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E-Quality: An Analysis of Digital Equity Discourse and Co-Production in the Era of COVID-19

Kelsey E. Edmond

E-QUALITY: AN ANALYSIS OF DIGITAL EQUITY DISCOURSE

AND CO-PRODUCTION IN THE ERA OF COVID-19

A Dissertation Presented

by

KELSEY E. EDMOND

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Approved as to style and content by:

_____
Michael Ahn, Associate Professor
Chairperson of Committee

_____
Aroon Manoharan, Associate Professor
Member

_____
Evan Stewart, Assistant Professor
Member

_____
Heather MacIndoe, Program Director
Public Policy Program

_____
Christian Weller, Chair
Department of Public Policy and Public Affairs

ABSTRACT

E-QUALITY: AN ANALYSIS OF DIGITAL EQUITIY DISCOURSE

AND CO-PRODUCTION IN THE ERA OF COVID-19

May 2023

Kelsey E. Edmond, B.Sc., University of Delaware
M.P.A., University of Delaware
M.S., University of Massachusetts Boston
Ph.D., University of Massachusetts Boston

Directed by Professor Michael Ahn

The digital divide refers to the social stratification due to an unequal ability to access, adapt, and create knowledge via information and communication technologies (Andreasson, 2015). Digitally disadvantaged individuals have inadequate access to services and resources, exacerbating existing vulnerabilities. The COVID-19 pandemic instigated a new model of digital equity policymaking that leverages co-production between numerous actors. As citizens faced new financial and community constraints and governments reached administrative capacities, both the digital divide and the policymaking process evolved.

This inductive study explores how digital equity policymaking shifted to a co-production model (Ostrom, 1996) amid the pandemic. Using a sequential mixed-methods approach, this research considers the interconnections of digital equity, co-production, and crisis policymaking. Digital divide discourse was first examined through a large-scale text analysis of verified tweets. Methods of investigation include natural language processing techniques, regression modeling, and unsupervised machine learning topic modeling. Descriptive and inferential analyses demonstrate a statistically significant increase in policy discourse as well as a diversification of topics, though suggest a disconnect between outputs and on-the-ground needs.

Next, semi-structured interviews were conducted with City of Boston policymakers, and the resulting data was open-coded and axially coded to reveal insights into the design and implementation of co-productive solutions. Additionally, interviews detail what conditions contribute to successful outcomes while working with limited time, knowledge, and resources. Analyses reveal that co-productive behavior is critical to coping with the effects of the pandemic and highlight the influential role of community-based organizations. Furthermore, the study provides contextual information on co-production prerequisites that were previously understood, and sheds light on interpersonal conditions that Ostrom does not address. This dissertation contributes to the developing body of scholarly literature on the digital divide in the era of COVID-19. This case study also advances theoretical knowledge, offers methodological innovations, and provides concrete policy recommendations to promote more egalitarian digital use.

DEDICATION

For my sisters

At times the world may seem an unfriendly and sinister place, but believe that there is much more good in it than bad. All you have to do is look hard enough, and what might seem to be a series of unfortunate events may, in fact, be the first steps of a journey.

*- **Lemony Snicket***

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would not be achievable without the exceptional education I received in both my bachelor's

program in Organizational and Community Leadership and master's degree in Public

Administration. Those experiences gave me the confidence to realize that a PhD was even in

the realm of possibility. While working at UD full-time in Development and Alumni

Relations, the support I received from my supervisor, team, and colleagues made it possible

logistically to pursue this next step.

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meal with Dr. Ahn at 산촌 본점 (SanChon Temple) on the other side of the world in Seoul,

South Korea is where this journey began. Fighting through our jetlag, we established a

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first-ever campus visit, I knew we'd be a good match. Your continuous encouragement to

pursue opportunities and publish was the reassurance I needed to realize that my ideas are worthy of being shared.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1: INTRODUCTION

The world has a long history of dealing with social inequities offline, and it is no surprise that society would face the same challenges digitally. As the opportunities of the information society rise, so do the consequences for those who are unable to take advantage of them. Despite the internet becoming the fastest-growing technology in human history, emerging digital infrastructure (or lack thereof) found in the home, school, and workplace create a resource disparity between those who can afford access and those who cannot. This inequality is known as the digital divide. With technology continually advancing, the issue of the digital divide cannot be ignored.

Access to information and communication technologies (ICTs) is more critical than ever as countries across the globe are increasingly seizing opportunities of a digital society. The world is collectively at a pivotal moment in history where societies are transitioning from a resource-based to a knowledge-based economy. On top of that, the COVID-19 pandemic accelerated a sudden shift to online access for many essential services, further accentuating the reliance on internet access as integral to participation in society. Being digitally connected has become the newest requirement to truly participate and contribute to humanity.

Figure 1.1 depicts that in 2018 the U.S. Census Bureau and the American Community Survey estimate that at best, 92% of American households had at least one type of computer

device, and 85% had a broadband internet subscription (Martin, 2021). However, those

percentages drastically reduce for low-income individuals, racial minorities, older adults, less

educated people, and other marginalized populations. Numerous studies have found that

access to ICTs has a significant impact on the ability to acquire other social resources such as

education, employment, financial support, political expression, and social position

(Warschauer, 2004). Thus, skewed technology usage leaves select groups of people in the

digital dark ages and reinforces existing social inequalities. If an information-age trajectory is

undeniably the future, it is crucially important that any societal advancements are done with

equitable values at the forefront.

Figure 1.1: Percentage of Households with Computer and Internet Use, 1984-2018
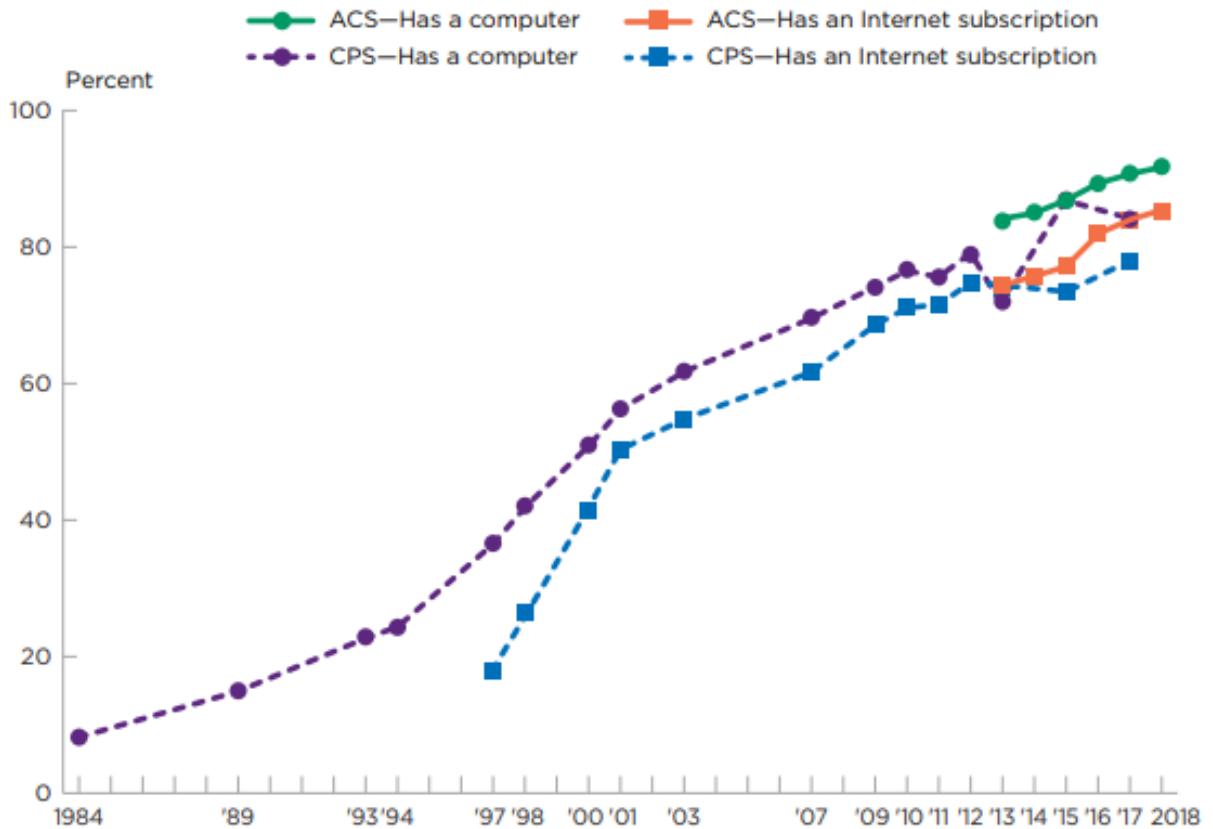
As technology continues to develop and infiltrate society, it is imperative that accessibility issues are addressed immediately. Otherwise, future innovations will exacerbate current divides. This study is uniquely situated during a time when the United States is battling multiple crises – public health, systemic racism, misinformation, and radically divisive political polarization. The opportunity to analyze the digital inequities at such a crucial point in history is an asset for unearthing the mechanisms that are truly driving the divide and effective solutions.

3

Operationalization of the Digital Divide

First coined in 1995, the digital divide refers to the social stratification due to an unequal ability to access, adapt, and create knowledge via the use of information and communication technologies (ICTs) (Andreasson, 2015). Other scholars understand it as "the disparities in the structure of access to and use of ICTs as well as the ways in which longstanding social inequalities shape beliefs and expectations regarding ICTs and its impact on life chances" (Kvasny, 2006, p. 160). Gaps in usage and access have been present since the invention of ICTs, but the rapid development of the information society has accentuated their importance. Inadequate access to digital technologies implies limited access to services, resources, and information – and their potential benefits.

Digital exclusion means that disenfranchised communities, families, and individuals are left further behind without access to online resources for education, communication, and a gateway to a better quality of life. While the phrase implies that the digital divide is a technical issue, in reality it a social problem of utmost importance. Generally, research has found that digital inequalities tend to mirror existing social inequalities in terms of socioeconomic status, education, gender, age, geographic location, employment status, and race (Robinson et al., 2015). "Digital inequalities" are referred to in the plural form to acknowledge the plurality, multi-dimensionality and complexity of social stratification in the context of digital technology. The digital divide is a fundamental equity issue, and mitigating it is essential to thriving economic and societal futures. Closing the divide is a contributing element to breaking the cycle of poverty.

History of Digital Divide

A distinction has emerged organically over more than two decades of research on digital inequalities which manifests in three well-defined levels. The first-level digital divide describes unequal access to the internet. In this early use of the term, the digital divide referred to "the gap between those who do and those who do not have access to new forms of information technology" (Van Dijk, 2006, p. 221–222). This type of research often relied on large scale surveys to demonstrate differences in internet access among different population segments.

Attewell (2001) is widely cited as the first to suggest that there are two digital divides: computer access and computer use. Access without the digital skill to use these resources represents an even more significant barrier. The term second-level digital divide was coined by Hargittai (2002) to differentiate binary inequalities in internet access (first-level) from inequalities in skills and uses (second-level). Research on the second-level divide, that can be further separated into quantity versus quality, has focused strongly on individuals' online activities for recreational purposes and the way in which they engage with and produce content. First and second-level digital divides combine to create another gap – the knowledge divide.

The concept of the third-level divide is a natural extension of the first- and second-levels, which refers to differences in gains from internet use, particularly where access and patterns are roughly similar (Scheerder et al., 2017). In other words, third-level divides relate to gaps in individuals' capacities to translate their skills and accesses into favorable and tangible offline outcomes, with respect to economic, social, political, or cultural terms.

Outcomes are measured by survey questions that ask situations such as if the respondent saved money by using the internet, if online information helped improve their health (Blank and Lutz, 2018), or if digital technologies have increased their ability to connect with friends and family (Van Deursen and Helsper, 2015). Van Dijk (2005) elaborates on how the third-level divide is in essence a feedback loop. Individuals who can leverage digital benefits to strengthen their social position profit disproportionally from internet use and exacerbate existing social inequalities. In sum, attention from scholars has increasingly shifted from digital access, to skills and uses, to outcomes. This cycle is depicted in Figure 1.2, a diagram created by Gómez (2018).

Figure 1.2: Relationship between Levels of the Digital Divide (Gómez, 2018)
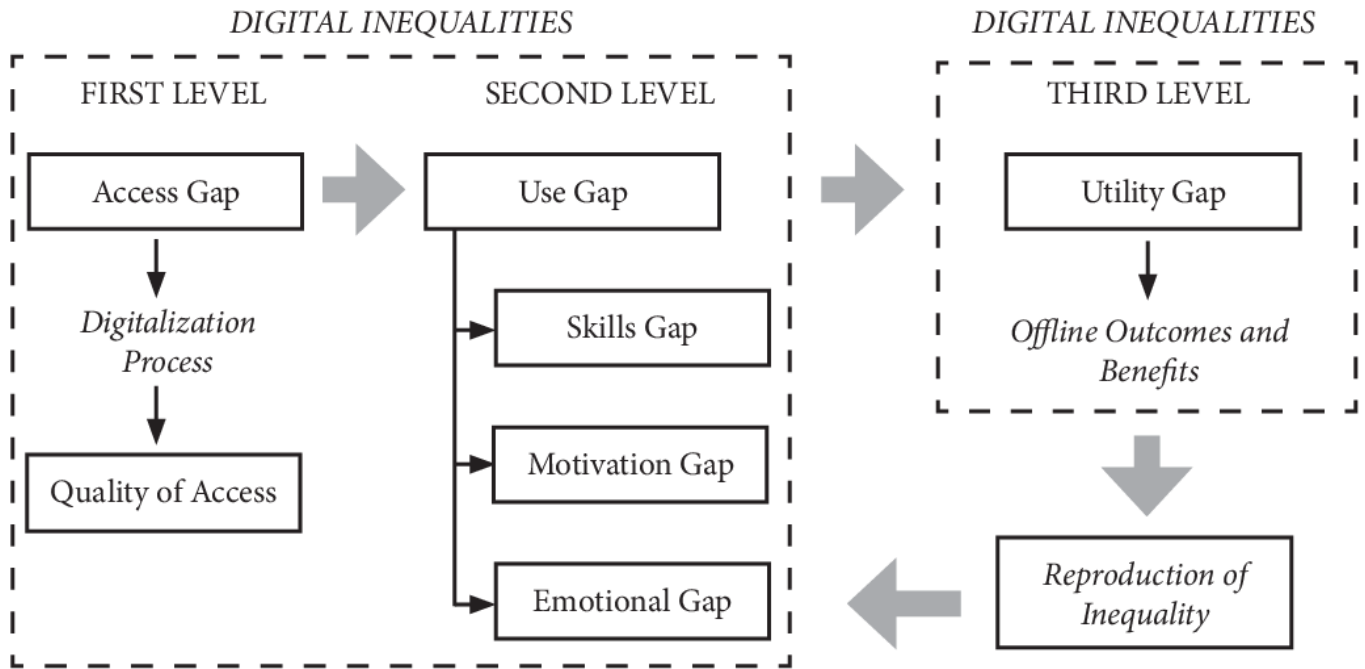
Digital Divide in the Era of COVID-19

The COVID-19 pandemic represents the first large-scale event for which digital inequalities became a major factor of vulnerability. When billions of people were advised to live in isolation, demand for internet connectivity increased exponentially. To help mitigate the spread of the virus, school and work closures and social distancing measures were implemented, requiring individuals to rely even more heavily on internet access to participate in all aspects of society. Lockdown strategies unintentionally increased digital inequality, and a lack of access to digital technologies during shelter-in-place laws had far-reaching consequences.

Pre-COVID-19, many strategies created to combat the divide entailed increasing Community Access Centers, such as opening new branches of public libraries. However, those solutions are only effective when public spaces are safe to be in, which is not always the case in instances of crises or natural disasters. Therefore, there is a need to study and systematically document the shift in the way public services are produced and delivered under stress and extenuating circumstances. According to emerging research on the digital divide during the COVID-19 pandemic, the effects of digital inequality and pandemic conditions will be reciprocal. Individuals who benefit the most from access to digital health services or remote social support are groups are those most likely to already be disadvantaged in terms of technology, internet access, and skills (Beaunoyer et al., 2020; Robinson et al., 2020). This rapid transformation of many activities due to COVID-19 bolsters the argument that being a productive member of a deliberative democratic society requires digital connection.

Significance of Study and Research Questions

During periods of crisis and high unpredictability, the demand for scientific and technical expertise increases as governments and the public search for certainty in understanding problems and choosing responses. This dissertation contributes to evidence-based policymaking, which signals to the public that decisions are being made based on reasoned and informed judgements that serve the public good, rather than special interest. Traditionally, formulating and adopting policy responses is the responsibility of government leaders. However, when many municipalities are at their capacity in the wake of an emergency situation, policy solutions are more likely to originate from a variety of sources, adopting the theory of co-production.

While the digital divide and the policymaking process are well documented and understood, these concepts both evolve when placed in the new environment of the COVID-19 pandemic. As illustrated in Figure 1.3, the unique elements this study observes are the interconnections of three main phenomena: digital equity; the theory of co-production; and crisis policymaking instigated by the pandemic. This study addresses how the COVID-19 crises alters the way digital equity is addressed in the City of Boston, by first examining public discourse then by framing the policymaking process through the lens of co-production. The study first uses natural language processing (NLP) techniques, a time series and regression discontinuity design, and unsupervised machine learning classification to analyze verified Twitter accounts and observe the national conversation on the digital divide. Next, semi-structured qualitative interviews with Boston policymakers that are open and axially coded unearths the digital equity policymaking process and outcomes and identifies

conditions necessary for success. Employing a sequential mixed-methods approach, this dissertation addresses the following research questions:

- **RQ1**: How has digital equity discourse changed nationally amid the COVID-19 crisis?
    - How has the frequency of discourse changed?
    - How has the content evolved?
- **RQ2**: How is digital equity addressed through co-production?
    - What are the outcomes?
    - What is the process?
- **RQ3:** What conditions lead to successful co-production in times of crises?

Figure 1.3: Elements of Research Study

9
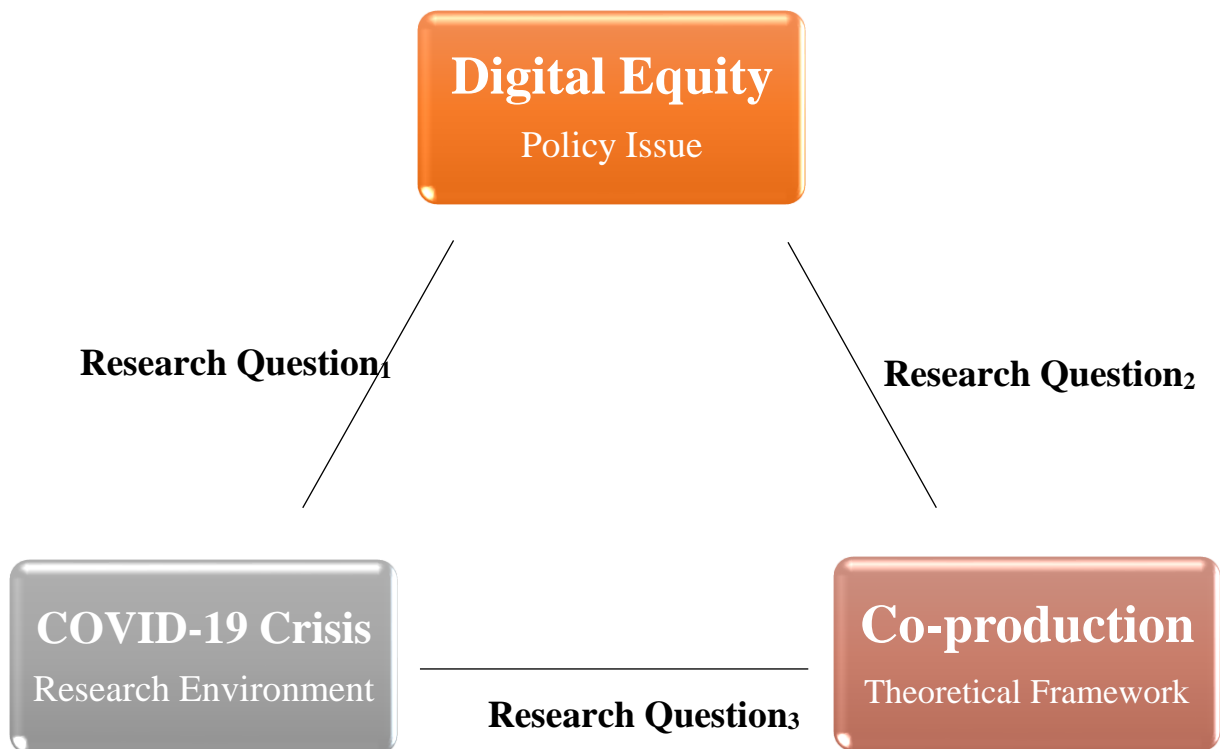
Boston as the Research Setting

The digital divide is not monolithic. The size and nature of the divide varies considerably across geographies and populations. Understanding the differences across populations is critical to developing permanent solutions that meet the needs of specific groups. In data collected by the U.S. Census Bureau's American Community Survey between 2016 and 2020, 19.4% of Boston respondents said they did not own any desktop or laptop computer, and 13% of households reported lacking either a wired or mobile broadband subscription (Columbia Telecommunications Corporation, 2022). Mayor Michelle Wu's Office estimates 15% of Boston households (or 32,000 families) lack any residential or mobile subscription (Building, 2021). Additionally, approximately 8% of households in Boston access the internet exclusively through a smartphone plan, constantly monitoring data usage to remain within their monthly data limit (Building, 2021).

On top of a demonstrated divide, Boston is a practical city in which to study this issue for a variety of other reasons. First, Boston is a racially and ethnically diverse municipality, allowing for examination of the racial implications of the digital divide. As of 2021, the City is home to an estimated population of 654,776 residents, 28.1% of whom are foreign born (U.S. Census Bureau, 2021). Boston's five largest ethnic groups are White (Non-Hispanic) (50.1%), Black or African American (Non-Hispanic) (23.5%), Asian (Non-Hispanic) (9.7%), White (Hispanic) (7.38%), and Other (Hispanic) (5.55%) (U.S. Census Bureau, 2021).

Second, Boston has a combination of high levels of poverty and an above-average proportion of college education residents, allowing for the examination of these two socioeconomic factors. The federal poverty rate in 2021 was 11.6%, and in Boston it is

significantly higher at 17.6% (U.S. Census Bureau, 2021). Since income level and economic stability, factors which will be explored more in depth in Chapter 2, are determined to play a huge role in becoming digitally advantaged, Boston has a significant population of digital have-nots. On the other hand, the percentage of Bostonians with a bachelor's degree is 52.1% (U.S. Census Bureau, 2021), which is well above the national average. The City also neighbors the City of Cambridge which has the highest percent of bachelor's degrees at 77% of the population (Boston, 2019). The combination of a racially diverse, highly educated, and high-poverty city allows for the examination of disparities along racial groups and within the context of the wealth gap.

Third, the City of Boston includes a large number of active nonprofit organizations that play a role in bridging the digital divide. According to the Massachusetts Nonprofit Network (MNN), the percentage of operating nonprofits in Massachusetts is higher than in many other states with comparable populations (Pfeiffer, 2016). In fact, among metropolitan areas with a population over 1 million, Boston registers the highest rate of locally focused nonprofits, followed by San Francisco and Washington, D.C. (Maciag, 2021). Nonprofit organizations have increasingly become important actors in policymaking and public service delivery; thus, this sector serves as some of the target population for qualitative interviews.

Fourth, Boston is a fertile area to observe influences of the digital divide because the City's Department of Innovation and Technology (DoIT) has been investing in resources and human capital to address this very issue. Boston employs a position titled "Broadband and Digital Equity Advocate," – one of the first in local government anywhere in the country to be assigned exclusively to full-time broadband and digital equity advocacy (Quaintance,

2020). With the inception of this position, there has been considerable buy-in for digital equity work at all levels of local government. This compliance creates a culture of digital inclusion in Boston that places it at the vanguard of the movement nationwide.

Of particular note is the Digital Equity Fund, established in 2017 to assist community organizations in helping residents engage online. Annual grants support digital equity projects for groups that have deep roots in the community and thus a greater reach than the City might have on its own. The fund is overseen by DoIT and the Digital Equity Fund Council, an external group responsible for selecting recipients. The fund's key goals are to promote job growth and educational opportunities while increasing the adoption of broadband within the greater Boston area. The fund is administered through a selective application process and supports projects that: help people use the internet, digital skills, and digital tools to pursue life goals; allow communities to work, play, learn, and engage in civic life on the internet safely and securely; and work to help households who do not subscribe to broadband get access to this service (Digital Equity Fund, 2017).

Lastly, the current Mayor of Boson Michelle Wu released a five-part digital equity plan that aims to "dismantle structural inequities and give all Boston residents the opportunity to thrive" (Building, 2021). The plan entails five broad categories: deliver technology for education and economic opportunity; promote digital justice in city services; secure health equity through technology; leverage transit for mobility and connectivity; and harness leadership for broader change. This backing from top leadership fosters a culture of digital equity. In conclusion, between the City's unique demographic characteristics, its numerous nonprofit organizations that are dedicated to addressing various digital gaps, and

municipal-level experts on the cusp of leading change, Boston is a logical setting to observe digital equity policymaking research.

Overview of Study

This study is designed to make practical recommendations and theoretical contributions to mitigating the digital divide and fostering co-productive policymaking, with a particular goal of advancing social equity. Chapter 2 of this dissertation further defines the digital divide and synthesizes what existing research identifies as causes and consequences of digital inequity. Next, Chapter 3 presents an overview of the theoretical model of co-production in policymaking which drives the rationale behind the research questions and methodology. Chapter 4 provides a justification for a mixed-methods, inductive study and gives a high-level summary of the methodology, ethical considerations, and pilot research.

Chapters 5 and 6, respectively, delve deeper into the quantitative and qualitative data acquisition, analysis, results, findings, and discussion. The quantitative findings show that attention given to the digital divide increased dramatically beginning March 2020, and that the conversation is dominated by the internet access tenet of the divide. The qualitative results suggest that community-based organizations are a central player in fostering digital equity, and that Ostrom's model of co-production does not fully encompass collaborative policymaking during crises. The limitations, threats to validity, and ethical considerations of each methodology are explored in their corresponding chapters. The closing chapter summarizes and details: policy implications and recommendations; contributions this research makes to scholarship, theory, and methods; areas for future research; and a conclusion.

13

CHAPTER 2: REVIEW OF LITERATURE

This chapter is a comprehensive review of existing scholarly research from primarily peer-reviewed sources and government reports. The literature review explores the three main tenets of digital connection, the benefits of closing the technology gap, and factors that contribute to the digital divide. This examination uncovers missing areas where further investigation is needed and aids in formulating the proposed research questions. Though, comparatively, few academic studies have been conducted on this topic in the era of COVID-19, the literature review covers as much detail as possible on the effect the pandemic has had on the digital divide.

Categories of Digital Divide

As mirrored by the three levels of the digital divide outlined in Chapter 1, "digital haves" are individuals who possess the following three components: access to a physical device; an internet subscription; and the know-how to utilize the technologies in a meaningful way. The divide is not a static condition, but rather a continuously shifting paradigm. Even if individuals are able to access one requirement of digital connection, they may face a variety of barriers achieving other prerequisites. The transformation from digital have-not to digital have is an incremental process with multiple stages and multiple pathways (Lei et al., 2008).

Figure 2.1 illustrates the necessary intersection of device access, internet, and digital literacy which are explored in the subsequent paragraphs.

Figure 2.1: Necessities of Digital Haves

★ = "Digital Have"
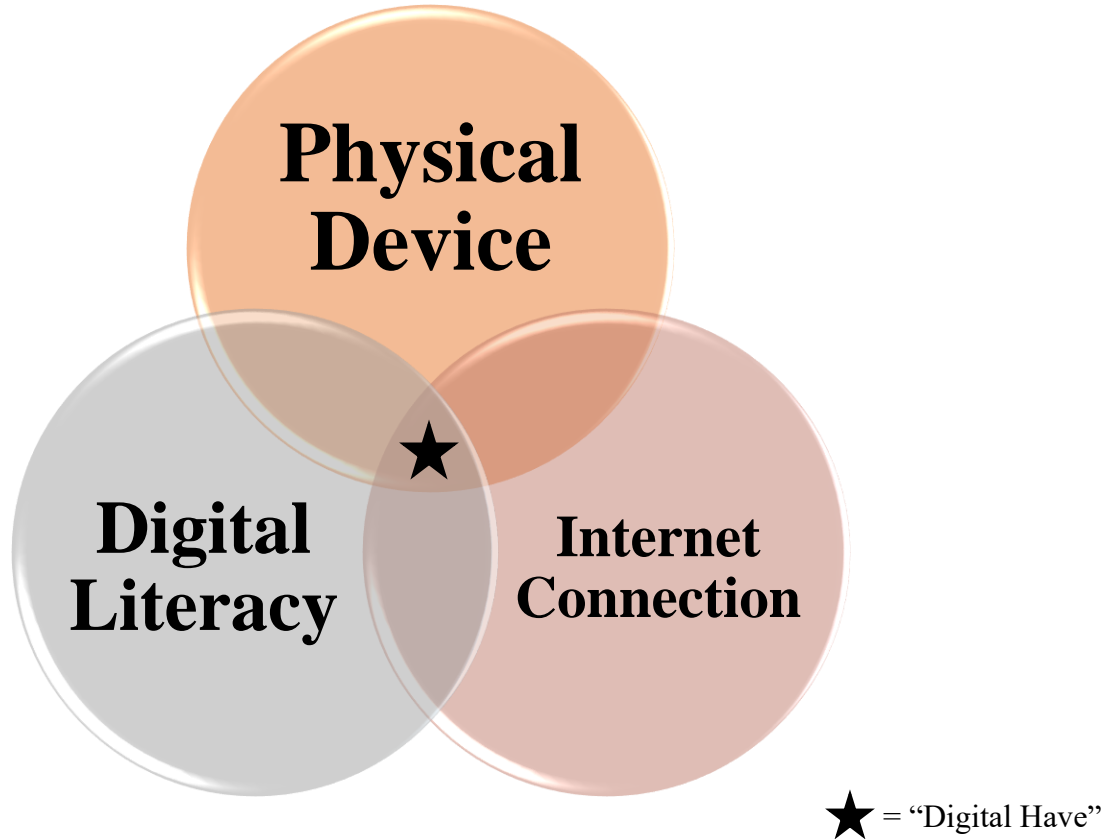
Physical Device

The ability to employ technology efficiently and effectively rests on the quality of users' hardware and software equipment alike. The material access layer of the digital divide refers to devices that afford the use of the internet over time. These machines may be: concrete computer devices such as desktops, laptops, tablets, or smart TVs; intangible software subscriptions; and peripheral equipment, such as printers, additional hard drives, secondary screens, docking stations, etc. The proliferation of smartphones has helped bridge some of

the material gap, however most functions are easier to execute using a traditional computer with a monitor and keyboard.

Due to smaller screens, greater scrolling requirements, and limited functionality when typing, mobile phones are not sufficient for completing school assignments or carrying out other tasks (Van Deursen & Van Dijk, 2019). Mobile broadband is also unreliable, less robust, and sometimes subject to restrictive data caps. Additionally, websites often lack a mobile-friendly version. Because a phone does not have the same memory, storage capacity, speed, or applications as a computer, most researchers do not consider it a comparable substitute (Ali et al., 2021; Van Deursen & Van Dijk, 2019). Overall, Napoli and Obar (2014) determine that smartphone and tablet internet access contributes to lower levels of user engagement, content creation, and information seeking.

New material divides manifest for a variety of reasons. Most often, gaps exist as a result of rapidly changing technology, the large variety of devices available to the general public, and because not all materials provide the same online opportunities (Van Deursen & Van Dijk, 2019). Furthermore, a device may malfunction or require updates, deeming the purchase price only a fraction of the total cost of ownership. Though increased competition among computer manufacturers has substantially reduced expenses, the following paragraph demonstrates how costs associated with owning a device are disproportionately prohibitive for underserved populations.

Research determines that the material divide is influenced by income, race, and ruralness. Low-income and minority children are less likely to have access to physical technological devices at home and school, and parents are less likely to have access to them

at home and work (Attewell, 2001). According to a Pew Research Center survey, 80% of white adults report owning a desktop or laptop computer, compared to 69% of Black adults and 67% of Hispanic adults (Atske & Perrin, 2021). There was once a significant device gap between rural and urban dwellers that has since narrowed – but rural adults still remain less likely than suburban adults to own multiple computing devices (Perrin & Turner, 2019). More specifically, Vogels (2021) reveals that about 31% of rulalites reported they have a desktop or laptop, smartphone, home broadband connection, and table computer. Comparatively, 43% of suburban and 44% of urban counterparts have all four technologies. Figure 2.2 demonstrates various device adoptions over time based on urbanicity.

Figure 2.2: Device Adoption by Urbanicity (Vogels, 2021)

% of U.S. adults who say they have or own the following
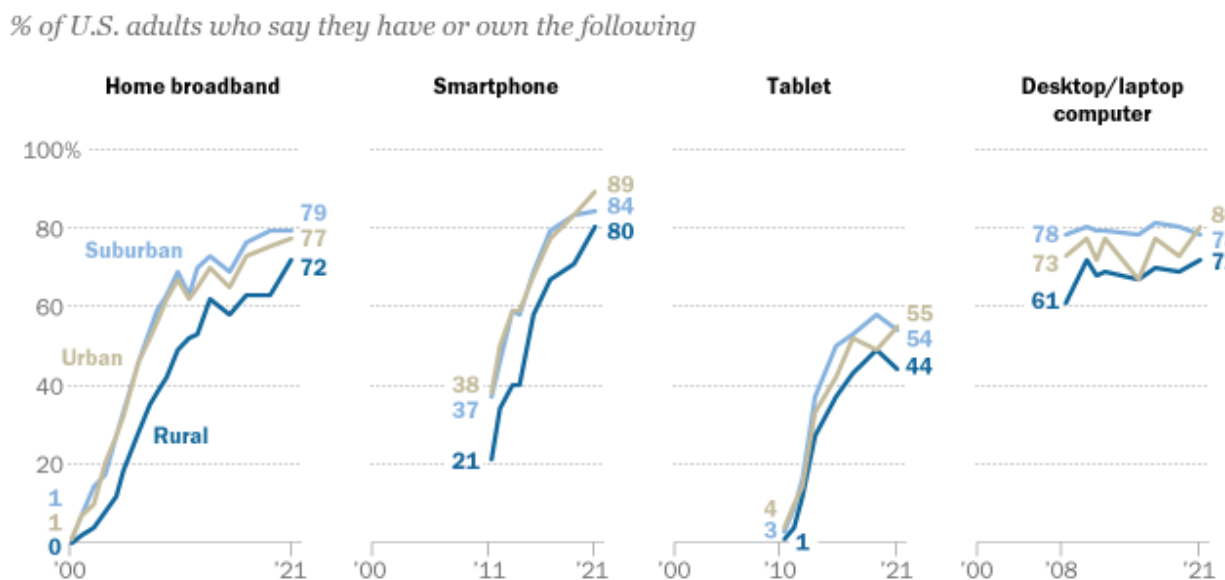
Source: Survey conducted Jan. 25-Feb. 8, 2021.

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In addition to adults at home and K-12 students, the digital device gap affects 3 million to 4 million postsecondary students – around 15% of all students attending four-year

private and public colleges or two-year community colleges (Chandra et al., 2021). Gonzales and Lynch (2020) found that postsecondary students of color and students from lower-income families are more likely to own lower-quality devices. College students are rarely mentioned in digital divide research because there is an underlining assumption that campus computer labs and libraries provide free access to devices. Despite these facilities, many college students remain under-connected. In conclusion, the material access layer of the digital divide demonstrates that many individuals have inadequate technology that prevents them from reaping the full benefits of the digital ecosystem.

Internet Connection

The internet represents a fundamental shift in how Americans connect with one another, gather information, and conduct their daily lives. For many Americans, broadband is commonplace in professional and personal spaces, and has become a basic utility for social inclusion. Broadband is provided by a series of technologies such as cable, telephone wire, fiber, satellite, mobile, and fixed wireless. These systems give users the ability to send and receive data at volumes and speeds necessary to support a number of applications. The U.S. Census Bureau defines broadband as anything faster than a dial-up internet connection (Tomer et al., 2020). Internet services must meet certain download and upload speeds – corresponding to how quickly a connection can retrieve or send data, respectively – to be effective.

Similar to how mobiles phones are not considered a suitable substitute for a laptop or computer, Napoli and Obar (2014) posit that mobile internet access is second-class internet access when compared to traditional or nonmobile internet access. Mobile internet access

offers lower functionality in terms of speed, memory, and storage capacity. Humphreys et al. (2013) describe smartphone internet as "extractive," meaning usage is often quick and prompted by contextual issues. In contrast, the authors refer to computer internet use as immersive, which entails longer and more meaningful sessions.

For some demographic groups – such as young adults, college graduates, and those from high-income households – internet usage is near ubiquitous (Pew Research Center, 2021). For others, research shows that internet adoption gaps are attributed to a combination of factors such as age, race, income level, education level, and community. According to 2015 U.S. Census data, roughly one-fifth of Americans do not have internet access at home (Galvin, 2017). Pinning down specific national numbers is difficult because access is fluid. However, those disconnected are most likely to be racial minorities, older adults, rural residents, less educated and lower-income individuals (Pew Research Center, 2021). There is virtually no difference in adoption rates by gender. Figure 2.3 illustrates the disparity in home broadband use across demographic groups as reported by the Pew Research Center.

Figure 2.3: Home Broadband Adoption by Demographic Groups (Pew Research Center, 2021)

Home broadband use by income
% of U.S. adults who say they have a broadband connection at home, by annual household income

Less than $30,000 $30,000-$49,999 $50,000-$74,999 $75,000+
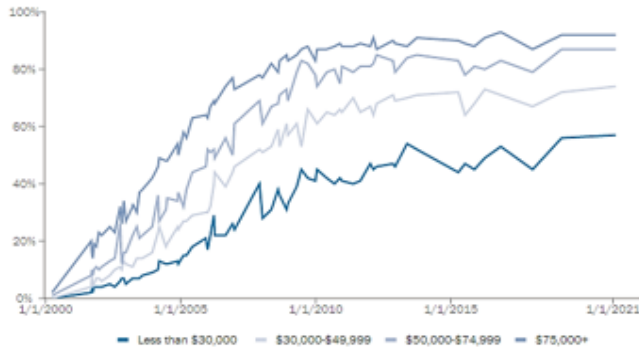
Home broadband use by race
% of U.S. adults who say they have a broadband connection at home, by race/ethnicity

White   Black   Hispanic
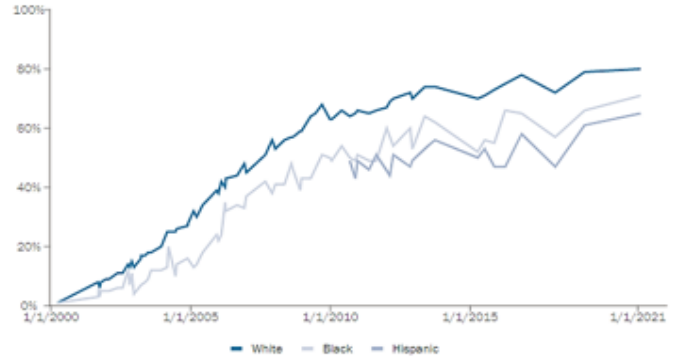
Home broadband use by community type
% of U.S. adults who say they have a broadband connection at home, by community type

Urban   Suburban   Rural
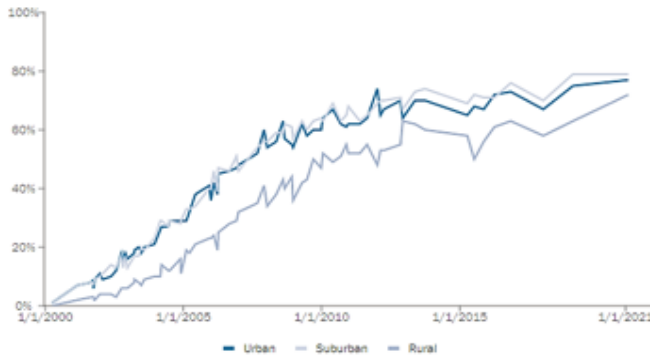
Home broadband use by age
% of U.S. adults who say they have a broadband connection at home, by age

18-29   30-49   50-64   65+
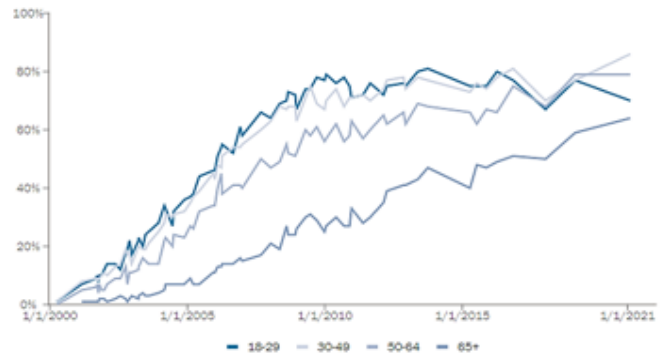
Home broadband use by gender
% of U.S. adults who say they have a broadband connection at home, by gender

Men   Women
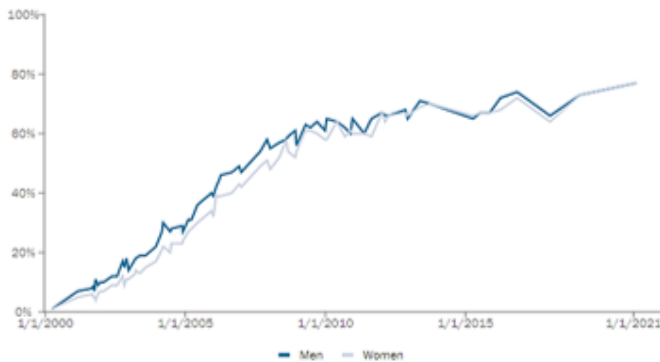
Home broadband use by education
% of U.S. adults who say they have a broadband connection at home, by education level

Less than high school graduate
High school graduate
High school or less
Some college
College graduate
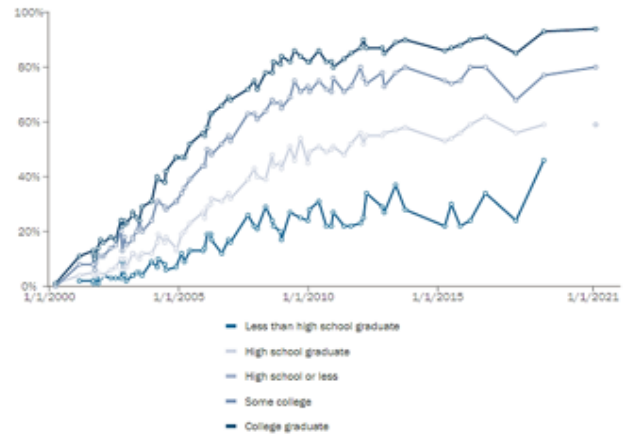
Though broadband gaps do traverse every kind of community, racial minorities report lower internet subscription rates (Perrin & Turner, 2019). A study by Tomer et al. (2020) supports that disconnected households are more prevalent in majority Black neighborhoods, where adoption rates are only 67.4%, compared with much higher adoption rates (83.7%) in majority white tracts. For individuals living on Tribal lands, 32% have no access to any fixed broadband with reliable speeds, and 36.1% only have access to reliable service from one provider (Kruger & Gilroy, 2019). Many surveys report they did not secure enough Asian respondents in the sample to be broken out into a separate analysis.

Rural Americans have made large gains in adopting digital technologies; however, they still lag behind. Roughly 72% of ruralites report they have a broadband connection at home, compared to 77% and 79% of their urban and suburban counterparts, respectively (Vogels, 2021). In a 2018 Pew Research Center survey, about a quarter of rural Americans denoted that access to high-speed internet is a "major problem" (Anderson, 2018). These results remained consistent between high and low levels of income and amongst various educational attainments. Rural areas present a unique issue as there are typically fewer broadband providers operating in them, and they tend to have slower internet speeds compared with other areas of the country.

Becket et al. (2020) report some that households, particular low-income ones, fluctuate between internet connectivity and cancellations due to prohibitive costs. Technical and technological issues can also impact the quality of access on a day-to-day basis, reinforcing that digital inclusion is fluid. The effect of the digital divide on households headed by individuals with a high school education or less is further explored in the

subsequent discussion detailing factors that contribute to the digital divide. Similarly, as income is a main driver of broadband access, studies on households lacking economic means are reviewed more in depth in the coming section.

Overall, the digital divide creates a trickle-down effect, because adults without working devices or high-speed internet subscriptions are raising children also without those amenities. Chandra et al., (2020) report that 15 million to 16 million K–12 public school students (about 30%) lack adequate connectivity, an e-learning device, or both. This represents the "homework gap" – a challenge K-12 students face in completing online homework assignments because they lack sufficient internet or devices at home (Chandra et al., 2020). Consistent with widespread digital divide literature, even amongst students, the disparity is most pronounced in rural communities and households with Black, Latinx, and Native American students.

Francis and Weller (2022) determined that at the start of the COVID-19 pandemic, almost one-fourth of Black households, 24.7%, and 19.1% of Latinx households did not have reliable internet and devices available for remote learning. Furthermore, up to 400,000 teachers (10% of all public-school teachers) lack adequate connectivity or devices at home to carry out distance education (Ali et al., 2021). When an educator is disconnected, learning limitations are magnified for all students in the classroom. Much progress has been made connecting Americans to broadband internet, but a substantial divide remains.

Digital Literacy

Although the matter of access to technical equipment and internet connection is essential, they are not the only two sides of a dichotomous digital divide. Having access to technology

does not equate reaping benefits from said technology. Material devices alone are not enough, nor is the digital divide problem solved if a community's internet connection rate reaches saturation. Beyond having hardware and a broadband subscription, users need a wide range of technological skills to be effective participants in digital spaces. This concept is known as digital literacy.

The American Library Association (2013) defines digital literacy, or e-literacy, as the ability to use information and communication technologies to find, evaluate, create, and communicate information, requiring both cognitive and technical skills. Another source defines digital literacy as, "the degree to which individuals have the capacity, knowledge, motivation, and competence to access, process, engage, and understand the information needed to obtain benefits from the use of digital technologies, such as computers, internet, mobiles devices, and applications" (Beaunoyer et al., 2020). Traditional literacy plays an important role. A lack of general ability to read, write, and understand text further disadvantages individuals.

Research on digital skills advanced when authors classified types of skills necessary to bridge the digital divide. Mossberger et al. (2003) distinguished between technical competence, or "the skills needed to operate hardware and software, such as typing, using a mouse, and giving instruction to the computer to type records a certain way," and information literacy, which is "the ability to recognize when information can solve a problem or fill a need and to effectively employ information resources." More recently, Van Deursen et al. (2016) coined three different types of digital skills. They are: "information navigation skills," the ability to find, select, and evaluate sources of information on the internet; "social

skills," the ability to use online communication and interactions to understand and exchange meaning and acquire social capital; and "creative skills," needed to create different types of quality content and to publish or share this with others on the internet.

Internet skills play an important role in translating internet uses into beneficial outcomes. The National Digital Inclusion Alliance (2021) refers to a digitally literate person as someone who can engage with four main pillars of literacy. The first is to use diverse technologies appropriately and effectively to retrieve information, interpret results, and judge the quality of that information. Next, digitally literate users must understand the relationship between technology, life-long learning, personal privacy, and stewardship of information. Additionally, the user must be able to use these skills and the appropriate technology to communicate and collaborate with peers, colleagues, family, and on occasion, the general public. Lastly, digital literacy entails using these skills to actively participate in civic society and contribute to a vibrant, informed, and engaged community.

The age of user is a strong predictor of digital capabilities, and a generational divide is becoming more and more evident as technology continues to advance Older generations are less familiar with ICTs compared to younger generations (Kang & Pamukcu, 2009). "Digital natives" are individuals who have been exposed to technologies at a young age, usually before their teenage years (Prensky, 2001). "Digital immigrants" refer to individuals who were born before the existence of widespread computer technology (Prensky, 2001). They are operators of ICTs but started using these devices during their adult lives, thus may not have as developed of a skillset. As a result, digital natives are typically more comfortable adopting technology than their immigrant counterparts in multiple areas. A study by Van

Deursen (2020) determined older people were less equipped to use the internet for information and communication during a time of crisis. This leaves elders particularly vulnerable, as digital literacy also entails the ability to discern whether information found on the internet is coming from a reliable and trustworthy source. Additionally, digitally literate users are better able to navigate and avoid potential cybercriminal scams. In conclusion, an individual's technological competency is embedded in their social, economic, and cultural context.

Digital Equity

Equity is a longstanding tradition in the United States and other democracies that strives to allocate resources and opportunities to those in need in order to reach an equal outcome. When cleavages form in online spaces, the goal is no different. The National Digital Inclusion Alliance (2021) defines digital equity as, "a condition in which all individuals and communities have the information technology capacity needed for full democratic and economic participation." In other words, digital equity refers to whether or not citizens can access and effectively use the technology necessary to participate in modern society. In the past, public policy has primarily focused on addressing the first level of the digital divide. However, Congress has recently expanded their focus to ensure policies are taking a comprehensive digital equity approach.

The Digital Equity Act was originally introduced in April 2019 by U.S. Senator Patty Murray (D-WA), and was reintroduced in 2021. The act authorizes more than $1 billion in federal grant funding over the next five years to support digital inclusion programs throughout the United States. It also establishes two grant programs administered by the

National Telecommunications and Information Administration (NTIA). In pushing this bill, Senator Murray explained that it will "direct significant new federal investments to help ensure people in our communities have the tools, support, and technologies necessary to take full advantage of a broadband connection when they have access to one" (Rinehart, 2021). In 2021, Congress passed the Bipartisan Infrastructure Law (Infrastructure Investment and Jobs Act) which promises every American access to high-speed internet via unprecedented investment in broadband infrastructure deployment (H.R. 3684, 2022). The legislation also aims to lower prices of internet services.

Digital equity is a highly challenging social justice goal, but there are tremendous power and opportunities that technology provides to communities, especially historically disenfranchised minority groups. This condition is necessary for: social, civic, and cultural participation; employment; lifelong learning; and access to essential services. As explored in the subsequent sections, the socioeconomic benefits of the information society continue to rapidly amalgamate in both public and private sectors. Universal access to connected devices, affordable subscription prices, and a population equipped with digital skills are vital characteristics of a healthy neighborhood, city, state, or country.

Economic Benefits

Digital equity creates economic benefits for both individuals and communities. From a macroeconomic perspective, high levels of broadband adoption lead to economic growth, higher average incomes, and lower unemployment rates (Tomer et al., 2020). A World Bank report on Information and Communication for Development reported that low- and middle-income countries could raise economic growth by 1.4% for every 10% increase in broadband

penetration (Andreasson, 2015). The impact can be even more robust once the penetration reaches a critical mass. Users that operate technologies to their advantages are more efficient and drive higher rates of productivity. Digital haves accelerate innovation by introducing new consumer applications or services. In the short run, enhancing digital access allows users to save time, money, and effort, while increasing efficiency.

Prevalent community digital connection also creates better labor market outcomes. Users are able to identify job openings, submit applications and resumes, or communicate with potential employers. Digital connection enables faster re-employment for unemployed individuals and creates a better skills match. It also permits telecommuting, which has its own spillover effects: workers can cut down on transportation time and decrease their carbon footprint by mitigating the amount of air pollution caused by driving or using other forms of transportation. Advantages afforded by broadband services in rural areas, in particular, have included enhanced home businesses (Anderson et al., 2016), reduced depopulation (LaRose et al., 2007), and higher farm sales and profits (Kandilov et al. 2017).

Social Benefits

Digital equity enriches social outcomes by improving access to education, healthcare, and social supports. Increasing a user's interaction with educational resources accelerates knowledge sharing and ties back into labor market outcomes. The rise in telehealth has improved access to medical providers and increased communication between patients and practitioners. Individuals experiencing social isolationism can connect with others, even anonymously. Digital connectivity overall boosts the quality of life in communities, making it easier to attract and retain residents. In this way, information and communication

technologies provide and facilitate social inclusion – the participation of individuals in groups and societies.

Factors Contributing to the Digital Divide

The digital divide persists across all spaces – in every single state, regardless of density levels, and among demographic groups of all races, educational attainments, and income levels. Thus, the divide perpetuates inequality based on various social factors. Minimizing the divide requires the consideration of multiple types of social cleavages. Digital inequality research identifies several interlocking factors which predict who is mostly likely to benefit from the diffusion of digital technologies. According to Ramsetty and Adams (2020) common contributions to the divide include an individual's: built environment; social and community context; education; and economic stability.

Built Environment

Built environment refers to a physical geographic location someone resides in, and if there is a region-wide lack of broadband internet availability. Unlike other essential infrastructure (systems and networks that provide essential services necessary for social and economic wellbeing), broadband is largely provided by private companies. This means there is no expectation for significant federal oversight regarding prices, development, or deliverability. Nothing in federal law requires internet service providers to provide the same level of service, or even to provide service at all.

Historically, broadband has been deployed unevenly, with lower cost, higher income areas receiving the service first, and lower income, high-cost areas receiving it last, or not at

all. A rural broadband network demands significant capital investment to reach a limited number of potential customers. Companies who do not predict an economic benefit from development of this essential infrastructure leave many lower-income communities subject to anti-competitive pricing, an unfortunate side-effect of the privately owned and financed industry model. This instigates "digital deserts" in rural areas with higher poverty rates (Tomer et al., 2020), causing substantial segments of rural America to lack the infrastructure needed for high-speed internet. A Pew Research Center report demonstrates that over one third of rural Americans (37%) do not have broadband internet connection at home, and rural Americans are 12% less likely than Americans overall to have home broadband (Perrin & Turner, 2019).

Nationwide, southern states account for 44% of the overall divide. Rural southern states, including Mississippi, Alabama, Arkansas, and Oklahoma, have the highest portion of disconnected individuals (Ali et al., 2021). This condition, observed in Figure 2.4, is due in part to underinvestment in infrastructure on remote, rural, and Tribal lands. Moreover, a Brookings analysis found that gaps in broadband infrastructure are caused, in part, by a decade-long pattern of "digital redlining" (Fishbane & Tomer, 2020). Digital redlining, as defined by the National Digital Inclusion Alliance (2021), is "discrimination by internet service providers in the deployment, maintenance, or upgrade of infrastructure or delivery of services." This practice of ISPs systematically underinvesting in infrastructure in Black and immigrant neighborhoods resembles the discriminatory housing practice, redlining, from the twentieth century.

Figure 2.4: Broadband Adoption Rate by State (Fishbane & Tomer, 2020)

Household broadband adoption rate across the United States
2018, 1-year estimates
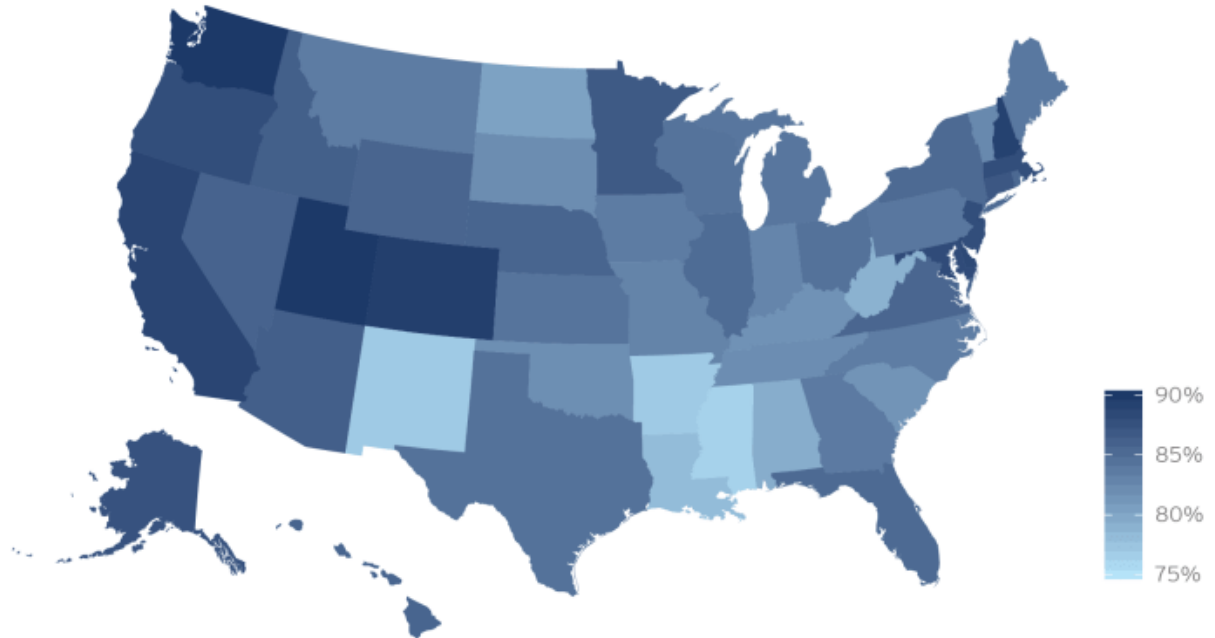
Source: Brookings analysis of American Community Survey data

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Even where infrastructure is accessible, 23.7% of Americans have only one option for a broadband provider (Kruger & Gilroy, 2019). Due to a lack of competition for internet services, consumers are forced to accept the limited or insufficient technological offerings available in their area, resulting in a natural monopoly. A natural monopoly is one that exists due to high start-up costs or significant economies of scale. They arise in industries that require specialized raw materials, technology, or similar factors to operate, or when they are the sole provider in a geographic region. A natural monopoly serves the public more economically than multiple competitors could.

Finally, built environment refers to the availability of free public internet access in community buildings, such as libraries or schools. Minorities and people with lower incomes rely more on public internet access (Dailey et al., 2010). Built environment also denotes the presence or absence of structural support or housing insecurity in an area, as public housing and homeless shelters that support unhoused and highly mobile populations assist with bridging the divide as well. Overall, disparate services related to one's built environment has varying effects depending on region, income level, race, and ethnicity.

Social and Cultural Factors

The social and community context of an individual is another factor that contributes to digital have-nots. This describes their shared or cultural expectations regarding use of digital devices, including any mistrust of technology. Social support networks are groups or individuals who assist inexperienced users. McPherson et al. (2006) suggest that older adults are more likely to have smaller social networks. Family and peers are important sources of digital support (Eynon & Geniets, 2016; Hunsaker et al., 2019; Micheli et al., 2020), which is necessary for internet adoption and retention (Hsieh et al., 2011). Technology exposure in a social network increases the likelihood of adopting new technologies.

A national survey of low-income households reported that 13% of respondents stated they "didn't think they needed internet" (Rideout & Katz, 2016). Internet-use research also determines that younger people exhibit the highest frequency and diversity of internet use, resulting from their generation's earlier exposure, peer use, and confidence in relation to new technologies (Dutton et al., 2013; Zillien & Hargittai, 2009). Digital immigrants, adults who did not grow up using computers, have been observed to use the internet less. One

representative study in the U.S. found that only 67% of people aged 65 years and older are online (Anderson et al., 2019).

There is a gap between those who are getting connected into broader networks and building social capital and those who are not. According to digital inequality research, users' internet access and skills vary by social contexts, which influences the benefits they derive from communication technologies. DiMaggio et al. (2004) differentiate between capital-enhancing and recreational online activities. Capital-enhancing activities are actions that are more likely to provide opportunities for upward mobility, such as researching financial and health services or participating politically. Individuals are linked to jobs, the economy, the government, and information through these actions. Recreational activities, such as checking sports scores or reading jokes, have fewer payoffs related to one's social or economic status. According to Van Deursen et al. (2016), those who are less advantaged tend to use the internet for recreational and less capital-enhancing purposes, thus reproducing inequalities online.

Across the board, ownership and use of information and communication technology in the United States is significantly lower among immigrants and populations living in non-English speaking households (Galperin, 2017; Ono & Zavodny, 2008). A 2016 Census Bureau survey showed that only 62.5% of multilingual households had broadband internet at home, compared to 82.3% of all other households (Ryan, 2018). Schools and teachers nationwide have reported that the resources needed for virtual learning are frequently less readily available in the homes of English learners than in those of native English-speakers (Zehler et al., 2019). The reasons are threefold: navigating the broadband application process

is difficult; options are overwhelming; and people are hesitant to share their personal information (Chandra et al., 2020). Broadband installation often requires entry of a technician into individual homes, which can cause discomfort. Certain adoption hurdles, such as language barriers and the provision of Social Security numbers, are more commonly or acutely experienced by Latinx families (Ali et al., 2021). Even when digital connection is free or heavily discounted, social and cultural preferences prevent people from using it.

Education

Becoming and remaining a digital have rests largely on the factor of education. This influence has two components: a users' demographical education level and a users' digital literacy level. The two metrics are not always related to one another. With respect to the former, more educated individuals are almost always on the "right side of the divide." People with higher levels of education have greater internet awareness, better training, higher capabilities, and greater abilities to evaluate online content (Van Dijk & Van Deursen, 2014). People with lower educational levels are less likely to use the internet in ways that are beneficial to them in an economic sense (Van Dijk & Van Deursen, 2014). Robinson et al. (2003) found that college graduates have a distinct advantage over those with only a high school diploma when it comes to using the internet to further their careers, education, and other goals. The most obvious benefits appear in the types of sites visited, uses made, and political discussion.

The secondary educational barrier refers to a level of technological experience. This is quantified as the time it takes for people to be familiar enough with the technology to retain benefits from its use (Beaunoyer et al., 2020). Without experience, users may be

unable to perform simple functions, such as read emails or log into online platforms. Quality technical support is required as users activate, build a knowledge base for, and troubleshoot issues with their connectivity, devices, and tools. Users who cannot access technology education fall further behind their peers who can.

Economic Instability

The digital divide is part of the broader socioeconomic divide and is closely linked to opportunities for economic and social mobility. Not surprisingly, and in direct correlation to education, household income also plays a significant role in the widening digital gap. Socioeconomic differences are the "primary domain of inequality," according to Hohlfeld et al. (2017), because they directly affect one's ability to upgrade technology or purchase an internet subscription. According to a Pew Research Center study, more than 40% of low-income Americans making less than $30,000 do not have internet in their home (Anderson & Kumar, 2020). As evidenced in Figure 2.5, the states with the lowest broadband adoption rates also have the lowest median incomes, highest percentages of rural communities, and the highest shares of communities of color (Tomer et al., 2020).

Figure 2.5: Broadband Adoption by Poverty Rate (Tomer et al., 2020)

Tracts with the highest levels of poverty have the lowest levels of broadband adoption

2018, 5-year estimates
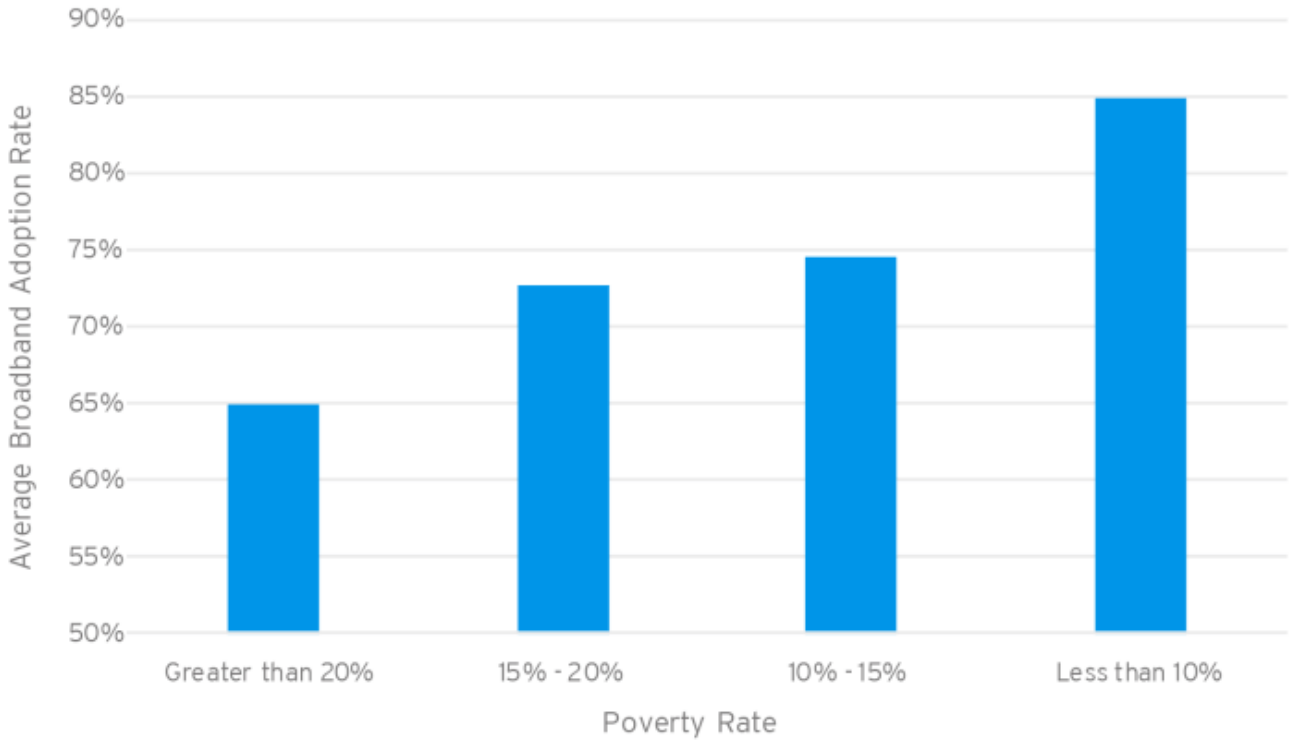
Source: Brookings analysis of American Community Survey data.

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Even after accounting for income disparities and other demographic factors such as education and employment, a racial digital divide persists. Among the same income brackets, Black and Hispanic families continue to lag behind white families in broadband adoption, indicating that systemic barriers continue to perpetuate inequality (Atske & Perrin, 2021). For instance, obtaining internet at home requires passing a credit check which has a history of long-fueling racial discrimination. This further exacerbates an income-related disparity.

Even among households that already have internet access, there are growing concerns about their ability to pay for it. A Pew Research Center study determines roughly half of lower-income broadband users (52%) are concerned about affording their connection, compared with 26% of those with middle-incomes, and only 9% of those with high incomes (Vogels et al, 2020). Hispanic adults are especially likely to express concerns about footing tech-related bills. 54% of Hispanic users say they worry about being able to pay for their home internet services, compared to 36% of Black users and 21% of white users (Vogels et al., 2020). The extent to which an individual can become and remain a digital have in the next decade and beyond will be determined by the availability and affordability of equipment, broadband-enabled services and applications, and educational opportunities.

Effect of COVID-19 on the Digital Divide

During the first months of the COVID-19 pandemic, industry reports showed that digital media consumption increased tremendously as people spent more time at home due to coronavirus lockdowns (Kemp, 2020). A Pew Research Center poll conducted in early April 2020 found that roughly half of U.S. adults (53%) said the internet was essential for them during the pandemic, and another 34% describe it as "important" (Vogels et al., 2020). A study conducted by Nguyen et al. (2021) about changes in digital communication during the pandemic found that older adults, Native Americans, and ruralites are less likely to be frequent internet users. Conversely, higher-income households, employment, and suburbanites are correlated with frequent internet use and greater digital skills.

Van Deursen (2020) reports that lower quality of internet access and lower internet skills correspond to less use of the internet for both communication and information purposes

related to COVID-19. The same study indicated that the greater an individual's existing

advantages, the more they benefit from the internet during a crisis. Because in-person

networks and opportunities were less accessible during the start of the pandemic, digitally

disadvantaged people had fewer options for taking actions, behaving as requested, or

receiving assistance. This creates a vicious cycle in which already vulnerable groups are

further marginalized in emergencies.

Finally, during COVID-19, school-aged children bore the brunt of the divide, as

widespread school closures increased the likelihood they struggled with schoolwork due to

technological limitations. According to a Pew Research Center study, roughly one-in-five

parents with homebound schoolchildren said it was "very likely" or "somewhat likely" their

children would not be able complete schoolwork because they do not have access to a

computer at home (Vogels et al., 2020). Another study found that roughly 30% of children in

grades K-12 (15 million to 16 million students) lacked adequate internet access or e-learning

devices to effectively continue their education from home (Chandra et al., 2021). Similarly,

roughly three-tenths of parents reported that it was at least somewhat likely their children

would have to do their schoolwork on a cellphone (Vogels et al., 2020). The effects felt by

this population demonstrate how the divide perpetuates disadvantages from one generation to

another, as inequities created in childhood carry over into adulthood and affect both

academic and non-academic behavior (Ma et al., 2018).

Effect of COVID-19 on Policymaking

When the COVID-19 pandemic struck, the United States took swift and significant action,

making use of limited federal Coronavirus Aid, Relief, and Economic Security (CARES) Act

funding which was approved in March 2020. The majority of digital equity solutions, however, were only transitory band-aids that addressed temporary affordability and adoption hurdles (Ali et al., 2021). In the next one to three years, more than 75% of state and municipal efforts to address the student digital divide will expire, according to Ali et al. (2021). In December 2020, Congress authorized additional emergency broadband-specific funding for: data collection; broadband infrastructure deployment and expansion; broadband service cost support; and other digital inclusion initiatives with a special focus on vulnerable communities. However, the funding is neither sufficient nor properly targeted to close the digital divide for the duration of the pandemic and beyond.

With the digital divide in the national spotlight in ways like never before, and funding available to address problems at unprecedented rates, the COVID-19 pandemic had a fundamental effect on federal and local policy creation process. Policy actors who had never before offered support in this area started to do so. For instance, many school districts issued computing devices to students so they could engage in emergency remote learning programs (Becker et al., 2020). Libraries, non-profit organizations, and small business communities all stepped up. Even telecommunication providers themselves assisted struggling customers by reducing fees or increasing internet speeds (Hachman, 2020). Overall, the COVID-19 crisis led to a diversification in the sources of policy solutions.

Summary of Literature

In conclusion, necessities of digital haves, factors contributing to the digital divide, and barriers to digital inclusion are well-documented. A user needs a reliable device, internet subscription, and skillset to fully reap the online benefits of the twenty-first century.

Research continues to confirm that those least likely to be digitally connected in America are communities of color, low-income households, older adults, and rural neighborhoods. Existing research identifies environmental, cultural, educational, and economic factors as contributors to the digital divide. The COVID-19 pandemic has made those influences more acute.

Since the onset of the COVID-19 pandemic, studies on the digital divide have primarily focused on the topics of adapting to remote learning and the effects on school-aged children. There is a dearth of policy-oriented literature that describes how municipal, state, or federal responses help mitigate the effects of the divide. What is especially unknown is how solutions are affected when there is an unprecedented emergency and administrations are pushed to full capacity. Through a sequential mixed-methods approach, this study addresses the gap in literature by: analyzing how experts discuss the digital divide; exploring outputs of posed solutions; and examining how emergency situations alter policymaking processes. These inquiries are situated within the framework of Ostrom's (1996) theory of co-production, discussed in the succeeding chapter.

CHAPTER 3: THEORETICAL FRAMEWORK

The COVID-19 pandemic represents a sudden and dramatic shift in the issues that policy

networks focus on. The global emergency spawned a surge in the number of public policies

adopted, including a diversity in the forms in which they are implemented across

governments. Due to the complex nuances of the digital divide explored in the previous

chapter, solutions are likely to stem from a variety of sources. This chapter reviews the

theoretical framework of co-production originally coined by Nobel Prize Winner Elinor

Ostrom (1996) and demonstrates how its examination can enhance digital equity

policymaking.

The Theory of Co-production

The term co-production has scholarly roots in the public sector, specifically in the work of

Ostrom (1996) and other economists from the 1970s. These researchers investigated

teamwork between government departments and citizens and discovered that collaboration

between professional providers and service users, rather than central planning, promoted

effective service delivery. Co-production is a process through which inputs used to produce a

good or service are contributed by entities who are not in the same organization (Ostrom,

1996). The logic is simple: by contributing, service users can help reduce costs and improve

the quality of services provided to them (Alford, 2014). Co-production is regarded as a

critical mix of activities in which service agents and citizens collaborate to provide public goods. It has become an increasingly important component of the public sphere and a worthy subject of investigation. During the pandemic, co-production received attention as it rarely has before (Steen & Brandsen, 2020).

Since its first appearance in scholarly literature in the 1970s, the concept of co-production has evolved significantly. Brudney and England (1983) initially defined it as citizen involvement or participation (rather than bureaucratic responsiveness) in the delivery of urban services. Co-production was specifically used to describe "an emerging conception of the service delivery process that envisions direct citizen participation in the design and delivery of city services with professional service agents" (Brudney & England 1983, p. 59). However, the definition of co-production has grown to include more than just citizen-government interactions. More recently, the theory has been contextualized as a variety of collaborative governance arrangements that can involve a diverse range of actors in a wide assortment of public service cycle activities. (Howlett & Ramesh, 2017, p. 3; Osborne & Strokosch, 2013).

The service management literature emphasizes the iterative interactions between the producer and the user in the co-production of public services, as well as their operational interdependence. Co-production recognizes the complex relationships between actors and organizations in the public, private, and non-governmental sectors. It also emphasizes a pluralistic model of public service based on multi-actor policymaking and public action. This results in the co-creation of value for the service user, which is fundamental to public services that are capable of not only addressing individual needs but also producing a

broader, viable, and effective contribution to society. This is the heart of sustainable public services in the twenty-first century.

Nabatchi et al. (2017) indicate there are two types of co-production participants: state actors who are government agents serving in a professional capacity, and lay actors who work together with state actors. "Regular producers," the state actors, are public agents, professionals, or service providers. State actors need not be government employees, but must work on behalf of the state either directly or indirectly (Nabatchi et al., 2017). "Co-producers," or the lay actors, run the gamut between citizens, clients, consumers, service users, community members, or other actors such as community organizations and volunteers. The number of actors in an activity will vary; one-on-one interactions may occur, or multiple participants may collaborate in groups.

Given the breadth of activities to which the term has been applied, defining the production side of co-production can be difficult. "Production" refers to situations in which state actors and lay actors collaborate during the service delivery stage, but it can also refer to any stage of the public service cycle (Bovaird et al., 2015). The prefix "co" denotes cooperative activity. The "co" side describes who is involved, while the "production" side describes what happens and when.

Stages of the Co-production Cycle

In this respect, Nabatchi et al. (2017) distinguish four stages of the service cycle in which co-production may occur:

- Co-commission pertains to activities aimed at strategically identifying and prioritizing needed public services or outcomes. This phase seeks to understand what needs to be delivered, to whom, and to achieve what outcomes. On occasion, terms such as co-prioritization or co-financing may be used as synonyms to demarcate more distinct activities (Nabatchi et al., 2017).

- Co-design captures all activities that incorporate user and community input into public service operation decisions. This stage is the most widely discussed phase, as Osborne et al., (2016) describe co-design as improving the performance of existing public services by actively involving service users in the design, evaluation, and implementation. This could be accomplished through active participation in the planning or incremental improvement of the service as a whole.

- Co-delivery refers to the collaborative effort of state and non-state actors at the point of delivery of services. This stage is inherent to the provision of certain services such as education or healthcare, and is frequently focused on quality and efficiency improvements (Osborne et al., 2016).

- Lastly, co-assessment classifies the monitoring and evaluation of public services. It concerns activities that have already taken place, the outcomes of which are used to rethink or improve services (Nabatchi et al., 2017).

Overall, a co-commissioning process produces a list of priorities or needs; a co-design process results in a plan or arrangement; a co-delivery process transfers a good or service; and a co-assessment process creates a monitoring protocol or evaluation (Nabatchi et al.,

2017). In general, co-productive elements are more of a continuum than a steady state, as depicted in the cycle in Figure 3.1.

Figure 3.1: Co-production Cycle adapted from Nabatchi et al. (2017)
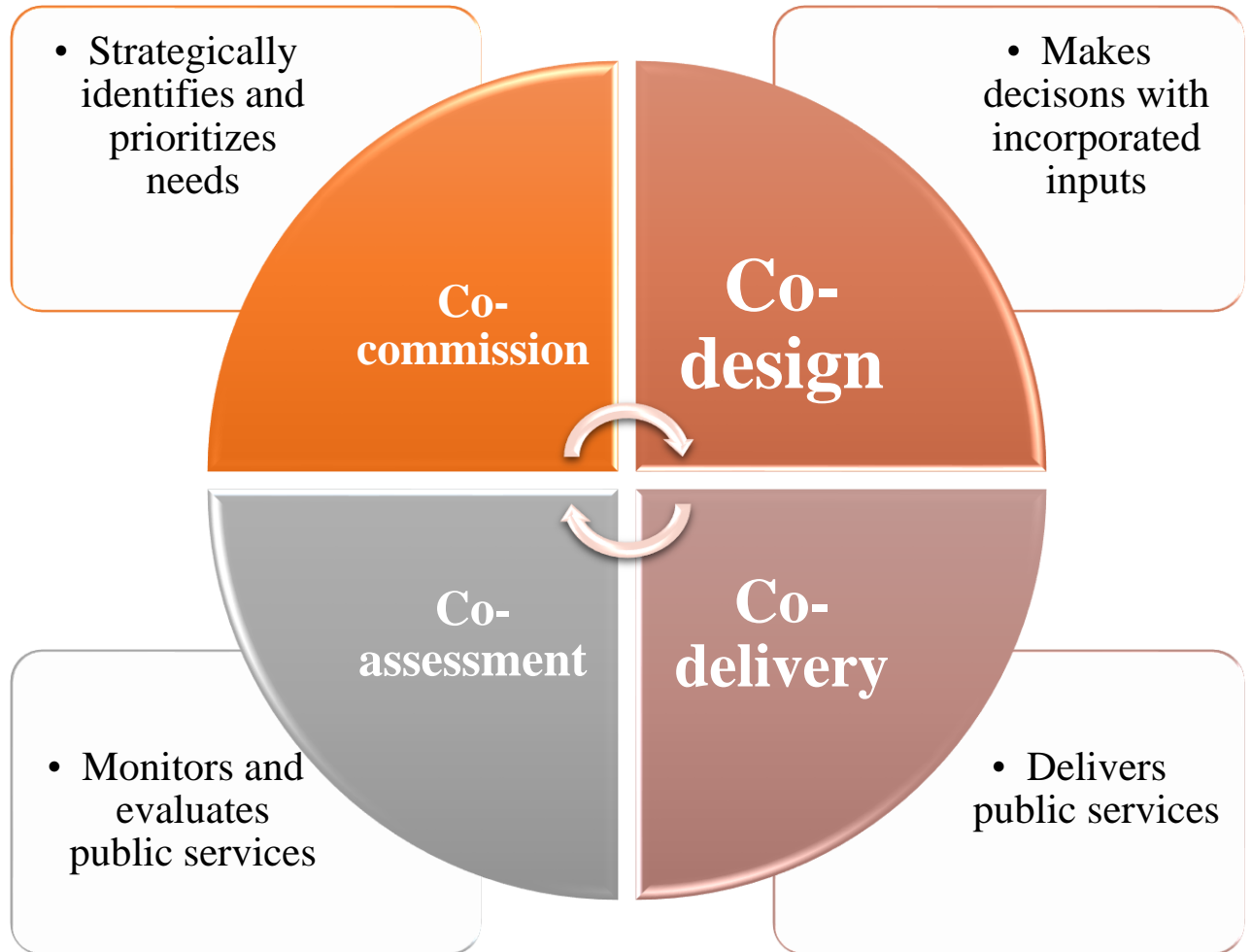
Both in literature and in practice, different roles meet and mix with different rationales for participation. Individual co-production describes a scenario in which a client or customer participates in the production of the services they use and receive benefits that are largely personal (Brudney & England, 1983). Collective co-production is based on the idea that production is not limited to users, but also includes citizens, volunteers, and non-

44

governmental partners. This type is intended to benefit the entire community. Cooperation increases the likelihood of: creating a shared understanding of complex problems; identifying, agreeing on, and implementing provisional solutions; and achieving "small wins." This refers to Lindblom's (1979) theory that an effective way to approach major policy challenges is to rely on incremental steps.

Conditions for Successful Co-production

Co-production is not universally advantageous, nor will it occur spontaneously simply because significant benefits can be achieved. Several circumstances heighten the probability that co-production will outperform traditional government production. The first condition is when inputs are owned by diverse entities. There is the possibility for synergy if "each has something the other needs, each providing their skills, time, and perspective" (Ostrom, 1996). When there is variety, each policy actor is more likely to be able to offer something unique, which when dovetailed with the offerings of other agencies, results in a better service.

Secondly, all parties must have access to legal counsel. Governments must make an effort to sustain funding and institutionalize legal flexibility. The third characteristic is the ability to build credible commitment to one another. According to Ostrom (1996), mutual commitment is needed so co-producers can trust that if they continue or even increase their input, other parties will likewise do so at the same or higher levels. Figure 3.2 depicts Ostrom's conditions for co-production.

Figure 3.2: Ostrom's (1996) Conditions for Co-production

Diverse Entities	• varieties of services to offer distinct inputs
Legal Options	• legal and institutional flexibility
Credible Commitment	• mutual understanding that levels of input will be matched
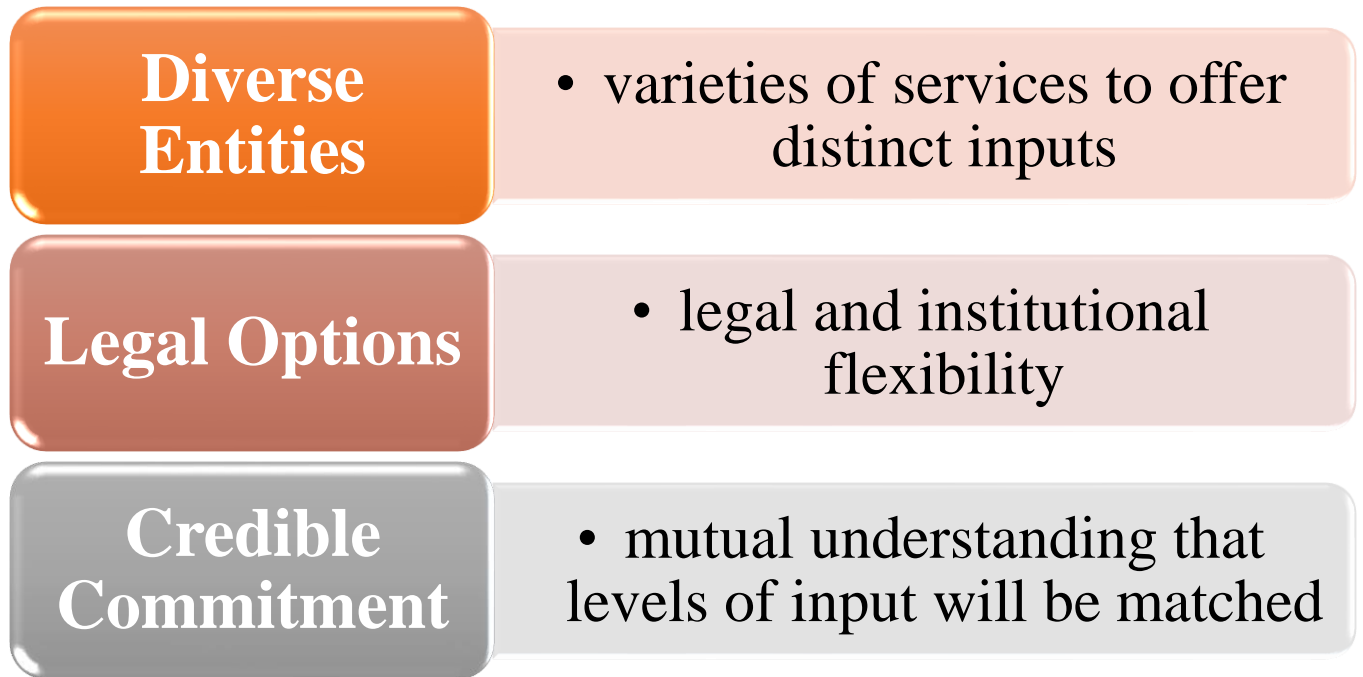
A polycentric political system is more likely to foster successful co-production than a monocentric one. Polycentricity is defined as systems of governmental and nongovernmental organizations at various scales, with small units nested within larger systems (Ostrom, 2008). As it denotes several centers of decision-making that are formally independent of each other, a polycentric polity provides opportunities to organize not one, but many governing authorities. In a polycentric system, public policy can be written in a general form that can then be tailored to local circumstances.

In a polycentric system, many more actions personalized to community needs can be authorized than in a monocentric system that attempts to establish uniform rules for all settings. This is because large units lack the necessary regional time and location

information. When various entities collaborate in a variety of open and nested arenas, productivity can increase and all forms of opportunistic behavior are more likely to be exposed (Ostrom, 1996). According to Torfing et al. (2013, p. 152), co-production broadens the "repertoire of possible governance roles."

Lastly, Jaspers and Steen (2019) emphasize the importance of maintaining co-producers' ability, motivation, and opportunity, arguing that these conditions are critical for not only facilitating co-production but also for sustaining it. In other words, incentives directed toward both citizens and professionals help encourage and prolong co-productive work. Sorrentino et al. (2018) summarize the key requisites to ensure effective operation and assessment as operable administrative structures, processes, and coordination, as well as political support. While these conditions have been well-established by Ostrom and subsequent scholars, they have never been studied in an emergency environment. This dissertation investigates co-production while in a phase of crisis policymaking, and identifies new necessary conditions when administrations are under extreme time and resource pressure.

Co-production and Digital Divide Discourse

The digital divide is defined by a lack of access to adequate devices, connectivity, and the requisite digital training and support. Because the digital divide is structured across three different domains, it is not uncommon for policy solutions to emerge from various sources. For example, broadband adoption efforts frequently necessitate collaboration among schools, internet service providers, and community-based organizations to ensure digital platform compatibility, to coordinate outreach efforts to reach every family, and to deliver adequate

digital literacy support. Much like digital have-nots, several studies have found that disadvantaged people, such as racial minorities, less educated individuals, and those in lower socioeconomic situations, are less keen to participate in co-production (Baker, 2010; Holmes, 2011). As a result, governments actually risk perpetuating inequities in service provision through co-production (Bovaird, 2007; Levine & Fisher, 1984; Rosentraub & Sharp, 1981).

Empirical studies on co-production are scant. There is little evidence available on either the enabling conditions or their relative impacts on the actors involved and on society as a whole. Durose et al., (2017) argue that co-production evaluation should be based on the local contexts in which collaborative activities occur. They purport that until the system is translated and adopted in community contexts, co-production will remain more of an ideology than a concrete organizational process. Brix et al. (2020) also surmise that activities in a co-production process can be affected by several factors, such as local rules, available resources, and organizational culture. Culture serving as a contextual variable is why this dissertation focuses specifically on digital divide discourse, a facet that is addressed in **Research Question**[1].

Discourse analysis is an academic field with connections to linguistics, sociology, psychology, philosophy, and communication. One advantage of this method is that it considers social context, as suggested by Durose et al. (2017) and Brix et al. (2020). Policy documents are inherently public relations documents. In a democracy, a policy has to be "sold," to constituents in order to ensure adoption of it.

The terminology used to talk about the digital crisis on social media can inform how experts are conceptualizing the divide and reacting to its evolution. In particular,

understanding how the topics discussed on Twitter change over time can be crucial to unearthing what aspects of co-production are perceived to be more salient and important for the population. Examining how digital equity is deliberated through the lens of COVID-19 will illuminate inequalities or how certain social groups may be misrepresented or underrepresented in conversation. Applying a governance angle to the analysis of co-production can reveal opportunities and challenges that specific forms will encounter on the ground at the individual, organizational and systemic levels.

Voorberg et al.'s (2015) and Sicilia et al.'s (2019) literature reviews of co-production research identify very few studies that examine the framework from a long-term perspective. The majority of co-production applications are concerned with the active or passive role that users play in the service delivery process, as well as their subsequent experience with the process. Little is known about organizational co-production, i.e., collaborations formed between different governmental entities or nonprofit-public partnerships. Nabatchi et al. (2017) acknowledge that more research is needed to flesh out the typology of co-production, to which this study contributes. This research will be useful and relevant to both policymakers interested in implementing or evaluating co-production programs and scholars interested in operationalizing the concept in real-world service delivery situations. These ideas will be addressed in **Research Question₂**.

Co-production and Crisis Policymaking

For the purposes of this study, a crisis is defined as "a situation of large-scale public dissatisfaction or even fear stemming from wide-ranging economic problems and/or an unusual degree of social unrest and/or threats to national security" (Flanagan, 1973). Crisis

management scholarship describes and explains societal actions in response to situations in which core values are threatened, there is an urgency to act, and there is uncertainty about the situation and courses of action (Rosenthal et al., 1989). These circumstances bring critical leadership challenges associated with decision making, public information, sense making, accountability, learning, and reform (Boin et al., 2016). They also require broad collaboration and coordination involving multiple individuals and organizations. Crises can shatter old patterns of thought and behavior, allowing new approaches and ideas to emerge (Luebbert, 1991, p.312).

According to Kingdon (1984) and others, a burst of successful policy innovation is only possible when the various constraints that normally stymie a government give way. This opens a "policy window," or opportunity for action on public policy initiatives. Two types of factors can act separately or in tandem to open such policy windows: political developments and societal problems (Keeler, 1993). This explains why the rise of the concept of co-production coincided with a period of fiscal austerity in the United States, which prompted calls to produce more with less, redevelop intergovernmental service delivery arrangements, focus on operational productivity, and de-professionalize bureaucracies (Alford, 1998; Brudney & England, 1983; Levine & Fisher, 1984; Parks et al. 1981). Furthermore, the global financial crisis that struck nations all over the world in 2007 and 2008 heightened interest in co-production (Nabatchi et al., 2017).

The COVID-19 pandemic requires all levels of government to act in an environment fraught with great uncertainty and strained by severe economic, fiscal, and social constraints. National, regional, and local governments find they cannot rely on a linear policy path

to manage, exit, and recover from the crisis. When the demand for public services rises suddenly and dramatically, governments increase their dependency on citizens or other entities to help create and deliver solutions. As a result, this dissertation is presented with a logical opportunity to redeploy the theory of co-production as the COVID-19 pandemic provides evidence for the importance of consultation, coordination, and collaboration among government and non-government actors.

Given fiscal constraints, organizational imperatives, and citizen expectations, co-production is likely to continuing growing in the future. Thus, it vital for scholars and practitioners to develop better ways to explain and study its applications and impacts. The pandemic has renewed attention to the importance of, and how little is known about, policy learning under stress and limitations. The conditions that gave rise to co-production are likely to change as emergency regulations and funds are phased out and the sense of urgency dissipates. Furthermore, deeply ingrained social behavioral patterns may afford institutions to easily revert back into business-as-usual practices. This further justifies why now is the ideal time in history to engage with this theoretical lens, not only understand how it operates in emergency environments, but also to sustain the benefits it provides. Answering **Research Question₃** will help better understand this phenomenon.

CHAPTER 4: OVERVIEW OF METHODOLOGY

Given its recent developments in history, little has been studied about how policies are created in the age of COVID-19, particularly when time, knowledge, and resources are limited. Furthermore, while it is recognized that the digital divide exacerbated due to the pandemic, research is embryonic in unearthing best practices from a policymaking and service delivery lens. This chapter justifies use of an inductive and mix-methods approach and provides an overview of the exact methodology employed to address these gaps in literature. It also reviews pilot research that was conducted for this study during the summer of 2020.

This dissertation builds off of the pilot research and addresses the three research questions below. Digital trace data answers **Research Question₁** and informs some details of the second half of this study, such as the lines of inquiry. Interviews with digital equity stakeholders in Boston supplement the quantitative findings that answer **Research Question₁**. Additionally, qualitative methods address **Research Question₂** and **Research Question₃**.

- **Research Question₁**: How has digital equity discourse changed nationally amid the COVID-19 crisis?
    - How has the frequency of discourse changed?

- How has the content evolved?

- **Research Question2**: How is digital equity addressed through co-production?

  - What are the outcomes?

  - What is the process?

- **Research Question3:** What conditions lead to successful co-production in times of crises?

Inductive Method

This study employs inductive logic because it begins with data to generate inferences, then progresses to theoretical generalizations and propositions. According to Thomas (2006), the benefits of inductive reasoning include the following: the abbreviation of raw textual data into a brief, summary format; the establishment of clear links between the evaluation or research objectives and the summary findings derived from the raw data; and the development of a framework of the underlying structure of experiences or processes that are evident in the raw data. This method is appropriate because elements of this study are exploratory in nature. Given the scarcity of theories and hypotheses on this topic, employing a deductive framework is difficult.

Mixed-Methods

Combining multiple research approaches affords a more in-depth and comprehensive understanding of the policy issue. This dissertation collects both primary quantitative and qualitative data sequentially and integrates the two in order to yield additional insights beyond what either method could provide alone. Social media allows for a broad reach and

rapid collection of data, whereas interviews afford targeted and local intervention. This study

achieves methodological congruence, meaning its objectives are interconnected and cohesive

as a whole rather than a collection of independent parts. Table 4.1 depicts a data matrix that

summarizes and synthesizes the executed methodology.

Table 4.1 Data Methods Matrix

Research Question	Needed to Know	What Kind of Data	Data Access	Data Analysis
How has digital equity discourse changed nationally amid the COVID-19 crisis?	Was there in increase in quantity of rhetoric and/or a change in content topic from news sources or public officials?	Aggregated tweets from verified social media accounts triangulated with interview data	Twitter API	Descriptive statistics, times series, regression, natural language processing techniques, unsupervised machine learning classification
How are digital equity policies co-produced?	What is the process like, and what are the outcomes?	Interviews with City of Boston policymakers, nonprofit organizations, municipal actors etc.	Connections with previously interviewed respondents	Open and axial coding of interviews
What conditions lead to successful co-production in times of crises?	Do traditional conditions documented by Ostrom (1996) change during emergencies?	Interviews with City of Boston policymakers, nonprofit organizations, municipal actors etc.	Connections with previously interviewed respondents	Open and axial coding of interviews

Quantitative Methods – Digital Trace Data

The digitalization of social life provides an unprecedented amount of data for investigating

human life and social systems. Digital trace data, defined as "records of activity undertaken

through an online information system" (Howison et al., 2011), has numerous advantages that make it a viable and logical method for this study. One of the most appealing aspects is that it is constantly collected, as opposed to surveys, which typically only provide a brief snapshot of the social world. Major events such as protests, revolutions, or emergencies are captured on social media as they unfold.

This "always-on" property gives the data a time dimension, making it suitable for studying unexpected phenomena and producing real-time measurements (Salganik, 2019). Another significant advantage of digital trace data is that it is non-reactive, or not produced through interaction between researchers and those being studied. Thus, respondents are more likely to act naturally because they are unaware that their data is being collected. This significantly reduces social desirability bias or other types of interviewer effects (Salganik, 2019). The following quantitative sections detail: justification for twitter as a data source, an overview of each text analyses conducted, ethical considerations, and data limitations. The analyses run include descriptive statistics, word frequencies, times series analyses, regression discontinuity design, sentiment analysis, and Latent Dirichlet Allocation topic modeling.

Strengths of Twitter as a Data Source

Twitter is an excellent platform for social science research because it provides a public record of attitudes, beliefs, and activities over a long-time horizon. The longitudinal nature enables research into how discourse changes over time with a degree of continuity that would be difficult to achieve by other methods. The volume of content is enormous – nearly 500 million posts are created every day (Sayce, 2022). Furthermore, the public network of Twitter makes it possible to see who is influencing the conversation. Another advantage of

social media as a data source is that it affords observations outside of the narrowly defined bounds of a specific setting or survey. This method allows for a more accurate representation of public discourse because it avoids many of the human biases that a research setting could introduce.

On the content production side, Twitter is used extensively by political actors for the diffusion of policy ideas, communication of news, and the organization of collective action. Its structure has proven to be especially responsive to breaking news events and similar rapid information cascades, facilitating quick dissemination of emerging information. Twitter is a particularly valuable source as it archives history as it happens. Users can generate social media content without being constrained by a news hole or broadcast schedule – production and broadcasting capacity are unlimited. As a result, social media exhibits a flexible nature, operating indefinitely with almost an unlimited number of content providers. Because of these unique features, there is evidence that social media has the potential to set the agenda of public debates. Neuman et al. (2014) discovered that agenda-setting is no longer a one-way pattern from traditional media to a mass audience, but rather a complex and dynamic interaction.

Research has determined that news organizations use Twitter as a supplementary means to disseminate their own material (Pew Research Center, 2011). For nearly every news organization, Twitter has become a regular part of the daily news outreach, thus capturing policy activity. The news content posted closely corresponds to the news events prioritized on the organizations' legacy platforms. A Pew Research Center study (2011)

reported that the vast majority of the postings promoted the organizations' own work and directed users back to their websites.

Text Analysis Overview

Discourses are powerful narratives that shape attitudes and actions toward major societal issues and those affected by them. Understanding policy discourse helps shed light on policy behavior. Quantitative text analysis is an increasingly popular method for the operationalization of various types of discourse analysis. Text analysis is the scientific examination of word use patterns in texts that employs both formal statistical methods and less formal, more humanistic interpretive techniques. A content analysis approach is defined as "a research technique for the objective, systematic-quantitative description of the manifest content of communication" (Berelson, 1952, p. 18). Content analysis consists of breaking down texts into pertinent units of information in order to permit subsequent coding and categorization. The following sections review in depth the analyses that are applied to the dataset in this study: descriptive statistics (exemplary tweets and histograms); time series and regression discontinuity design; sentiment analysis; and Latent Dirichlet Allocation topic modeling.

Descriptive Statistics

This analysis begins by highlighting exemplary tweets that have garnered the highest levels of engagement. In this study, engagement is operationalized as liking a tweet, retweeting it, replying to it, or quote tweeting it. Understanding these outliers aids in identifying what communication or conceptual frames resonate most with citizens. This measurement is

balanced by histograms of aggregated frequency counts that explore the most frequent n-grams used in the dataset. Figure 4.1 show a flowchart by Silge and Robinson (2017) depicting the process for frequency text analysis – the data is cleaned, organized, summarized, then visualized.

Figure 4.1: Flowchart of Text Analysis (Silge & Robinson, 2017)
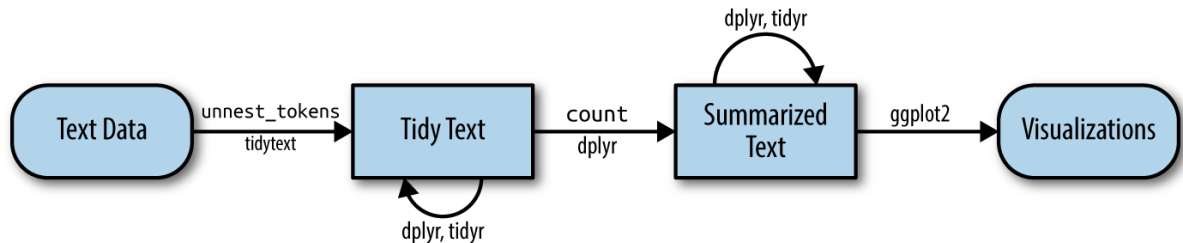
Time Series

A time series analysis addresses the first sub-question of **Research Question**[1], and illuminates how the frequency of discourse changed. This graph plots the rate of social media usage across time and elucidates changes and upticks in digital divide discourse. Peaks in the graph are contextualized with background information about the event responsible for the spike. By analyzing the time trends in the discourse, policymakers gain insight into what incidences are deemed worthy of discussion and at what levels.

Time series analyses are also used in this study to delve deeper into framing effects. The process by which people develop a specific conceptualization of an issue or reorient their thinking about an issue is referred to as framing (Chong & Druckman, 2007). The central tenet of framing theory is that an issue can be viewed from various angles and interpreted to have implications for multiple values or considerations. Frames of the concept digital divide versus digital equity are analyzed and compared in magnitude and timing.

58

Sentiment Analysis

Sentiment analysis is a subfield of natural language processing (NLP), computational

linguistics, and text mining. It is a term for the computational treatment of opinions, feelings,

or subjectivity of texts, and refers to any measures that extract subjective information from

textual documents (Feuerriegel & Proellochs, 2021). The goal of this method is to

systematically unearth value judgments of text in a way that is more consistent and replicable

than a holistic human judgment. The extraction of the emotional polarity encoded in the

tweets has the potential to predict future behavior. For example, Bollen, Mao, and Zeng

(2011) applied a sentiment analysis to large-scale Twitter feeds, and discovered that

measurements of collective mood states are correlated to the value of the Dow Jones

Industrial Average over time.

The lexical approach refers to the use of a dictionary coded for specific sentiment

features, such as positivity, negativity, anger, fear, joy, etc. (Pawar et al., 2015). Through this

method, the text to be analyzed is divided into either individual words or groupings, then

compared against the dictionary. Then, the values of all the groupings are totaled up to

identify the coded emotion score. Figure 4.2 demonstrates a typical flowchart for sentiment

analysis (Silge & Robinson, 2017) that this study mimics. The text data is cleaned, reconciled

with a coded dictionary, summarized, then visualized.

Figure 4.2: Flowchart of Sentiment Analysis (Silge & Robinson, 2017)
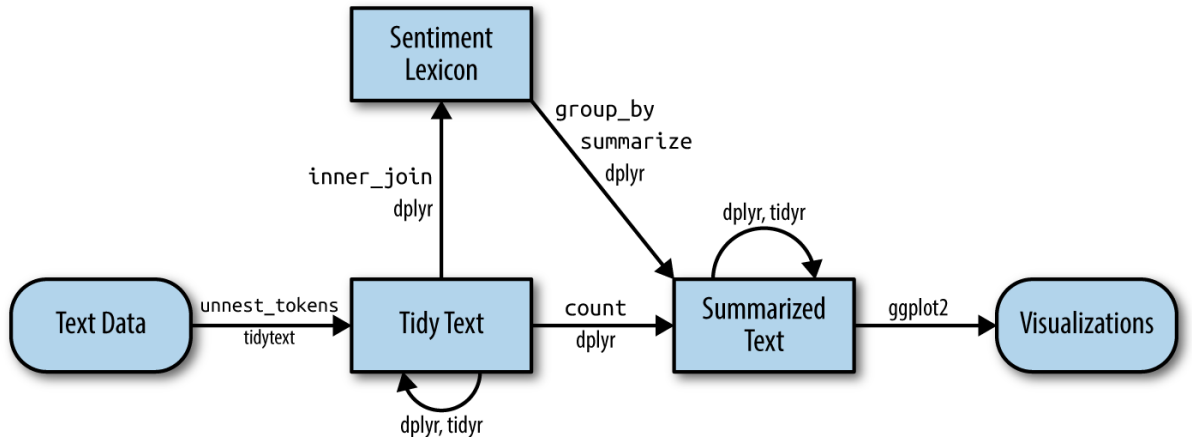
Topic Modeling

Machine learning refers to the computer application of induction algorithms, which take specific instances as input and produce a model that generalizes beyond those instances. Provost and Kohavi (1998) identify two commonly discussed approaches to machine learning: supervised and unsupervised. Supervised learning describes techniques used to learn the relationship between independent attributes and a specific dependent outcome. Unsupervised learning describes methods that organize data based on independent attributes without a specific outcome variable.

Topic modeling is an inductive, unsupervised machine learning method for large-scale text mining. It is the statistical process of extracting themes from documents and one of the primary theoretical frameworks for studying meaning-making in text and speech. This method reduces the complexity of a large corpus by representing each text as a combination of topics revealed by a hierarchical Bayesian model (Foster et al., 2013). Topics are groups of words that appear repeatedly in texts; however, whether these groups are interpreted as

themes, frames, issues, or other latent concepts depends on methodological and theoretical choices. Topic modeling does not eliminate qualitative interpretation, but rather displaces it to a later stage of the analysis.

Latent Dirichlet Allocation (LDA), a method developed by Blei, Ng, and Jordan (2003), is one example of a topic model used to extract topics from a document. LDA is a probabilistic generative model that represents documents as mixtures of topics and assigns certain probabilities to each word, thus topics may overlap. The Latent Dirichlet Allocation method aids in determining which issues, frames, or populations are commonly discussed together in digital divide discourse and how strongly they may be linked. Figure 4.3 illustrates a flowchart by Silge and Robinson (2017) for formatting text into a Document Term Matrix, readying it for unsupervised machine learning analyses and visualizations. This investigative, bottom-up, data-driven technique of data mining assists in answering the second sub-question of **Research Question**1. Specifically, it addresses how the content of digital equity discourse has changed by understanding what is discussed through clusters of topics.

Figure 4.3 Flowchart of Topic Modeling (Silge & Robinson, 2017)
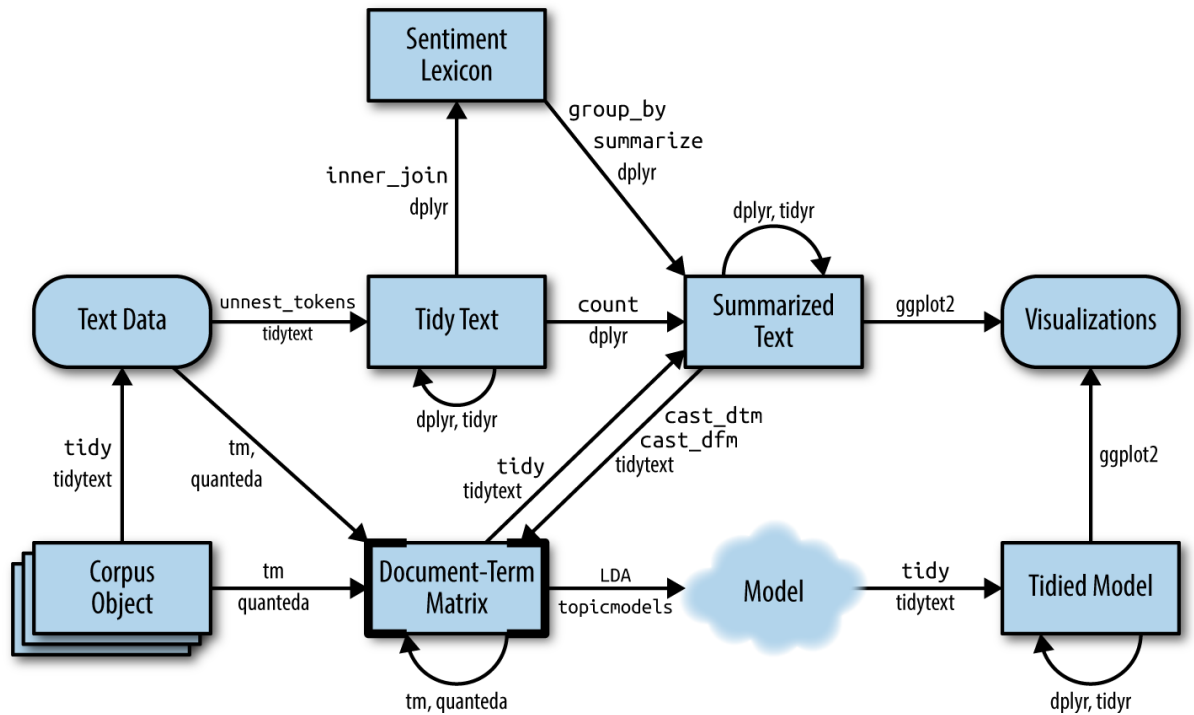
Ethical Considerations

The use of Twitter data in research falls somewhere between primary and secondary data

analysis. It is primary data because there is no formal curatorial activity between the

participant who provides the data and the researcher who analyzes it. At the same time, it is

considered secondary data because the information is gathered from an aggregating

intermediary rather than the participants. Regardless, this analysis does not require

Institutional Review Board approval; however, it does require registration for a developer

account with Twitter. Developer accounts are only available for graduate students or

academic researchers working on projects that require Twitter data. The brief application

requests a name, Twitter account, affiliation, proposed project, and proof of student or

scholar status via an institution's department website or Google scholar. In Summer 2021, a developer account was created for this research, granting access to all of the previously described data and methods.

As such, Twitter requires an informed consent process that meets its own acceptability criteria. At the point of signing up to use its services, users are informed of what will happen to their data, including that it may be used for research. Terms of service specifically state that users' pubic posts will be made available to third parties. By accepting these terms, users legally consent to this process. The platform is designed to be public, carrying no expectation of privacy, which allows researchers to search and analyze the data while complying with human subjects' protection protocols. The reasonable expectation of tweeters may therefore be assumed to be that when posts are public they may be analyzed in accordance with the agreements that Twitter set forth. Nothing more than active compliance with the terms would therefore be required from an ethics standpoint.

Specifically for this study, verified Twitter accounts are not considered a vulnerable community. In fact, all of the tweets collected were curated by a public figure with the intent to reach as wide an audience as possible. There is no anticipated risk or harm to individuals or the population as a whole. No participants were actively recruited nor was information collected outside of the terms and conditions (such as data scraping). Other safeguards were also implemented to ensure proper use of data. Files were stored on a password protected computer and all protocol set by Twitter was abided by. Figure 4.4 presents a flowchart (Williams et al., 2017) that was consulted to reach decisions on the publication of Twitter communications.

Figure 4.4: Flowchart of Twitter Publication Decisions (Williams et al., 2017)
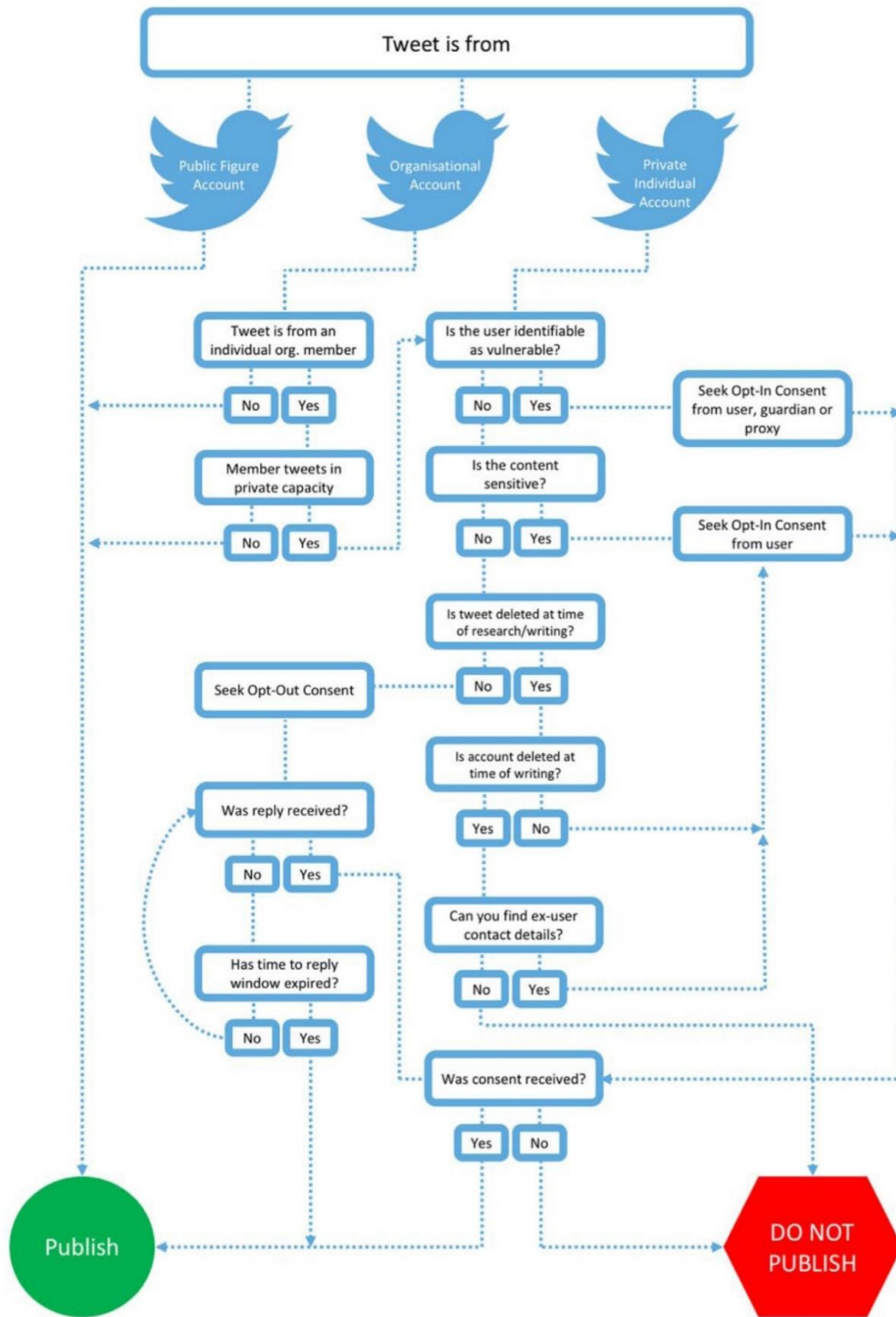
Data Limitations

Due to the dynamic nature of the platform and users' ability to produce and delete their own content, reproducibility and reliability challenges exist. There is no guarantee that each analytical attempt will yield the exact same results. Other limitations arise as a result of the fact that all social media data is proprietary and owned by technology companies. As a result, data sources and data types that could strengthen the conclusions of this research are unavailable. Additionally, Twitter is neither the only nor largest social media platform. However, most companies' datasets, such as Facebook, Instagram, or LinkedIn, are not publicly or commercially available. While misinformation does pose a threat on social media websites, there is no literature to support that any of the collected tweets contain widespread misinformation or disinformation on the subject of the digital divide.

Qualitative Methods – Interview Data

A qualitative research method implies that social reality is constructed by people. This worldview lends itself to a more inductive approach which aids in the generation of a theory. Because COVID-19 created a brand-new set of digital equity policymaking challenges, not a lot is known about the situation at this point in history. Therefore, it is appropriate to incorporate exploratory qualitative interviews into the study. Further qualitative research is needed to understand in-depth processes and complement the findings of the quantitative approach.

Interview Overview

The term "policymaker" is not easily defined. In government entities, there are numerous systems and complexities that must be recognized and accounted for. For the purpose of this study, policymakers are operationalized as policy creators or implementors. This is because local entities with no direct regulatory or statutory authority over broadband providers play a role in closing the digital divide.

Interviews with policymakers are an essential step towards understanding how digital equity solutions are crafted now and throughout the COVID-19 pandemic. Professionals who have a historical understanding of digital policies and their evolution were recruited. Because the typology of co-production provides language for describing and explaining the variations of the theory, interviews facilitated the examination and comparison of cases and experiences. The overall goal of the interviews was to highlight where various entities fit into the model of co-production (**Research Question$_2$**): co-commission; co-design; co-delivery; or co-assessment. Additionally, conversations were designed to address **Research Question$_1$** and **Research Question$_3$** by discovering changes in policy framing, disincentives to co-production, and conditions necessary for success. More details, such as participant recruitment, ethical considerations, and data analysis is explained in Chapter 6.

Pilot Research

In response to the COVID-19 crisis, the City of Boston worked to address emergency gaps in internet access among Boston Public School students and adult learners. This was accomplished primarily through the distribution of Wi-Fi hotspots and Chromebooks, and by helping disseminate information about low-cost internet service options. The City was

actively creating plans to continue addressing gaps in access to internet and digital tools

through existing resources and the support of partners. In addition to making existing

priorities more urgent, the COVID-19 crisis also presented new challenges as the City

worked to maintain a commitment to their organizational missions in the present reality.

There was a need to better understand how local government could best support

organizations as they adopted and utilized new models of reaching their constituents.

Between June 2020 and August 2020, when the COVID-19 crisis and its effects were

still widely unknown and in their infancy, eleven semi-structured qualitative interviews about

digital equity in the City of Boston were conducted. Respondents included a mixture of City

department officials and non-profit experts, all of whom promote missions catering to adult

education, workforce development, or social services to a vulnerable population in the

greater Boston area. This research[1] sought to understand the online transitions that

organizations had to suddenly make amid the pandemic, the difficulties that constituents

faced connecting with them, and new digital needs that arose. Via a snowball sample, these

organizations were interviewed and asked open-ended questions regarding the changes they

made to their models, their short-term and long-term barriers, and opinions about what a

future modality would look like for their classes and programs. More information about the

time frame and interviewees can be found in Appendix A.

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[1] This research was made possible by the City of Boston's Department of Innovation and Technology (DoIT) and the Rappaport Institute, housed in the John F. Kennedy School of Government at Harvard University, which aims to improve the governance of Greater Boston.

Digital Equity Outputs

The pilot study was instrumental in identifying various manifestations of digital equity. In line with the literature, outputs included both material devices and intangible trainings or educational resources. One nonprofit organization that provides free tech training reported, "We loaned out laptops to many students, we loaned them webcams, we loaned them headsets, and for a few students in Boston we loaned them MiFis as well, because they didn't have access to the internet." In addition to also supplying hardware to patrons, the Boston Public Library provided educational resources to organizations and library-goers alike. A representative stated, "Every Tuesday and Wednesday we had a one-hour Q&A, that was just an open Q&A where anybody can come and ask questions and we could give them feedback on how to refine their virtual programming." Additionally, the library redeployed their community learning team to monitor a technology helpline where patrons could call in to received assistance over the phone.

For organizations that had the financial capacity, it was common to provide both material access and digital literacy training to their constituents in tandem. A vocational service non-profit explained,

> "We bought 300 Student Pros, they're the student version of Surface Pros, and we're now deploying that as a student lending library. So, when you sign up for a class, if you don't have access to a computer, you will have one. And we brought on a student help desk, like a tech help desk. We contracted with a company that has the ability to speak ten languages, and they're doing the help desk for the students."

Some organizations, such as a digital equity nonprofit, have been battling the digital divide since before the pandemic. In those cases, their mission statements shifted from, "get new computers, quality internet, and digital life-skills training into the hands of those that don't

have it," to providing additional videos or webinars on how to order groceries online or how to file for unemployment. Other outputs included bilingual instructions or training sessions, software access, and vouchers for discounted at-home internet.

Evidence of Co-production

The pilot research yielded numerous insights that aided in the decision-making process for this current study. For example, interviews revealed numerous instances of co-production at various stages of the cycle, proving it an effect lens to marry with crisis policymaking and the digital divide. In one instance, a nonprofit focusing on digital equity stated they worked closely with the City of Boston for twenty years, although the interview did not expand on in what capacity. Overall, it was clear that many of the entities had collaborated together in both the past and present emergency environment. The following paragraphs detail at least one example of each phase of co-production as outlined by Nabatchi et al. (2017): co-commissioning, co-design, co-delivery, and co-assessment.

Co-commission

The data suggests a specific instance of co-commission took place when a leader from the Boston Public Library worked with the Boston Public School District to identify needs and comfort levels of their patrons. They stated, "we aligned programming with using Zoom because of the Boston Public Schools using Zoom. So, there was a lower barrier for people who are young adults or have children, in that they don't have to learn two technologies to join one of our programs." Another actor who helped to prioritize constituents' needs was the Office of Immigrant Advancement. A representative suggested, "[we did] a lot of just

assessing the needs in the community. Because we work with immigrant communities there's

not one need that the community has, there's a whole sort of things that are needed." This

information was shared with other organizations, signifying the presence of co-commission.

The interviewee expanded,

> "When everything started, we basically did a round of calls to make an assessment of what were the needs on the ground. We have a list of organizations that we work with and we basically said, "okay let's start calling people." … We said that the best way we can keep those communities informed is by keeping those leaders informed who are still doing the work on the ground."

Co-design

The Boston Public Library also discussed a collaboration with a local nonprofit to co-design

solutions:

> "We're partnering with Tech Goes Home. We're starting to do some classes. They flipped their model where they ship devices to people before the class begins, so they can join virtually, etc. I would like for us to do something more like that here, where if someone comes into the library, we don't just give them time with the computer, we can give them an actual computer as long as they commit to completing a training, etc."

Another nonprofit that supports adult English as a Second Language programs expressed

gratitude for the City of Boston who helped set up professional Zoom accounts and get

devices to their learners.

Co-delivery

The library similarly indicated a partnership with another Mayoral office to co-deliver

resources. "One thing we were looking at doing was partnering with the Office of Returning

Citizens and providing education around how to use a smartphone." Another government

office, the Age Strong Commission, spoke of coordinating with nonprofits to distribute

tablets, and also worked through the Department of Innovation and Technology to secure iPads to disseminate to senior citizens. The interviewee expressed that it was easy to hand out the devices, but would prefer to outsource the education component to a nonprofit organization – highlighting the intricate layers of the digital divide and the need to co-produce solutions.

Co-assessment

Evidence of co-assessment was observed by a vocational service non-profit organization who built the following mantra into their model. A leader specified, "the only rule is that if it works, let other people know what it is and how you use it, and if it doesn't work, let people know what it is and why not to use it." The extent to which any evaluations were shared outside of the organization was unclear due to that being outside the scope of the interview. However, there was a strong potential to provide valuable feedback to other policy-focused entities.

Summary of Pilot Research

Overall, preliminary research on this topic during the early stages of the pandemic proved this is an area worthy of further exploration. There is a clear need to understand all the different forms that digital equity outputs may take in order to best leverage skills and resources. The pilot interviews revealed signals of co-production occurring at every stage of the cycle: co-commission, co-design, co-delivery, and co-assessment. Chapter 6 builds on the list of established outputs and expands on the idea of co-production as a necessary driver for

71

effective policy change by reviewing even more granular themes that emerge within the four

stages.

CHAPTER 5: QUANTITATIVE FINDINGS

Chapter 5 empirically observes and measures the impact of the COVID-19 crisis on the digital divide in order to understand how digital equity solutions were developed throughout the pandemic. One way to investigate this effect is to track changes in policy discourse over the course of the digital divide's existence. Digital trace data provide nonintrusive insights into human behavior with high precision and granularity. These digital footprints can be gathered from a wide range of technical systems, including websites, social media platforms, apps, and so on.

Social media platforms generate a vast amount of data on a daily basis on a variety of topics, representing a key source of information for understanding twenty-first century society. Specifically, Twitter is the data source for the subsequent quantitative methods as it facilitates intra- and inter-organizational activities among peers, governments, businesses, and organizations. This study starts with a large-scale quantitative analysis of verified tweets to identify topics in the ongoing digital divide discussion and understand its trajectory. These insights also help inform the second half of the study. This research did not require institutional review board approval, as it employs publicly available, anonymized, and aggregated data for all analyses. The quantitative data collected for this section of the study answers the first question proposed in this dissertation:

- **Research Question₁**: How has digital equity discourse changed nationally amid the

    COVID-19 crisis?

    o   How has the frequency of discourse changed?

    o   How has the content evolved?

The following sections outline the strategies used to acquire and validate the dataset then reviews the findings in the context of digital equity policymaking. Example outlier tweets are included to frame the discussion and demonstrate resonating content. Tweet sources and users' profiles are also analyzed to understand the validity of the sample acquired. The analyses run include descriptive statistics, word frequencies, times series analyses, regression discontinuity design, sentiment analysis, and Latent Dirichlet Allocation topic modeling.

Data Acquisition

The advent of social media significantly altered the way many people, communities, and organizations communicate and interact. With roughly 152 million active users worldwide as of 2020 (Statista, 2020), Twitter remains the most popular social media platform for academic research because it provides data through a variety of Application Programming Interfaces (API). Via the publicly accessible API services, tweets that users post online can be mined and studied. This study uses the statistical software program R to gather and analyze tweets.

Twitter's Academic Research product track allows authorized users to access the full archive of (as-yet-undeleted) published tweets. This data can be accessed with precise filters and shortcut functions for tweets containing media content, geographic location information,

URLs, and so on. The R package "academictwitteR" (Barrie & Ho, 2021) enables efficient and responsible storage of data as well as a number of query building functions. Each observation contains approximately thirty variables, ranging from publicly available information to metadata.

The tweets in this study have the following characteristics: original version (not a retweet); not a paid advertisement; written in the English language; posted between July 1st, 2006 and March 11th, 2022; contain at least one of a number of specified terms of interest; and authored by a verified user[2]. The goal of requesting tweets from verified accounts is to ensure that content is from a credible source, such as a government office, news outlet, or public figure. Moreover, including only verified tweets increases the likelihood the sample captures a distinct set of political and media elites, whom political science literature would expect to be leaders of disfcourse and policy framing. The verification process that was in place at the time of data collection is thoroughly explained in an upcoming section. A repository containing code for the R package academictwitteR, which is discussed in the succeeding segment, can be found in Appendix B. There is a monthly tweet cap of ten million tweets.

The search query ranged from shortly after Twitter's inception to two years into the COVID-19 pandemic. The beginning time was operationalized on July 1st, 2006, and the end date was March 11th, 2022. March 11th was selected because exactly two years prior in 2020,

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[2] The Twitter verification process has changed since the data used in this dissertation was collected and analyzed. After the company underwent new ownership in late 2022, verified statuses became available to any user willing to pay a monthly fee. The subsequent section outlines the previous Twitter verification process, prior to the changes made by the new CEO.

the World Health Organization (WHO) declared COVID-19 a global pandemic, the

organization's first such designation since the H1N1 pandemic in 2009 (Cucinotta & Vanelli,

2020). Capturing pre-pandemic life and exactly two years of society during the global crises

allows for observations on how discourses shift and terminologies evolve. The total number

of observations in the final dataset is 427,250.

Search Query Strategy

The main workhorse function in the academictwitteR package in R collects tweets that match

a specific search query. The repetition of this action produced a data frame containing all

relevant tweets about the digital divide. To begin, a query was coded in R to request all

original tweets (excluding retweets) written in English by verified users that contained the

desired phrases. An iterative, step-wise process was used to develop and validate the search

scheme. Successive operators separated by a space produce Boolean "AND" logic, which

means that tweets match only if both conditions are met. Tweets match if either condition is

met if successive operators with "OR" between them are used. This search makes extensive

use of the "OR" operator, as the Academic Research product track allows queries of up to

1024 characters in length. Because of the nuanced way users construct language, it is likely

that not every tweet talking about the digital divide is captured. The purpose of the keyword

search is to identify a valid sample for the population of interest.

The query began with terms that appeared frequently in the background and literature

review of this dissertation, such as "digital divide," "digital equity," "digital equality,"

"digital inequity," "digital inequality," "digital inclusion," and "digital exclusion." The

phrases were coded in such a way that the tweet would be captured if both words appeared

anywhere in the text. There was no requirement for the words in the phrases to occur in any particular order. This was done in order to capture the complex ways in which people discuss the divide. The search terms would not apply to tweets if they were only found in a user's name or Twitter handle.

Using the initial data frame, word frequencies were calculated to determine other adjacent phrases, and the search was repeated with the addition of the new terms. For example, tweets were found to use both the terms "e-literacy," and "e literacy," (without the hyphen.) As a result, both iterations of the word were included in the subsequent search. This procedure also helped identify relevant hashtags, such as #digitaldivide and #meaningfulconnectivity. This process continued until additional terms were no longer substantially contributing to the dataset.

Queries were tested with geolocation filters turned on to try to limit the data to content within the United States. Twitter users can enable location services on their accounts and geotag their tweets with precise location data in the form of latitude and longitude measurements. This feature is disabled by default and must be enabled by the user. Previous research by Sloan et al. (2013) shows that approximately 0.85% of tweets are geotagged. When a US-bound geolocation filter was specified at first, the search returned a very small number of observations.

With the geolocation filter turned off in successive searches, the number of results increased by a factor of a hundred. Because less than 1% of tweets have geocoordinates attached to them, the location requirement was too stringent and excluded majority of tweets of interest. A number of excluding terms were added to the search to allow for results that

were not restricted by location yet still focused on the United States. To find these expressions, words were ordered by frequency and any location with more than a thousand mentions was used as a negator. The most popular destinations were India (n = 5,621), Africa (n = 4,449), the United Kingdom (n = 3,158), and Cuba (n = 1,847).

Twitter Verification Process

Analyzing solely verified content assists in the removal of bots, false positives, sarcasm, and misinformation. Verified tweets also filter out general public opinions in favor of digital divide research or policymaking from public figures. A verified user on Twitter ensures that the public interest in the account is genuine. Prior to 2022, to be verified an account must represent or be associated with a well-known individual or brand, as well as meet specific notability criteria.

Accounts of current key government officials and offices are eligible for verification, including heads of state, elected officials, appointed ministers, institutional entities, ambassadors, official spokespeople, and official candidates for state- or national-level public office. Individual accounts of journalists employed by authenticated news organizations, as well as official accounts of qualifying news organizations, may be verified. Qualifying organizations include: newspapers; magazines; broadcast, cable, satellite, or streaming TV and radio news networks, stations and programs; digital news publishers; podcasts; and similar media. Accounts representing prominent organizations and secondary affiliated accounts, including companies, brands, nonprofit organizations, as well as their leaders and other distinguished executives may undergo the verification process. Outside the professional categories defined above, people who use Twitter effectively to bring awareness, share

information, and galvanize community members around a cause, bringing about socioeconomic, political, or cultural change, may be verified (Twitter, 2021).

Sampling Validity

Because this approach attempts to analyze nearly all existing digital divide content, it does not involve traditional sampling processes. However, validity of the sample was still tested in a number of ways. For one, custom-building the dataset, as opposed to utilizing a pre-built tool, ensures the data collection, sampling, analysis, and reporting needs are tailored to this specific study. Additionally, as suggested by Jang and Park (2017), human coding can offer contextual sensitivity to text and provide an opportunity to test validity.

The corpus was manually scanned to ensure the expected data was included and demonstrate that the dataset of tweets for this study is a valid sample. Upon review, there were a number of tweets found related to individuals using customer support personnel to troubleshoot problems with online bank accounts. As a result, words such as, "ATM," "banking," and "wallet" were also excluded. Tweets related to Elon Musk's provision of internet in Ukraine were also omitted by eliminating hashtags such as #ukrainerussianconflict, or "Starlink," a satellite internet constellation operated by SpaceX. While these examples refer to digital problems or solutions, they are not contextualized in the same way as the digital divide in the United States.

To further empirically establish sampling validity, the source of the tweets was analyzed. Tweets posted from a computer browser, for example, have the source value "web client," whereas tweets posted from a mobile phone have the value "Twitter web app." This

variable can reveal whether the most frequent sources are linked to verifiable and credible

entities. Table 5.1 displays the top ten most popular sources and their frequency.

Table 5.1: Frequency Table of Tweet Sources

Source	N	Percentage
Twitter Web Client	61,976	14.5%
Tweetdeck	53,544	12.5%
Twitter Web App	52,637	12.3%
Twitter for Iphone	39,035	9.1%
Hootsuite	27,971	6.5%
Hootsuite Inc	19,161	4.5%
Sprout Social	15,999	3.7%
Buffer	14,043	3.3%
Khoros Cx	13,476	3.2%
Twitter for Android	12,091	2.8%

The data suggests the most widespread method of tweeting in this sample of tweets is

through a computer browser. This add confidence to the sample as professional users are

likely to engage with the platform on a laptop or desktop while at work. The sources

"Tweetdeck," "Hootsuite," "Hootsuite Inc.," "Sprout Social," "Buffer," and "Khoros CX,"

are all social media marketing and management dashboards. These systems allow

organizations to monitor multiple channels in one place, manage customer service, and

receive performance reports and insights. They cost money and require expertise to operate,

lending credence to the fact that the majority of the dataset is composed of professional,

credible authors.

User Information

In addition to identifying the source of the content, knowing who the rhetoric is coming from also tests that the sample captures the population expected. Out of the over 427,000 tweets, there are 64,307 unique authors. Due to software constraints, the top 1,935 most active user profiles in the dataset were analyzed. The accounts range from customer service support to global coalitions to the Federal Communications Commission. Table 5.2 lists the official account names, a brief description, and how many tweets they have in the dataset, grouped by entity type.

Table 5.2: Most Active Twitter Accounts

Public Figures

Name	Handle	Description	Location	N
Vala Afshar	@ValaAfshar	Chief Digital Evangelist at Salesforce	Boston, MA	720
Alex Howard	@digiphile	Director at The Digital Democracy Project	Washington, DC	523
Thomas C. Murray	@thomascmurray	Director of Innovation at All4Ed	Washington, DC	401
Jessica RosenWorcel	@JRosenworcel	Chairwomen of the Federal Communications Commission	Washington, DC	385
Jessamyn West	@jessamyn	Librarian and Researcher	Vermont	369

Political Entities

Name	Handle	Description	Location	N
Alliance for Affordable Internet	@A4A_Internet	Global coalition working to make broadband affordable for all	Worldwide	1,520
World Wide Web Foundation	@webfoundation	Nonprofit advocating for free and open web	World Wide Web	1,515
Paradign Initiative	@ParadigmHQ	Nonprofit working to deepen digital inclusion	Africa	1,147
NYC Housing Authority	@NYCHA	Largest public housing authority in North America	New York City	1.131
Free Press	@freepress	Nonprofit fighting for rights to connect and communicate	Washington, DC	980
Federal COmminications Commission	@FCC	Independent agency of the US federal government	Washington, DC	842

Companies

Name	Handle	Description	Location	N
EE	@EE	Mobile network operator and ISP	UK	3,509
MTN Nigeria Support	@MTN180	MTN Nigeria Online Customer Service Team	Nigeria	2,699
SBI Card	@SBICard_Connect	Indian Credit Card Market	India	2,478
Virgin Media	@virginmedia	Telecommunications Company	N/A	2,246
Ask Playstation	@AskPlayStation	Video Game Brand	N/A	1,985

Companies, particularly those with customer service accounts that tweet one-on-one with clients to troubleshoot any problems, tweet the most when compared to organizations or individuals. However, these tweets receive very little engagement outside of the specific user who was intended to receive it. The most predominant accounts in the public sector demonstrate a variety of initiatives, some of which exist solely online. Other organizations

that are vocal, but not quite as active as the parties in Table 5.2, include Pew Research

Center, United States Agency for International Development, Government Technology

Magazine, and the International Literacy Association. The most prolific public figures

include individuals in leadership positions at companies or non-profits, one chairwoman, and

a researcher. These entities are what the expected sample should include.

The account-level location field is a variable that a user can fill out as part of their

profile. Because specifying a geography is not required, and since any value can be written in

the text field, it is not a systematically reliable unit of analysis. With about 10% of usable

data, this convenience sample serves as a proxy measure to understand where in the country

conversations are originating. Figure 5.1 demonstrates the most common locations in the

United States that the top users indicated in their profiles. Blank observations were omitted,

and geographies with the same but differently worded names (such as New York City and

NYC) were combined.

Figure 5.1: Most Common United States Profile Locations
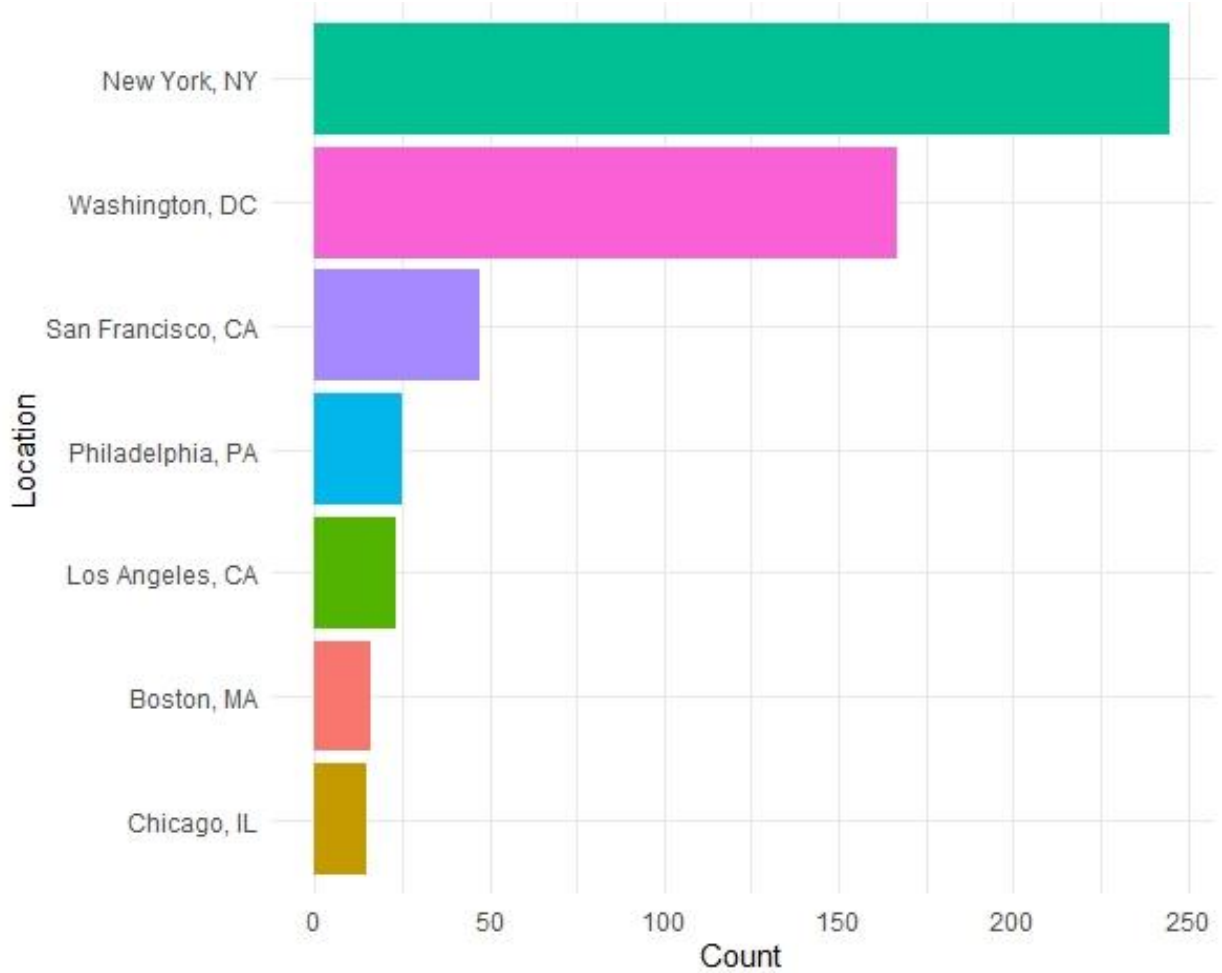
The data indicates the mode location is New York City. As the most populous city in the United States, it is a region where the digital divide became a large concern at the onset of the COVID-19 pandemic. Washington, D.C., is the second most popular area. This district is a fertile ground for policy research and lends support that a plurality of the voices come from policy-oriented sources. Other cities in the United States include: San Francisco, CA; Philadelphia, PA; Los Angeles, LA; Boston, MA; and Chicago, IL. As this dissertation

makes a case for Boston as a frontrunner in digital equity policymaking, its inclusion in the dataset as one of the top cities corroborates that the sample captures the topic of interest.

Data Analysis

In order to understand the nature and scope of Twitter discourse on the digital divide, the data was analyzed via an inductive approach. A series of rigorous preprocessing steps were performed to prepare the data for the natural language processing (NLP) type of analyses. First, all stop words were removed from the text. Stop words are words that are frequent but provide little information and are customarily extracted from analyses. In addition to standard stop words, a secondary group of custom stop words was created. These words included common structures found in a tweet, such as, "https," "http," "RT," "bit.ly," and so on. The word "digital" was also coded as a stop word. Finally, the tweets were tokenized, meaning the sentences were split into individual words and punctuation was removed. This step also cleaned the data from emojis and URLs.

Research Question₁ Findings: Digital Divide Discourse

The following sections review the quantitative research findings as they relate in a policy context. Content analysis methods (Berelson, 1952) break down text into pertinent units of information. Multiple methods are employed to validate the results of this study. The data demonstrates that the attention given to the digital divide online at the start of the COVID-19 pandemic not only increased but transformed in content as well. Descriptive statistics (outlier tweets), word frequencies, times series analyses, regression discontinuity design, sentiment analysis, and topic modeling, work together and answer **Research Question₁**.

Exemplary Tweets

Descriptive statistics aid in summarizing key features of a dataset. To determine peak engagement on this topic, the most retweeted, most replied to, most liked, and most quoted tweets were examined. Though these tweets are outliers in terms of the attention they received, dominant messaging helps frame the discourse and sets the upper boundaries. Succeeding analyses balance this by observing the most common content through frequency counts of words and bigrams.

The most retweeted tweet in the dataset was written by Los Angeles City Council Member Kevin de León on August 28, 2020. It reads: "Two students sit outside a Taco Bell to use Wi-Fi so they can 'go to school' online. This is California, home to Silicon Valley… but where the digital divide is as deep as ever. Where 40% of all Latinos don't have internet access. This generation deserves better." A photo of two children sitting on a curb with laptops is included in the tweet. The message was retweeted more than 25,000 times.

Figure 5.2: Most Retweeted Tweet
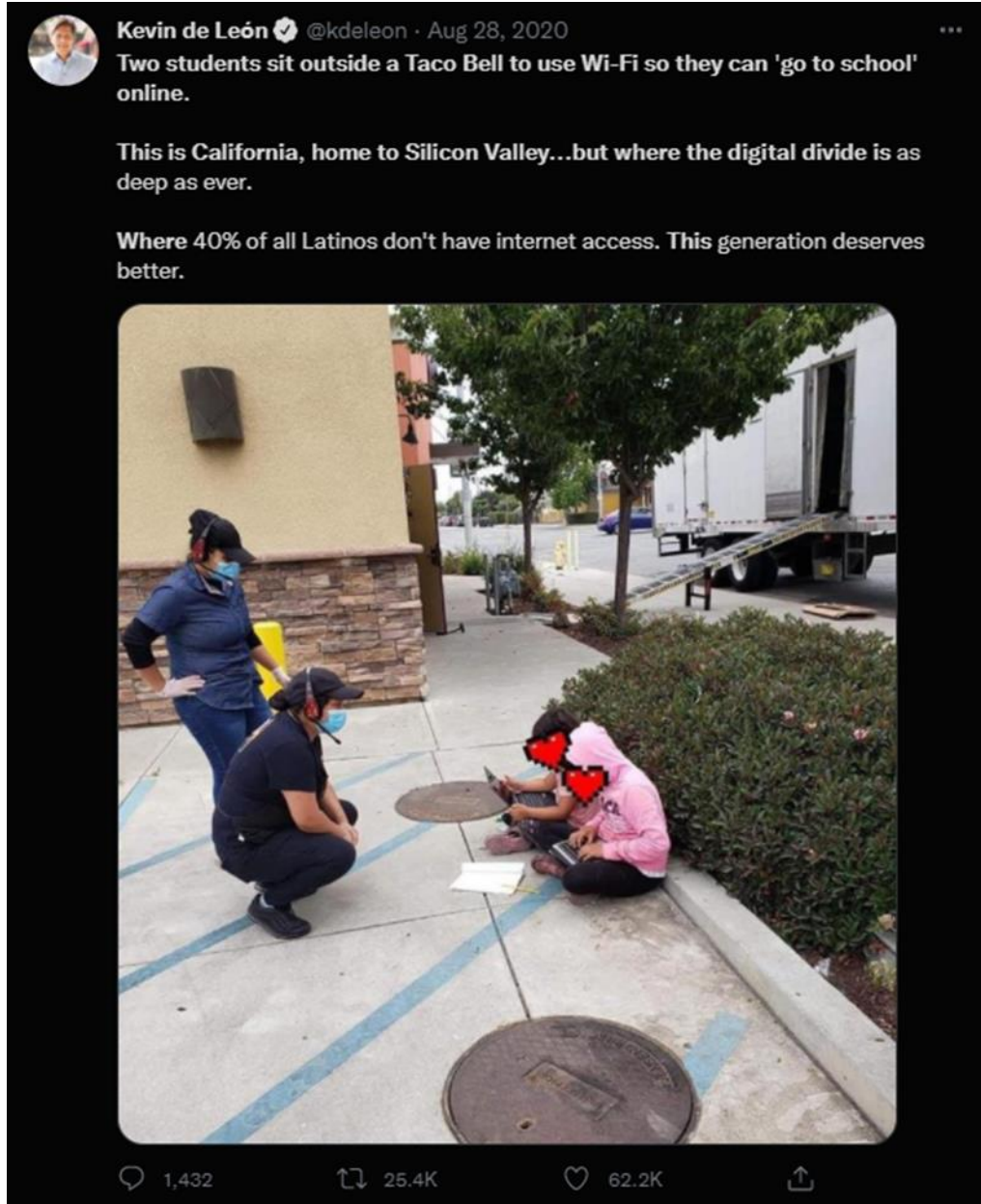
The most replied to tweet is a communication from President Biden, posted on April

24th, 2021. It reads, "Let's close the digital divide once and for all. Our American Jobs Plan

will make sure every American has access to high-speed internet." Included in the tweet is a

graphic that states "35% of rural America lack access to reliable high-speed internet." There

is a tag on the tweet that demarcates it is United States government official. The message

garnered 13,836 replies.

Figure 5.3: Most Replied to Tweet

The most liked tweet is from Rex Chapman, a former American professional

basketball player and social media influencer. The tweet is dated from December 31st, 2019,

prior to the WHO's declaration of the COVID-19 crisis as a global pandemic. He shares a

heartfelt story, that says, "Humanity. This young man doesn't have internet access at home

so a store in the mall allows him to use their tablets to do his homework." The tweet is

embedded with a link that is no longer functioning. The sentiment was liked over 85,000

times.

Figure 5.4: Most Liked Tweet

The most quoted tweet is from the news outlet The Associated Press. A quote tweet is

a retweet with an added comment that allows a user to add their own commentary while still

giving the original post exposure. 7,963 users quote retweeted the below message on

December 14th, 2017. It reads: "BREAKING: the FCC votes on party lines to undo sweeping

Obama-era 'net-neutrality' rules that guaranteed equal access to internet." Of the outliers,

this is the earliest tweet that went viral addressing the digital divide.

Figure 5.5: Most Quoted Tweet

Summary of Top Tweets

While these examples are considered the upper thresholds of the data, they each provide a

unique perspective on the many facets of the digital divide. The authors themselves are

diverse, ranging from various levels of politicians to celebrities to journalistic news outlets.

This demonstrates how important all of those entities are to mitigating the divide, whether

through raising awareness, disseminating statistical information, or reporting on sweeping

legislative change. Half of the tweets occur before the World Health Organization declared

the COVID-19 virus a global pandemic. All of the messages demonstrate how the topic of

internet access dominates the discussion of the divide – none of the four tweets lend any

mention to device access or digital literacy.

Two of the four tweets attempt to evoke emotion, using terms like "humanity," and

statements such as, "this generation deserves better." Relatedly, both of those tweets use

heart-themed emojis, although in different ways. Council Member de León uses heart images to tactfully cover the faces of the children in the photo, and Chapman uses a globe emoticon paired with a heart-eyed face. This provenly successful strategy that attempts to humanize the digital divide and offer personal, micro-level examples of the effects of the disparity.

Unigram Frequencies

Histograms of the most frequently used terms and bigrams were created to investigate which themes are most prevalent in digital divide discourse. Exploring term frequencies reveals how language is used in a collection of natural speech. Understanding a specific conceptual framing used in communication about the digital divide provides an indirect measure of expert's attitude toward the disparity. Especially in crisis situations, social media analyses are used to investigate real-time public opinion, thus allowing authorities to gain insights and quickly decide the best assistance polices to be taken. Histograms illuminate what those framing structures might be.

Figure 5.6: Most Frequent Words
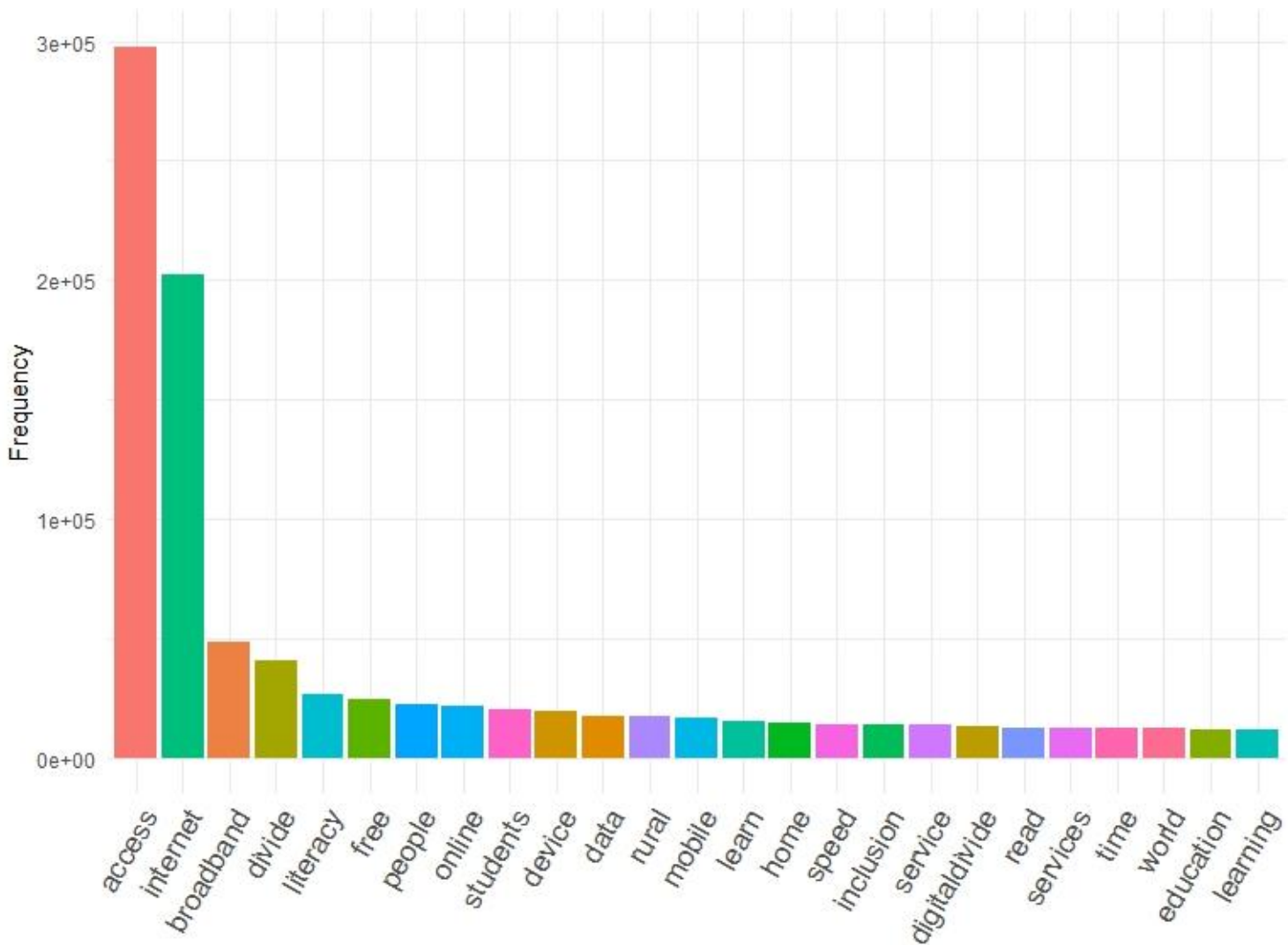
The words are organized in Figure 5.6 from most frequently to less frequently tweeted. The unigram "access" (n = 296,939) soars to the top as the most central discussion point. Following it are the terms "internet" (n = 202,212) and "broadband" (n = 48,889), nomenclatures which commonly precede "access." The data suggests that an overwhelmingly majority of the time an author discusses digital access, it is in reference to either an internet or broadband connection. The word counts for "internet" and "broadband" add up to roughly

85% of the proportion of the term "access." The expression "service," (n = 13,968) also implies discourse about internet, as the other two requisites for a digital connection are more likely be described as a tangible (device) or intangible (literacy) product, rather than a service. This finding is consistent with what the exemplary tweets depict – the most resonated messages all regard the internet tenant of the divide. The raw counts of the terms are shown in Table 5.3.

Table 5.3: Word Frequencies Raw Count

Word	N	Word	N	Word	N	Word	N
Access	296,939	**Online**	21,572	**Home**	14,749	**Time**	12,851
Internet	202,212	**Students**	20,697	**Speed**	14,385	**World**	12,628
Broadband	48,889	**Device**	19,812	**Inclusion**	14,211	**Education**	12,304
Divide	41,312	**Data**	17,790	**Service**	13,968	**Learning**	12,253
Literacy	26,562	**Rural**	17,584	**#DigitalDivide**	13,129	**Information**	11,275
Free	24,464	**Mobile**	16,959	**Read**	13,071	**Media**	11,236
People	22,723	**Learn**	15,542	**Services**	12,927	**App**	11,229

The other two layers of the digital divide are represented in the data via the words "literacy," (n = 26,562) and "device," (n = 19,612) but at a fraction of the same rate as the discussion of internet. The phrase "mobile" (n = 16,959) appears in the top half of the most common words, demonstrating that a mobile device is being discussed in tandem with more traditional methods of accessing the internet. The terms "students," (n = 20,697) "learn," (n = 15,542) "education," (n = 12,304) and "learning," (n = 12,253) indicate that a portion of the discourse centers around school-aged individuals navigating their online classrooms. This is

consistent with much of the digital equity literature that has been published since the onset of the COVID-19 pandemic.

The word "rural" (n = 17,584) emerges, likely concerning the urban-rural broadband divide. The debate over internet "speed(s)" (n = 14,385) is also commonly mentioned with respect to rulalites' often slow and limited connection options. This demographic was likewise represented in President Biden's most replied to tweet. This is the only word in the top 28 words from Table 5.3 that references a marginalized characteristic. Other ways that the disparity manifests, through age, race, ethnicity, or income-level, are not represented by any descriptive terms (however, the most retweeted tweet by Council Member de León does mention the divide as it pertains to the Latino population.)

With the exception of the word "inclusion," (n = 14,211) language framing the problem as an issue of inequity, equity, inequality, or equality does not breach the top words, despite comprising a handful of terms in the search query. Expressions such as "free," (n = 24,464) and "information," (n = 11,275) provide evidence of solution-focused messages, which will be explored further in the time series and sentiment analyses. Overall, the frequency counts suggest that internet access is the most pressing policy concern, with rural areas and school-aged children as the primary populations of interest. To ensure that no major topics are excluded simply due to the way sentences are constructed in the English language, bigrams were also explored.

Bigram Frequencies

Individual words are the most commonly used facets for text classification, but sometimes they can miss important contexts. Therefore, bigrams (two adjacent elements) were analyzed

to better understand which words are often written about together. Because many of the

expressions used to discuss the digital divide are compound phrases, the context of the

neighboring words matters. Figure 5.7 establishes the top ten most frequent bigrams after

stop words and custom stop words were removed. For this analysis, "digital" was not

included as a stop word as it was when exploring single word frequencies.

Figure 5.7: Most Frequent Bigrams
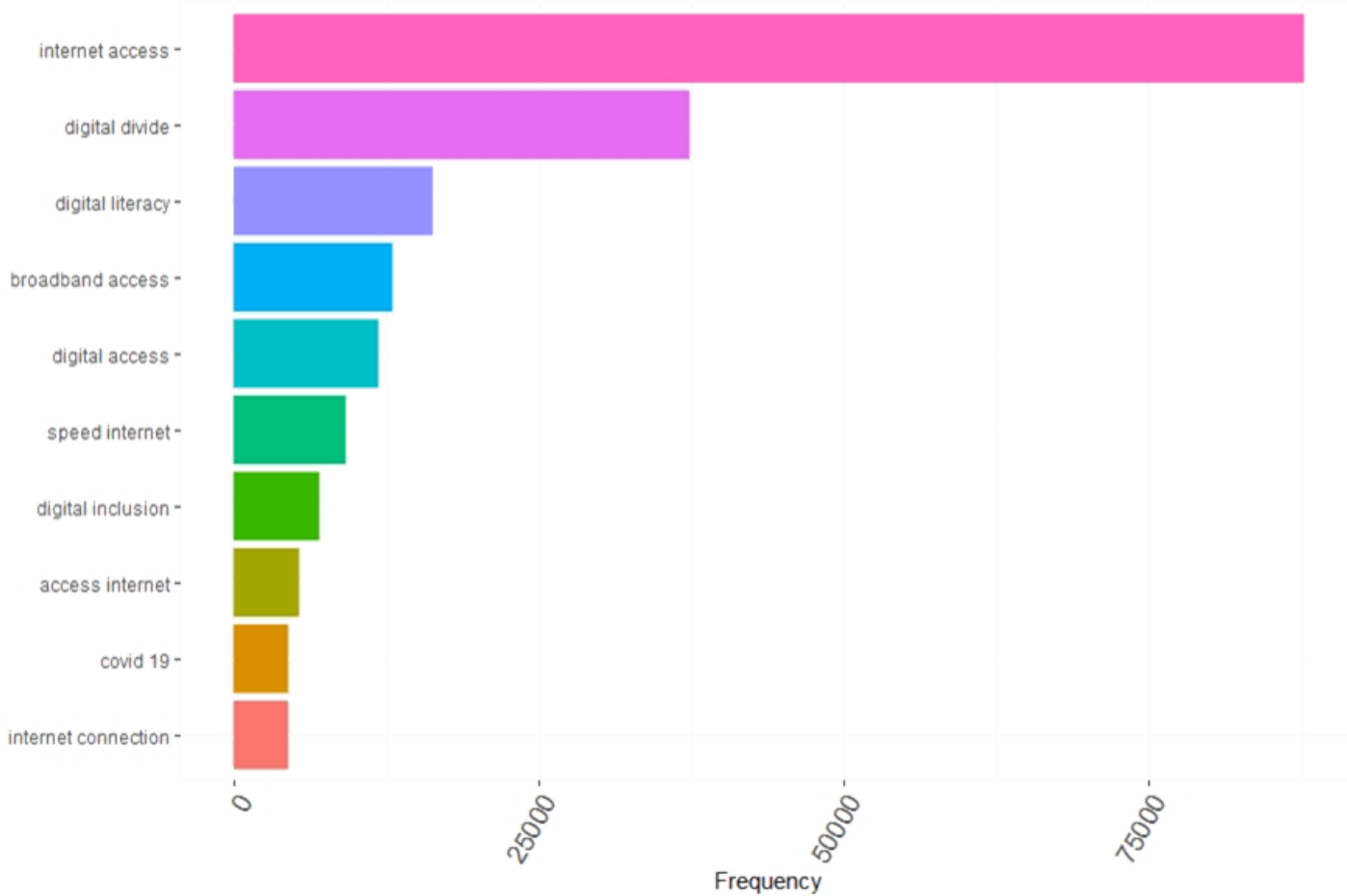
Mirroring the most frequent words, "internet access" is the most commonly written

sequence by a wide margin. This finding supports the interpretation that the majority of the

discourse on the digital divide is referring to internet connections. "Broadband access,"

"speed [of] internet," "access [to the] internet", and "internet connection," all correspond with that same theme. The phrase "digital literacy" is strongly represented, which parallels the high ranking of "literacy" in Figure 5.6. However, digital literacy is mentioned at a fraction of the rate (approximately 16%) that internet or broadband access is discussed.

Although the word "device" debuted at number ten in Figure 5.6, there is no bigram that describes the physical equipment facet of the disparity. While this may be due to the fact that there is no single bigram generally used to discuss the material divide, evidence is mounting that physical access is the least discussed barrier for digital have-nots. Additionally, despite being the subject of one of the most engaged with tweets, no bigrams reference the two-word phrase "net neutrality." This implies that the effect of the FCC's policy reversal is minor in the grand scheme of the last decade and a half of digital divide history. Finally, despite only existing for two of the sixteen years covered by the data, the term "COVID 19" was tweeted enough to become one of the most common bigrams. This supports the study's claim that the COVID-19 pandemic has fundamentally changed how society talks about, frames, and designs solutions for the digital divide.

Table 5.4: Bigram Frequencies Raw Count

Bigram	N	Bigram	N
Internet Access	87,742	Access Internet	5,259
Digital Divide	37,401	Covid 19	4,388
Digital Literacy	16,341	Internet Connection	4,357
Broadband Access	13,004	Social Media	4,094
Digital Access	11,849	Broadband Internet	3,793
Speed Internet	9.097	Wi Fi	3,667
Digital Inclusion	6,938	Low Income	3,369

Table 5.4 shows the raw counts of the graphed bigrams, extended to the top fourteen phrases. The overall interpretation remains consistent with the four additional expressions; however, an additional detail emerges. The term "low-income" is introduced, referring to a user's socioeconomic status. "Low income," along with the unigram "rural," are descriptors of often digitally disenfranchised citizens. Evidence suggests that financial constraints are taken into account when discussing or disseminating information about digital policies. There is yet be proof of widespread consideration for an individual's age, race, or ethnicity in comparison.

Time Series Analysis

The first sub-question of **Research Question$_1$** addresses how the frequency of digital divide discourse may have changed over time. This inquiry can be answered by a time series analysis which examines a sequence of data points collected over an interval of time. Figure 5.8 depicts the pattern of digital divide discourse on Twitter by plotting tweets based on their

"created at" variable. Tweet counts are aggregated by month. The graph includes a best-fit

line and descriptions of the events that caused outliers in the data.

Figure 5.8: Digital Divide Discourse Time Series Plot

Frequency of Digital Divide Discourse from July 1st, 2006 - March 11th, 2022

Twitter status (tweet) counts aggregated by month
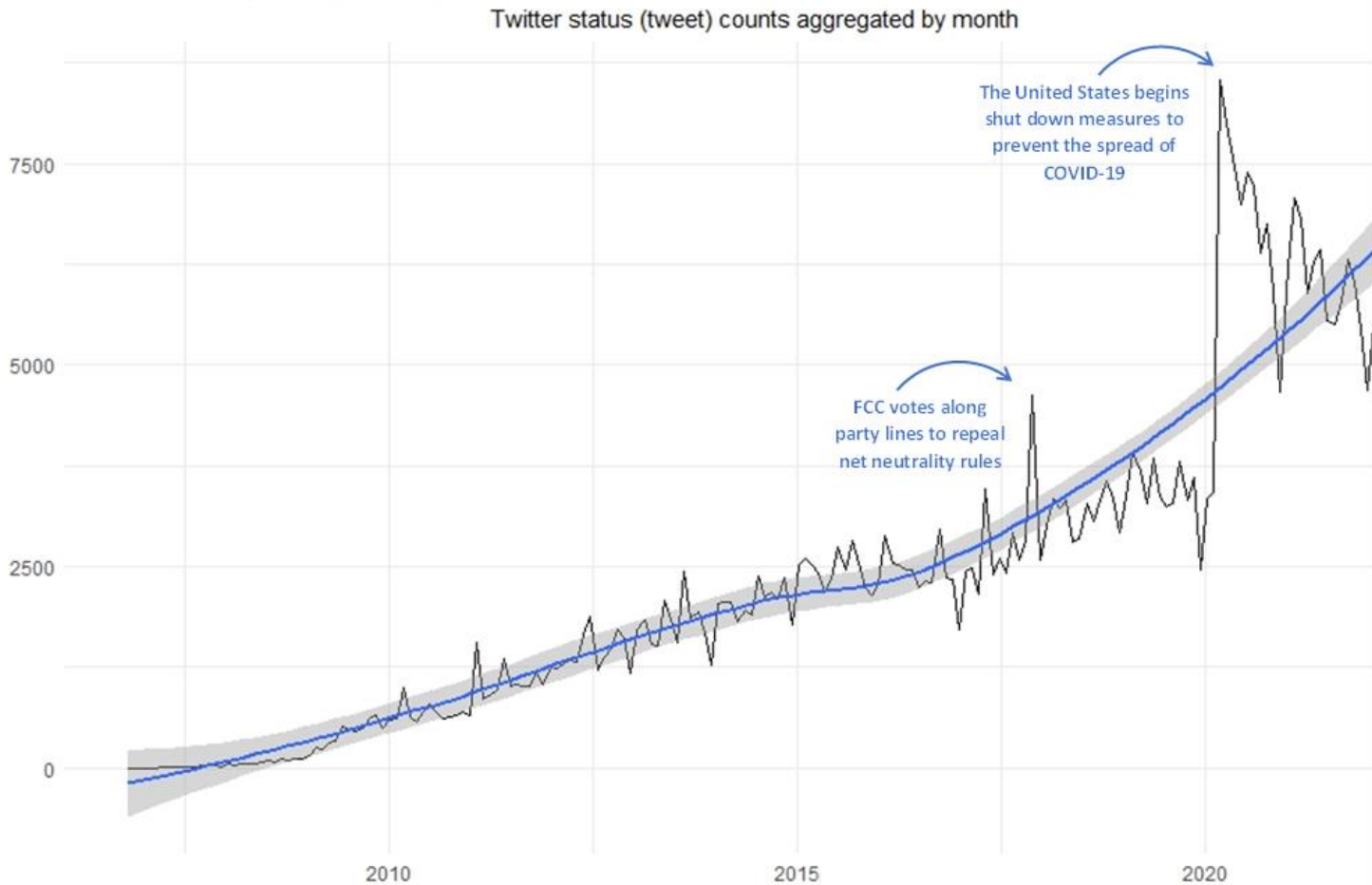
Source: Data collected from Twitter's REST API via academictwitteR

The graph portrays the evolution of tweeted digital divide terminology from Twitter's

inception in July 2006 to early 2022. The initial years of the social media platform saw very

little engagement with the topic. In fact, the first few tweets in the dataset were from users

complaining about the lack of internet access when they were traveling – commentary not

necessarily related to the social disparity. From around 2010 on, the data suggests a steady

increase in discourse, with typical fluctuations, reaching roughly 2,500 mentions a month at

the start of 2015. According to Forbes, Twitter as a whole experienced a steady decline in

popularity from 2012-2018 (Leetaru, 2019). During that time, the platform lost more than

100 million users who tweet on a daily basis and was down almost 200 million daily tweets.

Therefore, an increase in digital divide discourse can be attributed to a rise in interest in this

topic, as opposed to growth of the platform itself.

The data reveals its first peak a few years later, around December of 2017. On

December 14, 2017, the Federal Communications Commission voted to repeal net neutrality

rules, which barred broadband providers from blocking websites or charging for higher-

quality service or specific content (Selyukh, 2017). The dismantling of the rules, which were

put in place during the Obama administration in 2015, propelled the issue of net neutrality

into the mainstream, transforming it into a more political issue. This data crest corresponds to

Figure 5.5, the most quoted tweet, which is when the Associated Press broke the news of the

reversal on Twitter.

With regard to the national attention given to the digital divide, March 2020 proved to

be a historic inflection point. The data demonstrates that the first few months of 2020 had

over twice as much rhetoric as the last few months of 2019. This surge occurred during a

time when school systems shut down, businesses closed, and social isolation policies were

implemented. The month of April 2020, the first full month after the COVID-19 crisis was

declared a global pandemic, saw the most digital divide tweets, with 8,036 tweets in the

dataset. While the fervent conversation eventually began to decline after that outlying month,

the frequency of discourse continued to operate at rates twice as high as pre-pandemic

discussions. Appendix C.1 lists the most prevalent months in the dataset. The top ten months

all occur between the years 2020 and 2021, during the height of the pandemic.

The term digital divide is used in this dissertation to set the stage for the main topic of

interest, digital equity. A time series analysis was performed after filtering out tweets

containing only those phrases in order to understand the national trends behind these

expressions. Figure 5.9 depicts the frequency of tweets containing the phrase "digital divide,"

which closely mirrors the trajectory of the population of digital divide discourse. At its peak

during the first quarter of 2020, the expression is tweeted over a thousand times per month by

verified accounts. This quickly drops to approximately half of that frequency in the following

months. Aside from the difference in magnitude, the main variances between the "digital

divide" sample and the greater digital divide discourse dataset are that there is no peak in

2017 following the reversal of the net neutrality rule, and the decline in usage is much

steeper after the first half of 2020.

Figure 5.9: "Digital Divide" Tweets Time Series Plot

Frequency 'Digital Divide' Tweets from July 1st, 2006 - March 11th, 2022

Twitter status (tweet) counts aggregated by month
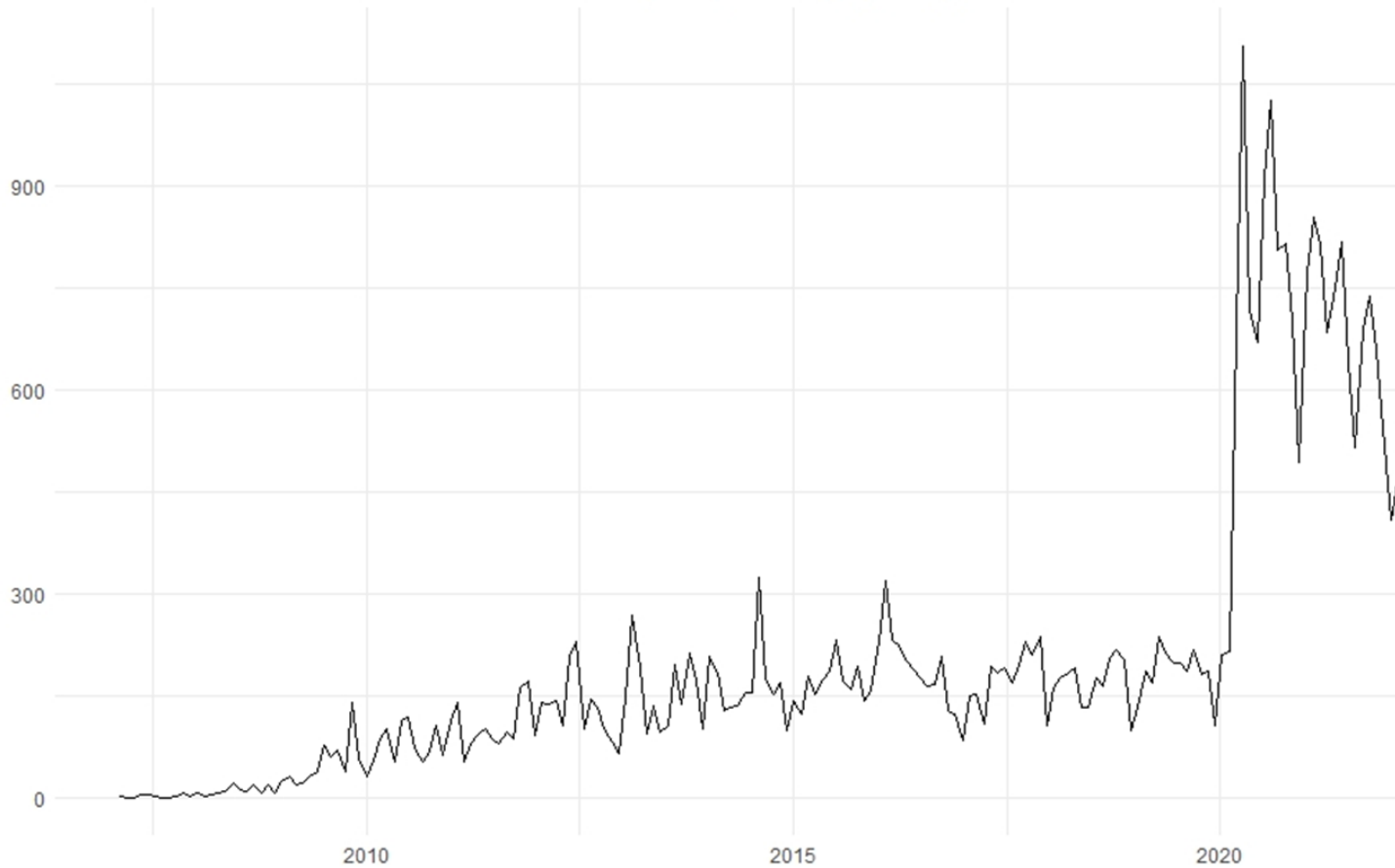
Source: Data collected from Twitter's REST API via academictwitteR

Comparatively, Figure 5.10 demonstrates that tweets containing the exact phrase

"digital equity" occur one-tenth as frequently. At the height of its popularity, the phrase is

tweeted less than 150 times per month. This suggests that while the digital divide is gaining

traction over time, the concept of equity receives far less attention. The graph's peak occurs

many months after the summits in Figure 5.8 and Figure 5.9. This deviance proposes that

there is a lag between individuals discussing the policy problem (divide) and conversations

about solutions to the issue (equity). This evidence is consistent with the observation that no

101

terms describing equality or inequality appear in Table 5.3 or Table 5.4, the frequency tables

of most used words and bigrams. Similarly, none of the four exemplary tweets contain any

references to digital equity.

Figure 5.10: "Digital Equity" Tweets Time Series Plot

Frequency 'Digital Equity' Tweets from July 1st, 2006 - March 11th, 2022
Twitter status (tweet) counts aggregated by month
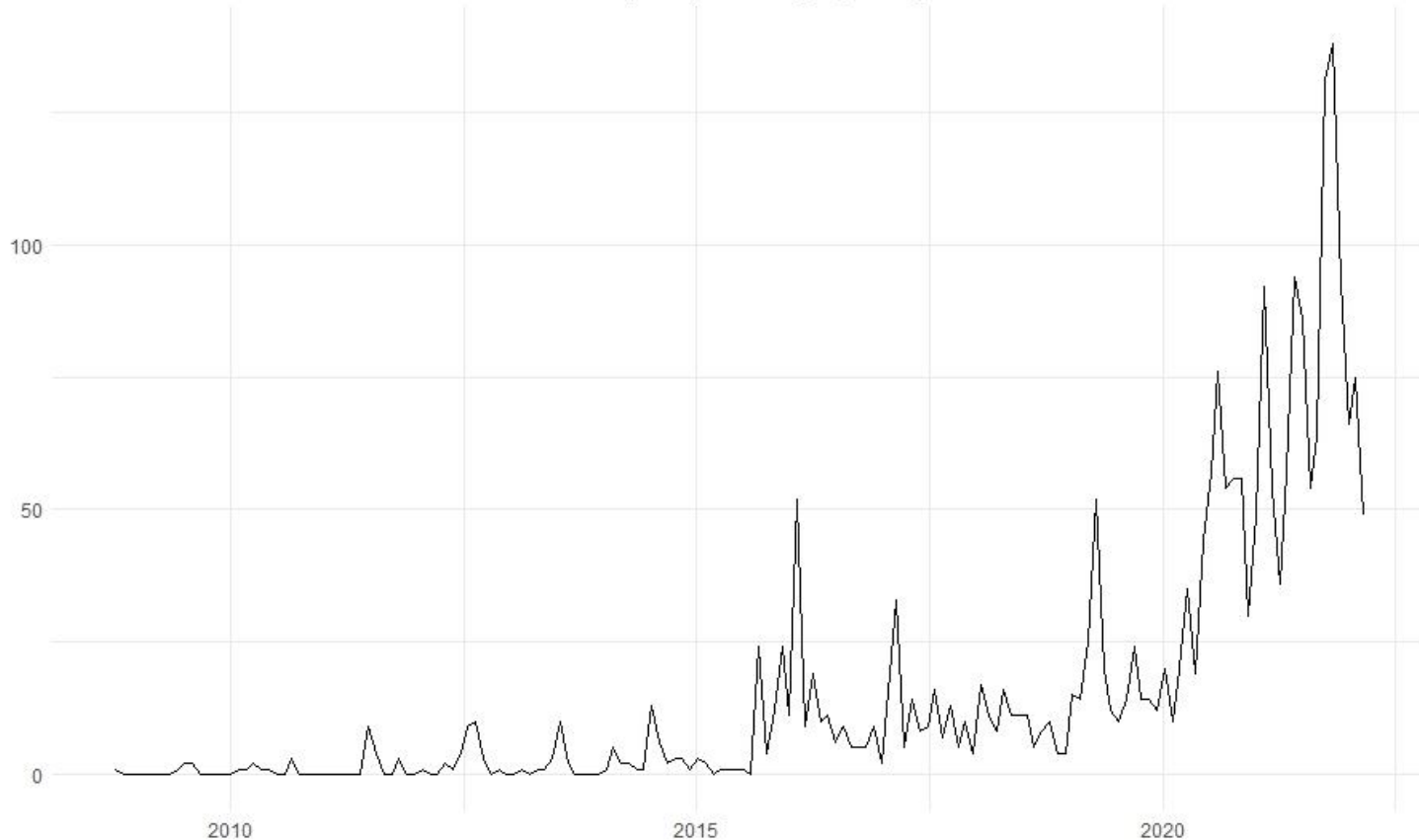
Source: Data collected from Twitter's REST API via academictwitteR

This lag, or difference in framing, can prove problematic. In communication

literature, a frame provides meaning to an unfolding sequence of events (Gamson &

Modigliani, 1987, p.143) and promotes "particular definitions and interpretations of political

issues" (Shah et al., 2002, p. 343). Citizens regularly adopt frames they learn from media –

framing is a tactic used by political entrepreneurs to organize people around particular

interpretations of their problems. Therefore, whenever possible, digital issues should be

framed within the context of striving for equity and promoting inclusionary goals and

language.

Regression Discontinuity Design

A regression discontinuity design is a quasi-experimental pretest-posttest design used to

determine the causal effects of interventions. The test requires running a variable which, at a

certain threshold, divides observations into a treatment and control group. For this study, the

intervention is the onset of the COVID-19 crisis, and the variable is time. The date used as

the cutoff point is March 11, 2020, when the WHO declared COVID-19 a global pandemic.

The "treatment" was applied to 154,799 of the 427,250 observations in the dataset, indicating

that the tweets were created on March 11, 2020 or later. 36.23% of all tweets in the corpus

were written in the age of the COVID-19 pandemic.

A linear regression was used to estimate the regression discontinuity design. To

indicate whether an observation is below or above the cutoff threshold, a dummy treatment

variable was created. The y-variable is a continuous variable of the number of tweets per

month, and the x-variable is an interaction between the treatment dummy and time. The

outcomes were modeled separately by treatment to demonstrate the discontinuity. The

distribution is depicted as a scatterplot with linear best fit lines in Figure 5.11.

Figure 5.11: Regression Discontinuity Design Scatterplot

Scatter Plot of Digital Divide Tweets
Twitter status (tweet) counts aggregated by month
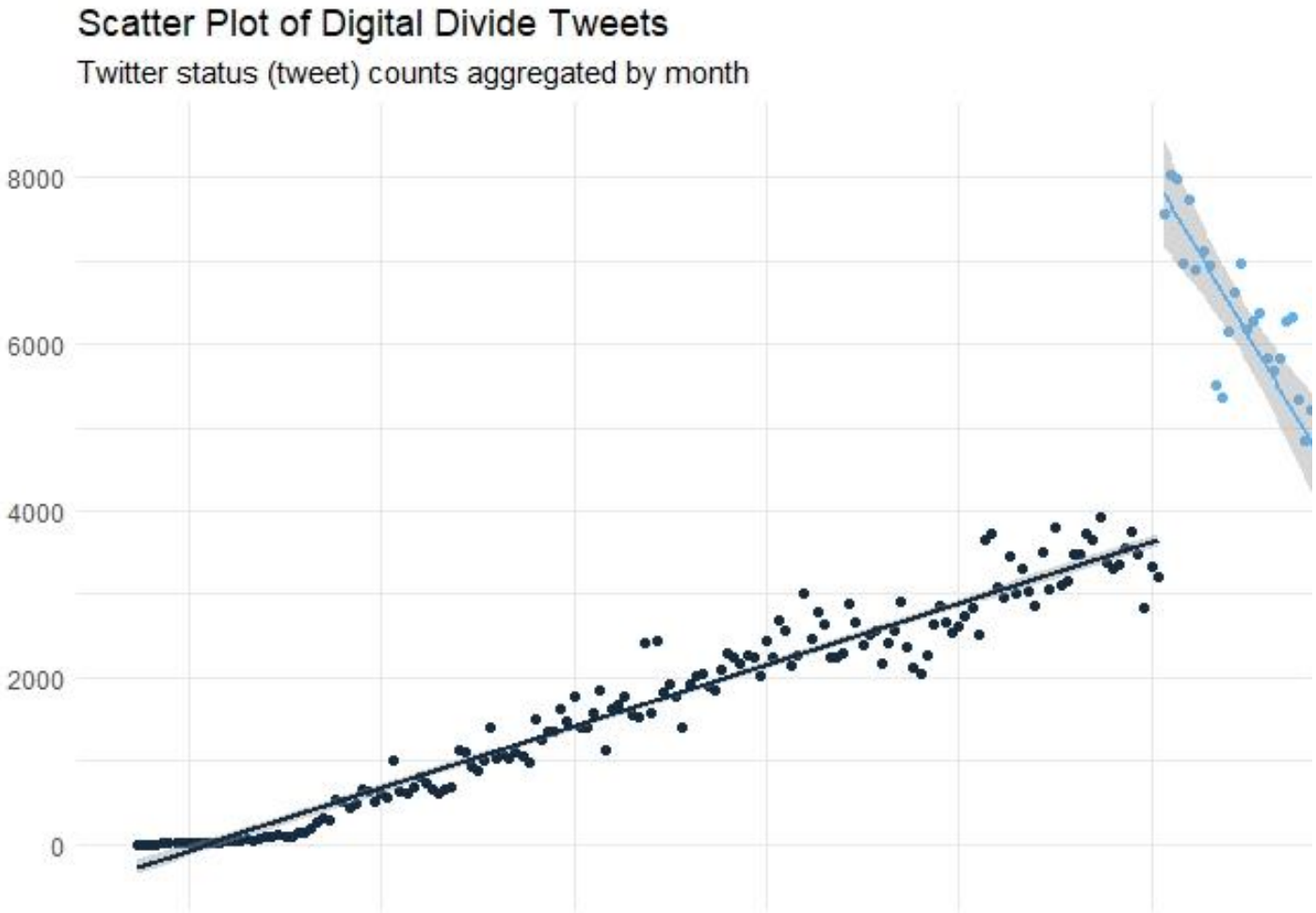
The linear regression model determines the impact of time on tweet frequency. The interaction effect is highly statistically significant (p-value < 0.001) holding all else equal. This mathematically answers the first sub-question of **Research Question_1** and suggests that the time threshold does, in fact, have a significant effect on the frequency with which digital divide discourse occurs. Tweets by verified users about the digital divide are sent at a statistically significantly different (higher) rate after the onset of COVID-19 than before the

pandemic. The treatment group's slope is steep and negative, whereas the control group's slope is gradual and positive.

Though there was a significant increase at the start of the pandemic, the data suggests that the decline gradually returns to the expected discourse level should the pre-trend continue uninterrupted. Other regression output statistics are shown in Table 5.5. The coefficients (β) have been scaled and thus reflect standard deviations of y for a one standard deviation change in x. The adjusted R^2 value is 0.96.

Table 5.5: Regression Discontinuity Design Output

	β	Standard Error
Intercept	-1.34 ***	0.03
Treatment	15.26 ***	0.99
Month	0.01 ***	0.00
Treatment x Month	-.08 ***	0.01

Sentiment Analysis

A sentiment analysis was performed to comprehend the connotations behind the language used in order to answer the second sub-question of **Research Question₁** that enquires about the nature of the discourse. The following section employs text mining tools to programmatically approach the emotional content of text. The sentiment of a text is defined in this study as the combination of its individual words, and the sentiment content of the entire text is defined as the sum of the sentiment content of the individual words. To increase the study's validity, the emotion of the unigrams was evaluated using two different dictionaries. The lexicons used contain extensive lists of words and phrases that have been labeled with subjectivity, sentiment, and/or emotion.

The Bing dictionary (Hu & Liu, 2004) categorizes words in a binary fashion into positive or negative categories. The NRC Emotion Lexicon (EmoLex) (Mohammed & Turney, 2013) divides words based on 8 prototypical emotions: trust; surprise; sadness; joy; fear; disgust; anticipation; and anger, as well as two sentiments: positive and negative. These dictionaries were constructed through crowdsourcing or by the labor of the authors and others. Because many English words are neutral, not every term is in the lexicons. Profanity was not removed prior to the analysis. Figure 5.12 depicts the overall sentiment of the population of tweets using the Bing dictionary, including the word that prompts the valence along the y-axis. The x-axis details the word counts that contributes to each sentiment.

Figure 5.12: Sentiment Analysis (Bing Dictionary)
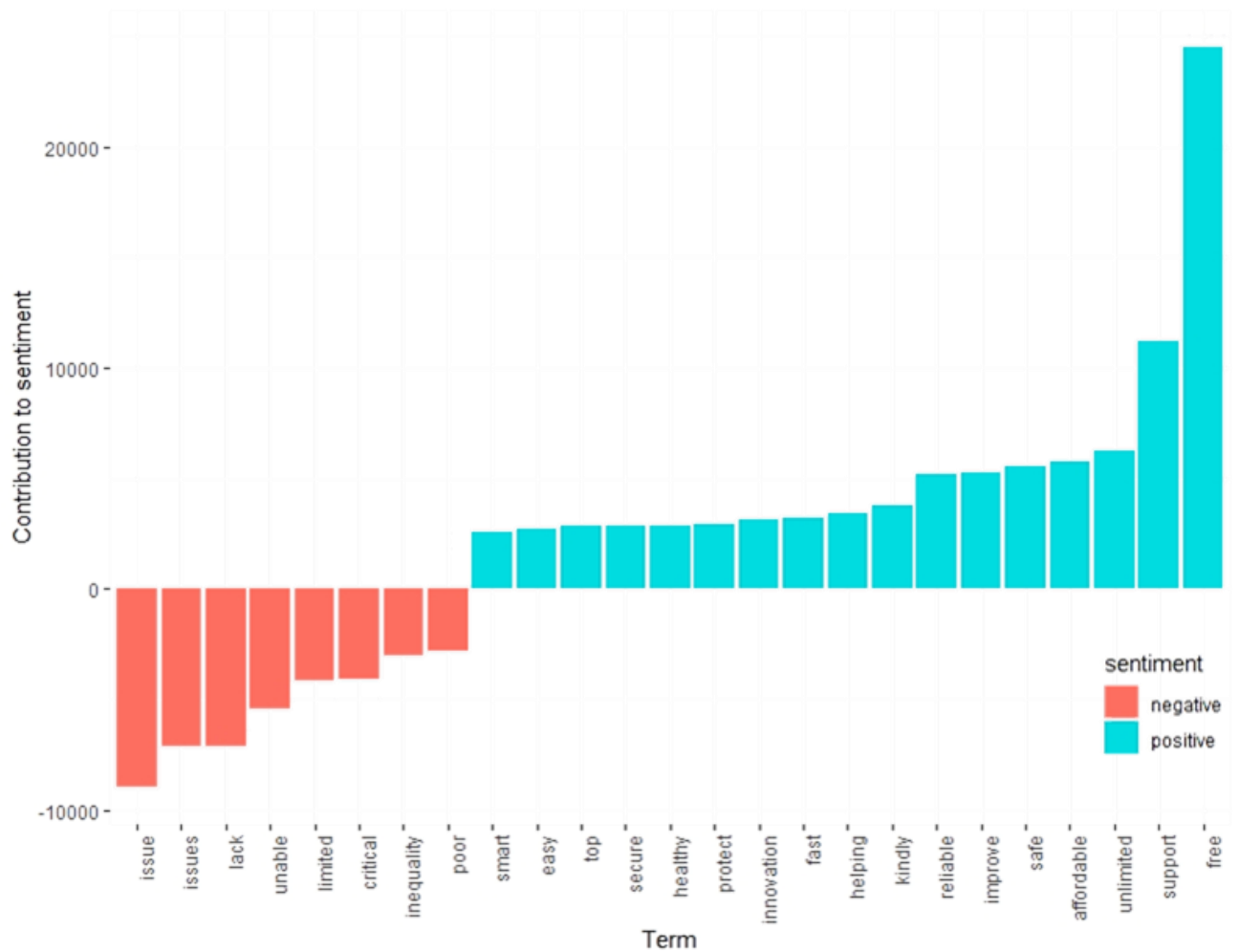
The Bing dictionary demonstrates that the text in the dataset has an inclination towards positively-coded words. The most common positive terms include "free," "support," "unlimited," and "affordable." Congruent with previous findings, these are all words that tend to describe accessible internet connections. Negative triggers in the dataset include "issue(s)," "lack," "unable," and "limited." Interestingly, the word "inequality" appears on the negative side; however, a counterpart such as "equality," does not emerge on the positive end. Figure 5.13 examines the same set of words vis-à-vis the NRC Emotion Lexicon.

Figure 5.13: Sentiment Analysis (NRC EmoLex)
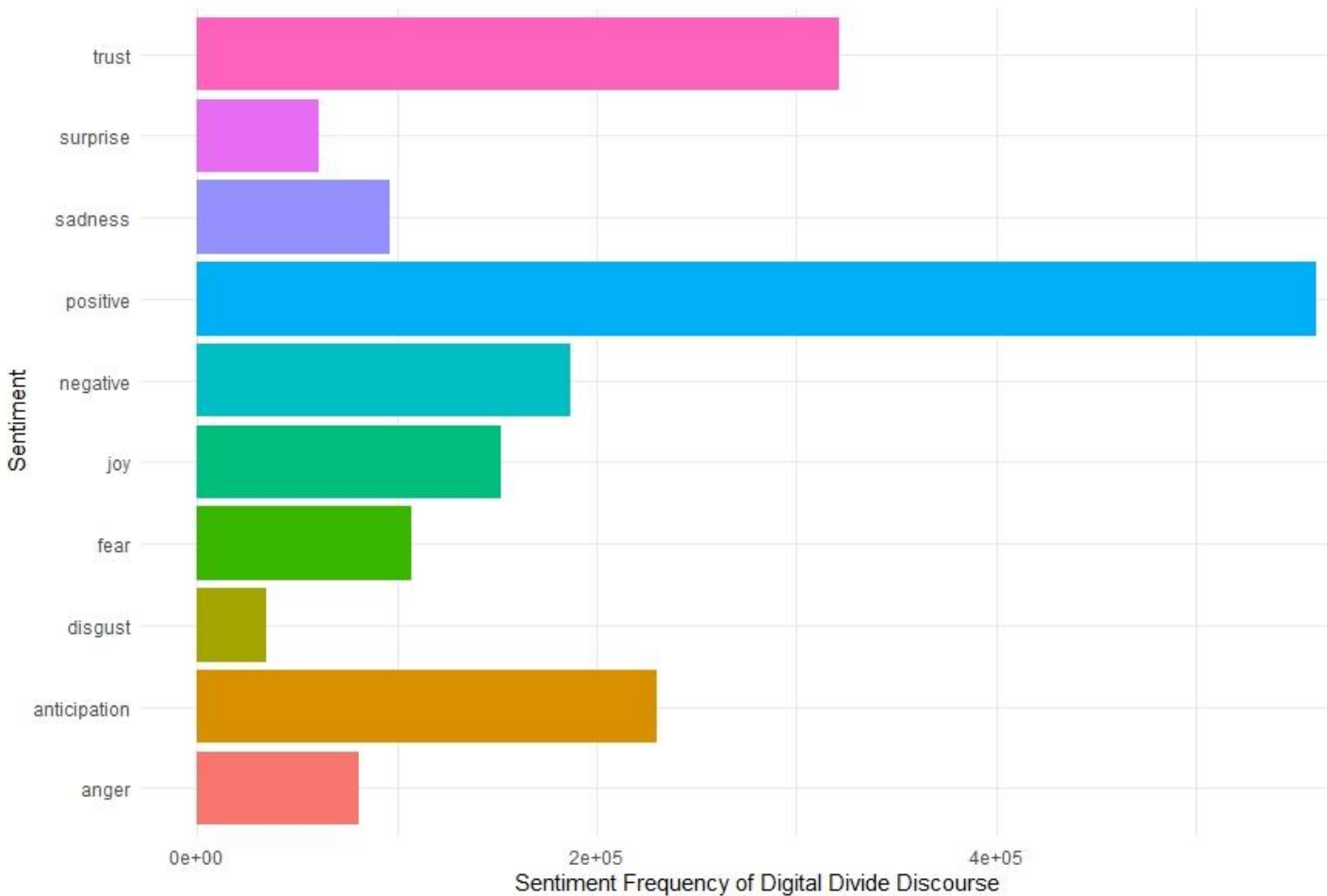
When the dataset is reconciled with the NRC lexicon, the overwhelmingly most popular sentiment is positive, similar to the Bing dictionary analysis. The feeling of trust is secondary, with slightly more than half the number of positive words. Disgust is coded with the fewest words. All of these inferences point to evidence that the digital divide is discussed in positive, reassuring terms, with a sense of urgency sprinkled in, as evidenced by a high anticipation measure. Unique to the NRC dictionary, a word may be classified as more than one emotion, and sometime conflicting ones at that. For example, "government" is catalogued as fear and negative, while "income" is coded as trust, negative, sadness, positive,

anticipation, and joy. Appendix C.2 shows a breakdown of each sentiment and the top ten

words in the dataset that activated that emotion.

Latent Dirichlet Allocation Topic Modeling

The most significant methodological advantages provided by large-scale text analysis tools

are well known. They reduce prejudices, allow for the precise study of finer-grained and

subtle aspects of language use, and make large-scale analysis possible (Baker, 2006, p. 10–

14). For this study, Latent Dirichlet Allocation (LDA), an unsupervised machine learning

topic modeling method developed by Blei, Ng, and Jordan (2003), was used in an attempt to

identify a number of topics of interest. Using the same treatment applied to the regression

discontinuity design, pre-COVID and during-COVID topics were modeled.

To preprocess the data, tweets were munged into a document term matrix, a matrix

describing the frequencies of all terms occurring in the collection of documents (tweets).

Each row corresponds to a document in the corpus and each column represents a term.

Numbers, stop words, custom stop words, extra spaces, and punctuation were removed.

Multiple models were run, each with a different number of topics (k) into which the data was

modeled. For example, by specifying k = 4, each tweet in the corpus received a likelihood of

belonging to one of four categories automatically identified by the algorithm. The k-value

was ultimately determined through a combination of fit statistics and theoretical implications.

The beta measure, observed along the y-axis, is the probability of each word being associated

with each topic.

Figure 5.14 demonstrates a topic model output for all tweets created prior to March

11th, 2020, the start of the treatment effect (n = 272,451). The model that had the lowest

Bayesian information criterion (BIC) had two topics, indicating the best fit. Topics were also modeled with a range of different k-values, but the addition of more classes did not appear to add any value or increase comprehension conceptually. The output reveals some overarching trends about the way the digital divide was discussed prior to the onset of the pandemic. The fact that the best-fitting model was statistically only two categories indicates that prior to COVID-19, conversations about the divide are rather homogenous and not deliberated in a very multi-faceted way.

Figure 5.14: Topic Model Output of pre-COVID-19 tweets, k = 2
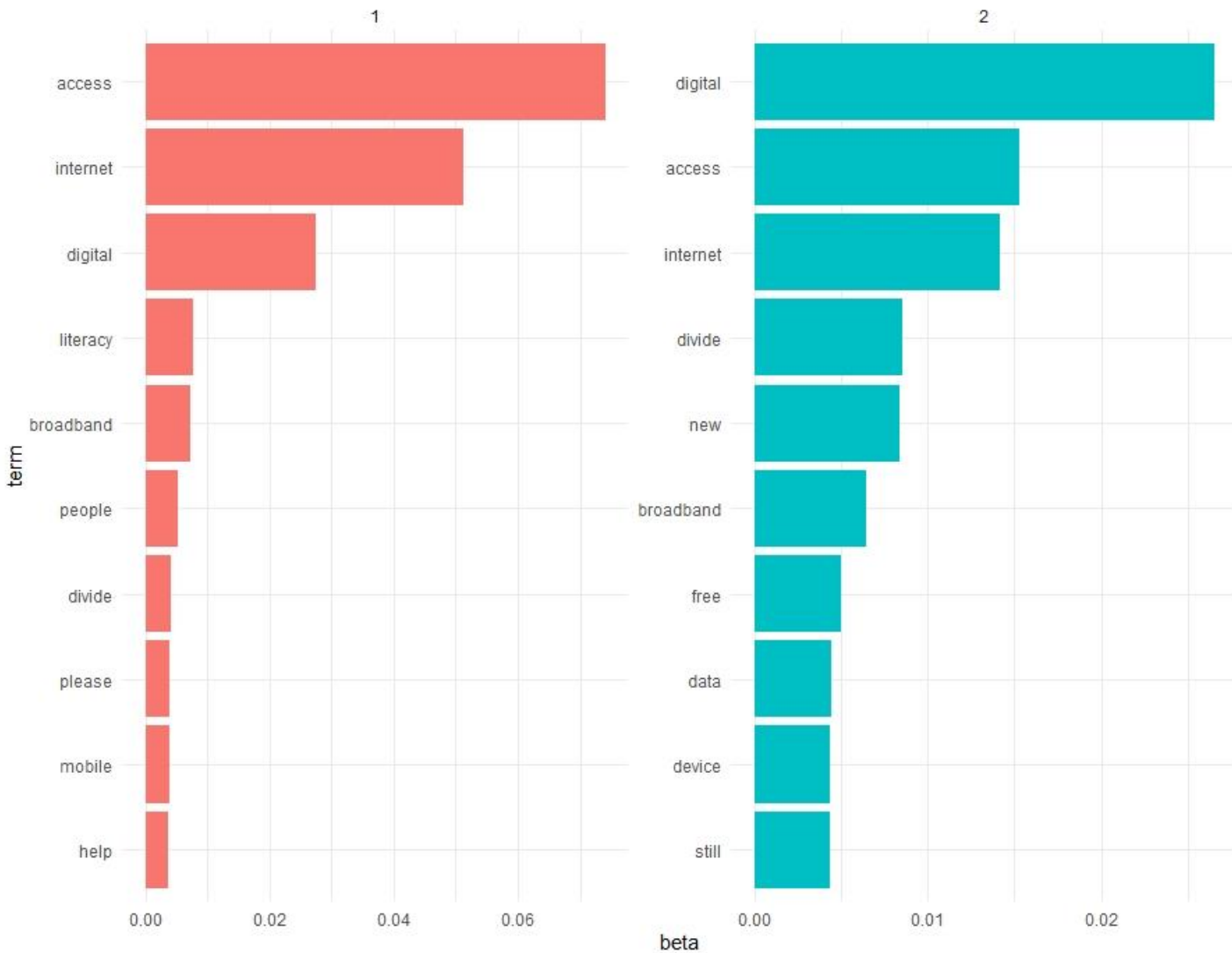
The terms "access," "internet," and "broadband" are present in both topics and are among the themes with the greatest betas.. Discourse about broadband and internet access is so prevalent online, especially pre-pandemic, that it is nearly statistically impossible to model a topic without including those words. This finding is congruent with the other natural language processing techniques explored in this chapter. Topic One appears to touch on the literacy component, and Topic Two includes the device facet. However, despite Chapter 2 of

this dissertation's literature review which neatly describes the digital divide as three distinct sectors (device, internet, and literacy) and multiple well-defined barriers, modeled topics in a pre-COVID-19 era heavily overlap.

Next, the treatment tweets were modeled (n = 154,799). As Bonikowski and DiMaggio (2022) explain, model fit is guided by carefully formulated theoretical priors, a thorough understanding of the data, and a careful application of multiple validation criteria. Because the time series analysis indicates an enormous jump in discourse and because pilot interviews determine that the number of policy actors increased, there is theoretical reason to believe that the topics themselves diversified and the k-value should increase. The BIC was negligibly different between k = 2, k = 3, and k = 4, so to balance model complexity and goodness of fit, the k-value was set at four. Figure 5.15 illustrates the new set of topics. Other themes appear despite the continued dominance of the internet and broadband.
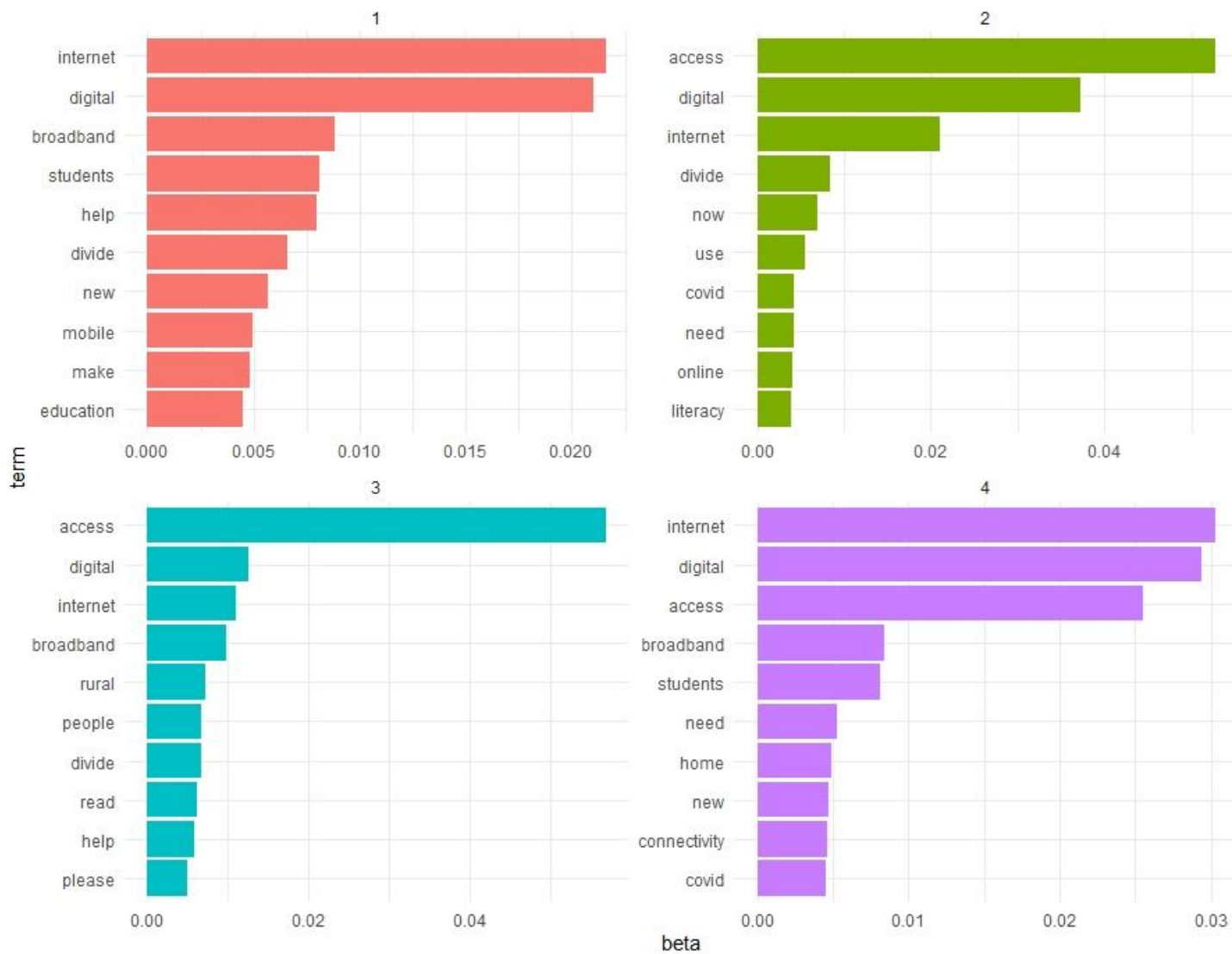
Figure 5.15: Topic Model Output of COVID-19 Tweets, k = 4

In addition to generating more topics than ever before, COVID-19 also led policy

actors to define particular audiences. For example, Topic One and Topic Four address the

student digital divide, as evidenced by the terms "students," and "education." This population

did not receive as much emphasis before, likely because students were always able to access

digital connections through their school or local library. However, when those public places

became inaccessible, it created a huge cause for concern, thus, why "students," and "home" appear together in Topic Four. Unigram frequencies from an earlier analysis also suggest school-aged individuals as an audience of interest.

In the same spirit, Topic Three references the attribute "rural," which, similar to prior analyses, is the only demographic feature to describe individuals more at risk of being a digital have not. Rural residents were not mentioned in the pre-pandemic data, inferring that they are disproportionately more affected by the pandemic in terms of a digital connection. Topics Two has the words "now," "need," and "covid," in direct reference to the ongoing pandemic. This supports the sentiment analysis' finding that there is a strong feeling of anticipation. In contrast, there were no urgency-related terms in the pre-pandemic models. In sum, the discourse appears to have diversified after the onset of the COVID-19 pandemic.

To observe even more specific changes around the time of COVID-19, the months leading up to the treatment effect and the first three months of the treatment were modeled. Similar to the larger population, the months preceding the pandemic have the lowest BIC when k = 2. For the treatment months, goodness of fit measures are so similar to the point k-values of four provided the most theoretical grounding, much like with the entire treatment population. Figure 5.16 and Figure 5.17 show outputs for February 2020 (n = 3,211) and March 2020 (n = 7,555). Outputs for December 2019 (n = 2840), January 2020 (n = 3,336), April 2020 n = 8,036) and May 2020 (n = 7,976) can be found in Appendix C.3.

Figure 5.16 Topic Model Output February 2020 (pre-treatment), k = 2
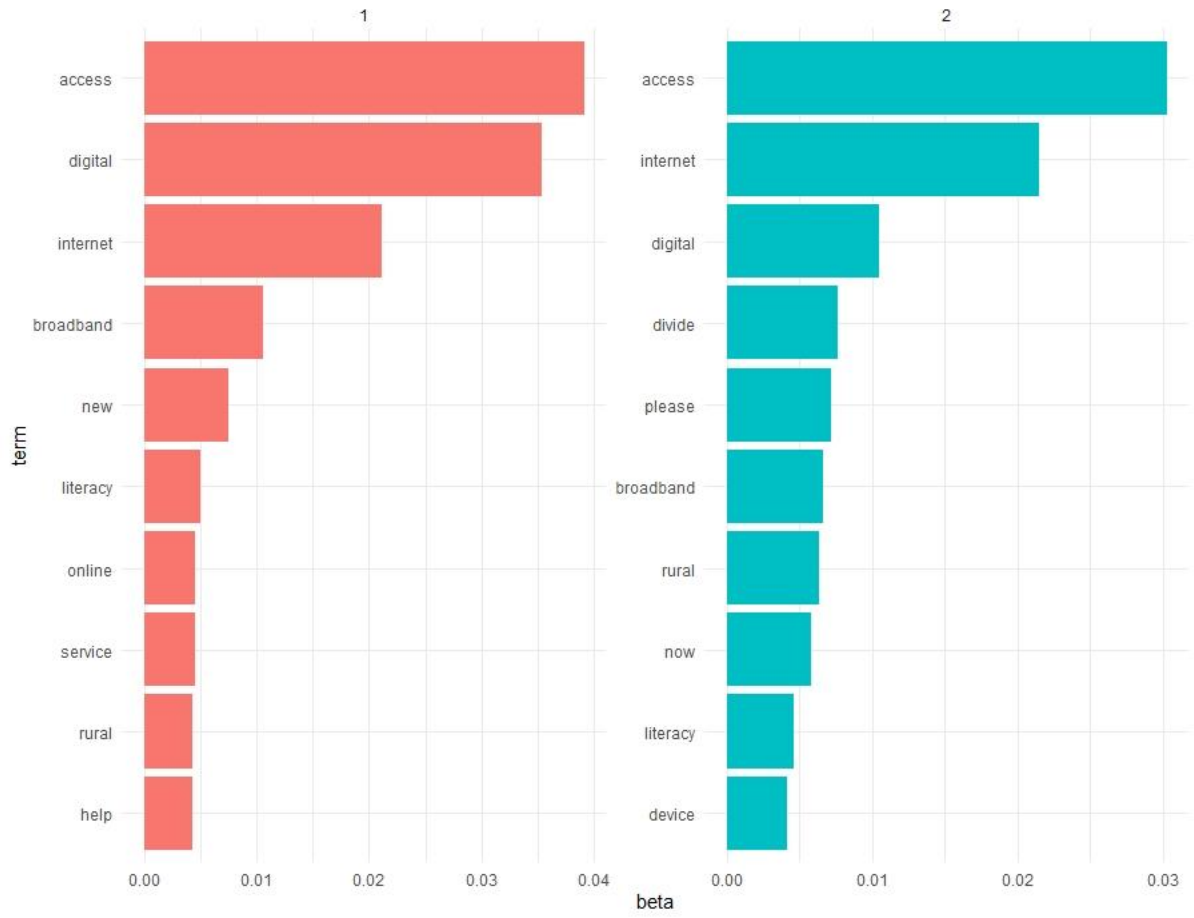
Figure 5.17: Topic Model Output March 2020 (treatment), k = 4
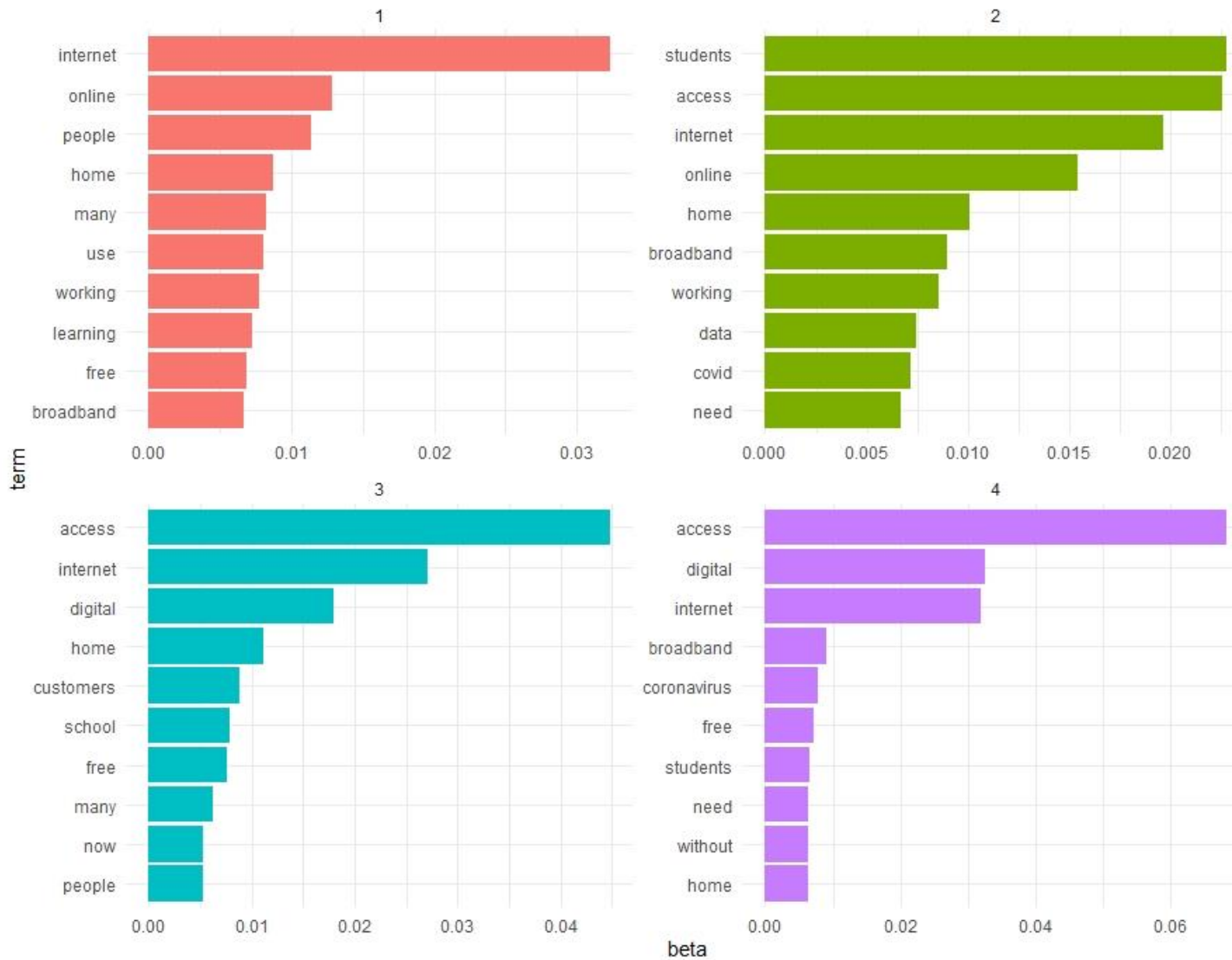
The data suggests that COVID-19 had an effect on digital divide discourses between

February 2020 and March 2020, even within a one-month difference. Not only did the tweet

count more than double, but the model needed a larger topic number (k) to make sense of the

content. Naturally, terms such as "coronavirus' and "covid" debut in topics. The word

"home" manifests in every single topic, implying that the rhetoric at this time was almost

entirely focused on getting digital resources into the homes of those who did not have them.

"Working" also appears in two topics, as working from home became a salient need. "Free" shows in three of the four topics, likely referring users to sign up for free internet promotions that internet service providers were offering at the time (e.g., Comcast offered 60 days of free service to eligible new customers). Similar to the larger analysis, school-themed words penetrate every topic and are the center of multiple foci.

Summary of Findings

Twitter and other platforms represent a sizeable and largely untapped resource for digital trace data and evidence. This data served in answering both sub-questions of **Research Question₁**. A look into the tweet sources and user profile information provides confidence that the sample captured the topics of interest. Outlier tweets contextualize the dataset and determine that messages tugging on the heartstrings and single, easy-to-understand statistics garner the most engagement from Twitter users.

The first sub-question of **Research Question₁** asks how has the frequency of digital divide discourse may have changed. This is addressed through the methods of time series and regression discontinuity modeling. Twitter is in fact being used by verified accounts to discuss the digital divide. Time series analyses determine that online attention on the divide more than double at the start of the COVID-19 pandemic. They also demonstrate a lag between framing the discussion of the problem (the divide) and the solution (equity). The regression discontinuity design statistically confirms that discourse increased at a significant rate ($p < 0.001$) at the start of March 2020. The model also highlights the attention given to the digital divide is steeply waning and projected to plateau to pre-pandemic levels.

The second sub-question of **Research Question₁** explores the content of the discourse itself. Exemplary tweets, as well as frequency counts of unigrams and bigrams, suggest that the digital divide is mostly conceived and operationalized as an issue of internet access. Similarly, unsupervised machine learning methods struggle to generate topics that do not include this tenant. LDA topic modeling determines that pre-pandemic, the data only needs a two-category model to successfully categorize the themes due to a lack of nuanced discussions. However, during the COVID-19 crises, it requires a four-category model due to an increase and diversification of topics. All methods reveal that the notion of equity is largely absent from the conversation. Regardless, the over-arching sentiments on the topic are positive and trustworthy. The following Chapter 6 will expand on these findings and provide new perspectives through interviews with policymakers in the greater Boston area.

CHAPTER 6: QUALITATIVE FINDINGS

With changes brought about by the COVID-19 pandemic, the digital world now penetrates deeper into nearly every aspect of society. Digital inequities that were magnified by the pandemic have now created new forms of vulnerability. Interviews with digital equity policymakers in the greater Boston metropolitan area reinforced how technology is now central to the economic competitiveness and social welfare of the Commonwealth. This method provided a practical understanding of the collaborative efforts between different levels of government and other organizations. The data unearthed how new kinds of risks emerged during the era of COVID-19, and how those risks are unequally distributed. The qualitative data collected from semi-structured interviews aimed to address all three research questions proposed in this dissertation:

- **Research Question$_1$**: How has digital equity discourse changed nationally amid the COVID-19 crisis?
    - How has the frequency of discourse changed, if at all?
    - How has the content evolved, if at all?
- **Research Question$_2$**: How is digital equity addressed through co-production?
    - What are the outcomes?

       o   What is the process?

- **Research Question3:** What conditions lead to successful co-production in times of crises?

Data Acquisition

Each interviewee was uniquely informative due to their professional expertise. Thus, the combination of participants took the form of a wide-ranging panel of knowledgeable informants. The idea of a panel of informants is to include diverse respondents who together can provide information the study requires. Ultimately, the panel took the shape of a loose collectivity – a collection of people in touch with one another but not as closely linked as those within the same organization (Weiss, 1995, p. 52-54).

      Outreach began by forming a purposive sample population with a number of staff in the City of Boston's Department of Innovation and Technology as well as previously contacted organizations from the pilot research phase. As data collection commenced, other participants were identified via a snowball sample. The final population demonstrated diversity in terms of constituency focus as well as area of expertise. Interviews continued until data saturation and diminishing returns were reached. Table 6.1 lists the panel of knowledgeable informants with relevant background information.

Table 6.1: List of Interviewees

Affiliation	Sector	Constituency	In role in 2020	Date of Interview
Local Initiatives Support Corporation	Nonprofit	Small Businesses	Yes	June 22nd 2022
Boston Public Library	Public (Local)	All Bostonians	Yes	June 23rd 2022
Tech Goes Home	Nonprofit	Digital Have-Nots	Yes	June 27th 2022
City of Boston Department of Innovation and Technology	Public (Local)	All Bostonians	Yes	July 1st 2022
Mayor's Office of New Urban Mechanics	Public (Local)	All Bostonians	Yes	July 13th 2022
City of Boston Department of Innovation and Technology	Public (Local)	All Bostonians	Yes	August 10th 2022
Massachusetts Board of Library Commissioners	Public (State)	Massachusetts Library System	Yes	August 10th 2022
Office of Immigrant Advancement	Public (Local)	Immigrants	No	September 23rd 2022
City of Boston Department of Broadband and Cable	Public (Local)	All Bostonians	Yes	October 5th 2022
Age Strong Commission	Public (Local)	Bostonians aged 55+	Yes	October 19th, 2022

Interviews were conducted throughout summer and fall of 2022 via video conferencing software at a time and date chosen by the participant. They ranged in duration from 30 minutes to over an hour long. Financial compensation was not provided to participants, and no individuals were contacted who are classified as a member of a vulnerable population. No interviewees required translation services or disability accommodations. Conversations were audio recorded upon consent and transcribed verbatim, producing complete and accurate transcriptions.

Interviews were semi-structured in nature. A core set of questions was asked of each participant in the study; however, the inquiries may have been addressed in a different order

or for varying lengths of time depending on the flow of the conversation. Rarely, but sometimes, additional clarifying questions were asked outside of the core lines of inquiry. This tailored structure provided the freedom to elaborate on certain processes central to the research questions. A copy of the lines of inquiry can be found in Appendix D. Some interviewees provided supplemental documents, which were collected and analyzed using the same coding scheme as the transcriptions as an additional way to validate the interview data.

Ethical Considerations

Discussants were presented with a consent form and were requested to sign it prior to the start of the interview. The consent form outlined the purpose of the study, the way in which their data will be used, and information regarding their rights and protections. Any questions were answered at the beginning of the engagement and respondents were made aware of their right to withdraw or cease participation at any point of the process. Per IRB protocol, no video files were collected. All data was stored on a password protected computer and will be destroyed upon completion of this study.

Data Analysis

Interviews were coded using NVivo software, a program widely used in the social sciences, which features organizing functions that allow users to link together text data in a variety of ways. Data was open coded to generate categories of information, then coded axially to position and interrelate the categories within the theoretical model. This coding strategy placed actions and policy actors into the four quadrants of the co-production cycle, demonstrating empirical rigor. Where applicable, findings were triangulated with results

from the quantitative section of this study to reduce the risk of chance associations and systematic biases. The convergence across quantitative and qualitative methods builds justification for themes and bolsters validity of the study.

Member Checking

To temper other threats to validity in the data, interviewees were presented with a member checking exercise which contained two pages of broad themes that were uncovered throughout the data collection phase. Member checking determines the accuracy of the findings by taking the specific descriptions and themes back to participants and letting them determine whether they are accurate (Creswell & Creswell, 2018). Respondents were asked to review the attached content and reply with thoughts and feedback. Interviewees were encouraged to express perspectives or lived experiences that were not captured in the document. Half of the participants responded with feedback, summarized and integrated in the subsequent sections.

Research Question₁ Findings: Digital Divide Discourse

An area of inquiry that the interviews addressed was policy discourse on the digital divide, providing support for **Research Question₁**. Interviewees were asked to reflect on the language and framing that was put forth regarding the digital divide or digital equity prior to the start of the COVID-19 pandemic, and compare that to the verbiage that is used in their work today, either publicly or privately to other stakeholders. Themes varied in popularity, with two respondents indicating they have been using the same language and experienced no change in discourse. However, majority of the other participants indicated that their

narratives of the divide have evolved in a number of ways, such as by increasing specificity, nestling the divide amongst deeper systemic disparities, critically comparing dialogues to reality, or promoting the newfound need for connection.

Increasing Specificity

The data suggests that professionals got more specific with their communications, because the pandemic provided them with concrete problems to solve. A local government representative who works with Boston's immigrant population shared how she is much more intentional when communicating the purposes of digital solutions. She stated,

> "I think what we're trying to frame it is, what is the purpose of giving someone a Chromebook? Is the purpose for them to get on to an English class? Great, then let's do it. Is the purpose for them to actually receive workforce training or learn to code? Great, but let's differentiate the types of digital literacy that needs to be happening."

Language that caters to more niche populations is triangulated with the LDA topic modeling output, which highlights new vulnerable groups after the onset of the pandemic. Increasing specificity was also considered by a state library representative. A respondent detailed, "we promote and provide equitable services across the State. We've had language like that forever… but I think we got a little bit more specific." More broadly, on the subject of discourse frequency, another respondent stated, "I would say that since the pandemic started, I have seen a lot more information about digital equity and what that means." This statement is directly supported by the quantitative time series analysis of tweets from earlier in this study that depicts a significant spike in attention beginning March 2020.

Linkage to Larger Systemic Problems

The notion of equity provides a seamless transition into another theme that was identified.

The data demonstrates that amid the COVID-19 crisis, leaders began acknowledging the

digital divide as a symptom of a larger issue. Two respondents highlighted racial injustices as

a root cause in society, and consider digital inequality an outcome of a system of oppression.

The CEO of a technology-based nonprofit mused,

> "I don't know if it's pandemic-related or George Floyd-related. It's probably all of it that
> has just shifted our narrative … COVID exposed so many inequalities that people were
> ignoring, so that's what's changed, at least from my point of view. The digital divide is a
> symptom of much larger and nefarious problems."

This thought is in line with what Bach et al. (2018) argue – that, the digital divide is not the

problem – rather, it is a "symptom of social and economic marginalization that has been

exacerbated by policies and practices that further disenfranchise poor and working people"

(p.36).

Policy versus On-the-ground Needs

Pondering the digital divide's position in the broader policy ecosystem promotes another

lived experience the data unearthed: a disconnect between policy outputs and reality. For

example, a Boston Public Library representative recounted his knowledge of the intake forms

that library patrons submit when seeking digital resources.

> "For people who are filling out the request forms, predominately it's a request for device
> and not internet. Still a fair amount of internet, too, but I think people have internet - an
> internet essentials program existed before. Or, they're okay not having internet at home
> because they have enough places that they go throughout their routine that has enough
> internet."

Interestingly, at the Boston Public Library, patrons' needs for a usable device supersedes the request for internet, for the two main reasons the respondent described. However, the large-scale quantitative text analysis section of this dissertation demonstrates that the internet or broadband component of the digital divide receives far more attention than device access or digital literacy. While the needs of Boston cannot be extrapolated to those of the rest of the country, there is evidence that policy discourse (i.e., what is most conceivable to leaders) is not always congruent with the on the ground policy needs.

Similarly, a technology-focused nonprofit stated, "I'm finding there's a big difference between what is purchased and what is subscribed to. The school system might say, 'we provided 5,000 internet licenses.' Well, how many of those were activated?" A representative from the City of Boston's Cable and Broadband Office also shared that only around 20% of citizens who are eligible for the federal Affordable Connectivity Program have signed up, citing challenges navigating the online forms and templates. This barrier was corroborated by a library spokesperson who shared that many patrons have attempted to sign up for the program but couldn't follow through due to a technology issue or because of the unfamiliar, paradoxical, digital nature of the form itself.

Another avenue where digital trace data supports interview findings is with respect to the lag between use of the expressions "digital divide" versus "digital equity." Quantitative data reveals that tweets containing the phrase "digital equity" occur a tenth as frequently as their "digital divide" counterpart, and appear in the more recent sections of the dataset. While the digital divide has gained traction steadily over time, the equity piece is oft absent from conversations. The delay between divide and equity was experienced firsthand by a library

126

communications professional, when asked about how they may have varied their language to constituents. She stated, "It feels like we've been talking about the digital divide for a long time. Digital equity was a term we didn't really use a lot until the pandemic."

Becoming a Necessity

By far and large, the most prominent theme that was generated from the interviews with respect to discourse was digital connection advancing from a "nice-to-have" to a "need-to-have." "I feel like the constant expansion of how much easier life is if you can access the internet had really crystalized during the pandemic," stated a representative from the Mayor's Office of New Urban Mechanics. Another respondent expressed this notion in similar terms, as internet access becoming a right instead of a privilege. A nonprofit leader who works with small businesses reported that a mentality shift transpired when businesses were forced to transform their models to accommodate newfound virtual lifestyles.

A city official, when asked to compare her digital equity work before the pandemic as opposed to now, said "I think we were probably aware of [the digital divide] but it didn't seem as life-threatening as before." This notion is consistent with another City of Boston representative from the Cable and Broadband division who stated that prior to the pandemic, they did not see the City's role as providing people with connectivity. However, now digital connectivity is held in a much higher regard. The interviewee stated, "We recognize as government today that it's an absolute must. You will be left behind if you don't have it."

A respondent who is knowledgeable about the allocation of the City of Boston's Digital Equity Fund, annual grants disseminated to assist community organizations in helping residents engage online, cited the fund as an example of how priorities at the local level have

shifted. "Our first round [of the fund] was in 2018. It was something nice, and everybody agreed that it was a good idea. I don't think anybody was anti-digital equity, but since COVID, it is everybody's priority." With respect to digital equity being a pillar of Mayor Wu's campaign, the participant went on to say, "It [digital equity] is at the forefront of everything we do, and we in DoIT [Department of Innovation and Technology] could not be happier. We have been saying this for so long! So, we're very amped that we all agree it is a number one priority."

Summary of Findings

In short, the interview data that addresses **Research Question1,** which explores how policy discourse frequency and content has evolved, suggests that the majority of entities in the digital equity ecosystem have altered their lexicon surrounding the digital divide in a number of ways. The pandemic inspired some leaders to be more specific with their mission statements or descriptions of services that they provide. As 2020 battled multiple epidemics including a racial reawakening, many individuals began communicating about the digital divide by nestling it into greater societal inequalities. Some participants commented on the gap between policy solutions and frontline needs, which can be triangulated and supported by social media data. Lastly, the most dominating sentiment held by the interviewees is that the pandemic shifted up the priority of digital equity. A digital connection has become a requirement to participate in modern day civilization. Both the quantitative and qualitative data demonstrate that the frequency of digital equity discourse has increased to mirror its newfound prominence.

Research Question₂ Part 1: Digital Equity Outputs

The data demonstrates that digital equity, the condition in which all individuals and communities have the information technology capacity needed for full democratic and economic participation (National Digital Inclusion Alliance, 2021), was co-produced in the City of Boston in a variety of ways. Due to the three-tiered structure of the digital divide, digital equity outputs themselves manifest in a multitude of different mediums. Some outputs are tangible and others are immaterial resources designed to increase one's social capital. Interviews from stakeholders helped address the first sub-question of **Research Question₂**: what are the outcomes of digital equity co-production? The digital equity "products" observed in the data include device dissemination, internet access, digital literacy knowledge, grants or funding, information or connections, programs, and other digital resources.

Physical Devices

Increasing citizen's access to technological devices was among one of the more popular solutions that interviewees addressed. For example, in early 2021, the Boston Public Library expanded its short-term device lending offering to include 75 "Connectivity Kits" (expanding to 150 units total). The kits include a 14" Chromebook, a hotspot, and a mouse, as well as the necessary chargers and a quick start guide, all in a bag for easy access and transportation. The library currently loans these Connectivity Kits for two weeks, and will automatically renew them for an additional two weeks if there is no one on the waiting list. In addition to this stop-gap measure, in December of 2021 the Boston Public Library utilized emergency connectivity funding and rolled out a long-term device lending service. In close partnership with the Boston Housing Authority and the Mayor's Office of New Urban Mechanics, the

program is designed to reach adult patrons who have unmet digital connectivity needs for devices not just for a few weeks, but for an indefinite amount of time. Lastly, a Massachusetts Board of Library Commissioners representative reported that they provided ancillary technologies to libraries such as green screens, camera, and microphones, so they could better carry out digital programming.

Internet Access

Internet or broadband access was the most widely reported output by the interviewees. A City of Boston representative estimated that their offices made over 75,000 connections with citizens, between providing hotspots in bulk, doling out vouchers for subscriptions to Comcast's Internet Essentials Program, or assisting citizen sign-ups for the federal Affordable Connectivity Program (ACP). Created by the 2021 bipartisan infrastructure bill, the ACP provides low-income households with $30 per month to reduce the cost of internet service. The Boston Public Library also maintains 225 hotspot devices in circulation which are available to rent by patrons for up to three weeks at a time.

Amid the pandemic, the library system expanded its Wi-Fi to provide a stronger signal outside fourteen branches, giving patrons free internet access on property surrounding local branches. According to the Boston Digital Equity Assessment, Boston Public Schools made 10,000 hotspots available to students for school use. The Mayor's Office of New Urban Mechanics disseminated their hotspots specifically to community-based organizations who needed internet to better serve the public, such as at COVID vaccinations or testing sites. They also prioritized handing them out to City departments that host public meetings in neighborhoods where Wi-Fi is less abundant.

Digital Literacy

Digital literacy, the ability to use information and communication technologies to find, evaluate, create, and communicate information, requiring both cognitive and technical skills (American Library Association, 2013), was another area of the digital divide that was addressed by respondents. At least five interviewees mentioned efforts related to computer skills training. A delegate from the small business community created a digital growth accelerator which provided small businesses of color with low-cost digital tools to connect with their customers, boost productivity, and increase revenue. The Boston Public Library expanded their offerings of virtual classes, workshops, and information sessions on digital skills. They also increased the content available via their online databases so patrons could avoid visiting a physical location. The Age Strong Commission funded various organizations to bring skills training into Boston neighborhoods where substantial populations of older adults reside.

A nonprofit organization that was doing digital equity for over a decade, piloted new educational models which allow participants to learn remotely, as opposed to the strictly in-person modality the program previously offered. By the end of 2020, over 3,000 learners participated in a distance-learning version of the organization. The Mayor's Office of New Urban Mechanics shared how they entrust community-based organizations with training because they are best able to approach instruction in the most culturally competent way. The concept of "digital navigators" – trusted guides who assist community members in internet adoption and the use of computing devices – was speculated about by a few participants, however nothing is formally in place to adapt the model to the City of Boston.

Grants and Funding

Not every digital equity advocate has the ability to carry out work on the ground or within a specific community, however many interviewees detailed how their organization contributes to the digital equity ecosystem by funding various initiatives. In addition to digital literacy work, the small business incubator provided grants to their constituents for the first time ever to help them acquire the equipment needed to run their small businesses remotely. The Massachusetts State library system provided sub-grants to local libraries to assist them with their online programming efforts. Most notably, the City of Boston granted the local technology-based nonprofit Tech Goes Home with an additional two million dollars in American Rescue Plan Act (ARPA) funding. This action is in line with a theme that will be explored more in depth in a subsequent section of this chapter – interviewees expressed a desire not to "recreate the wheel," which makes funding preexisting initiatives an attractive contribution rather than building new programs from scratch.

Information and Connections

Lastly, digital equity was co-produced in the City of Boston by the sheer dissemination of information or contacts. The data suggests that a public servant facilitating an introduction for a community member could be a determining factor in whether a household becomes a digital have or not. A representative that serves immigrants in the greater Boston area shared that much of her work entails connecting migrants to community-based organizations in their neighborhoods, or even connecting nonprofit organizations to each other. The City of Boston's Department of Innovation and Technology often served as a central hub of information. A City representative stated, "As far as the community work, I would say that

we supported and connected people to the right place. If we had a contact for an ISP [internet service provider] company that we knew had hotspots, we'd tell them to reach out to them and also be on the call." The City has also shifted its focus from providing internet subscription subsidies to efforts getting individuals enrolled in the federal Affordable Connectivity Program (ACP), as that will provide more long-term access. A state library representative also described connecting citizens to ACP enrollments opportunities was similarly their near-term goal. Fostering strong relationships between resources and residents is key, as increased social capital is likely to last longer than many of the emergency stop-gap measures originally put in place.

Summary of Findings

Research Question₂ asks what are the outcomes that address the digital divide? In conclusion, digital equity outputs take various forms. Aid can run the gamut from easily-observable device dissemination, to more abstract actions such as financial bequeathing or social capital leverage. Solutions such as internet subsidies or digital skillset training typically fall somewhere in between. Table 6.2 summarizes the presence of outputs as described by respondents. Some of the added responsibilities that policy actors have shouldered is evident in the pilot research as well. This table should not be interpreted as a holistic list of yields as it is specific to the qualitative data collected for this study. The "other" column includes outputs such as increased digital entertainment content or improved open access to online databases.

Table 6.2: Digital Equity Outputs

Affiliation	Device	Internet	Literacy	Funding	Info	Other
Local Initiatives Support Corporation			X	X	X	
Boston Public Library	X	X	X		X	X
Tech Goes Home	X	X	X			
City of Boston Department of Innovation and Technology	X	X		X	X	
Mayor's Office of New Urban Mechanics		X			X	
City of Boston Department of Innovation and Technology	X	X		X	X	
Massachusetts Board of Library Commissioners	X	X	X	X		X
Office of Immigrant Advancement					X	
City of Boston Department of Broadband and Cable	X	X	X	X	X	
Age Strong Commission				X	X	

Research Question₂ Part 2: Co-production of Digital Equity

The digital divide is structured between three separate device, internet, and skills domains.

Because of this, policy solutions often stem from differing sources, emulating the theory of

co-production. Co-production is a process through which inputs used to produce a good or

service are contributed by entities who are not in the same organization (Ostrom, 1996),

requiring strong collaborative efforts between local, state, and federal governments. Co-

production is used to describe activities involving traditional and untraditional service areas,

as well as activities that have little to do with service delivery but rather address other aspects

of public services and public policies.

   While the digital divide exacerbated amid the COVID-19 pandemic and citizens

faced new financial and social constraints, municipal governments were pushed to

administrative capacities. As the notion of co-production is continuously evolving, this crisis was a significant impetus for policymakers to shift away from more traditional policy processes and adopt more collective approaches. Grounding the digital divide within the co-production framework aids in answering the second sub-question of **Research Question₂**: what is the process of digital equity co-production? Interviews revealed that co-production was a vital part of coping with the COVID-19 pandemic and the digital divide in the City of Boston. Furthermore, the data suggests that collaboration was crucial at every stage of the co-production cycle.

Co-commission

The first stage of Nabatchi et al.'s (2017) co-production cycle is co-commission. This stage details activities aimed at strategically identifying and prioritizing needed public services, outcomes, and users. This phase seeks to understand what needs to be delivered, to whom, and to achieve what outcomes. Co-commissioning uses knowledge and expertise from both the public sector and citizens to triage service provision. The collected data revealed that agencies co-commission most commonly with community-based organizations or directly with citizens. In some instances, due to the nature of the emergency environment, digital equity co-commissioning was executed haphazardly, or sometimes not at all.

Community-based Organizations

A common theme that was identified is the reliance on local, on the ground collaborations. Almost every single interviewee either previously had, or was required to build, relationships with community-based organizations to further their digital equity efforts. Specifically, these

135

close collaborations aided tremendously in identifying the needs of a community. "I think

that's the benefit of working so closely with departments and community groups, is that

we're localized enough to where we hear so much of that directly," stated a former City

technology employee, when asked who the department primarily collaborated with to

understand citizens' lived experiences. The interviewee also shared that they pulled data

from Boston's 311 system to better comprehend how to provide necessary services to

residents.

A technology-teaching nonprofit emphasized how crucial neighborhood partners are

to the success of their model. A representative stated,

> "Our partners, our program partners are organizations on the ground in the
> neighborhoods where we are. They have trust with members of the community and
> they ask questions like, 'what resources do you need or want?' Or, if that's too
> specific of a question, it's like, 'well, tell me about your needs in general.'"

A similar sentiment was shared by a government employee, who stated, "we're not out in the

community every day, so we look to the organizations that work with these communities to

tell us what they need." Interviewees stressed how the importance of community-based

organizations cannot be undersold. The same respondent emphasized,

> "I would never claim to know the best way to get somebody connected in East Boston
> – I'm in Jamaica Plain, that would be a stretch. But we have neighborhood liaisons,
> we have a lot of touch points with the community aside from just the actual
> departments who are working with different populations. So, that's really helpful, and
> I think working with advocates like that helps us scope what we need."

Markers of data saturation appeared when a liaison who works with the older adult

population in the City shared an almost verbatim statement. She stressed, "we cannot be in

every single community every day delivering services, so we rely on our partners. Through

conversations with our partners, we are constantly learning about and understanding the changing needs within the communities in Boston." An employee of the Mayor's Office of Immigrant Advancement shared that the department has at least 80 community organizations plugged into their office. The Mayor's Office of New Urban Mechanics described community-based organizations as having more access to resources with the ability to perceive a lot of the barriers or opportunities available to their constituents.

The Boston Public Library relies on their community contacts to help disseminate a press release and inform residents of their long-term and short-term device lending programs. This evidence was corroborated by one of their partners and fellow interviewee from the Mayor's Office of New Urban Mechanics: "BPL [Boston Public Library] runs the day-to-day pieces of the program, but in terms of getting the word out, doing the community organizing, literally running the meetings and then building external partnerships and structuring those, that's me." The library also depends on these associates to provide any necessary language translation services, citing an observed barrier that many non-native English speakers experience while attempting to access resources. This embedded community aspect is uniform even across sectors – a small business representative stated how her organization heavily leaned on business support organizations (BSO) to identify needs, as those are the on the ground entities that have the robust connections to resources.

Direct Citizen Engagement

City departments that receive federal funding are typically held to stringent reporting requirements that invoke co-commissioning directly with citizens. The Age Strong Commission, because they are an Area Agency on Aging, are obligated to pilot a needs

137

assessment every four years. In 2020, the Commission facilitated a city-run evaluation and distributed surveys to older adults and service providers and conducted a series of focus groups across Boston. This exercise highlighted the dire need for training around technology and connectivity for the older population. A secondary mandate requires a Senior Mayor's Advisory Council to be comprised of at least 50% older adults. This group of active leaders meets monthly, advocates in their respective communities, and most importantly serves as a conduit between the City and their peers. The Age Strong representative summarized, "we rely on them to bring feedback back to us, and also get information and resources out into their communities." This exemplifies the growing need of inviting members of the affected population to the table.

Lack of Co-commissioning

In the wake of the COVID-19 crisis, the data demonstrates how co-commissioning was other times performed haphazardly. When describing how the City of Boston deployed their fleet of hotspots and tablets to community members, a leader described the process as strictly reactionary. "We weren't interviewing people; there wasn't an application. We piled and shipped and went down to the car to drive them," he stated. This provides some evidence that the nature of co-production operates differently in crises situations, a concept that will be explored more thoroughly in **Research Question$_3$**.

Co-design

Co-design captures all those activities that incorporate inputs from users and their communities into the operation decisions regarding public services. Its philosophical

138

underpinnings treat community members as equal collaborators in the design process. This participatory approach engages stakeholders to find solutions to complex problems. Outputs in this stage of the policymaking cycle include a plan, policy, strategy, or arrangement. Common themes identified in the co-design stage include cooperation between municipal agencies, with community-based organizations, and between various levels of government.

Intra-governmental Teamwork

In terms of taking the identified needs and converting them into policy solutions, the data suggests it is common for various government departments to work together to resolve problems. For example, the Digital Equity Fund has proven to be a successful collaboration between the Department of Innovation and Technology, the Age Strong Commission, and the Equity & Inclusion Cabinet. Especially as digital equity emerged as an uncharted policy area for many government employees, the Department of Innovation and Technology provided answers and resolutions whenever they could. A collaborator reflected, "This is an area that until last year I was not very familiar with and did not do a lot of work in, so I relied on their [DoIT's] expertise."

Often, an effective model transpired when one leader typically drove the process. For example, the Boston Public Library stated, "we created the hotspot lending program with the City's Department of Cable and Broadband and the Boston Housing Authority. I owned it more than they did, but I looked to them for input." In this specific instance, there were various funding requirements that had to be met for the program to operate. With strict constraints at hand, it was most efficient if there was one main point person at the helm who then consulted others.

139

Community-based Organizations

Community-based organizations once again provide invaluable contributions to policy production. More times than not, interviewees provided indication of including local expert's opinions into the design of a digital output. A nonprofit that provides digital literacy training detailed, "the designing of the courses really is a two-way street as well. All of that is designed with our learners' input and our partners' input." In the same way in which co-production operates as a continuum rather than a static state, partnerships are also fluid providing the two entities have the same end goal. One nonprofit leader stated, "we'll work with anyone who wants to work with us that are going to serve the people we want to serve."

Similarly, a representative for the Massachusetts Board of Library Commissioners shared that when cultivating broadband equity programs across the state, community anchor institutions are called out to be explicit partners in the planning phase. It is written into legislation as part of the Digital Equity Act that these organizations must be at the table during development stages. In various capacities, community involvement ensures designs meet residents' needs in appropriate, feasible, and culturally competent ways. This requirement aids in tailoring the design of the policy and increases its chance for success. Another respondent likewise discussed this necessity: "we have partners who are very culturally specific to the neighborhood that they work and reside in, and that's essential to deliver effective programs. So, understanding the community and being a member of the community, yourself is really important."

140

Vertical Co-design

Another way that departments co-created was by combining their budgets to increase

potential impact. The City's Department of Innovation and Technology and the City's Age

Strong Commission joined forced to provide even larger-sized grants specifically targeted at

older Bostonians. Co-design not only occurred horizontally across departments, but also

vertically between levels of government. The City of Boston began working with the State's

Broadband Office (Massachusetts Broadband Institute), and the Massachusetts Department

of Telecommunications and Cable (MassDTC) to further develop digital equity plans.

Co-delivery

Co-delivery refers to the joint effort at the point of delivery of services and centers on quality

and efficiency improvements. This is the stage where a tangible good or abstract idea reaches

the intended constituency. The data proposes that co-production is extremely common at this

phase of the policy cycle due to various physical or cultural barriers preventing entities from

delivering goods or services. Evidence of co-delivery was identified in the data primarily

with community-based organizations, and to a lesser extent, between municipal departments

and large nonprofits.

Community-based Organizations

From a productivity standpoint, co-delivery is required to ensure resources are being used in

the most effective ways. For example, a library representative stated that,

> "Hotspots were distributed to over 15 community organizations and city departments.
> Our partners used these to empower youth organizers, provide connection to public
> housing residents, connect farmers' market and food pantry clients with easy access to

SNAP and recipes online, make telehealth a reality for our most vulnerable neighbors, offer digital English classes available for Afghan refugees, and much more."

When community organizations are part of the service delivery aspect, they are able to put the resources to use in the way which makes the most sense for the context and in a way that has the biggest impact. Community representation increases the opportunities for resources to reach marginalized or vulnerable populations.

For example, the Age Strong Commission depends on their nonprofit partners in the neighborhoods where older Bostonians reside to deliver information and amenities to them. Even just buildings that house older adults became crucially relied upon partners for disseminating surveys to residents. Apartment complexes also helped Age Strong conduct focus groups with constituents virtually when in-person meetings were prohibited. Because many older adults lack digital access, a representative in the building would set up a group video conference call so all were able to participate. The Boston Public Library also partners with the Boston Housing Authority to distribute devices to patrons in other harder to reach low-income housing blocks.

More generally, community-based organizations also provide opportunities for individuals to get connected that wouldn't exist otherwise. For example, a city official stated that, "we have community partners who have offered to accept shipments on behalf of people in their network and then push it forward. Not every organization can do that." A library employee also emphasized that it was the local organizations and even small businesses who helped identify hard-to-reach populations that were disconnected and disseminated information and resources to them. They also leveraged these channels to distribute

equipment in-person as there were concerns over theft of devices when shipping directly to individuals' homes. Again, a delegate from the corporate sector recounted how much of the information was relayed to the small businesses via the on the ground business support organizations.

Additionally, the data suggests that community-based organizations assist with skills identification as well. It was the Age Strong Commission's partners, who work with older adults day-to-day, that were able to recognize technological knowledge gaps in their constituency and relay that information back to a public sector representative. "Education or training can look very different from one community to another, so it is important to give that community the flexibility and ability to make decisions based on the needs of the community," mused a Commission employee. Through the Digital Equity Fund, Age Strong was able to empower community organizations to provide group classes, end user support, small workshops, and assistance hotlines.

The importance of personalized services was also underlined during the member-checking exercise. Upon reading the major themes extracted from the interviews, one respondent noted that there was not enough emphasis on modifying the services accordingly. "We believe that the curriculums for adoption need to recognize that not everyone needs a 101 basics course, and that courses should be tailored to meet the community needs." Although the process of adapting outputs was not mentioned as frequently during interviews, it has been noted as a crucial component to community success.

NGO and Public Sector Synergy

Lastly, public sector-NGO[3] collaborations also take place. A technology nonprofit described how they work with various branches of City government to deliver programming, such as the Boston Housing Authority, Boston Public Library, Boston Center for Youth & Families, and numerous community centers. The Mayor's Office of Immigrant Advancement cited this partnership as instrumental throughout the pandemic as the nonprofit supplied citizens with tablets so they could continue English language classes during lockdown. The nonprofit also fosters relationships with a number of Boston and Cambridge public schools that offer up their classrooms to deliver inter-generational and family-based programming.

Co-assessment

Co-assessment categorizes the monitoring and evaluation of public services. It concerns activities that have already taken place in which results are used to rethink or improve services. This process typically produces a monitoring protocol or policy evaluation. The data suggests mixed experiences for how this final stage in the policymaking cycle is addressed. Given the emergency situation society was thrust into, some organizations did not tackle assessment activities at all. For others, co-assessment primarily occurs within the silos of individual departments or organizations, largely through a distributed surveys or qualitative follow-up interviews or focus groups. Additionally, there is some evidence that outside entities are consulted to help ensure success.

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[3] While a non-governmental organization has similar goals to a community-based organization, they are distinguished entities in this study because their scope is typically not limited to a specific geographic area.

Lack of Co-assessment

For some parties, outcome documentation is a nascent component of their model, or has even yet to be implemented. A library official said, "the impact piece is definitely something that we want to try to get more data on. It's not something that we've addressed at this point, because we've been trying to put more effort into making sure we get all of these devices distributed as soon as possible." The data provides more evidence of how co-production manifests differently while under extreme pressure and time sensitivity. With scarce resources and human capital at capacity, the assessment phase is the one most likely to be overlooked. An agent from the state library system shared, "In the midst of the pandemic, we just needed to get these [hotspots] out there. We were going to be very light-handed in terms of the reporting requirement. All we absolutely required was that they [municipal libraries] gave us circulation numbers." A City employee who works with Boston's immigrant population articulated a similar sentiment: "During COVID, especially the first year, it was just crisis and then we respond. But I think that was really necessary." Finally, another local government representative stated, "During the pandemic there was a bit of a mad rush to get money out the door, to fund resources that were greatly needed. And there wasn't necessarily the time to learn how to do the evaluation piece."

Siloed Assessments

Another finding is that the assessment component is present for a policy actor, yet it doesn't necessarily incite teamwork across institutes. The small business group launched a survey to understand the success of their digital growth accelerator, but did not rely on expertise external to their division to analyze the results. Likewise, the Mayor's Office of Immigrant

Advancement reported internally conducting informal qualitative interviews and focus

groups with participants who were part of their programs. However, these actions did not

extend beyond their own constituency.

Mandated Reporting

Other organizations that provide funding and grants have a reporting structure built into their

model because it is federally mandated. The Board of Library Commissioners stated,

> "If it's federal money, we have to [assess impact] … We have to give them [federal
> government] a five-year program plan with measurable objectives. It's like a long-
> range plan. And every year we file a state program report where we tell them what we
> spent the money on, how many libraries and how many people were affected by the
> programs, various other outcomes and output measures that we defined at the
> beginning of the activity."

Existing literature does not demarcate whether or not compulsory reporting is considered co-

assessment. However, it is clear that knowledge and analyses are being shared vertically

through different levels of government.

In a similar instance, the Age Strong Commission, which subsidizes organizations via

the Digital Equity Fund, asks all collaborators to disclose a progress report. A respondent

detailed, "We did a mid-year check-in and had each partner share a write-up with us so we

could understand, not so much the numbers, but what does the program look like right now,

and what will it look like for the next six months?" The Commission plans to do another

progress update when the year has ended. The interviewee explained that as the grant-

funding component of her role grows, so will the evaluation piece.

Cross-sector Co-assessment

Other interviewees provided indication that evaluation measures do occur between entities from separate administrations. A nonprofit that offers digital literacy training stated, "we do an intake survey, we do an outtake survey, then one year later we do a follow-up … We've worked with a number of organizations over the years to help frame our questions. We've also worked with Simmons [University] at times, to do some analysis of our data." In this instance, academic institutions are called upon to provide a skillset that is outside of the capacity of the nonprofit, a prime example of vital collaborative efforts. Academia was not mentioned frequently in the data, indicating it could be an untapped resource for all types of partnerships.

Some evidence illustrates that co-assessment expresses in the form of associated accomplishments, namely from all-important community-based organizations. One local government official described their impact observations as, "we have measured our success based on how well our solutions are working for our departments who are working with the community. Their success or their struggles, we piggyback off of." This highlights the importance of local, on the ground efforts at every single stage of the policy cycle. The data suggests that in some instances, outcome measurement would otherwise be overlooked for not for the community representatives.

Summary of Findings

The second sub-question of **Research Question₂** asks, how is digital equity co-produced? In the City of Boston, digital equity work does not happen effectively without strong collaborations. Interviewees offered a remarkably consistent take that underscored special

emphasis on local, neighborhood involvement. They strenuously endorsed community participation and direct involvement from those whom digital equity strategies seek to serve.

A technology nonprofit summarizes it nicely: "our partners are one of, if not the most important part of our model. It doesn't work without them – we've tried … there's that special sauce of that organization on the ground that is already serving the community in a certain way." In short, it is imperative that digital equity policymaking is community-centric. The member-checking exercise yielded additional support for the community arm of the model. It particularly highlights the long-held notion that policymakers cannot solve problems that they are unaware of or do not comprehend. (Kingdon, 1984; Bardach & Patashnik, 2019).

For example, there are multiple entities and levels of policymakers who have authority over aspects of the digital divide. It is probable that these individuals themselves are not members of a digitally disadvantaged population. Policymakers are professionals who most likely always have access to internet-connected computers at home and work along with the appropriate digital training. Therefore, the digital divide must be articulated in a way that helps the relevant public administrators understand why it is a problem and the benefits of solving it. This is one of the knowledge gaps that community-based organizations can fill. One interviewee responded to the member-checking exercise in agreement: "One thing I'd add is that expertise with technology can impede understanding what barriers constituents may have to technological adoption. Trying to solve problems without talking to residents or resident-serving partners/providers can limit the scope of questions we should be asking and concerns we should be prioritizing."

Overall, co-production can be used as a governance model in which service providers and service users work collaboratively to design, deliver, and evaluate public services. The key message for policymakers is to more fully consider the local and personal social contexts of citizens when designing interventions. This means understanding people's communities and how to tailor strategies in a way that is meaningful to them and their everyday lives. Blanket policies adopted from other regions will likely fail.

Lastly, the data suggests cross-sector partnerships are the foundation of an effective strategy to close the digital divide. Deep relationships are crucial to be able to problem-solve in real time. Co-production increases accountability by creating a shared sense of ownership, and enhances democratic participation by giving service users a voice in the decision-making process. Anecdotes from the interviews also reveal that in practice, there is more overlap between quadrants than Nabatchi et al. (2017) originally purport. Figure 6.1 displays the co-production framework further contextualized with findings from the qualitative portion of this dissertation.

Figure 6.1: Digital Equity Co-production Policymaking Cycle in the City of Boston

- CBOs relay specific, contextual needs to the City

- Cross-departmental collaborations design solutions

Co-commission

Co-design

Co-assessment

Co-delivery

- Mixed results; specialized skill set is provided

- CBOs leverage resoruces, accept shipments
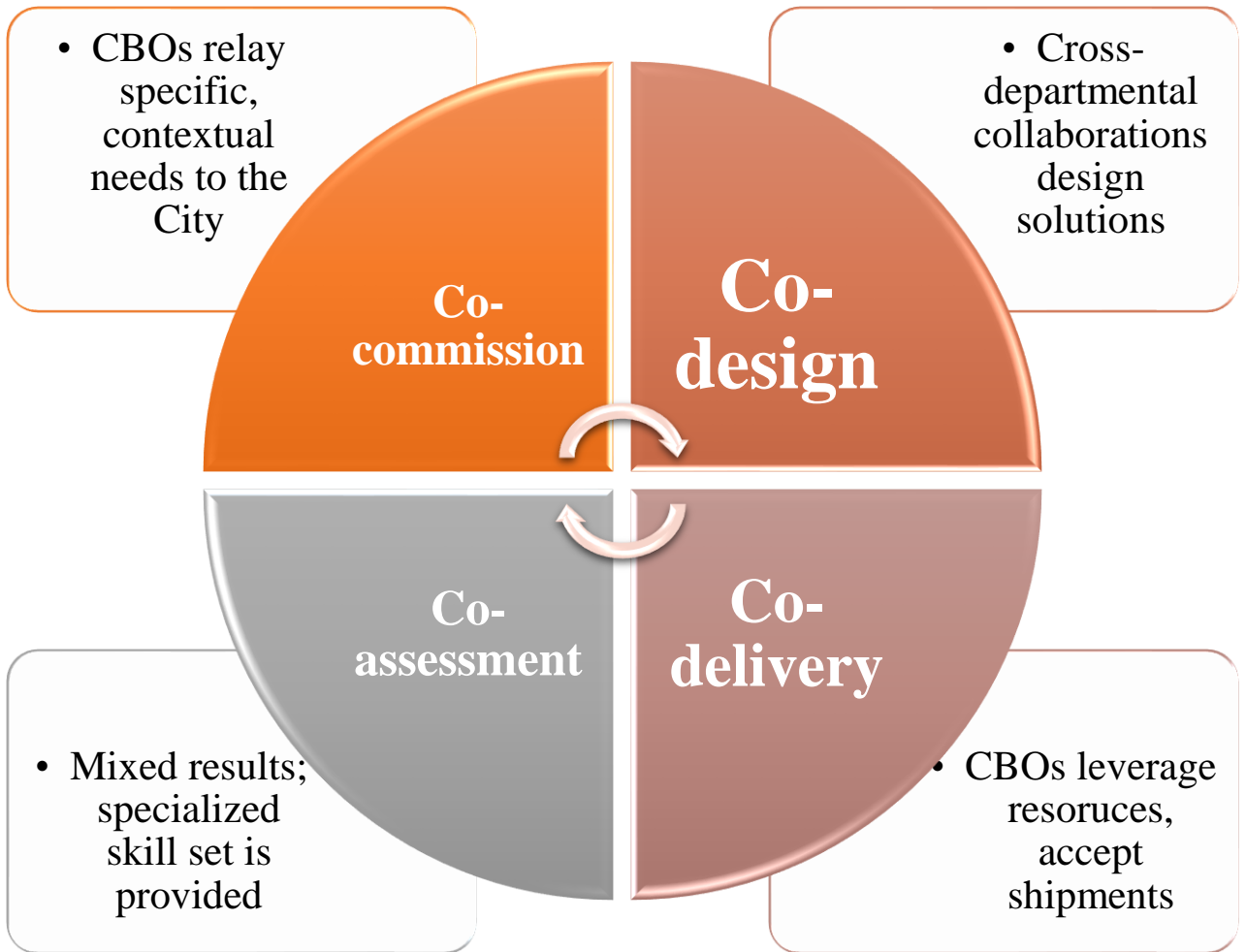
To reiterate, in the co-commission stage, community-based organizations gather and relay specific, contextual needs to the City. Almost every single respondent shared that they rely on community organizations who have direct, day-to-day contact with the constituents that they serve to better explore and understand precise needs of niche populations. Direct collaborations between government departments and citizens also transpire. In emergency

environments, the data suggests co-commissioning may be fulfilled chaotically or omitted altogether.

In the co-design phase, local administration takes that gathered information and seeks input from other City departments to craft the best fitting solutions. Sometimes, but less frequently, co-creation happens with on the ground organizations and with other levels of government. Co-delivery ensures that resources are not only actually reaching citizens by physically disseminating items or information, but community organizations also guarantee those resources are implemented in the most effective and culturally competent way. Co-delivery also seldomly occurs through NGO-public sector partnerships.

In the co-assessment phase, organizations might rely on other entities with more robust skillsets to help carry out their evaluations. In some cases, collaborative monitoring provides a starting point for other departments to piggyback off of. On the other hand, there is overall evidence that evaluations occur, but often do not extend beyond a given department. In few instances, outcome monitoring is absent altogether. Overall, all four stages of the cycle are greatly enhanced by community-based organizations. Table 6.3 summarizes at-a-glance which departments conveyed evidence of co-production at a given stage in the sequence.

Table 6.3: Reported Presence of Digital Equity Co-production

Affiliation	Co-commission	Co-design	Co-delivery	Co-assessment
Local Initiatives Support Corporation	X	X		
Boston Public Library	X	X	X	
Tech Goes Home	X	X	X	X
City of Boston Department of Innovation and Technology	X	X	X	
Mayor's Office of New Urban Mechanics	X	X	X	X
City of Boston Department of Innovation and Technology	X	X	X	
Massachusetts Board of Library Commissioners		X	X	X
Office of Immigrant Advancement	X		X	X
City of Boston Department of Broadband and Cable			X	
Age Strong Commission	X		X	X

Research Question₃: Co-Production in Crises

There is scant literature on how the theory of co-production deviates from its normal

behavior when society enters a wide-spread emergency situation. In this dissertation, a crisis

is regarded as "a situation of large-scale public dissatisfaction or even fear stemming from

wide-ranging economic problems and/or an unusual degree of social unrest and/or threats to

national security" (Flanagan, 1973). Crisis management scholarship describes threats to core

values, urgency to act, and uncertainty concerning the situation or course of action as an

agreed upon set of crisis conditions (Rosenthal et al., 1989). The global COVID-19 pandemic

creates a unique research opportunity to reexamine the theory of co-production and

contribute addendums to its conceptual framework. The theoretical impacts of this study aid

in addressing **Research Question₃:** what conditions lead to successful co-production in times

of crises?

Disincentives to Co-Production

Co-production is not universally advantageous, nor will it occur spontaneously simply

because substantial benefits can be achieved. If not executed ethically, co-production can

reinforce existing power imbalances, particularly if certain actors are not adequately

supported or empowered to participate fully in the process. In order to understand how to

foster a thriving co-productive environment, respondents were first asked if they experienced

any challenges or disincentives to co-producing. Themes range from encountering conflicts

of interest and managing the bifurcated expectations of involved parties, to battling time

constraints, to navigating public acknowledgement or lack thereof. Interviewees also

experienced setbacks related directly to the effects of COVID-19.

Conflicts of Interest

Subjects in the study expressed incompatible visions between them and their partners as a

formidable deterrent to co-production. For example, one organization considered growing its

services to be state-wide, however faced pushback from collaborators due to others' foci

being squarely within the jurisdiction of the City of Boston. The fear was that service

expansion would stretch employees too thin and weaken city-centric missions. Another

respondent voiced that receiving subsidies from various sources often meant that each funder

was expecting a different outcome, making it challenging to work holistically with all parties

involved.

153

One participant cited their experience working with different capability levels, signifying some partners needed more "hand-holding" than others. Others encountered situations where associates misrepresented the capacity that they had available. One policymaker verbalized, "I had assumed there wouldn't be as many requests to community learning, because there was all of this support, but that just wasn't fully there at each location." Someone else mentioned the need for a more centrally-focused staff person to manage projects.

Delayed Outputs

Another barrier to co-production was trouble meeting time-sensitive deadlines. Anecdotes from the data outline how the more partners that are added, the more complex and lengthy review processes become. For example, sometimes a community-organization will return materials back to the City and request them to be translated into another language. While this cultural perspective is highly valuable and strengthens the program overall, it often delays the launch time of goods or services. A participant summarized, "Sometimes things can slow down or become more complicated, but often it's for the collective betterment of the program." The member-checking exercise generated feedback that is slightly outside the scope of these research questions as it relates to direct interactions with digital have-nots as opposed to relationships between policymakers, however it addresses the theme of time-dependent priorities. An interviewee offered the following viewpoint in response to the list of general themes:

> "The only thing I would have to add is that one major challenge is in how time consuming it is to assist people with understanding how to use devices once they receive them. Generally, people don't like reading instructions and are intimidated by

new technology. They need a lot of hand holding through the basics which is very hard to do at scale."

City Recognition

A challenge specific to co-creating closely with community-based organizations is ensuring that the City of Boston is still recognized as a partner in the work. A City official noted how programs such as the long-term lending program, because it is advertised through community partners, is not always understood by residents as a service provided by their local government. A public sector official further explained,

> "Sometimes when we bring in community organizations – and I will always choose a community organization as a partner over not having them involved, but one thing is that community organizations – it's a lot easier for them to provide an interesting visual to the public or to the media of them helping somebody, because they are doing the work on the ground – and often, programs are only possible or primarily possible because of the City's funding and work on the back end."

With trust in local government reaching all-time lows, the public perception of using taxpayer dollars efficiently is a slight, but valid obstacle. Another respondent, on the same topic of constituents crediting the City even when the output is coming from a different name, surmised, "I think in the grand scheme of things, as long as the work is getting done, that's okay."

Pandemic-related Setbacks

Lastly, the COVID-19 pandemic provided its own set of challenges to co-producing. Respondents reported many of their partnerships were understaffed and the human capital that was available was overexerted or juggling too many tasks at once. In some instances, joint in-person events were forced to cancel due to coronavirus spikes in the area, making it

155

difficult to achieve goals. At the start of the crisis, many competing co-existing hardships led

one participant to describe society as "on fire," which prevented the city from working to

their fullest potential and enact sustainable plans. COVID-19-related financial constraints

also instigated challenges providing grants to local communities. An interviewee who was

part of the allocation process for Boston's Digital Equity Fund detailed,

> "I think the biggest struggle we had, especially with the last round of the Digital Equity Fund is that there was no application I received where it felt like the recipients didn't deserve it … We wanted to help as much as we could, so I think general budget constraints were a struggle."

These barriers, whether specific to pandemic-era operations or not, contribute new details to

the nexus of stipulations required for successful co-productive policymaking.

Conditions for Successful Co-Production

Ostrom's work (1996) in the public management sphere previously outlines three

circumstances that heighten the probability that a co-productive model will facilitate an

improved experience over regular government production. The first condition is when inputs

are owned by diverse entities. If "each has something the other needs" (Ostrom, 1996) and

each player provides their skills, time, and perspective, there is opportunity for synergy.

When there is variety, each service is more likely to be able to offer something distinctive

which, when dovetailed with the offerings of other agencies, adds up to a better service.

Secondly, legal options must be available to all parties. Governments must make an effort

to sustain funding and to institutionalize the legal flexibility. The third characteristic is the

ability to build credible commitment to one another. Ostrom (1996) finds that mutual

commitment is needed, so that co-producers can trust that if they continue or even increase

156

their input, the other party will proportionately do so at the same or even higher levels.

Figure 6.2 pictorially represents Ostrom's reported requisites. The data collected in this

dissertation suggest that in emergency environments, there are additional conditions needed

to achieve fruitful co-production.

Figure 6.2: Ostrom's (1996) Conditions for Co-production

Diverse Entities	• varieties of services to offer distinct inputs
Legal Options	• legal and institutional flexibility
Credible Commitment	• mutual understanding that levels of input will be matched
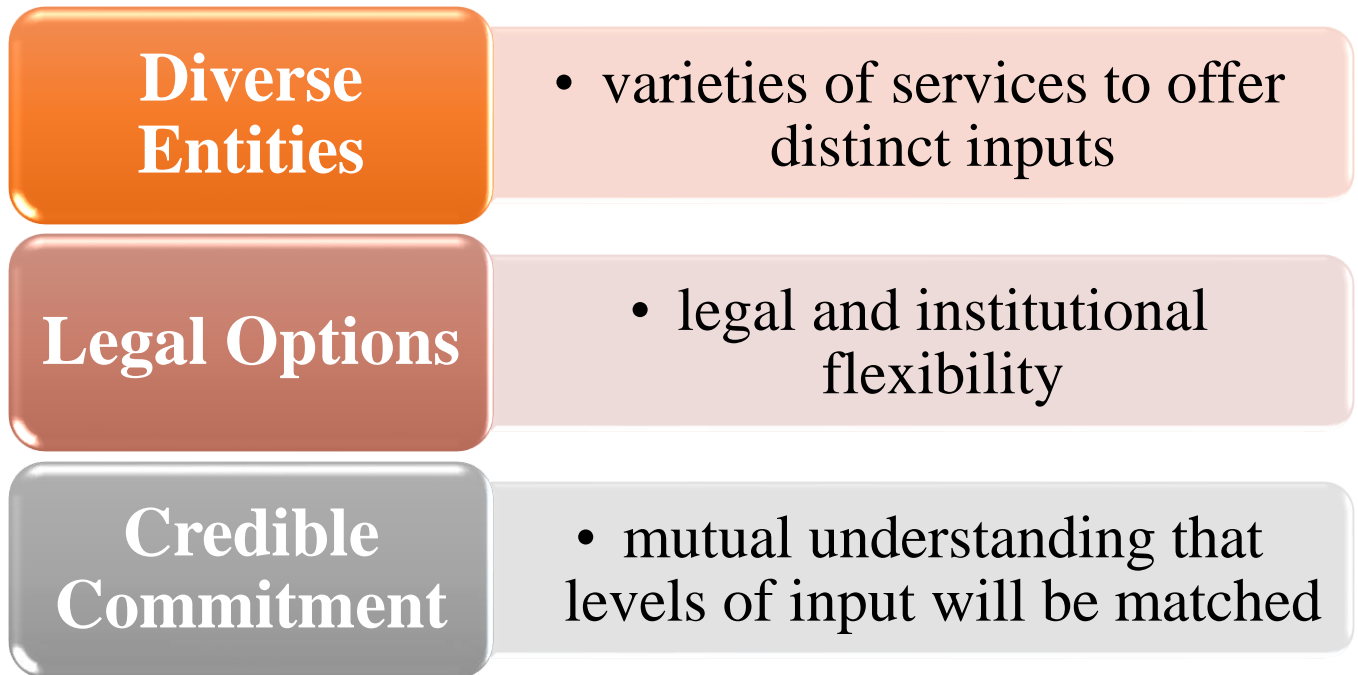
Respondents from interviews reported a variety of factors which were necessary to

successfully foster digital equity in the City of Boston. Some themes mimic the

considerations of Ostrom, such as the need for trust. Others provide a more nuanced

understanding of her suggested conditions, such as ensuring efforts aren't duplicated. Other

trends were identified that are specific to crisis environments in which Ostrom's research

doesn't broach. These additional influences include well-established relationships,

preexisting preparedness, a heightened sense of unity that facilitates the ease of asking for

help, and funding availability.

Trust

The strongest condition that was indicated by interviewees for successful co-production is a

high level of trust between collaborators. This finding is directly in line with Ostrom's third

condition of credible, mutual commitment. Stated bluntly by a participant, "trust is huge. I

don't think you can downplay that word. I really don't think you can." Respondents

expressed a direct correlation between developing trust with organizations over the years and

being able to carry out digital equity work during COVID-19, with one participant describing

the parallel as, "the benefit of history." Explicitly, trust with community organizations was

highlighted as a crucial component. Local establishments are the entities that have the most

trust with citizens because they interact with them on a daily basis, so on the ground units

bring in constituents who would otherwise not have the credence to interact with a

government office.

In this sense, interviewees built upon Ostrom's ideas by describing how good-faith

interactions need to work in both directions. This theme extends beyond simply two units

trusting each other to complete tasks – additionally, it details how public sector entities need

to be perceived as trustworthy themselves as the donner of information and resources. This

mutual exchange is summarized by a representative from the Mayor's Office of New Urban

Mechanics:

> "We were able to connect Afghan refugees with Wi-Fi through the hotspot lending
> program. Usually, refugees who are fleeing from one really bad government and an
> incredibly bad set of circumstances may not always look at the next government and

say, 'yep, I trust you.' Obviously, that's an extreme over-simplification of all of those different factors, but community-based organizations have a level of trust. And they have us."

The same respondent also shared that her department encountered challenges with signing citizens up for the Affordable Connectivity Program, since many individuals do not trust the federal government. This research further develops Ostrom's condition of mutual commitment by fleshing out different trajectories that the levels of trust need to flow in.

Resisting Reinvention

Another prominent condition for success expressed in the data is the importance of not replicating efforts. This finding is akin to Ostrom's stipulation of inputs being owned by diverse entities. A respondent who was on the technology front-line at the start of the pandemic shared,

> "I think people knowing their roles was huge. And taking a step back to be able to coordinate with departments to make sure that we were not duplicating work ... if we tried to get a bunch of people Chromebooks, I think it would just be duplicative of what another organization does."

Multiple respondents embody this theme by focusing their attention on signing constituents up for the federal Affordable Connectivity Program, as opposed to attempting to buy and distribute internet vouchers themselves. A key part to this condition for success that Ostrom fails to describe is the willingness to work behind the scenes and out of the spotlight. The data suggests that supporting existing work instead of re-creating it for the recognition is imperative in emergency contexts.

Deep-rooted Networks

Related to individuals "knowing their role," another contributor to successful co-production was that the City of Boston maintains well-established relationship networks that predate the pandemic. When asked why it was easy for the department to roll out new policies during COVID-19, a cable and broadband specialist replied, "We have people like me and [redacted] who were very close. We have people who knew the issue locally and went to work on broadband issues." A nonprofit CEO also voiced a comparable idea: "we've been around long enough that people know who we are and we know who they are. That counts for a lot. I think that was huge." Later on in the interview, the participant reiterated, "I do think that it's the network of relationships that has kept us going."

The data suggests that the longevity of staff members is an important variable interrelated to quick action and swift policy decisions. Long-standing employees typically have developed a robust network of individuals who can be called upon in times of need. Community-based organizations are among the most effective conduits for digital equity initiatives because they have established relationships. This is particularly significant for residents who have limited English ability and those who are older. This relational, social capital side to policymaking is excluded altogether in Ostrom's model. Other co-production frameworks undersell the human components that explain the importance of interpersonal relationships.

Preexisting Processes

Participants in the study accentuated how beneficial it was that some groundwork had already been laid out years prior to the COVID-19 emergency. A leader from the Age Strong

Commission, who worked tirelessly to disseminate Digital Equity Fund aid to organizations that work with older adults, exclaimed how imperative it was that the grant process existed beforehand with protocol already in place. Another interviewee expressed gratitude for her relationship with the nonprofit organization who was already doing digital literacy work for years whom she referred her constituents to. Once again, on the ground organizations were lauded. A stakeholder from the Mayor's Office of Immigrant Advancement reflected, "I think something that is super important is the preexisting relationships with the community-based organizations. We already were talking to them all the time."

Sense of Unity

Another theme that was identified in the dataset regards a more emotional response to crisis situations. Many participants shared that success stemmed from a place of vulnerability. A small business leader in Boston acknowledged, "we didn't realize it so much until we needed to collaborate. And I think what made us successful was that everyone put their wall down." An amplified sense of unity and an "all-in" attitude were cited as necessary co-production circumstances. The same respondent continued,

> "I think we were extremely successful because that realization hit hard and fast. And because we were dealing with folks who were stakeholders in the ecosystem already, everyone was just all in. Everyone saw the urgency, saw the need, and did whatever they could to pull together and lift up small businesses in any ways that we could. I just think everyone was on board, but I think being willing to put their walls down and understand that we do more and work greater together."

Other respondents shared similar sentiments. A local government official pondered, "I would say that something that really worked to our advantage was just the unity of the goal." A library official explained how the case to ask for help is a lot more compelling in a

161

crisis. Another interviewee recounted how having additional human capital due to other jobs being displaced allowed their department to think through problems better and understand barriers faster. This "same team," community empowerment mentality that tends to magnify during emergencies is the second more human, emotional element that Ostrom neglects to acknowledge in her research.

Agenda-setting

The final theme unearthed in the qualitative data is reminiscent of Kingdon's (1984) theory of agenda-setting and policy streams. Kingdon suggests that policy change comes about when three streams connect: problems; politics; and policies. What distinguishes this model from previous frameworks is its focus on timing the "window of opportunity" when all three streams intersect. In this sense, interview respondents reported their successful co-productive activity was due in part because digital equity rose to political agendas and received attention from decisionmakers in ways that it never had before in the history of the digital divide.

With that increased national attention also came funding opportunities at unprecedented rates. A nonprofit leader summarized, "because the pandemic shined this terrible spotlight on digital inequities, there was so much more funding available. We had our best fundraising year we've ever had last year." Other respondents shared how they were able to redistribute capital to better focus on the immediate need of digitally connecting citizens. The intersection of agenda-setting and co-production frameworks contributes a new layer of conditions necessary for success that previous scholarship has yet to explore.
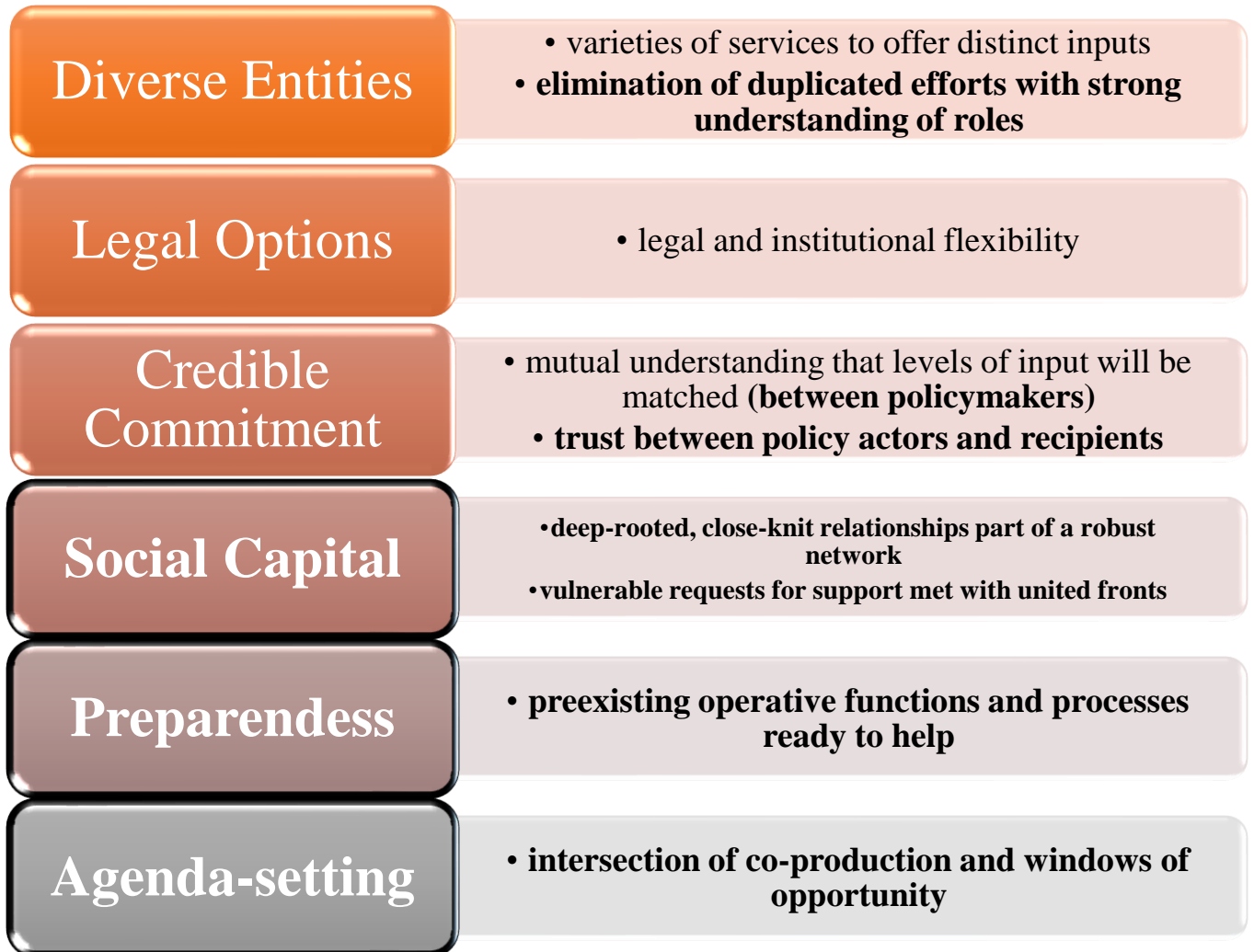
Summary of Findings

The findings demonstrate that co-productive behavior was a vital solution to coping with the effects of the COVID-19 pandemic and the digital divide in the City of Boston. The phenomenon centers on aligning efforts toward a common goal to achieve far greater impact than any single organization could reach operating on its own. Despite reported disincentives of conflicts of interest, time constraints, lack of municipal recognition, and pandemic-related setbacks, data from interviews propose co-production is a better way of identifying problems, finding solutions, and implementing initiatives than traditional bureaucratic processes. One respondent summarized many of the themes expressed in the data: "in a crisis, government can move pretty impressively."

Research Question₃ asks, "what conditions lead to successful co-production in times of crises?" The qualitative analysis in this study brings light to circumstances necessary for co-production to occur in emergency situations. Strong relationships and a culture of collaboration across agencies and organizations are critical to success. Specifically, it is vital to leverage organizations close to the ground that have preexisting relations and a great deal of trust with the residents they serve. This is critical to getting households over the significant hump involved in providing personal information, signing agreements for discounted services, and inviting internet installers into their homes.

Other findings not only add more context to previously understood prerequisites to co-production, but also illuminate the interpersonal stipulations that Ostrom and other public management scholars do not address. Co-production under constraints develops more rapidly than during periods of societal stasis The manner and timing in which issues reach political

163

agendas also plays an important role in curating solutions quickly. Figure 6.3 depicts this study's contributions to Ostrom's conditions for successful co-production with addendums highlighted in bold.

Figure 6.3: Conditions for Co-production in Emergency Environments

Diverse Entities	• varieties of services to offer distinct inputs • **elimination of duplicated efforts with strong understanding of roles**
Legal Options	• legal and institutional flexibility
Credible Commitment	• mutual understanding that levels of input will be matched **(between policymakers)** • **trust between policy actors and recipients**
Social Capital	• **deep-rooted, close-knit relationships part of a robust network** • **vulnerable requests for support met with united fronts**
Preparendess	• **preexisting operative functions and processes ready to help**
Agenda-setting	• **intersection of co-production and windows of opportunity**

CHAPTER 7: POLICY RECOMMENDATIONS, DISCUSSION, AND CONCLUSION

The digital divide has been a salient issue for information and communication technology

policymakers since the emergence of the internet. This research was conducted to provide a

better understanding of how formal, informal, and emerging digital inclusion strategies in the

United States, then more specifically, Boston, have been working to address the increased

demand for digital devices, internet access, and training in digital literacy caused by the

COVID-19 pandemic. Chapter 7 concludes the mix-methods study and connects the

reviewed literature, theoretical components, and analytical results. The contributions from

this research provide a broader understanding in the case of a major health pandemic by

using the ongoing COVID-19 crisis as a context for empirical work. This study also advances

scholarly, theoretical, and methodological social science research. In detail, this final chapter:

discusses the quantitative and qualitative findings within the context of policy

recommendations; reviews the various types of contributions this dissertation makes to

scholarship, theory, and methods; explores areas for future research, and offers concluding

thoughts.

Policy Recommendations

Digital inequalities have come into play for the first time in shaping exposure risks during a

pandemic. Prior to the COVID-19 emergency, efforts to bridge the digital divide were

generally narrow and led primarily by organizations dedicated to the cause. Today, leaders

from a variety of industries are joining forces to form collaborative digital equity

partnerships. These initiatives are rapidly mobilizing resources in order to mount a

multifaceted response to the digital divide. Quantitative findings highlight the importance of

congruency between policy discourse and on the ground action. Qualitative findings suggest

that well-organized cross-sector partnerships can tap into the wealth of knowledge held by

industry leaders. The following policy recommendations are intended primarily for

government actors; however, given their critical role in fostering digital equity, it would be

remiss to not also provide implications for community-based organizations.

### Implications For Government

The data suggests that Boston has made great strides closing the digital divide since the onset

of the COVID-19 pandemic. Far more residents have access to adequate computing devices,

internet subscriptions, and necessary digital knowledge as initiatives were created and then

expanded. However, even with public resources, a substantial digital divide remains.

Stakeholders interviewed as part of this study indicate households still face considerable

challenges related to broadband affordability, devices, and skills. The following

recommendations for government officials entail implementing holistic communication

strategies, capitalizing on funding, leveraging partnerships, investing in emergency

management systems, and piloting a formal digital navigator program. In general, these

recommendations can be transferred and applied outside the City of Boston, so long as the

region has a baseline digital equity ecosystem.

Holistic and Consistent Policy Communication

Both the digital trace and interview data demonstrate a disconnect between policy discourse and policy action. The quantitative portion of this study determines that nationally, the topic of the digital divide is dominated by broadband and internet access concerns. While this focus is extremely important, it undermines efforts needed to also bridge the device gap and enhance digital literacy. Operationalizing the entire disparity as a binary matter of access to the internet can be harmful in the long-run as it gives the impression that the divide is solved once broadband saturation is reached. Similarly, topic modeling determines that since the onset of the pandemic, digital divide discourse diversified in terms of topics expressed. Communications should reflect the broadened lens created by COVID-19, and specify specific audiences when applicable.

This observation holds true even at the local level. An example is the City of Boston Department of Innovation and Technology's (DoIT) pinned tweet. Highlighted in Figure 7.1, a pinned tweet stays static at the top of a profile and is the first piece of content that visitors will see. DoIT's pinned tweet informs users about the federal program that offers low-cost internet as well as a one-time discount on a new device. Information on two of the three dimensions demonstrates that Boston is likely ahead of its peers in terms of digital resource communication. However, to be truly transparent about all of the work being done to achieve digital equity, the department should consider replacing this pinned tweet with information and resources that address all three branches of the divide.

Figure 7.1: City of Boston DoIT's Pinned Tweet
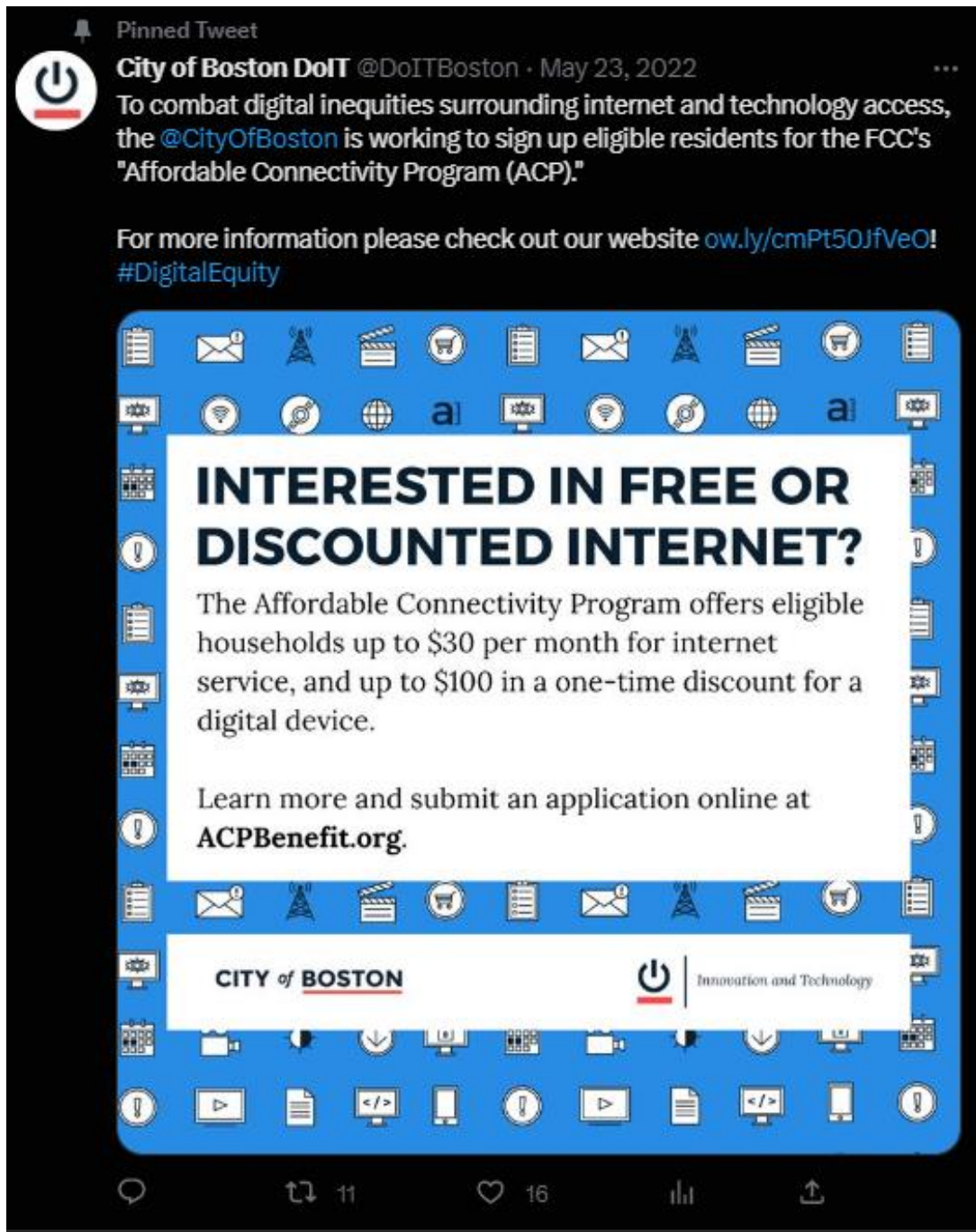
In the same vein, regression modeling demonstrates that public dialogue on the digital divide is rapidly waning after receiving peak attention in March and April 2020. Even if the

digital equity initiatives themselves are not new, communication about options and resources should be disseminated on a consistent basis. This will assist policymakers and public administrators in aligning their goals and messaging. Communication about programs should also be conveyed in non-digital formats to ensure it reaches those who are not digitally connected. The City should consider utilizing flyers, billboards, and signage in public areas to inform the population of interest. The national sentiment of digital divide discourse was found to be appropriately positive and trustworthy, and correspondence should continue along those lines.

Capitalize on Available Funding

The time series analysis of all digital divide discourse in the dataset demonstrates a statistically significant increase in the amount of attention given to this issue beginning in March 2020. With that amplified national attention also came funding opportunities at unprecedented rates. This open policy window was likewise explicitly highlighted in interviews as one of the conditions driving successful policy co-production. This once-in-a-generation funding available to close the digital divide will only have a long-term impact if it is deployed in a way that results in structural change.

Municipalities must seize the unparalleled infusion of federal resources and other public and private funds to secure their social and economic future. Using this funding, many existing programs in the City of Boston should be maintained, and if possible, expanded. However, the data determines a key condition for successful co-production is lack of policy reinvention. Thus, there is a delicate balance to strike to ensure that efforts are not duplicated.

169

For example, the City should continue to provide subsidies and grants through the Digital Equity Fund to disseminate low-cost devices to disadvantaged communities, but only to those who may be ineligible for the Affordable Connectivity Plan's one-time discounted device as described in Figure 7.1. Similarly, the City already distributes funding to nonprofits such as Tech Goes Home (TGH) who is a national leader in digital inclusion. Boston-based Tech Goes Home collaborates with community partners and a network of hundreds of instructors to offer learners 15 hours of free digital skills instruction. Each student receives a year of free internet service as well as a new Chromebook or iPad. As evidenced by local government interviewees, the City has a good grasp on when to launch new initiatives versus when to support existing ones. But by prioritizing grant funding to fill in the gaps of current services or replace ones that have already been exhausted, municipalities can ensure they do not squander the windfall of monetary support and instead elicit sustainable change.

Enhance and Leverage Partnerships

This dissertation concludes that bridging the digital divide requires concerted efforts by governments, nonprofit organizations, and community-based organizations. Co-productive behavior is a vital solution to coping with the effects of the COVID-19 pandemic and the digital divide in the City of Boston. Data from interviews propose that co-producing is a more effective way than traditional bureaucratic processes for identifying problems, designing solutions, and implementing initiatives. Interviewees offered a remarkably consistent perspective that emphasized the importance of local, neighborhood involvement.

The findings show that coalitions with pre-pandemic relationships were able to quickly respond to the increased demand for computers, low-cost internet service, Wi-Fi

hotspots, and virtual training. Fortunately, the City of Boston has a long history of working

with community-based organizations to engage within the City's wide range of communities.

Programs funded through the Digital Equity Fund and partnerships like Tech Goes Home are

a few examples of initiatives that encourage collaboration and success in community-based

work. Given this track record, the City should continue to invest in this effort and partner

with community-based organizations to formulate strategies to increase reach and impact on

the ground.

Community groups have valuable working relationships and goodwill with residents

most in need of support. As several studies have found that disadvantaged people, such as

racial minorities, less educated individuals, and those in lower socioeconomic situations, are

less eager to participate in co-production (Baker, 2010; Holmes, 2011), partnerships are

critical to ensuring members of the affected population are at the table. At a time when trust

in government is at historic lows, certain organizations have inherent advantages with

initiating processes. Collaboration between entities on a larger scale will allow for more

efficient streamlining and addressing of areas of need. To achieve this, specific and periodic

action is required to ensure that agencies work together synergistically.

The City should establish bi-monthly meetings to synthesize efforts among these

entities and standardize metrics. As co-assessment was found to be the most neglected stage

in the policymaking cycle, there is an urgent need to monitor progress over time.

Interviewees furthermore identified barriers such as conflicts of interest, elongated timelines,

and misplacement of municipal recognition. Structured meetings and open lines of

communication will also aid in ameliorating the reported disincentives to co-production.

Invest in Emergency Management

Crisis situations, such as the COVID-19 pandemic, necessitate quick and coordinated action that adapts to changing conditions. Respondents from interviews reported a variety of factors that were required to successfully foster digital equity in the City of Boston. New conditions that this researched unearthed relate to the emergency environment they were produced in. The data suggests that established relationships, awareness of existing policy constraints, capacity and knowledge about how to best engage with key stakeholders (both inside and outside local government), and years of digital inclusion experience made it possible to respond quickly and effectively. Thus, municipalities should ensure that multiple people thoroughly understand the issue at hand, including all its nuances, and be prepared to address it should a crisis strike.

According to interviewees, the longevity of staff members is an important variable interrelated to quick action and swift policy decisions. Long-standing employees typically have developed a robust network of colleagues who they can call on in times of need. As a result, organizations should do what they can to retain staff as long as possible; or at the very least engage, in succession planning should a role have a high turnover rate. Moreover, participants in this study accentuated how advantageous it was that some digital equity groundwork had already been laid out years prior to the COVID-19 emergency. Communities should work to build systems and blueprints during times of stasis so they may be easily activated in the event of an emergency. As co-production flourished during the pandemic, co-production initiatives will almost certainly need to be sustained after the

immediate crisis has passed in order to increase resilience and better prepare for future health, economic, social, civil, or climate-related shocks.

Pilot Digital Navigators

In response to the pandemic, a number of new institutions became involved in digital equity work, with K-12 schools, health care providers, and local nonprofits showing particular interest. This diverse group of actors has the potential to help launch a Digital Navigators program. Digital Navigators are trusted guides who help community members adopt the internet and use computing devices (National Digital Inclusion Alliance, 2021). According to the National Digital Inclusion Alliance, navigators can be volunteers or cross-trained staff who already work in social service agencies, libraries, health, and other organizations who provide remote and socially distant in-person guidance.

The Digital Navigator model is a scalable framework for municipalities that already offer digital inclusion services. Often at trusted community-based organizations, Digital Navigators are familiar with resources that relate to digital equity and help residents learn to use critical online services that provide guidance with food support, rent, education, employment, childcare, government benefits and more (National Digital Inclusion Alliance, 2021). They make resource recommendations and check back with the client, which would bolster oft-ignored co-assessment. Outcomes from this study indicate that Boston has the knowledge, infrastructure, and network in place to be able the sustain this program.

At a smaller scale, this arrangement is already occurring in the City of Boston, as evidenced by the interconnections with community-based organizations at each co-production stage. Therefore, the City should formally adopt this program, develop language

173

and protocol to meet specific needs, and create a website landing page along with printed materials to inform citizens of this resource. The data overall suggests that there is an opportunity for the City, particularly the Department of Innovation and Technology, to assume the role of a digital convener. This leadership would ensure that the framework proposed includes thoughtful community engagement and diverse representation from underserved populations

Implications For Community-based Organizations

When developing policies, it is crucial to focus on solutions within the jurisdiction of the community at hand. There are likely multiple resolutions to problems, but if attention isn't paid to political feasibility there is no chance of implementation. Too often, well-intended social change initiatives fail because members of the affected population are not involved in identifying the problems and contributing to the solutions. The data suggests that community-based organizations play a leading role in every stage of the co-production cycle by contextualizing the digital equity needs of local residents and working collaboratively to address them. From schools and libraries to health centers and community development corporations, local organizations not only know residents best, but are much more likely than higher-level organizations to have the public's trust. The following recommendations for community-based organizations entail adopting a learning community as well as inclusionary communication strategies.

Learning Community

Those leading digital equity efforts on the ground would also benefit from a learning community. These leaders represent a diverse range of organizations and sectors, including

education, health care, housing, libraries, senior services, small business assistance, and workforce development. Without a formal effort to bring them together on the issue, they have little opportunity to interact outside of their local or regional partnerships. A community of practice would provide a valuable forum for sharing lessons learned, problem-solving, expanding networks, and cultivating new thinking. Community learning groups can be especially constructive when the issue at hand is sensitive, highly personal, or plagued by widespread misinformation. This arrangement should be in addition to a potential City-wide schedule of bi-monthly digital equity meetings.

Inclusionary Communication

Finally, the time series analyses from Chapter 5 indicates a lag between organizations that use problem-focused language (digital divide) versus solution-focused language (digital equity). This was also corroborated from interviews with policymakers. The data demonstrates that society is just beginning to enter an "equity era," – i.e., notions of equity are finally being adopted more widely. To stay in line with this trend, community-based organizations should revisit their mission statements and consider implementing inclusionary language that accurately reflects their goals, values, or other epidemics that may currently be at play. To ensure that policy framing is inclusive, organizations should engage with a diverse range of stakeholders to actively seek out perspectives and experiences.

Other Research Contributions

Overall, the outcome of this research encourages more creative and cooperative policymaking that can withstand future shocks to the system. In addition to the

aforementioned policy implications, this study contributes to the breadth of literature on the

digital studies. Quantitative analyses provide novel contributions to the intersection of public

policy discourse and social media data. Qualitative methods empirically observe the

policymaking process at the local level. The following section reviews the scholastic,

theoretical, and methodological contributions this study makes to social science research.

Scholastic Contributions

Digital inequality is a major concern among national and international scholars and

policymakers. A plethora of studies identify determinants of digital divides. However,

research that addresses how these factors change in times of crises are still scarce. As a

COVID-19 case study, this dissertation makes unique contributions that not only help better

understand the social disparity, but also provides a roadmap for municipalities and

organizations to nurture more digitally equipped citizens in the face of emergencies. By

identifying specific communities or demographic features that are indicators of digital have-

nots, policymakers can more easily engage with stakeholders and design interventions with

greater precision. Thus, with this research practitioners can glean real-world applications that

will enhance their communication, decision-making, and collaboration strategies.

Theoretical Contributions

The research questions are directly driven by Ostrom's (1996) existing theoretical framework

of co-production. In this study, co-production is defined as an umbrella concept that

encompasses a wide range of activities that can occur in any phase of the public service

cycle. Previously, little was known about organizational co-production, i.e., collaborations

formed between different governmental entities or nonprofit-public partnerships. This dissertation explicitly identifies instances of these partnerships and highlights their importance in representative policymaking.

The prior lack of conceptual clarity made it difficult to discern variations in co-production processes, analyze the use of co-production, and conduct cumulative research. Durose et al., (2017) argue that until the theory can be translated and adopted in local contexts, co-production will remain more representative of an ideology than a concrete organizational process. In this case, inductive inference is a good fit to garner generalized conclusions based off of specific scenarios. Through open and axial coding of interview data, this study transports co-production from nebulous ideas into a conclusive and empirical operation. It employs the framework in a highly specific policy area (digital divide), in a localized place (City of Boston), during a historic time (COVID-19).

However, Ostrom's theory falls short of explaining how entities collaborate in crisis situations under limited time, knowledge, and resources. This dissertation ascertains and expands on ideas of co-production by unearthing three new conditions for success that Ostrom and other public management scholars fail to address. These elements are namely human components that explain the importance of interpersonal relationships. Additionally, pre-existing operative functions and agenda-setting notions matter too. Lastly, this research identifies pertinent actors essential to commissioning, designing, delivering, or assessing public policies. As co-production initiatives need to persist well beyond the pandemic, this dissertation provides long-lasting policy implications.

Methodological Contributions

The use of social media for analysis opens up new avenues for answering policy questions. Instead of single time point snapshots of a survey, social media is constantly happening and always being recorded, allowing policy questions to be considered longitudinally and continuously. Developing tools and methods to understand the records of human behavior may allow social science in general and policy analysis specifically to gain unprecedented insights into human behavior, social structure, and the influence of public policy. As social media is a rapidly changing phenomenon, there has not been a centralized and incremental accumulation of the best data analysis methods. However, there is a wide range of work being done to improve social media analyses. Existing social media research employs a wide range of theories and models to investigate the socio-psychological behavior of users and other stakeholders such as marketers and customers. Twitter, in particular, has established itself as a key platform that is important in public, real-time conversation.

An advantage of social media as a data source is that it allows researchers to observe how people discuss a topic outside of the narrowly defined bounds of a lab setting or survey. Traditionally, the observation of peoples' language has been primarily the concern of sociolinguistics. The literature search in Chapter 2 did not result in any findings from academic work using data sources characterizing how individuals discuss the digital divide. Ngai et al. (2015) systematically consolidated and analyzed 46 journal articles which utilize social media data between 2002 and 2011 and determined three main groups of theories: personal behavior, social behavior, and mass communication. This study, with its policy discourse objectives, falls into none of those three classifications neatly, suggesting unique

methodological contributions. As researchers are in the early stages of understanding what kinds of conclusions can be drawn from text mining, employing social media data to better understand the policymaking process, policy discourses, and co-production theory is a novel use of digital trace data.

More specifically, this dissertation demonstrates the process to classify and analyze large volumes of unstructured text. It attests that it is possible to create a rigorous approach to generating a keyword search strategy by iteratively drawing samples based on keywords, identifying frequent terms, and expanding the search strategy using those. Topic modeling in particular suggests advances in areas where discourse analysis has typically struggled, such as with scaling, repetition, and systemization (Jacobs & Tschötschel, 2019). Analyses that go beyond simpler frequency and collocation counts are scantily applied to public policy, let alone the specific domain of the digital divide. Topic modeling directly improves the ability to methodically investigate and interpret discourses in large collections of text.

Importantly for this dissertation, topic modeling allows for comparative discursive research that more traditional methods cannot accomplish by facilitating the study of the differences, similarities, and changes in rhetoric over time. Studies that do employ natural language processing techniques to analyze policy discourses are done so primarily in domains where a lot of misinformation exists, such as climate change or vaccine efficacy. The application of computation social science methods to not only digital disparities but also more conventional policymaking ideals from Ostrom or Kingdon propels research questions about society into the twenty-first century. Ultimately, Twitter data appears to be an effective

tool for analyzing policy discourse and can be a replacement or a complement for the traditional survey methods depending on the specifics of the research question.

Areas of Future Research

Due to time and resource constraints, this study can be expanded upon in scope in a number of ways, primarily by diversifying the population of interview respondents. For example, several affordable housing directors and coordinators were contacted for an interview for this study but did not respond. Interviewing housing partners or the Metropolitan Area Planning Council would help assess community needs from the perspective of individuals who may face housing insecurity. Regional planning agencies make excellent backbone organizations to lead digital equity coalitions. They have the sophistication to work with state and federal funding programs, they know the municipal officials in their regions well, and many have in-house staff to perform technical analysis or manage pilot programs.

Furthermore, while this study does not focus on school districts, quantitative data shows that school-aged children are a growing population of interest, particularly in light of the COVID-19 pandemic. The review of literature and the LDA topic modeling analysis both highlight students and the homework gap. Health and human services providers and workforce development nonprofits, some of whom were interviewed during the pilot research phase of this study, were unable to be reached for a follow-up. However, they may continue to provide valuable insights to more nuanced populations and should be considered in future analyses.

Moreover, this research was limited in scope to public-facing policymakers. Private-sector partners can play a major role seeding new digital equity efforts and encourage rapid

prototyping, process improvement, and replication. The private sector can also develop products and services that are affordable, accessible, and easy to use. Exploring public-private partnerships can provide knowledge on how to best pool resources, share expertise, and develop innovative solutions. In a similar vein, though less private, more research could better determine where else academics can fit in the co-production model, if at all. Additionally, the theory of co-production could also be applied not just to the policymaking process, but also to test policy adoption or encourage specific societal behaviors.

Lastly, social media analysis is a young field with many opportunities. This work demonstrated a methodology to capture and understand policy-relevant discourse. The digital divide dataset used for all analyses has a cutoff point of March 11th, 2022. The relative ease with which social media evaluation can be repeated suggests that updates of analyses can be performed on demand. Replicating the natural language processing techniques with a more recent and thus larger dataset may yield additional insights that have yet to be captured in this study.

Furthermore, discourse could also be investigated by capturing all tweets from a list of identified authors, rather than by a list of key words. Employing biterm topic modeling (BTM), a popular topic model for short texts, in addition to or in lieu of Latent Dirichlet Allocation topic modeling may provide an even stronger model fit. Methodologically, more research is needed to determine where and how social media differs from survey data, as well as when social media can be a faster and less expensive source of research information. Scholars may also benefit from studying digital inequities in conjunction with other disparities.

181

Conclusion

The digital divide remains an enormous and complicated issue – intertwined with the influences of race, education, and poverty. To effectively bridge the digital divide, it must be understood first and foremost as a symptom of larger forms of oppression, power, and privilege. Success will require stakeholders to break down silos and partner across public, private, and social sectors to assess needs and inform policy responses. Digital equity innovation has the potential to significantly improve outcomes in community health, education, support for older adults, small business assistance, workforce development, and other areas. By combating the digital divide, many types of inequalities can be ameliorated from there.

While the digital divide predates the coronavirus pandemic, it will persist indefinitely unless policymakers and other stakeholders develop robust and long-term sustainable solutions. The Infrastructure Investment Bill and American Jobs Act (IIJA), enacted in 2021, allots $65 billion for broadband funding and digital divide reduction activities (Lee et al., 2022). The funds will primarily be distributed to states, municipalities, and tribal communities, which will decide how to allocate funding locally in accordance with the IIJA's aspirational statutory goals. Internet infrastructure investments and adoption programs are foundational to more equitable economic development, education, healthcare, and civic life and need to be at the forefront of planning, managing, and delivering digital equity programs across the nation.

Access to information and communication technologies is more critical than ever before as the COVID-19 crisis underscores the urgent need for a national effort to close these

gaps. Digital inclusion activities that arose in response to the pandemic will continue even after the health crisis ends, so citizens should expect greater reliance on and integration of technology moving forward. Despite progress, disparities will widen in the absence of systemic political change, likely to the detriment of those who are most vulnerable during times of crisis. Additionally, the recent explosion in Artificial Intelligence (AI) has the potential to deepen the divide in a number of ways. As AI technologies continue to develop and become more widespread, those who have access to the latest technologies and tools will be at an advantage. Implementation of new public-private partnerships and government- or community-led digital equity programs need to prioritize service to communities who need it most. The ultimate goal of this dissertation is to develop adequate policies targeted at more egalitarian digital use, finally aiming to decrease digital and subsequently social inequalities.

APPENDIX A: PILOT RESEARCH INTERVIEW DETAILS

Interview Date	Organization	Website
June 9th, 2020	City of Boston Age Strong Commission	www.boston.gov/departments/age-strong-commission
June 10th, 2020	Tech Goes Home	https://www.techgoeshome.org/
June 12th, 2020	Mayor's Office of Immigrant Advancement	https://www.boston.gov/departments/immigrant-advancement
June 19th, 2020	Boston Center for Youth and Families	https://www.boston.gov/departments/boston-centers-youth-families
June 24th, 2020	St. Mark Community Education	https://www.stmarksesol.org/
June 25th, 2020	Boston Public Library	https://www.bpl.org/
June 26th, 2020	Career Collaborative	https://www.careercollaborative.org/
July 1st, 2020	English For New Bostonians	https://www.englishfornewbostonians.org/
July 7th, 2020	Silver Lining Mentoring	https://www.silverliningmentoring.org/
July 16th, 2020	Per Scholas	https://perscholas.org/?city=greater-boston
July 21st, 2020	Jewish Vocational Services (JVS)	https://www.jvs-boston.org/

APPENDIX B: CODES FOR ACADEMICTWITTER (BARRIE & HO, 2021) PACKAGE

Arguments	Description
query	Search query or queries e.g., "cat"
exclude	Tweets containing the keyword(s) will be excluded "grumpy" e.g.,
is_retweet	If TRUE, only retweets will be returned; if FALSE, retweets will not be returned, only tweets will be returned; if NULL, both retweets and tweets will be returned.
is_reply	If TRUE, only reply tweets will be returned
is_quote	If TRUE, only quote tweets will be returned
is_verified	If TRUE, only tweets whose authors are verified by Twitter will be returned
place	Name of place e.g., "London"
country	Name of country as ISO alpha-2 code e.g., "GB"
point_radius	A vector of two point coordinates latitude, longitude, and point radius distance (in miles)
bbox	A vector of four bounding box coordinates from west longitude to north latitude
remove_promoted	If TRUE, tweets created for promotion only on ads.twitter.com are removed
has_hashtags	If TRUE, only tweets containing hashtags will be returned
has_cashtags	If TRUE, only tweets containing cashtags will be returned
has_links	If TRUE, only tweets containing links and media will be returned
has_mentions	If TRUE, only tweets containing mentions will be returned
has_media	If TRUE, only tweets containing a recognized media object, such as a photo, GIF, or video, as determined by Twitter will be returned
has_images	If TRUE, only tweets containing a recognized URL to an image will be returned
has_videos	If TRUE, only tweets containing contain native Twitter videos, uploaded directly to Twitter will be returned
has_geo	If TRUE, only tweets containing Tweet-specific geolocation data provided by the Twitter user will be returned
lang	A single BCP 47 language identifier e.g., "fr"

APPENDIX C.1: TWEET COUNT BY MONTH FREQUENCY TABLE

Month	N
April 2020	8,036
May 2020	7,976
July 2020	7,741
March 2020	7,555
September 2020	7,107
June 2020	6,977
March 2021	6,975
October 2020	6,936
August 2020	6,897
February 2021	6,624

APPENDIX C.2: WORD FREQUENCIES BY NRC SENTIMENT

Trust	N	Surprise	N
Inclusion	14,245	Money	3,989
School	10,021	Wireless	3,300
Account	9,159	Hope	2,899
Provide	9,073	Youth	2,463
Content	8,007	Cable	1,981
Team	6,710	Emergency	1,583
Resources	5,601	Vote	1,360
Safe	5,531	Excited	1,327
Improve	5,248	Chance	1,327
Reliable	5,186	Advance	1,302

Negative	N	Joy	N
Pandemic	7,424	Content	8,007
Lack	7,096	Resources	5,601
Government	6,267	Safe	5,531
Unable	5,425	Improve	5,248
Income	4,943	Income	4,943
Gap	4,285	Equality	4,091
Limited	4,133	Money	3,989
Inequality	2,981	Share	3,912
Calls	2,410	Create	3,702
Challenge	2,282	Providing	3,682

Sadness	N	Positive	N
Pandemic	7,424	Learn	15,555
Unable	5,425	Learning	12,253
Income	4,943	Information	11,312
Limited	4,133	Technology	10,879
Inequality	2,981	Public	10,630
Black	2,152	Provide	9,073
Error	1,907	Content	8,007
Emergency	1,583	Join	7,691
Tax	1,542	Equity	7,538
Poverty	1,515	Library	6,418

Fear	N	Disgust	N
Pandemic	7,424	Powerful	2,171
Government	6,267	Congress	1,812
Watch	4,665	Poverty	1,515
Change	3,692	Exclusion	1,441
Inequality	2,981	Lose	1,234
Youth	2,463	Remains	1,120
Challenge	2,282	Finally	1,047
Powerful	2,171	Bad	1,003
Risk	1,945	John	648
Fight	1,586	Winning	594

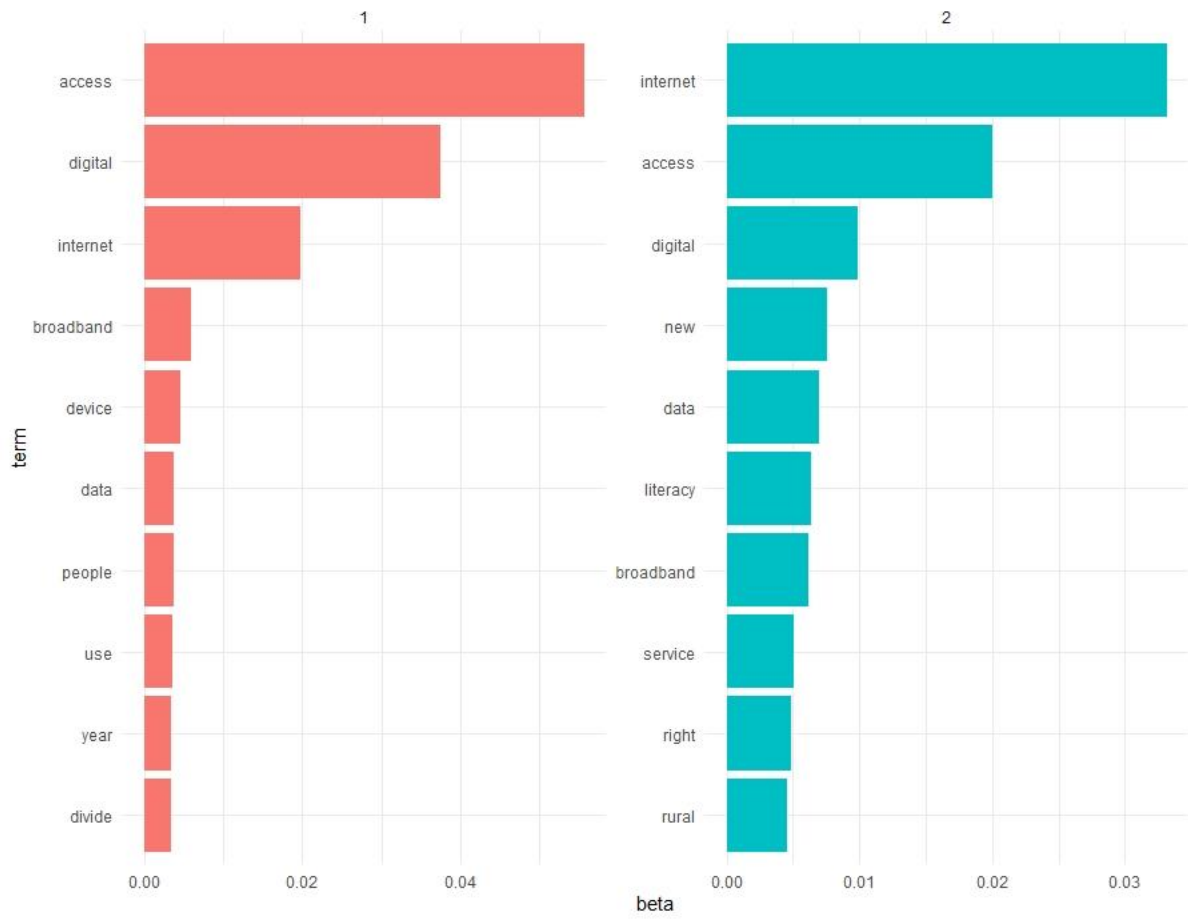| Anticipation	N	Anger	N
Mobile	17,076	Limited	4,133
Time	12,870	Money	3,989
Public	10,630	Wireless	3,300
Network	7,663	Inequality	2,981
Plan	5,435	Youth	2,463
Improve	5,248	Challenge	2,282
Income	4,943	Powerful	2,171
Watch	4,665	Demand	1,880
Subscribe	4,036	Fight	1,586
Money	3,989	Poverty	1,515

APPENDIX C.3: TOPIC MODELING OUTPUTS
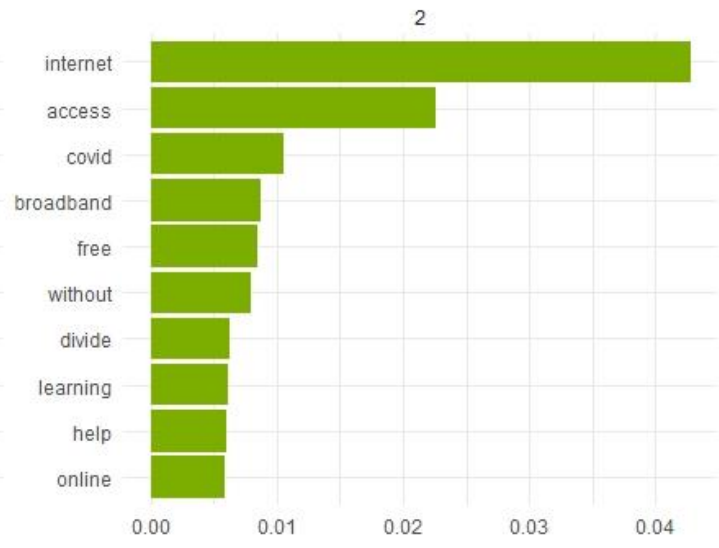
December 2019, k = 2
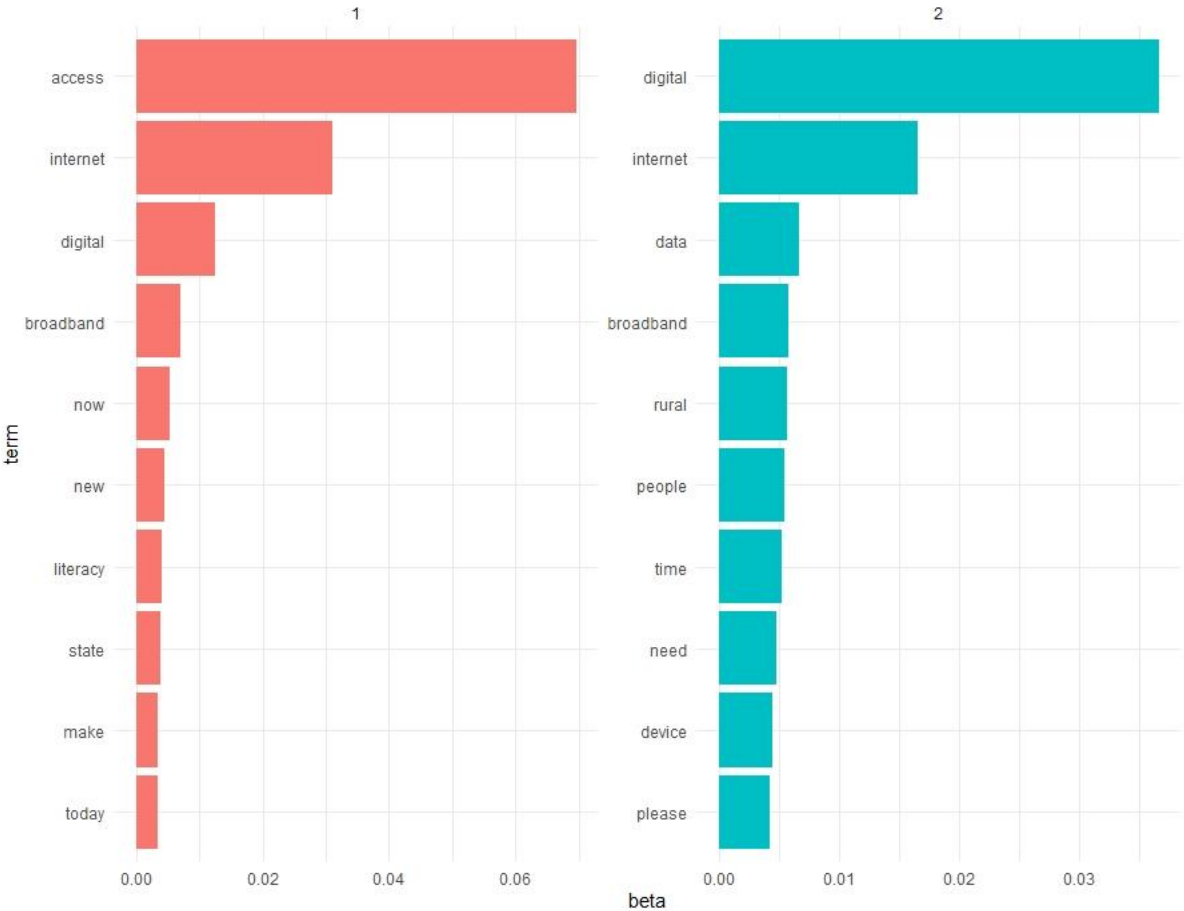
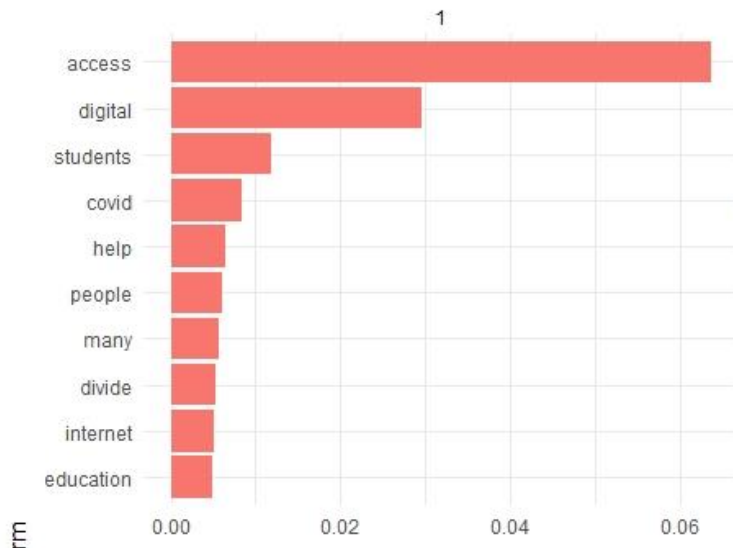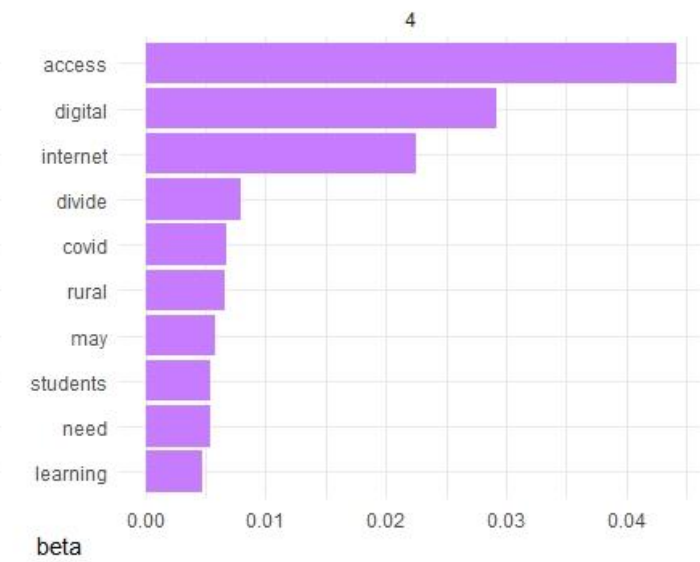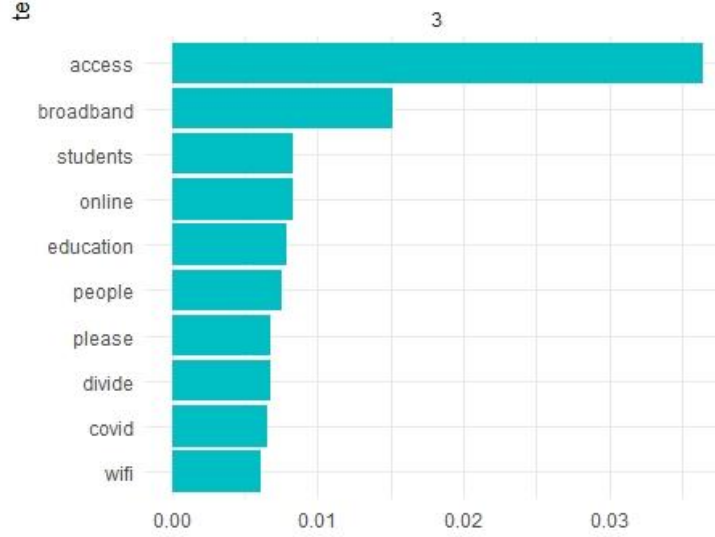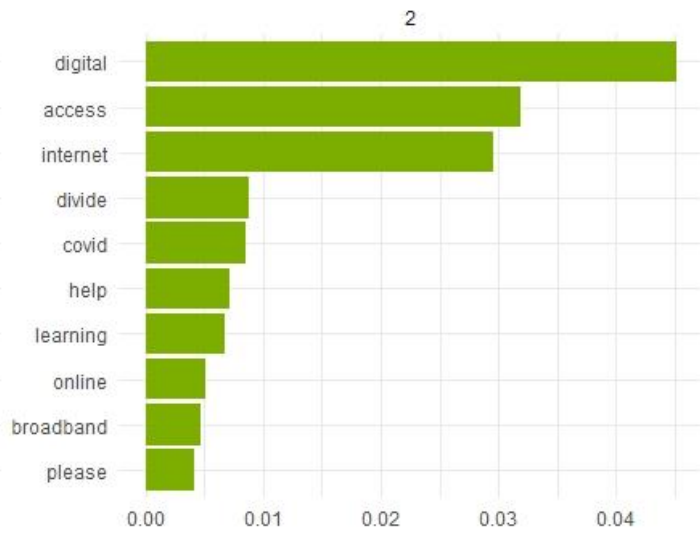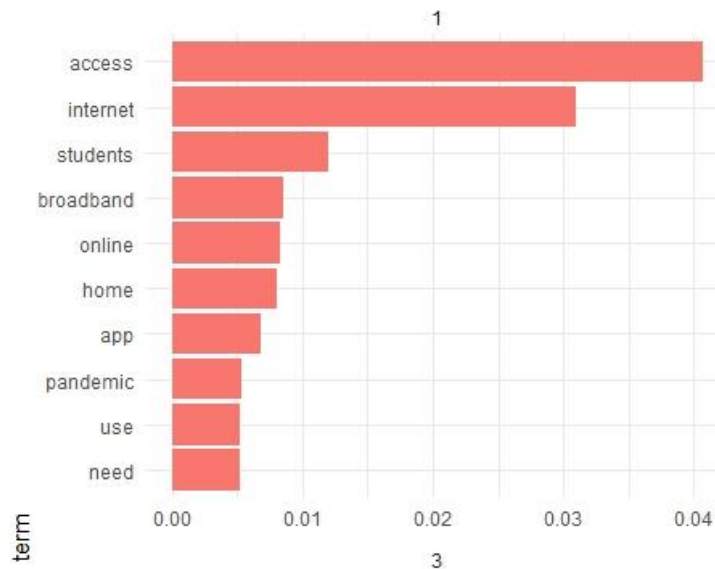# January 2020, k = 2

April 2020, k = 4
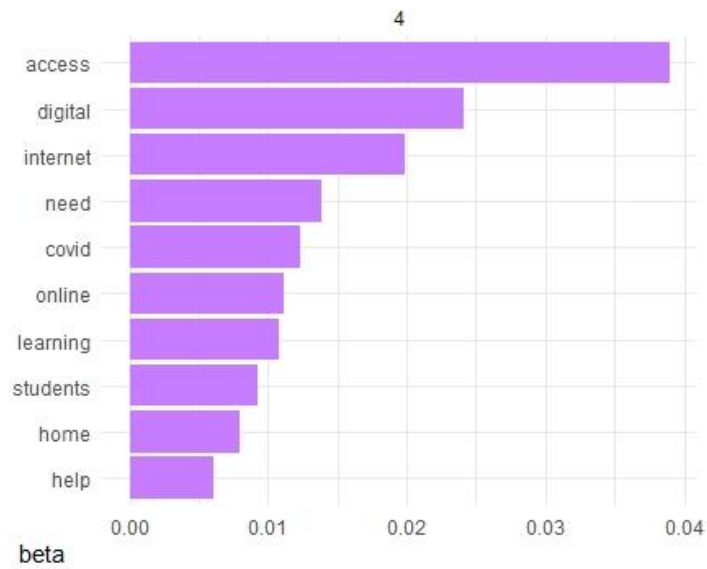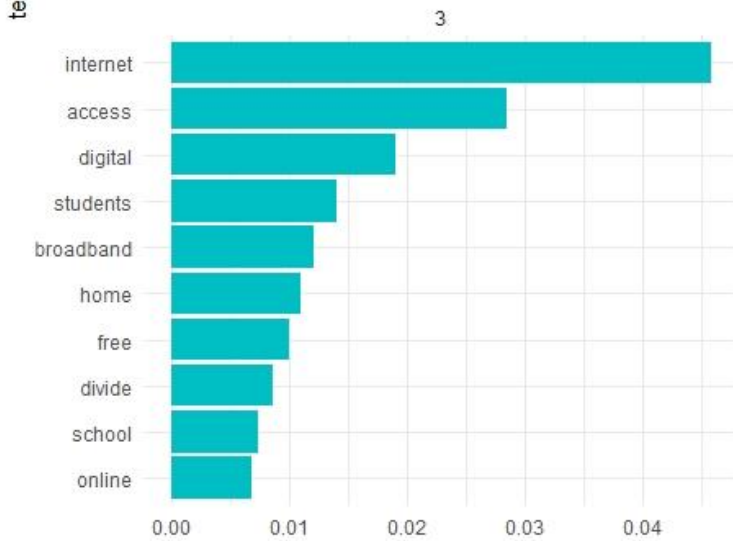
May 2020, k = 4

APPENDIX D: QUALITATIVE INTERVIEWS LINES OF INQUIRY

- Can you tell me a little bit more about the digital equity work you do in the [insert focus] community?
- Do you work with any other partner organizations to carry out these initiatives?
- What is the importance/role of the partners?
- How do you identify the needs of your constituents?
- How do you work with the other organizations to design the solution?
- What does the collaboration look like to actually deliver the services?
- How are you assessing the impacts of this program? Are you working with anyone external to your organization on that?
- Aside from the organization you've already mentioned, is there anyone else that played a role in the collaboration process?
- One thing I am trying to learn more about is how this co-production happens, or doesn't happen, when we are in these states of crises like during the COVID-19 pandemic. So, why do you think you were successful in your initiatives?
- What were/are some of the conditions needed that lead to successful collaboration?
- What were/ are some of the costs and benefits to co-production? Incentives/disincentives? Outcomes? Challenges? Are there any barriers or disincentives to coproduction?
- In terms of the way the way your organization framed or discussed the digital divide, did you notice a difference in the actual language used prior to the pandemic versus during the pandemic?
- Finally, I just want to brainstorm who else I should be speaking with that, that's played a role in fostering digital equity in the city of Boston. Are you aware of digital equity policymaking happening anywhere else?
- Would you be willing to participate in a member-checking exercise?

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