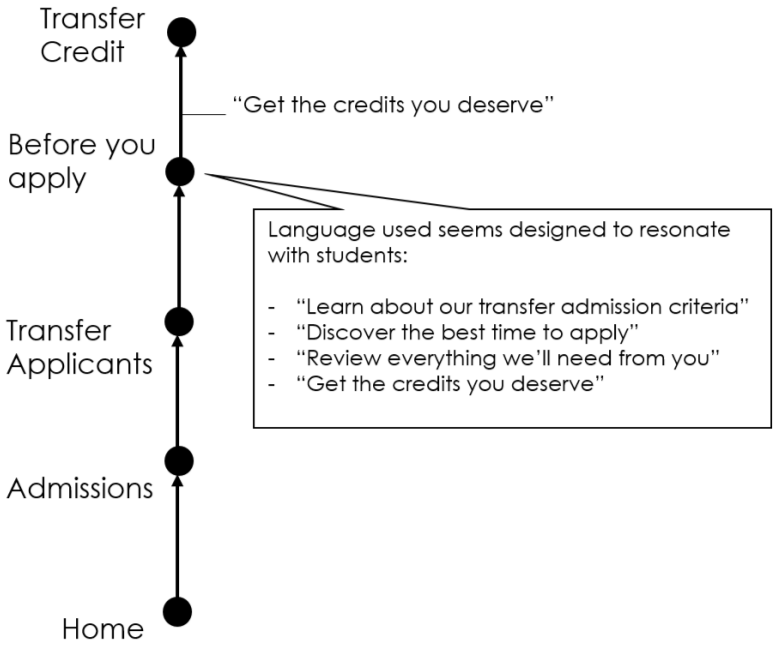
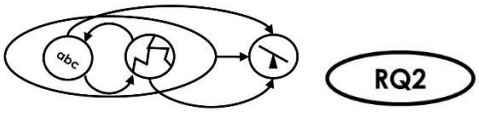


Figure 49. An example of Building Rapport theme in LPub2

Considering the stigmatization of transfer students (Laanan, Starobin, & Eggleston, 2010; Shaw, Spink, & Chin-Newman, 2019), making a transfer student feel welcome on campus is a necessary step in designing literature to attract them to the institution. LPub17 makes a welcoming statement to students on one of the first pages, “Ready to take the next step in your education? LPub17 welcomes nearly 4,000 new transfer students each year.” Note how the perspective is changed to second person once again, just like LPub2. The less formal type of communication in some sense could be a way to reduce asymmetries by guiding students through

the information structures using more common language as opposed to academic jargon – especially *early* in the information design.



4.7 Revisiting the Cluster Analysis Solution

The process of cross-case comparison began with deriving sets of institutions from which to sample based on their network structure. A natural question to ask is whether the emergent themes and narratives relate to the clustering solution. The coverage of the institutions relative to the clusters is shown in Figure 50. The complete figure is shown in Appendix C as Figure C.3. Reviewing the figure reveals each narrative contains at least two institutions, and each institution was used at least once. Moreover, all narratives were drawn from at least two clusters. The relationship between the narrative and the cluster membership of the institutions was relatively weak.

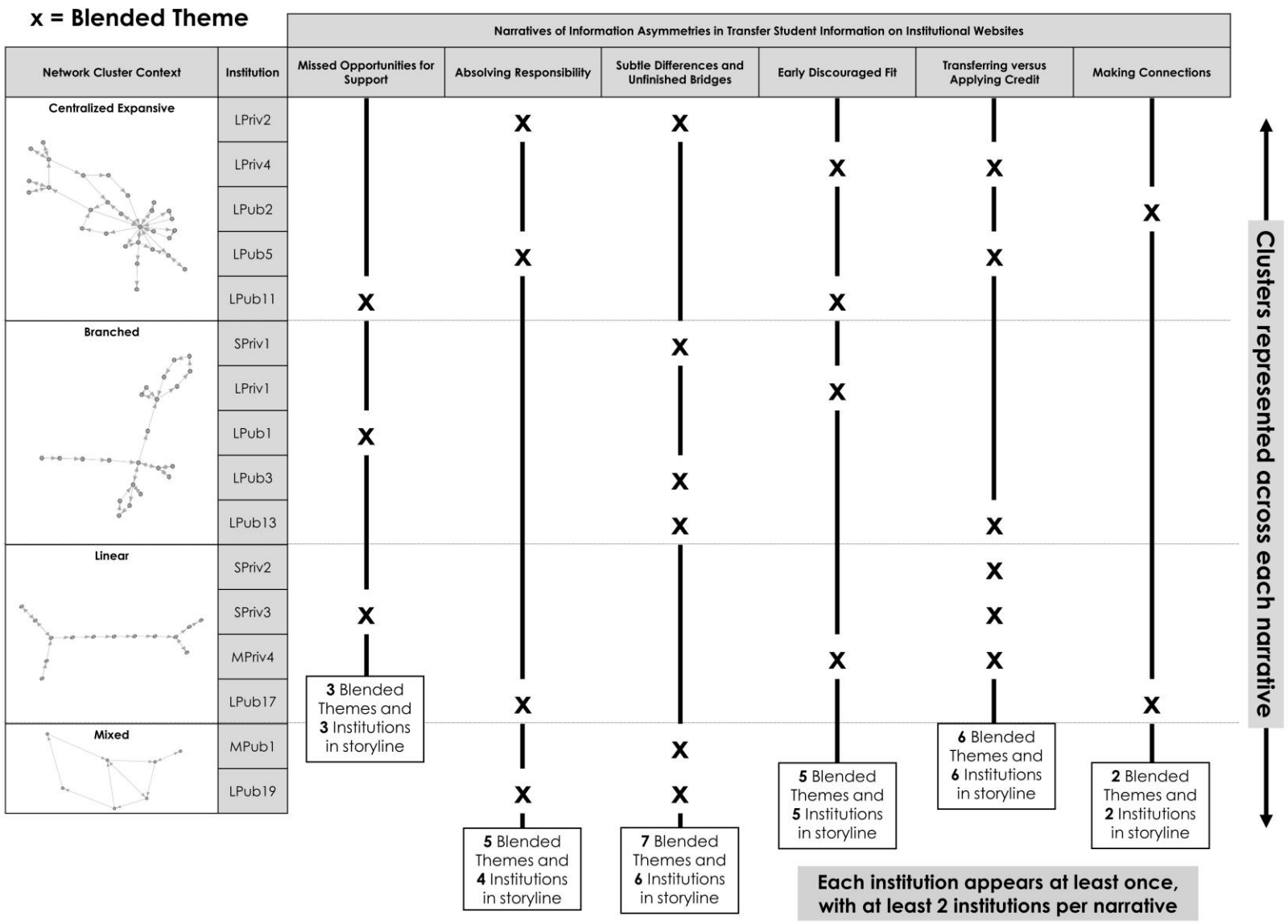


Figure 50. Formative Joint Display to show the narratives' coverage of institutions and clusters

Causal claims cannot be made as to whether the clustering solution could be confirmed via the theme generation process, but some inferences can be made based on the institutions visited. For instance, the *linear browsing* cluster contained most instances of *deviance from common practice*, likely because of the private institutions belonging to that group. The private institutions sampled tended not to have a specific transfer program with articulation agreements or course equivalencies, so the data transformation step earlier in the design terminated early – leaving a small linear network. Because many of their networks were small relative to the other clusters, they could lay claim to *early* instances of language, fragmentation, blended themes.

The *centralized expansive browsing* cluster had the most contributions to the narratives. What could be driving the dominance is the shape of the network, as the distinguishing feature in the *centralized expansive* cluster was the network size, often created by general admissions pages referencing department level directives on transfer credit or admission through *neighborhood linking*. Such differences could also be attributed to institutional characteristics. The *centralized expansive* cluster hosted a substantial portion of the large institutions, which often involved more departments to explore and more places where policies could diverge. The *subtle differences and unfinished bridges* narrative speaks to the fragmentation of information sources to the point where contradictions could emerge. Networks with such branchy structure could be an indicator of this type of asymmetry emerging. The same was true for the *branched* cluster.

4.8 Chapter Summary

This chapter reported the initial results of the network analysis and cluster analysis to form groups of institutions. I found a solution with good structure that contained four clusters from the 38 networks: *centralized expansive, branched, linear,* and *mixed*. I purposefully sampled 16 institutions to explore for themes of fragmentation and language. The two-cycle coding elicited four themes of fragmentation (unlinked divergence, progressive disclosure, lack of uniformity, and neighborhood linking) and six themes related to language (hedging transferability and applicability, legalese handwaving, building rapport, exclusivity, deviance from common practice, and defining terms). I blended the themes together and situated them in the network, whether the theme occurred early or late, to show how fragmentation and language occur simultaneously and influence one another. I then selected instances of the blended themes from the 16 institutions to create narratives, supplementing the themes with the network analyses and clusters when appropriate. The data mixing resulted in six narratives: *missed opportunities for support, absolving responsibility, subtle differences and unfinished bridges, early discouraged fit, transferring versus applying credit,* and *making connections*.

CHAPTER 5. DISCUSSION AND CONCLUSIONS

5.1 Summary of Discussion

The existing literature on transfer information asymmetries can be juxtaposed against the results of this work with considerable convergence. Messacar's (2015) work on information asymmetries in transfer maps particularly well to the concerns highlighted in the narratives. Moreover, the results extend how we can discuss asymmetries in transfer student information beyond the existing typologies and frameworks. The application of this work is particularly palpable considering the design of engineering degree programs – in terms of matriculation into the major and the majors' plans of study. This discussion outlines insights related to the way institutions organize their information on websites, the way institutions talk about transfer on websites, and the design of the study itself.

5.2 How Institutions Organize their Transfer Information 

The organization of transfer information was a mixed picture. Institutions generally placed the information in a webpage close to the home page of the institution's website, but it was unclear how much thought went into crafting a narrative for students to follow through subsequent webpages. The overall fragmentation was not ignorable, especially when key resources were not explicitly linked in initial pages describing transfer processes. The network and cluster analyses provided a foundation to discuss the dispersion of the information, which the qualitative analyses elaborated upon to arrive at the narratives.

A useful result from the cluster analysis was that interpretable and meaningful clusters emerged from graph-level measures found in the network analysis. Using hierarchy and adjusted centrality (i.e., the composite variable of betweenness centrality variable multiplied by the nonlinear variable) provided enough information to split the networks into groups that corresponded with their visual characteristics. Adjusted centrality was more useful in sorting institutions because the clustering seemed to split groups along adjusted centrality's axis. The variable was likely more powerful because it was a product of two variables with features that can be readily observed in the graph, a clear center and having no cycles. On the other hand, hierarchy is harder to visualize in smaller networks and had less variation in the sample. Regardless, the solution was still practically useful and allowed for an understanding of different broad patterns in information designs before analyzing them in more detail.

The overall network structures derived from the interrelations between the webpages provided a glimpse into the broad organization of information. Based on the structured pathways I took through the 38 institutions' websites, I observed distinct patterns in the networks' visual representations. A common network exhibited browsing with several branches, which was seen in both public and private institutions. The branched browsing patterns showed pools of information separated by several pages, which yielded the lanky structures in the branched browsing cluster. Alternately, institutions would also point students to other units in the organization. Related to the branched browsing, some networks had strong central nodes that I kept coming back to in my browsing. Such networks with strong centers were clustered into the centralized expansive grouping and were mostly found in large institutions. A small group of five

networks with fewer pages fell into a different cluster which seemed to have a mixture of the centralized expansive and branched browsing characteristics. Finally, some networks were composed of straight paths with no loops between pages. This cluster was called linear browsing, home to most of the private institutions. Sampling based on network structure using the four clusters provided a reasonable method of maximizing variation between institutions based on their information designs, which enabled the variety of fragmentation and language themes found.

Attempting to differentiate the clusters in terms of the narratives was difficult because the language and fragmentation issues occurred anywhere in the network. Multiple narratives could be seen in each institution. Likewise, multiple clusters could be seen in a single narrative. Institutions would generally exhibit similar issues independent of their cluster. The organizational literature would support the observation that an element of institutional isomorphism might have been taking place – the process of organizations becoming more alike over time (Beckert, 2010; DiMaggio & Powell, 1983). The layout of the transfer information was generally invariant across institutions within the same cluster, and deviance from the pattern was often a result of deferring authority on policies to other units in the organization. The deviance was worse when the levels of authority increased, especially with state policies interacting with institutional policies. For example, LPub13 had several areas in its information design where divergence could occur. Students could check Transferology, the articulation agreements, community college partnerships, the statewide articulation system, or a set of courses by major which were guaranteed to flow between institutions. The statewide system admits to not capturing local agreements, leaving students to check the other sources – which

could cause confusion when systems do not agree. Differences in information structure across clusters were most apparent when an institution had an organizational unit specifically tasked with supporting transfer. Finally, institutions claiming not to have pathways for transfer students, SPriv2 and MPRiv4, had linear information structures that clustered together.

When I analyzed the networks further, Messacar's (2015) themes of information asymmetries in the transfer process – credit evaluation, the application process, GPA calculation, prerequisites, degree and program requirements, prerequisites, and general policies – continue to ring true in my analysis, as there were examples where the fragmentation of information would make it difficult for students to assess their position in the market. Fragmentation played a considerable part in the narratives "Missed Opportunities for Support" and "Subtle Differences and Unfinished Bridges." For example, one asymmetry caused by fragmentation was "how GPA is calculated." The example of LPub2's use of three different calculations of GPA, at the institutional level then twice in engineering, but disclosing the relevant version for transfer students multiple pages into the network is an illuminative case of how simple missteps in communication can create unnecessary asymmetries through fragmentation. MPub1's multiple FAQs, two of which were in the same unit, is another instance where information was needlessly distributed across multiple pages. Students become frustrated when they need to dig deeper than three levels (Poock & Lefond, 2001), so avoiding deep dives for information is desirable.

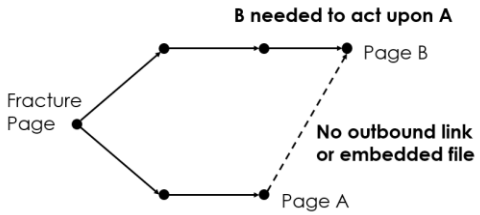
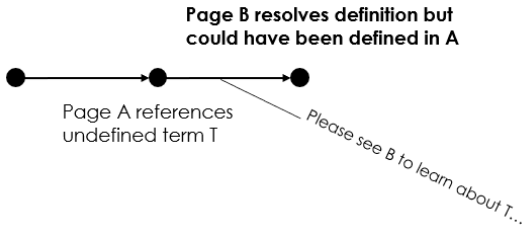
Whatever agency an engineering college or department has with their information design could be leveraged to reframe transfer information – or curricular information

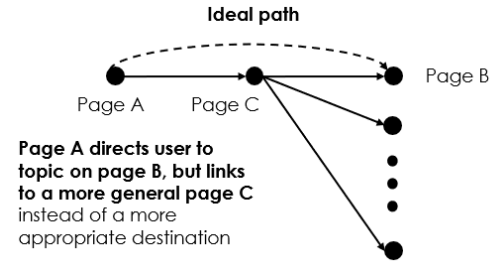
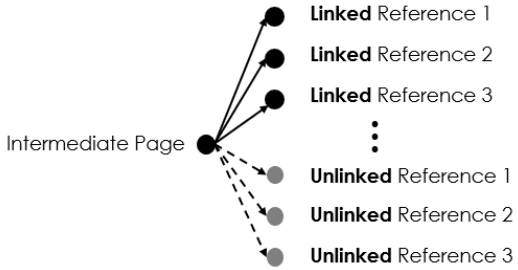
generally – using the themes. For those with variation at the department or program level, especially with a common first-year program followed by matriculation into majors (Chen, Brawner, Ohland, & Orr, 2013), making the transition experience clear for transfer students by mapping out the process and consolidating information is vital to avoid fragmentation. Beyond transfer information, there are areas in which engineering could benefit from exploring the ways in which information is organized. For example, the organization of course pages in a learning management system is a practical application of using the themes for evaluation. Considering the potential for course sites to expand over a series of pages, being more thoughtful about the page organization – both within and between pages – can be facilitated through the themes.

The connections to Messacar (2015) are illustrated in Table 13 to show how the fragmentation themes related to the common asymmetries she uncovered in her investigation. The fragmentation themes were mapped to several asymmetries in the transfer process, which demonstrate how simple dispersion in an information design can obscure or hide essential information. A tool with guiding questions for practitioners to reflect on the information organization is available in Appendix D.

Table 13

Fragmentation themes and their relationship to Messacar's (2015) themes

Theme	Characteristics	Network Realization	Examples Tied to Messacar's (2015) Themes
Unlinked Divergence	Page A contains some bit of information, but information from page B is needed to act upon what is seen in A. This code could also be applied if the pages should be linked or combined but are not.		**Asymmetry in Policies and Associated Terminology** MPub1 hosts several frequently-asked-questions pages – two of which are in the same unit – which do not link to one another in a meaningful way.
Progressive Disclosure	Page A refers to an undefined term and prompts the user to visit page B to clarify what is meant on A. Page B could also reveal information that elaborates on A that is not necessarily specified as needing explanation. This theme can apply more generally where details are seemingly withheld unless a user digs deeper into the network.		**Asymmetry in GPA Calculation** LPub2 outlines the requirement for overall and technical GPA for admission into the college of engineering, but a subsequent page reveals that the combo GPA, not overall or technical individually, are used for admissions decisions.

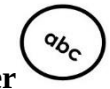
Theme	Characteristics	Network Realization	Examples Tied to Messacar's (2015) Themes
Neighborhood Linking	Page A refers or directs the user to page B though a link. However, page A links to some intermediary page C that is more general.		**Asymmetry in Prerequisites** LPub5 explains that schools and colleges have different admissions requirements. The page links to an 'Engineering Transfer Students' page, but the user then needs to find the admissions requirements page. The prerequisites are then listed on the requirements page. However, one department links to their own departmental page to explain their requirements.
Lack of Uniformity	An intermediate page links to several other pages but does not link to similar pages in the same context. Or the linked pages may not be consistent.		**Asymmetry in the Evaluation of Credits** LPriv2 outlines several community college partnerships – which are codified in articulation agreements. However, only three institutions have their articulation agreements available online. The student is prompted to ask for the agreements not publically available.

5.2.1 Time-based Fragmentation

The observations made about *time-based fragmentation* were natural consequences of the system constructed and maintained by actors in higher education. Therefore, the consequences may be unavoidable. What appeared to be a factor in increasing potential information gaps was the idea of holistic evaluations of credits. Rather than observable fragmentation in the information design, I found holistic evaluations constituted a fragmentation in terms of time. Several institutions assert that credit evaluations do not occur until the student is admitted. Messacar's (2015) notions of "prerequisites" and "program requirements" can be applied here, especially because program requirements are constantly in flux. The variation inevitably affects relationships between community colleges and the agreements outlining transfer credit. The hedging against the correctness of the articulation tools can make the process of determining what will transfer and apply an arduous task. Given such constraints, students need to wait to receive an official audit of their credits beyond speculating their transferability or applicability based on speculation. The lag time is a fundamental asymmetry in higher education (Kivistö & Hölttä, 2008) and constituted fragmentation that is created by language.

Highly individualized processes shrink the market down to a single exchange between the institution and the student, leaving large margins of speculation based upon the available evidence. One of the students' concerns in Messacar's (2015) work was how credits are evaluated, which a "holistic process" does little to provide insight into how the process works. In a sense, *time-based fragmentation* is based on the lag in time between the first contact with the institution and admittance. Such fragmentation is a

fundamental element of what causes asymmetric information in higher education (Kivistö & Hölttä, 2008). The uncertainty in estimating credit transfer is reminiscent of attempting to quote how much giving birth will cost at the hospital and expenses related to a wedding. All three of the exchanges have qualities in common, people do not frequently "buy" a hospital visit, items for a wedding, or transfer credits. The lack of familiarity leaves the buyer unsure of the optimal price in the market (Dill, 1997). Moreover, hospital bills do not come until after the service has been provided. Similarly, credit evaluations are not made until the students make significant enough contact with the institution in the form of being offered admission to receive a more comprehensive quote on how their credits are valued. Although little can be done to counter the time-based fragmentation, supports such as department-based bridge programs can be put in place to mitigate the asymmetries which spring from it – which have been implemented in engineering (Duis, et al., 2016; Lumpp, et al., 2019; Lee, Grote, Knight, Erwin, & Watford, 2019).

5.3 How Institutions Talk about Transfer 

This discussion is split into language processes that I observed as well as commentary on the extent to which such processes might be intentional. The discussion on language use closes by integrating the language themes identified in my analysis with an existing typology of communicative strategies in online privacy policies to illustrate how institutions talk about their transfer procedures.

5.3.1 Asymmetries Emerging from Language Use

Students, especially those transferring from a four-year university assume their credits, often assume their credits will transfer (Lukszo & Hayes, 2019); yet, I observed all institutions hedging to some degree in their information design. The severity of hedging should be not too surprising considering the market in which higher education exists. Articulated pathways mandated at the state level or through a collective articulation agreement *should* eliminate the need for hedging, yet uncertainty persists for students in what the transfer process involves. The required steps to bring credit into a different institution becomes obscured, partially because the "credit economy" is a volatile multilevel market. Credits could be converted from quarters to semesters, semesters to quarters, or to a different credit system unique to the institution. The credits could be filtered for delivery mode, whether it was taken in-person, online, or a mix of both. Where the course was taken is also considered. College and departmental stipulations are placed over the credits as well.

After the credits are scrutinized, there are three main outcomes: (1) the credits are not transferred in, (2) the credits are transferred in but not applied, and (3) the credits are transferred in and applied. Within the application of credits, there could be variation as well, where credits may only apply to certain programs – potentially driving major choice by placing additional asymmetries in the credit application process. Even within an institution that establishes agreements with the state community college system, courses that are listed as transferrable can be stigmatized in certain departments who have come to classify which community colleges have the "good" version of the class versus a "bad" version. I observed language that blurred the line between the three outcomes, especially the tacit departmental knowledge not disclosed on the articulation pages. The language processes can create asymmetries that lead to misunderstandings for transfer students.

Another aspect of the language concerns how articulation agreements evolve over time. I showed that several institutions in the sample would hedge on the accuracy on their information on their articulation platforms, even saying their information was "believed to be correct" in the "Absolving Responsibility" narrative. "May" frequently appeared in the sampled webpages, especially in the context of describing transfer credit: "Courses *may* be eligible for transfer credit if they are analogous to undergraduate courses offered." The use of the word "may" can express an element of probability or possibility in whatever action is being modified (Kreidler, 1998). It is understandable for course offerings to change over time, but the acceptability of courses toward certain requirements or being transferred in at all rest with the assumption of treating courses as packages rather than the transferrable skills students derive from engaging in the courses. The hedging benefits the institution, as it assumes the position of power to determine

what is a legitimate credit in their context. Accordingly, the language can be seen as an additional layer of uncertainty in what students already deem to be an adversarial system (Hodara, Martinez-Wenzl, Stevens, & Mazzeo, 2016). The adversarial nature is further evidenced in the "Early Discouraged Fit" narrative, wherein institutions downplay the fit transfer student's chances of matriculating. Perceptions of fit for transfer students is especially crucial for their academic integration (Laanan, 2007), which language associated with "Exclusivity" in the "Early Discouraged Fit" narrative works against.

Messacar's themes (2015) can also be tied to the language-use issues, specifically the "policies and associated terminology" asymmetries. Students appreciate the use of less academic terminology – e.g., assuming students can decipher the difference between school, department, and college – when organizing information (Poock & Lefond, 2001). Transfer specific words like "articulation agreement" are likely not the terminology students would use, but such terms were often used without prior definition. Some institutions like LPub2 engaged students with more casual, emotional terminology – e.g., "get the credits you deserve" – whereas others used more typical institution-leaning language – e.g., "reserves the right to make corrections and revisions." In addition, institutions were seen using localized language at the state and institutional levels without properly introducing it. The issue was that the localized language could be interpreted differently by students depending on how familiar they are with the market. Take for instance the "[Mascot] Promise" at LPub1 in the "Missed Opportunities for Support" narrative. The term appears on the transfer page but is undefined with few cues to signal its meaning to students. The subsequent page provides a more general picture of the [Mascot] Promise without a succinct definition of what the Promise happens to be. Those

students with greater transfer student capital may fare better in navigating the terminology, however (Laanan, 2004; Laanan, 2007; Laanan, Starobin, & Eggleston, 2010). Stepping back to evaluate the formality of the language, particularly the extent to which academic jargon is used, would be a useful exercise for any institution.

Table 14 shows a summary of the relationship between the language themes and Messacar's themes (2015) revealed in this discussion. The language themes, aside from *exclusivity*, were applicable to at least one of the common asymmetries in the transfer process. A tool with guiding questions for practitioners to reflect on webpage language-use is available in Appendix E.

Table 14

Language themes and their relationship to Messacar's (2015) themes

Theme related to Language	Characteristics	Relationship with Messacar's (2015) Themes
Hedging Transferability and Applicability	Uses language to instill doubt about the transferability or applicability of student credits	Increases **asymmetries in the evaluation of credits.** Almost all institutions had some phrasing that claimed credits would likely transfer or likely apply to varying to degrees.
Legalese Handwaving	Explicitly hedges to benefit the institution by absolving institutional responsibility for inaccuracies, defers authority to other units	Increases **asymmetries in transfer credit portfolio (location, units, personnel involved)**. For example, institutions like LPriv1 claim to have holistic credit evaluations. What holistic means, however, is by the virtue of its own definition is discussed loosely. Such actions make it difficult for students to understand what goes into the process
Building Rapport	Uses terminology that might resonate with students, switches to student perspective.	Reduces **asymmetries in policies and associated terminology**. Some institutions like LPub2 had language that would likely guide students toward the information they sought, like "get the credits you deserve" to find transfer credit pages.
Defining Terms	Terminology unique to the institution (university course credits) or general terms used in transfer (articulation) is defined	Reduces **asymmetries in policies and associated terminology**. LPub13 was one of the few institutions to make a clear distinction between 'transfer' and 'apply' in the context of credits early in their information design. Other institutions would muddy the terminology.
Deviance from Common Practice	Claims the institution does not engage in transfer agreements or transfer credit itself. A unit may also deviate significantly from the institution's usual transfer practices.	Increases **asymmetries in variations in structure of the institution and program type**. For example, SPriv3 "technically" doesn't transfer credit. However, they do award credit for work done else and they "casually call" it transfer credit.
Exclusivity	Makes claims that do not add relevant information for the transfer student, rather, it downplays their fit.	Not a clear relationship but could change students' perceptions of the asymmetries. As in, does the institution care about transfer students? If not, then the asymmetries *might* be viewed as not supporting transfer into the institution.

The "Transferring versus Applying Credit" narrative, which draws upon various ways "Deviance from Common Practice" and "Hedging Transferability and Applicability" could manifest in the network, raised an often-muddied distinction

between the idea of transferring credits and applying them to specific requirements. Clarifying the difference between transferability and applicability is critical, which LPub13 did well early in their documentation. Conflating the two concepts can lead to suboptimal decision-making for students not familiar with the market of transfer credits in the context of the institution they plan to attend. For example, credits students planned to apply to specific degree requirements may be relegated to elective credits. The demotion is not necessarily a loss, as additional credits can benefit students by, for example, allowing them better positions in a housing lottery for on-campus residence at certain institutions and decreasing time to degree.

However, inert credits like electives may also be detrimental. GPA requirements for remaining in "good standing" with the institution or to continuing receiving financial aid, like scholarships, can change based on class standing. Because standing is often benchmarked with credit hour thresholds, transfer students could be held to a higher GPA requirement despite not having the graded coursework to be fairly held to the new standard. The situation is especially troublesome for engineering on top as choosing classes necessary to make progress through prerequisite chains could be delayed (Davis, Ogilvie, & Knight, 2017). Moreover, different admissions policies on how students matriculate into engineering majors (Chen, Brawner, Ohland, & Orr, 2013) may place transfer students at a disadvantage if admission is based on GPA or fulfillment of certain prerequisites. Moreover, the introduction to engineering class may not be applied toward the degree requirements as the content of such courses vary considerably (Reid, Reeping, & Spingola, 2018). Therefore, understanding what applies and what does not is crucial so students can make the decision that makes the most sense for them. The contextual

features of the “degree and program requirements” and the “variations in structure of the institution and program type” from Messacar’s themes (2015) can create further asymmetries because of the treatment of credits in different contexts – influencing the potential conflation between “transfer” and “apply.”

The “Transferring versus Applying Credit” narrative is especially an issue for engineering. STEM students comment that institutions could be clearer in articulating what credits will transfer into the institution (Davis, Ogilvie, & Knight, 2017). Engineering has a highly intertwined curricular structure relative to other fields in the humanities based on Heileman’s et al. (2017) measure of curricular complexity (Slim et al., 2014). The high curricular complexity implies that it is difficult to shuffle courses around and the program is heavily prescribed. If courses do not apply, students can be stuck retaking a course in a long prerequisite chain, leaving few course options each semester. On the other hand, students could have fulfilled all their general education credits but have not made progress on prerequisites for upper-level engineering courses – making students take a heavy load of STEM courses (Laier & Steadman, 2014). Being clear about transferability and applicability is fundamental to establishing transparent communication with transfer students.

5.3.2 Institutions Talk Like Companies Writing Privacy Policies

The framework of academic capitalism can suggest that institutions purposefully talk about transfer in generalities to maintain leverage. The academic capitalism perspective supports such a position because the essence of the theory alludes to institutions participating in market-like behaviors (Slaughter & Leslie, 1997; Slaughter & Rhoades, 2009; Jessop, 2018; Cantwell & Kauppinen, 2014), which naturally involves

injecting competition into the system – winners and losers. As the authors of the policies guiding the transfer process, institutions have the "power to disguise power" and "the power to constrain content" as they see fit (Fairclough, 2001, p. 43).

To explore the intentionality of information asymmetries as motivated by the academic capitalism formulation, an additional form of integration in making inferences was conducted, which situated the coding scheme developed inductively through the network elaboration codes to an existing scheme that was developed in a different context. This process was a form of elaborative coding, which is a way of analyzing text to advance a particular theory (Auerbach & Silverstein, 2003). The integration backdropped an existing theory from the context of online privacy policies against the newly developed themes within the context of undergraduate engineering curricular information.

The typology of communicative strategies from Pollach (2005) that focused on online data privacy policies was backdropped against the codes synthesized in the first cycle of coding. The success of the integration suggests that although student-facing policies and information are intended to help students make more information transfer decisions, their use of language contradicts that assumed goodwill – much like online data privacy policies. The integrated themes associated with Pollach's (2005) typology, described in the following sections, are *mitigation and enhancement, obfuscation of reality, relationship building, and persuasive appeals.* The summary of Pollach's (2005) themes is given in Table 15.

Table 15

Communicative strategies in online privacy policies

Communicative Strategies	Characteristics	Examples
Mitigation and enhancement	(De)emphasizing qualities Downplaying frequency	Carefully selected Occasionally
Obfuscation of reality	Hedging propositions Obscuring agency	May The sharing of You receive
Relationship building	Switching perspectives Addressing audiences	I / my You / your
Persuasive Appeals	Appealing to common practice Appealing to fear	Like most Not sell

Note: Recreated table from "A Typology of Communicative Strategies in Online Privacy Policies: Ethics, Power and Informed Consent," by Pollach, I. (2005)

A summary of the mapping from the inductively derived set of themes from my work into Pollach's (2005) can be seen in Figure 51. The leftmost column shows the themes derived from this work and the definition of each theme. The communicative strategies from the privacy policy context are shown in the rightmost column. A bridging quote to highlight the mapping between the two sets of themes is provided in the middle of the figure.

Transfer Student Information Context			Online Data Privacy Policy Context	
Theme	Description	Bridging Quote from the Sample	Description	Communicative Strategies
Hedging Transferability and Applicability	Uses language to instill doubt about the transferability or applicability of student credits.	"**Generally**, departmental requirements for majors and certificate programs **may not be** fulfilled through transfer credit."	(De)Emphasizing Qualities	Mitigation and Enhancement
		"Because of the unique nature of our curriculum, we are **typically unable** to take transfer credits from courses completed at other institutions."	Downplaying Frequency	
Legalese Handwaving	Explicitly hedges to benefit the institution by absolving institutional responsibility for inaccuracies, defers authority to other units	"Information displayed in this Transfer Guide is **believed to be correct.**	Hedging Propositions	Obfuscation of Reality
		However, the **university reserves the right** to make corrections and revisions."	Obscuring Agency	
Building Rapport	Uses terminology that might resonate with students, switches to student perspective.	"Review everything **we'll need from you"** **"Get the credits you deserve"**	Switching Perspectives	Relationship Building
Defining Terms	Terminology unique to the institution (university course credits) or general terms used in transfer (articulation) is defined.	**"One of the most common questions is "Will my credits transfer?"** But there is an important distinction between transferability and applicability of transfer credits.	Addressing Audiences	
Deviance from Common Practice	Claims the institution does not engage in transfer agreements or transfer credit itself.	"**Technically**, SPriv3 doesn't transfer credit. We award credit for work done elsewhere, and **we casually call this transfer credit**."	Appealing to Commonalities	Persuasive Appeals*
Exclusivity	Uses language to instill doubt about the transferability or applicability of student credits.	"**As competitive** as the admissions process is for freshmen, the **transfer process is even more so**. … candidates **should have compelling reasons** for attending LPriv1 and **should think carefully** about whether LPriv1 is the right fit for them."	Appealing to Fear	

*Privacy policies convey a sense of normalcy by asserting commonalities as in – "like most companies" – or assuring private data is safe in the hands of the company to ease user concerns, but the observed theme of *Exclusivity* is the reverse of this theme.

Figure 51. Integration of Language Themes back into the literature with Pollach's (2005) Communicative Strategies

The language used by institutions was found to be reminiscent of how companies write online privacy policies as described by Pollach (2005). The implications of such a mapping can be jarring, especially because higher education institutions should operate in good faith as ideal public goods to ensure the students have a successful journey through their programs. The mapping of the language themes to the communicative strategies used by companies drafting privacy policies in Pollach's (2005) work was especially concerning considering the lack of student power. Vague statements and the obfuscation of reality by the institutions lulls the reader into a state of potential confusion, which results in the user eventually accepting their position in the market by discouraging them reading the documentation in full – much like the online privacy policies.

5.3.3.1 Mitigation and Enhancement

The concept of *mitigation and enhancement* from the online privacy policy space concerns how language is used to emphasize or de-emphasize certain qualities of something, especially its frequency. Words used to communicate a sense of frequency were often "may," "typically," or "generally." The emergent theme from the data was *hedging transferability and applicability,* as the language used also accomplished the same goal as Pollach's (2005) theme with the specific result of instilling doubt in the student. This asymmetry creates an imbalance of power between the institution and the student because the "seller" in the transaction now has leverage over the "buyer," which is exacerbated by the other themes.

One might argue that the mention of hedging propositions would better fit with the theme of *obfuscation of reality*. However, the theme *hedging transferability and applicability* was seen more as a matter of perceived credit quality. The institution was

"de-emphasizing" the quality of the credits in the sense that the credits may or may not apply and may or may not transfer. Institutions limit the allowable number of credits students can transfer into their programs, so there is a "careful selection" of which credits can be used for different purposes – as Pollach (2005, p. 231) presents in her example phrase.

5.3.3.2 Obfuscation of Reality

Obfuscation is the process of making something unclear. In this case, *obfuscation of reality* refers to language that hedges propositions and obscures agency. The associated emergent theme from the data was *legalese handwaving.* In the theme of *legalese handwaving*, the language used in policies and information places the institution in a position of power while, potentially at the same time, downplaying mistakes. What is peculiar about this theme is the apparent textual absolution of responsibility. "Obscuring agency" was seen from the perspective of responsibility, in that language could be used to excuse oneself and defer authority up or down a hierarchy. The division of educational units into loosely coupled systems seemingly guarantees a situation where one unit refers to another unit having more decision-making power, information, or political pull. Transfer credit policies are susceptible to this deference. Individual departments can make their own rules as to which credits can apply to requirements in their programs, even if the credits transfer into the institution. The same is true for admissions to specific programs at some institutions. Therefore, policies in the admissions office can only make general claims and must often defer the authority down further to smaller parts of the institution.

Even odder is the seemingly arbitrary redefinition of rules in the same utterance, particularly using intimidating strings of courtroom-like language. “Reserves the right” is a particularly combative phrase. Coming across the phrasing that information being presented to them, prepared by the institution, is “believed to be correct” immediately followed by the claim that the institution “reserves the right” to make changes paints a fuzzy reality for students. Should the information be trusted? What is the “statute of limitations” on being able to claim the guide made one claim before revising it to make a different claim? It is with these doubts that reality is obfuscated, hence the fit of *legalese handwaving* with *obfuscation of reality*.

5.3.3.3 Relationship Building

Two themes fell under the *relationship building* theme from Pollach (2005): *building rapport* and *defining terms*. The themes from the data concern a more positive perspective on the communicative strategies where the institution attempts to be more transparent with their policies. *Building rapport* was created to recognize the patterns in language that would resonate well with students. “Getting the credits you deserve” is a striking example of where such a code would apply. Not only does the perspective switch to second person for the student, but the language also uses strong qualifiers like “deserve” with respect to their achievements. I interpreted “switching perspectives” to not strictly mean switching to first person as she outlines in her textual realization of *relationship building*. Rather, the use of language to switch to first or second was permitted.

Moreover, the *defining terms* theme fits into the context of *relationship building* because the theme concerns how the university assumes the student does not know all the

intricacies of institutional policies, particularly the meaning of common words used to mean something specific in a certain context. The aim of *defining terms* is shared understanding, especially if the language explicitly corrects misconceptions. The theme fits into the idea of "addressing audiences" because the relationship building was commonly set off in the form of a question – e.g., "will my credits transfer?" Note however, the ways in which institutions *define terms* did not only have to take place in the context of frequently asked questions documents.

5.3.3.4 Persuasive Appeals

The last theme from Pollach (2005) spanned two themes from the data, *deviance from common practice* and *exclusivity.* In the theme of *persuasive appeals* as defined, institutions would make comparisons to draw a sense of normalcy or safety. The negation of these were observed in the data. The theme of *deviance from common practice* fit with *persuasive appeals* under "appealing to common practice" as the negation of drawing comparisons. Instead of drawing comparisons, "like other institutions," claims about their articulation agreements were often made. Institutions generally have some policy to handle transfer credit. However, it was more productive to illustrate the cases for institutions who elect not to participate in transfer agreements as a theme.

Exclusivity as a theme seemed loosely connected with appealing to fear, but in the sense that the language instilled doubts of fit. This practice occurs at the level of admissions, not necessarily for transfer credit. The type of language in *exclusivity*, in contrast to building confidence and mitigating fears like in the unapproved sharing of personal data, is almost extraneous information that could break down student confidence. The claims almost entirely refer to the prestige of the institution, such as how

difficult it is to be selected for the privilege to attend. Because of the doubt of fit, such statements might dissuade students from applying to transfer. Therefore, the *exclusivity* theme fit into the negated *persuasive appeals* theme.

5.4 Practical Application of the Narratives to Mitigate Asymmetries

The previous sections discussed the fragmentation and language constructs separately. This section takes the next step and reflects on the narratives combining the two constructs to explore information asymmetries generally. In fact, the narratives are manifestations of the overarching meta-inference of this study. That is, the network analyses and linguistical analyses were so intertwined, that broader narratives of potential asymmetries for transfer students could be created beyond the scope of typical web evaluation rubrics. I illustrate this in Figure 52 by expanding upon Creamer's (2018) template for displaying meta-inferences. Learning from these narratives provides general recommendations for communicating and organizing transfer information to fill the gap in common rubrics for website evaluation, specifically for transfer students.

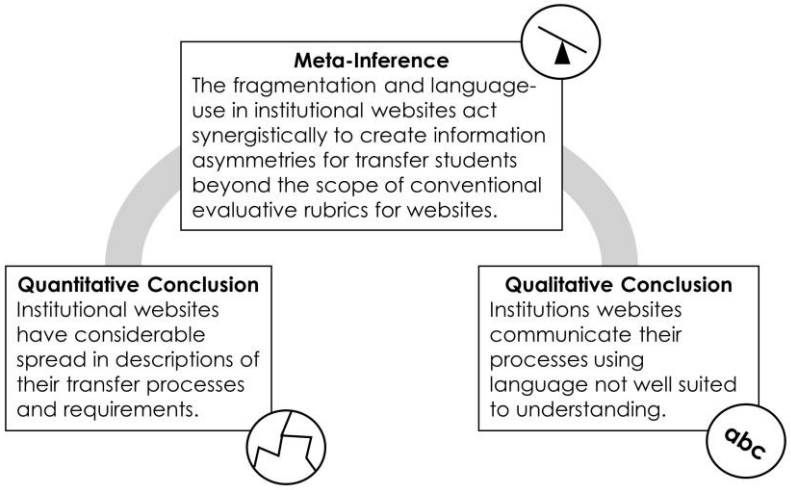


Figure 52. Meta-inference obtained from the previous inferences in the design

A tangible output of this work for practitioners who maintain information systems for institutions or create information for transfer students is a set of common missteps that fragment information or distort it using certain language. This work highlighted six elements of language-use and four elements of network structure to consider when evaluating one's information structure for transfer information. The themes for language-use and fragmentation can be used separately or as complementary schemes to evaluate a subset of pages related to transfer. It would likely be most beneficial to a single institution to map out their structure in detail based on guiding keywords and locate their network elaboration codes in the network. The process provides a mental map of the information structure so a designer can assess which parts of the network are too fragmented or unapproachable from a language perspective. Modifications or further evaluations with students can be done based on different alternatives in the institutional context. The methods go beyond marking items on a rubric like Tarafdar and Zhang's (2005) characteristics of successful website design, which splits success into six constructs: information content, navigation, usability, customization, download speed, and security.

Although the notion of "good" versus "bad" is suggestive as this stage of the work, some ideas to combat the narratives can be drawn. Table 16 summarizes the narratives and what could be done to close holes in information structures and build the necessary structures to support transfer by combining the reflective tools in Appendices D and E. I draw from Wyner et al.'s (2016) Trasnfer Playbook, a report from the Community College Research Center on research-based strategies to support transfer, in aligning my recommendations with web-design and transfer.

Table 16

Summary of narratives and potential solutions

Narratives	Summary	Guiding Questions	Potential Solutions
Missed Opportunities for Support	Essential resources are available but are absent in first contact pages. Organization of pages leads to difficulty in locating information relevant to the user.	- Are resources for transfer students clearly labeled? - Are acronyms, programs, and terminology defined in text? - Will a student understand what a program or initiative is or what its goals are based on the information leading up to its detailed description on a subsequent page? - Does the page explain what information a link will lead them to? - Is there a large body of text that could have a more suitable visual representation?	Visual representations of processes like the application process or the plan of study may enhance the comprehension of its stages. Define terms upfront and explain initiatives by their goals, not necessarily their names. Do not expect students to know about institution-specific initiatives by arcane acronyms or coded language. (Requires greater communication between units to understand what is happening within the institutional ecosystem.) Make sure links to resources specific to transfer students are explicitly linked, including people and centers.
Early Discouraged Fit	Diction used in early pages suggests a fixed mindset, i.e., students must already be excellent and cannot become more than they already are, where students will face difficulty in getting into the institution.	- Does the language used in describing processes have a demeaning connotation or suggest superiority? - Could messaging meant to manage expectations be interpreted as discouraging to the applicant?	Remove any filler phrases that imply a spot at the institution as a privilege for select groups of students or simply flex the institution's prestige. Only do so if you intend to manage expectations. Tell them what they need to know directly without making value judgments about their fit.
Absolving Responsibility	One unit – department, college, or institution – uses language to imply they are not liable for the information. Defers authority down to units with little guidance.	- Does the page unnecessarily link to another page to explain or clarify something that could be done on the current page? - Does the page identify differences in policies at subordinate units but does not elaborate on what the differences are? - Does the page encourage the reader to another page or policy but links to a more general page? Does it guide the reader on where to look?	(For both Absolving Responsibility and Subtle Differences and Unfinished Bridges) Only link to other pages when information is not summarizable on the current page. If the information is not summarizable – do *not* link to general pages. Collect any differentiating features for admission or transfer in one spot. Ideally should be updated semesterly. (Requires greater communication between units to understand what is happening within the institutional ecosystem.

Narratives	Summary	Guiding Questions	Potential Solutions
Subtle Differences and Unfinished Bridges	Different units contradict one another in their information structures, making it difficult to understand which source is correct.	- Does the page contain information that agrees with similar information at different levels in the organization? - Is it clear who can be contacted for issues in understanding transfer information?	(For both Absolving Responsibility and Subtle Differences and Unfinished Bridges) Only link to other pages when information is not summarizable on the current page. If the information is not summarizable – do *not* link to general pages. Collect any differentiating features for admission or transfer in one spot. Ideally should be updated semesterly. (Requires greater communication between units to understand what is happening within the institutional ecosystem.
Transferring versus Applying Credit	The use of words like transfer or apply are muddied through academic or institution-specific jargon.	- Does the language used in describing how courses apply and transfer clearly articulate the differences in the two outcomes? - Does the page contain academic jargon that could be replaced with more student-friendly terms?	Visually represent the flow of credits through the system through graphical communication in simple terms. Locate jargon like “distribution requirements” and replace it with language more familiar to students. Define such terms upfront.
Making Connections	The pages focus on a student perspective by not privileging the intuitional perspective.	- Does the language used have a high level of narrativity? Does the page use language a student might use? - Does the page make it clear what level of agency students have at different points in the transfer process?	Define terms upfront and describe initiatives by their goals. Use language to resonate with students.

More work will need to be done to understand students' perspectives, but the potential solutions described in Table 16 offer some resolutions based on the results of this research design. The suggestions align with general recommendations for website design. For example, Kent and Taylor (1998) discuss principles to establish a dialogic relationship with website users: (1) staff should be available to respond to concerns by users, (2) the information on the site benefits the user and not just the organization, (3) the design should motivate users to return to the site, (4) the site should be easily navigable, and (5) sites should contain clearly marked links to return to the site itself. The principles align well with the intent of the suggestions provided in this discussion, but urging "navigability" can potentially be too broad of an idea. Accordingly, the suggestions here are specifically targeted for transfer information.

It should be stressed that the recommendations are not just indicators from a rubric or set of principles. Most evaluation tools for websites are rubrics with specific indicators to increase interrater reliability and reduce subjectivity in ratings. Such rubrics are useful for standardizing website reviews but can obscure elements raised in this study. For example, Pinto et al. (2009, p. 274) used a rubric with 70 indicators, three of which related to navigability: "(1) contents menu always visible on all the pages and in the same place, (2) pages use consistent terminology (i.e., the same term is used in every section), (3) navigation buttons make it possible to go up to a more generic level." Similarly, Hasan (2013) had dichotomous indicators for when a problem was identified in a website based on a set of usability themes wherein navigation had five problem areas: weak navigation support, misleading links, broken links, orphan pages, and ineffective internal search. The constructs in the rubrics tend to be more concerned with the technical

efficacy of the website than the logical consequences of language or policy embedded in its page.

This dissertation explicitly analyzed the flow of information, showing it to be just as crucial to consider as the underlying technical features of the website – creating information asymmetries for the user all the same. Other metrics to evaluate usability from a user's perspective employ a questionnaire like the classic System Usability Scale (Brooke, 1996), which consolidates the perceptions of usability into a single composite score from 10 items. However, using either the rubrics or scales in isolation paints an incomplete picture of the information design in the website's context. My work highlights the need for a mixed and situated perspective to website evaluation - with and without users – by showing the fragmentation between the pages and the language content of the pages themselves to uncover missteps in their designs.

5.5 Methodological Contributions

Engineering education has made use of mixed methods research designs; however, current implementations could be improved. Kajfez and Creamer (2014) identify that the current weaknesses in engineering education's use of mixed methods lie in framing mixed research questions and clearly stating the rationale for mixing. This dissertation was motivated, in part, to exemplify the characteristics of a fully integrated mixed methods design – as Kajfez and Creamer's (2014) critiques are accounted for in the design. Using Creamer's (2018a) tabular method of describing mixed methods designs, I was able to communicate the purpose of my design, the priority of the strands, and research procedures. Moreover, I visualized the necessity for mixing in my research questions using a blended approach (Plano Clark & Badiee, 2010) to communicate how

the analyses would interact with one another. As of writing, there are no *explicitly labeled* fully integrated mixed methods studies published in the *Journal of Engineering Education* or the *European Journal of Engineering Education* – excluding a piece outlining examples of mixing during analysis (Reeping, Taylor, Knight, & Edwards, 2019). The only example in ASEE's paper repository was conducted by Davis et al. (2018) to characterize students' intercultural development in a global engineering program. Accordingly, my dissertation moves toward a fully integrated approach to mixed methods research in the field of engineering education.

A methodological push in this work is the emphasis on a literal interpretation of "mixed methods" – mixing methods, not data. Creamer (2018c) notes that QUAN data + QUAL data does not necessarily constitute a mixed methods study, and we do not need to limit ourselves to only integrating at the inferences stage. Conventional approaches to mixed methods position mixing in terms of data and drawing inferences, however (Reeping et al., 2019). Creswell (2014), in describing the tenants set forth by Johnson, Onwuegbuzie, and Turner (2007), describes a core characteristic of mixed methods as the collection of both qualitative and quantitative data. This dissertation challenges the axiom of foundational mixed methods inquiry that necessitates the collection of the two types of data. Moreover, it also interrogates the premise of what can be deemed "mixed" by only using one primary strand of data, and an archival strand at that. The transgression against typical typologies of mixed methods designs aims to address the concern articulated by Tashakkori and Teddlie (2010), that procedures to integrate qualitative and quantitative inferences are not given much attention. Creamer (2018a) argues that the pre-specified, cookbook approach to mixed methods designs may not necessarily be useful and goes as

far as claiming it also may be damaging to expand our repertoire in how we decide to mix. The "little quant here, little qual there" approach to mixed methods – collecting both types of data and integrating at the end or conventional sequential designs – does not elucidate the process of mixing, rather it is undermined (Reeping, Taylor, Knight, & Edwards, 2019; Creamer, 2018c; Bazeley, 2018). No single aggregate template design like sequential explanatory or concurrent triangulation (Rauscher & Greenfield, 2009) can capture integration faithfully because of the sheer number of dimensions through which one can compare and consolidate.

5.5.1 Pinpointing the Design in Existing Typologies

Mixed methods designs in engineering education are typically grounded in some existing formula-based design from the literature. However, this dissertation demonstrated that relying on mixed methods design typologies is not essential provided the work is done with a high degree of methodological transparency. I framed my design in terms of the analyses to communicate my study as having mixed priority (Creamer, 2018a). I drew inspiration from the mixing flowchart in Jang, McDougall, Pollon, Herbert, and Russel (2008) which Creamer (2018a) highlights in her text on fully integrated mixed methods research. Rather than framing the mixing from the perspective of data collection, analytical procedures are given priority in what defines the design's mixing approaches. Moreover, the mixing throughout the design can be highlighted, from data collection to drawing inferences. This work used all of Creamer's (2018a) mixing described in her text, which were better articulated through the mixing flowchart rather than the Morse notational system. Moreover, placing the mixed strand in the middle of

the two strands, representing the data and inferences made on the fragmentation and language constructs alone, aided in communicating the process of weaving the data, analyses, and inferences into a cohesive set of conclusions toward a mixed priority design.

The approach also illustrated the weakness of conventional typologies describing mixed methods designs that aggregate too finely, especially in terms of integration. The design was sequential in its sampling but also embedded in its analyses. Only one strand of data exists, but the typologies like those of Creswell and Plano Clark (2018) and Teddlie and Tashakkori (2009) include at least two strands. The difficulty is further exacerbated by the lack of a way to describe a mixed strand throughout a design in the typologies appearing in Creswell and Plano Clark (2018) and Creswell (2014), which Creamer (2018) argues in her text. More troubling, however, is the black box the typologies append to each design, a nebulous stage that goes by several names – integration, interpretation, compare, relate. The interactive approach to design (Maxwell, 2013; Maxwell & Loomis, 2003), which moves away from typologies to instead seek alignment along the design's goals, research questions, conceptual framework, methods, and validity, does not help either as it does not aid the researcher in making mixing decisions. Creswell and Plano Clark (2018) contend that integration is the "centerpiece of mixed methods research" (p. 220) but the literature has not done well in describing its processes. The lack of clarity is perhaps evidenced by the fact many researchers have considerable difficulty in linking their analyses in narrative form (Bryman, 2007). This study demonstrated how integration can be achieved multiple times across the design, especially in forming integrated narratives.

5.5.2 Formative Joint Displays to Manage Integration

Because engineering education has not made explicit use fully integrated mixed methods designs, there are few examples showing how to manage the integration of the various strands throughout the research process. The design in this work had four explicit points of comparison within the scope of the usual black box of "compare or related" appended to the end of several mixed methods designs alone: (1) comparing internal qualitative themes to external qualitative themes (language-based to communicative strategies), (2) integrating qualitative priority themes with quantitative priority themes (language-based and fragmentation), (3) comparing the integrated themes to the quantitative analyses (language-based and fragmentation to cluster analysis) results, and (4) comparing the integrated themes to the results of the data transformation at the beginning of the design (language-based and fragmentation to the derived networks). The multiple comparisons elicited narratives that connected across the four integration points, which was difficult to pinpoint in the typologies and find methods to manage divergence between the strands.

Visual methods aided in creating the integration points, not only at the inference stage, but throughout the design. Few pieces in the literature have discussed the use of visual approaches to advance integrated analyses (Onwuegbuzie & Dickinson, 2008). Recent work has provided a push toward the use of joint displays, both summative and formative, to serve as an explicit mixing point in the design (Guetterman, Creswell, & Kuckartz, 2015; Edwards & Creamer, 2019; Creamer & Edwards, 2019). This dissertation made use of formative joint displays, visualizations integrating quantitative and qualitative data/inferences for the purpose of initiating the next stage of analysis, at

each stage of the design – in some cases, several were used. Given how instrumental the joint displays were in managing the various strands of data and inferences, engineering education can make use of the formative joint displays in their own mixed methods research designs.

5.5.3 Fully Integrated Mixed Methods from One Main Strand

Although the main data, policies and webpages, for this dissertation were qualitative on the surface, I argue that this study was *still* a mixed methods design. The design can be justified through Creamer's (2018a) characterization of mixed methods as inquiry with an inductive and deductive component. With the non-data dependent definition, the assertion by Morse (2010) and Small (2011) that two qualitative strands could constitute a mixed methods study provided there are deductive and inductive elements was satisfied. I contend the mixing potential was enabled by a non-trivial data transformation.

Engineering education often makes use of data transformation to quantitize qualitative results in the form of counting. However, this dissertation makes a contribution to thinking about other ways to transform data into a form suitable for analysis. The data transformation in this work provided a non-trivial example of quantitization. Rather than focusing on frequency, this transformation elaborated on structure. Interrelations between other objects is a fundamental mathematical property data can have. Mapping out the interrelations provided a mathematical description of the data, encoded as a series of ordered pairs and objects but also represented visually as a network. Nooraie et al. (2018) comment on the mixing potential of social network

analysis because of the intrinsic properties the unit of analysis contains. In fact, deriving a network from qualitative data was a process that illustrates how data can be represented in different forms – or how features of the data can be extracted and analyzed as a new strand. Uncovering the latent structure of the data provided an opportunity to perform visual analyses, and if there were enough observations, calculate different measures from the network. In the case of this work, there were thirty-eight unique networks of varying sizes that could be compared.

The derived strand of data provided a means to create a fully integrated mixed methods design without needing to collect a different quantitative strand of data. The rich derived quantitative strand of data illustrated how the mixing analysis strategy can cast one set of data in a completely different light, only by revealing dependencies among individual observations. Analyzing dependencies were particularly crucial to addressing the driving research questions because the constructs of language and fragmentation interacted, specifically in the case of fragmentation being caused by language. The data transformation elicited the necessary structures to form fully integrated narratives through a cross-case comparison, highlighting the mixing potential of parsing features of data into constituent parts. However, it must be noted that the parsing is *not* reductive in the sense of the following perspective: "Problems to be solved were first 'cut down to size;' that is, reduced by analysis to a set of simpler problems." (Ackoff, 1974, pp. 9-10). Analyzing the networks separately can potentially be seen as 'cutting the problem down to size,' but they were not created to make analysis easier. Rather, the approach can be described as expansionism: "Expansionism is another way of viewing things, a way that is different from, but compatible with, reductionism. It turns attention from ultimate elements to

wholes with interrelated parts, to systems." (Ackoff, 1974, p. 12). The networks highlight interrelation in the data itself, noting that the data are part of a greater system that itself can only be partially represented. Weaving the extracted representations back into the data in the narratives ensured the information systems remained treated as a whole.

5.6 Future Research

My dissertation focused on available data to understand how information contained on and across institutional websites can be fragmented in structure or skewed using language. Although I adopted the perspective of a user seeking information in collecting and organizing data, the actual perspectives of students were absent. An avenue for future research concerns the usability of the websites and the findability of certain pieces of information from students' perspectives. A similar design has been conducted with locating information related to the curriculum, course assignments, and conditions for degree completion (Toleva-Stoimenova & Christozov, 2013) – which can be expanded to other subpopulations like graduate student information sources. However, outcome measures were mapped to a questionnaire on efficiency, effectiveness, and user satisfaction – the journey students took through the network was not tracked in their design.

Repeating a similar design in future research would involve generating the networks from the students' perspectives rather than the researchers using keywords and guiding questions to structure the paths. The alternative data collection procedure would capture how students navigate through the site, allowing me to track how searches are done from the students' perspectives. Charting the students' trajectories through the information structures supplemented by a think-aloud protocol during the navigation

would be an illuminating exercise but was beyond the scope of this work. Next steps could involve working with students searching for transfer information and examining how their searching behaviors connect with the themes observed in this work.

Other potential future work involves testing the fragmentation and language themes with a larger set of policies and websites. For instance, an existing popular sampling frame for institutions in engineering education is the Multiple-Institution Database for Investigating Engineering Longitudinal Development (MIDFIELD), which is a large scale data-sharing agreement between several U.S. institutions (MIDFIELD, 2019; Ohland, Zhang, Thorndyke, & Anderson, 2004). Applying the themes to the websites of the institutions in the database would provide another layer of context for studies about transfer, particularly in studies concerned with the impact of policies and the design of information systems. For example, the relationship between transfer student retention or graduation rates with the information asymmetries in their transfer processes could be studied.

Larger sample sizes would also allow for comprehensive text analyses that this study could not reasonably defend because of its design. A corpus of text samples should contain statistically independent elements. The design used in this work explicitly described the text samples as statistically dependent through the network representation, making the defense for treating them as independent less sensible (Snijders, 2011). Taking multiple webpages from the network would be like taking sections from multiple chapters in a book – which are narratively dependent on each other. However, it could be possible to argue independence by defining the source at the unit level rather the institutional level because the texts would be written by different authors. Such a process

would be like recognizing an issue of a journal being composed of articles written by different people – so the "chapters" are in fact not necessarily related to each other. With a substantially larger sample of institutions and the refined level of analysis to the unit instead of the institution, Coh-Metrix (McNamara, Graesser, McCarthy, & Cai, 2014), a computational tool developed to measure the coherence of a text across multiple indices, could be used to quantitatively evaluate the semantic properties of webpages and policies. The tool allows the user to run analyses across whatever size sample is computationally feasible. The tool is currently on its third version and boasts 106 indices ranging from simple descriptive statistics such as the number of words, letters, and paragraphs, for example, to novel measures of what the authors of the tool call text easability. Future work could serve to analyze the latent semantical structures at work in the policies of a large portion of universities.

5.7 Final Conclusions

Given the growing work documenting difficulties faced by engineering students in the transfer process, attention needed to be paid to the policies and information structures outlining the process. This dissertation characterized how information is distorted through language and fragmented in structure for transfer students in engineering. Without the structures to support the transition between the two endpoints, information asymmetries will continue to place students in a challenging position.

My dissertation focused on one information source, institutional websites. I used network and cluster analyses to find four types of potential information structures – centralized expansive, linear, branched, and mixed – based on two variables, adjusted centrality and hierarchy, to inform sampling. The networks outlined pathways students

could take in top-down searches of an institutional website. I explored a subset of 16 institutions and identified four themes related to fragmentation (unlinked divergence, progressive disclosure, lack of uniformity, and neighborhood linking) and six themes related to language (hedging transferability and applicability, legalese handwaving, building rapport, exclusivity, deviance from common practice, and defining terms).

I tied the two sets of themes to existing typologies. First, I related both sets to information asymmetries transfer students commonly experience with examples across the different student concerns apparent in the data. Second, I found my critical linguistics lens for analyzing the language used in the webpages converged with a typology of communicative strategies used in privacy policies. The integration implied institutions were talking like private companies trying to write potentially deceitful privacy policies.

Using a fully integrated mixed methods design, I combined themes of fragmentation of webpages related to transfer with themes of language-use on the webpages to create six narratives of how asymmetries are created for transfer students. Extreme cases of institutions exhibiting qualities that might cause asymmetries were highlighted. I offered recommendations for each of the narratives by grounding the potential solutions in existing web design rubrics and guidelines. However, the recommendations will need to be tested with students in future work.

This work characterized the information design for transfer students as a messy web of loosely connected structures with language that complicates understanding. Although the concept of perfect information in the market for transfer credits is practically infeasible, as in most real markets, it is necessary to create information

designs that communicate what students need to know – perhaps then we can do a bit better than “believing” information to be correct.

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APPENDIX A

Forming the Composite Variable, Adjusted Centrality

Having 38 institutions and three variables – hierarchy, centrality, and nonlinear – made it challenging to find meaningful clusters (note: the clustering process is described subsequently). In addition, "nonlinear" was defined as a dichotomous variable, which is generally regarded to be incompatible with *K*-means, a common clustering methodology (Chaturvedi, Green, & Carroll, 2001). Initial attempts to run clustering algorithms as described in the next section failed to produce useful clusters to advance analyses in the next stage of the design. Other variables were considered, like the graph's diameter or the largest distance between any pair of vertices, but alternatives often correlated too strongly with one another to be useful.

It was determined that combining nonlinear with the centrality variable solved two problems with my approach. The first problem was dimensionality. Forming a composite variable retained more appropriate dimensionality while still adding useful information. The second problem was conceptual. Fragmentation was operationalized to convey a sense of spread and divergence, so the linearity bias needed to be corrected – otherwise the values of centrality did not correspond to the operationalization. Centrality is strictly positive by definition. Therefore, nonlinear could be multiplied by centrality without fundamentally changing what it meant for this work. The only difference between the unadjusted centrality and its new value was to account for the biasing linear networks. The choice of variables was deduced by identifying an issue in the definition of one variable as it related to the operationalization of a construct and correcting it to enable consistent comparisons in later analyses.

APPENDIX B

Detailed Description of K-Means and PAM

K-means places *K* random points at the beginning of the algorithm to serve as the centers of the clusters, which are then moved throughout the optimization process to find the best groupings. Because *K*-means makes decisions based on local information to optimize its objective function, it may only converge to a local minimum– i.e., not the "best" solution but a "good" one. It is possible for the algorithm to converge to a global minimum, the "best" solution, if the clusters are well dispersed (Meilă, 2006). One thousand random starting points for the centers were used to avoid weaker solutions.

PAM is a similar technique to *K*-means, but it uses data points as the centers – the medoids – rather than random initialization points that most likely do not correspond to any of the observed data (Kaufman & Rousseeuw, 2005). The algorithm uses sums of pairwise dissimilarities rather than optimizing the sum of squares with respect to the cluster centers, making PAM less sensitive to outliers than *K*-means (Jin & Han, 2011). An inconvenient limitation of the *K*-means and PAM approaches is that the optimal value of *K* is not defined by a formula (Milligan & Cooper, 1987) nor is it known a priori for many applications, even though *K* is a crucial parameter of the algorithm. Although no formula exists, several indices for *K* have been proposed (Desgraupes, 2017). In this case, two specific indices were used to provide alternative solutions to consider for assessing which clustering to choose. First, the Elbow Method was used to examine the within-cluster sum of squares. The goal of the method was to find the point at which additional clusters do not explain a satisfactory additional piece of the variance, or reduce the within sum of squares, which then provides a suggested value of *K* (Kodinariya & Makwana,

2013). The value of *K* is a heuristic, so potential *K*'s around the point of diminishing returns in the within sum of squares should be checked for practical interpretability and compared with other indices.

Accordingly, the Silhouette Method was also used to examine the validity of the clusters with respect to consistency (Rousseeuw, 1987). A peak in the maximum average silhouette value $\overline{S(\iota)}$ is desirable (Kodinariya & Makwana, 2013). More specifically, the silhouette width is calculated as

$$S(i) = \frac{b_i - a_i}{\max(a_i, b_i)}$$

where a_i is the mean distance from observation i to all the other observations in the cluster and b_i is the smallest mean distance from observation *i* to the observations in any other cluster (Brock, Pihur, Datta, & Datta, 2018).

APPENDIX C

Formative Joint Displays

The following formative joint displays are the tools I used to ensure integration at each stage of the design. Some were suitable to be included in the main body of the text, but other contained too many details and obscured the message. In the spirit of sharing the details of the research process, I offer the complete formative joint displays in this appendix.

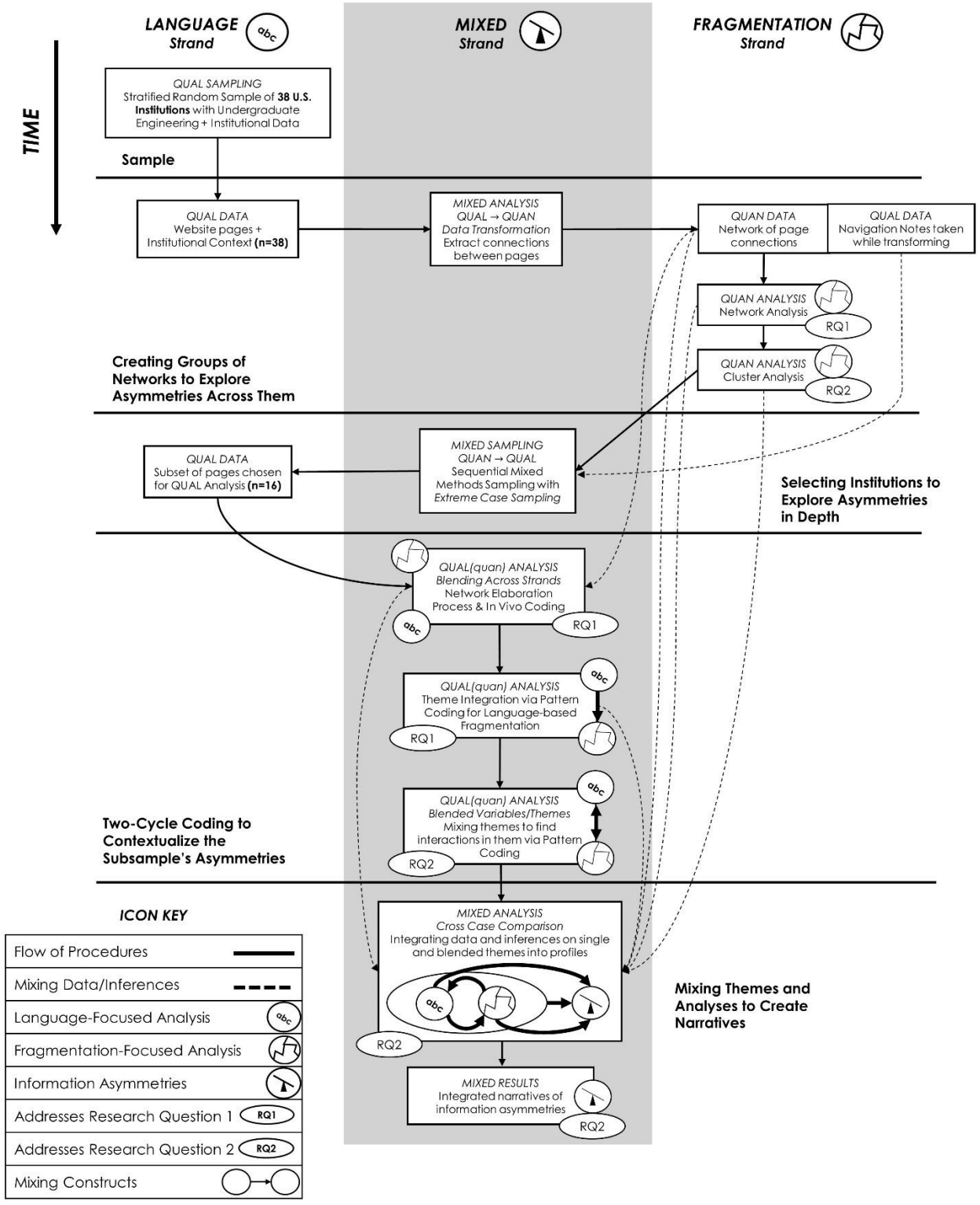

Figure C.1. Diagram of analyses and where mixing occurs between the two strands throughout the design (companion to Figure 7)

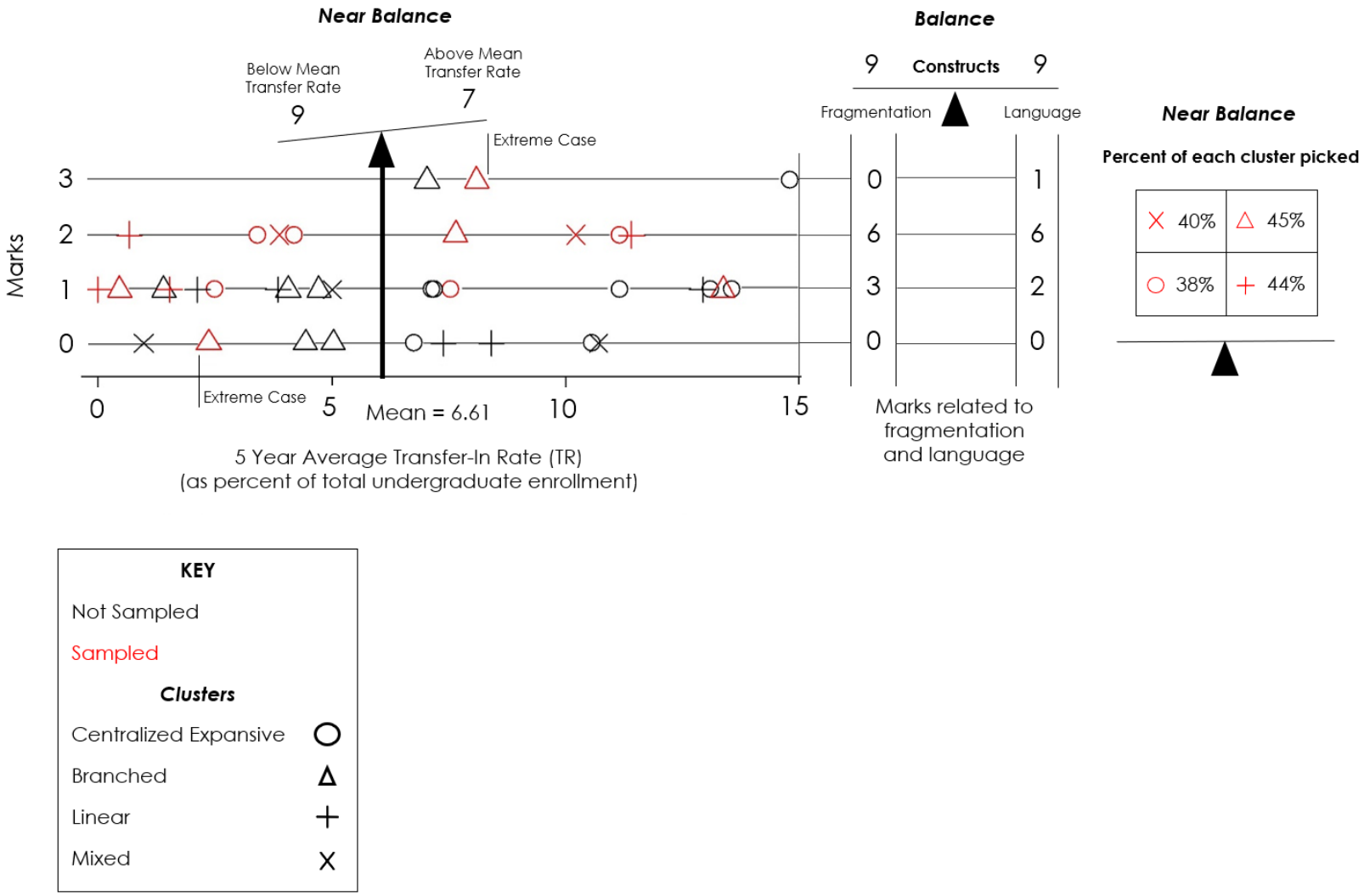

Figure C.2. Sequential Mixed Methods Sampling Formative Joint Display (companion to Figure 17)

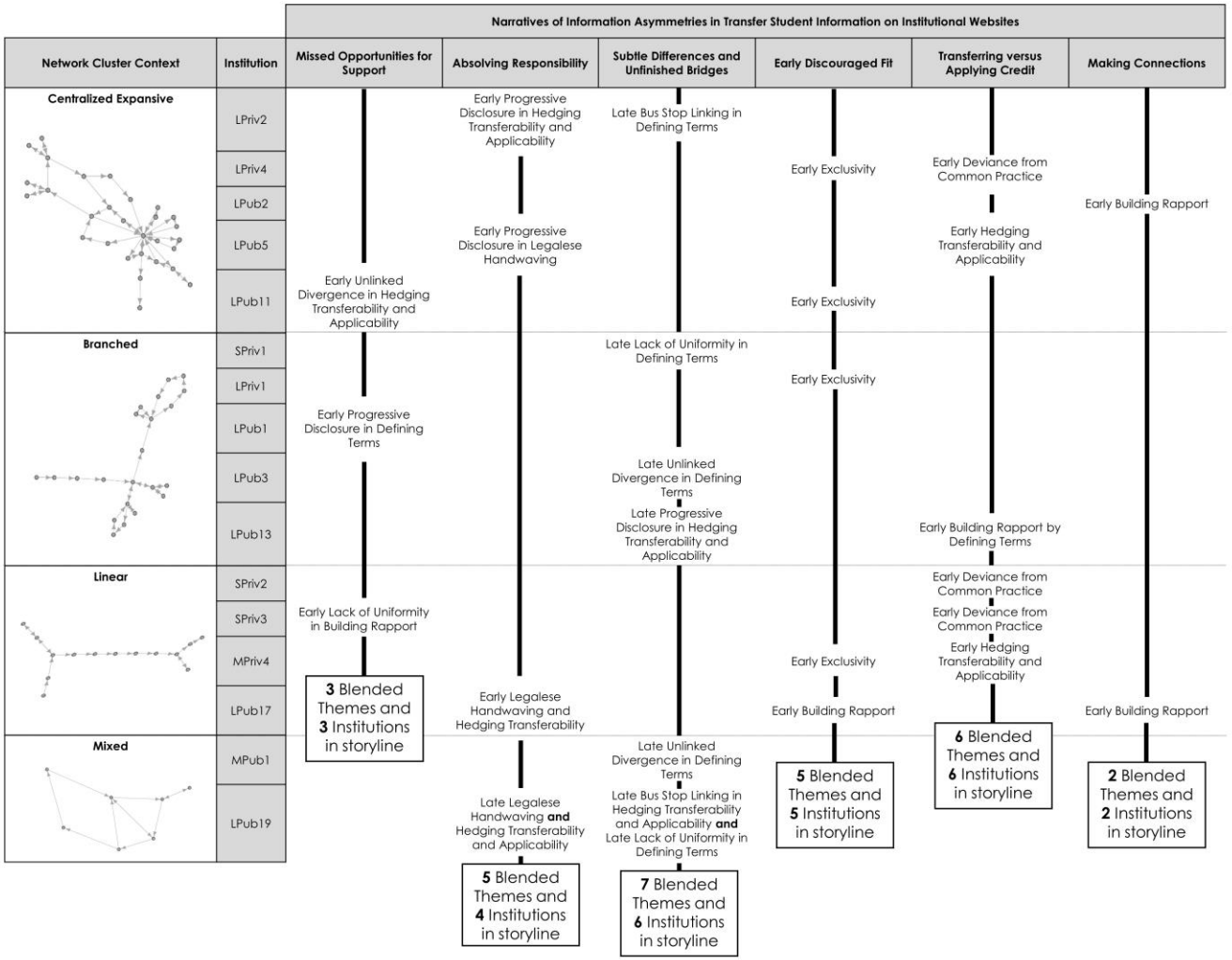

Figure C.3. Formative Joint Display to show the narratives' coverage of institutions and clusters (companion to Figure 50)

APPENDIX D

Reflective Tool for Fragmentation Themes

This reflective tool of guiding questions is intended to help developers and content writers think through the ways in which information could be dispersed. Each fragmentation theme has a set of guiding questions to prompt the evaluation of the webpages to avoid unnecessary asymmetries.

Table D.1

Reflecting upon organization in web-based information

Theme	Summary	Reflective Questions
Unlinked Divergence	This type of organization may obscure details for users or prompt them to look for information across units without much direction.	- Does the page make it clear to the user what their next steps need to be given the information on the page? - Does the page link to all the documents it references?
Progressive Disclosure	Burying information that should be disclosed earlier invites the potential for asymmetries.	- Are details disclosed later in a set of pages that misalign with claims made in previous pages? Map out major claims by page to follow the causal reasoning. - Are details of policies misleading in early pages? - Are definitions of institution-specific or transfer-specific words defined in-text?
Neighborhood Linking	Linking to a more general page or larger document technologically makes sense to avoid broken links but doing so without guiding the user on where to look can cause unnecessary frustration and information asymmetries.	- Is the content summarizable on this page? - Are there instructions on where to find the unsummarizable content in the more general document?
Lack of Uniformity	Being consistent in linking shows a level of transparency and content management to mitigate issues with information gaps.	- Do you link to all possible pages or documents possible? (e.g., are all articulation agreements available to view?) - Is content presented with equal weight as appropriate? (e.g., in describing courses, are all syllabi or course descriptions available online?)

APPENDIX E

Reflective Tool for Language Themes

This reflective tool of guiding questions is intended to help developers and content writers think through the ways in which information is communicated. Each language theme has a set of guiding questions to prompt the evaluation of the webpages to avoid unnecessary asymmetries.

Table E.1

Reflecting upon language-use in web-based information

Theme related to Language	Summary	Reflective Questions
Hedging Transferability and Applicability	Hedging is natural, especially when discussing the idea of transfer credits. However, there are ways to be more transparent.	- Are resources for transfer students clearly labeled? - Is there a large body of text that could have a more suitable visual representation? - Does the language used in describing how courses apply and transfer clearly articulate the differences in the two outcomes (transfer vs. apply)
Legalese Handwaving	In a highly hierarchical system like higher education, deference to units is common. Making exceptions between units can be made clearer.	- Does the page contain academic jargon that could be replaced with more student-friendly terms? - Does the page identify differences in policies at subordinate units but does not elaborate on what the differences are? - Is it clear who can be contacted for issues in understanding transfer information?
Building Rapport	Engaging students with language they might be more familiar with is an easy way to increase the clarity of the text.	- Does the language used have a high level of narrativity? Does it use language a student might use? - Does the page make it clear what level of agency students have at different points in the transfer process?
Defining Terms	Defining terms with your audience is fundamental to being transparent.	- Do you define acronyms, programs, and terminology in text? - Will a student understand what a program or initiative is or what its goals are based on the information leading up to its detailed description on a subsequent page? - Does the page explain what information a link will lead them to?
Deviance from Common Practice	When units disagree with more general policies, making this exception abundantly clear is paramount.	- Does the page contain information that agrees with similar information at different levels in the organization? Or is it clear at all levels of the organization that there that the unit in question is a special case?
Exclusivity	Flexing institutional prestige is filler and distracts from understanding the key points of an informational page.	- Does the language used in describing processes have a demeaning connotation or suggest superiority? - Could messaging meant to manage expectations be interpreted as discouraging to the applicant?