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Inequalities in the access to and use of information and communication technologies (ICT) have become an important area of concern for over a decade. Yet, theoretical attempts to understand the dynamics behind shaping these inequalities are scarce. This study draws upon the extent literature on digital divide and explains how the four different access gaps (motivational, material, skills, and usage) interact and contribute to digital divide. Revealed causal mapping (RCM) is utilized to analyze the data collected from eight same-gender focus groups in four primary schools located in Iran. The revealed causal map demonstrates the interaction and linkages between different access gaps. The findings provide a theoretical account of the dynamics behind shaping digital divide and generate insights into extending the concepts of access gaps. We establish a theoretical model that places an emphasis on the centrality of motivational-related factors such as “lack of interest in IT-related things,” and “lack of motivation to learn recent technology” as well as skills-related factors such as “operating skills”, “anti-filtering skills,” and “lack of IT background”.

Keywords: Digital divide, Internet, Access, Access gaps, Qualitative methodology, Revealed causal mapping

1. Introduction

Similar to many historical transitions, it has been argued that the Internet is the source of several benefits as well as challenges (DiMaggio and Hargittai 2001, Norris 2003). One of the important challenges pertaining to the phenomenon of the Internet is the so-called concept of digital divide (Gunkel 2003, Chen and Wellman 2004, Barth and Veit 2011, van
Dijk 2012). The key concern in digital divide research and policies is the growing gap between individuals, groups, and nations, which is due to an unequal allocation of Information and Communication Technologies (ICT) access and use (Vicente and Lopez 2010, Barth and Veit 2011, Wei et al. 2011).

Digital divide literature has attempted to understand digital divide outcomes and digital divide antecedents (factors that shape digital divide) (S. Mescha and Talmudb 2011, Wei et al. 2011). In terms of outcomes, it is believed that digital divide contributes to several inequalities such as immaterial, material, social and educational types of inequality (Katz et al. 2001, Katz and Rice 2002, Rice and Katz 2003, Van Dijk and Hacker 2003).

The underlying reasons behind the growing digital divide ("digital divide antecedents") could be related to several factors such as international politics, inequality of positions and power in social networks, and inequalities of skills, capabilities and interests (Bonfadelli 2002, Cho et al. 2003, Chen and Wellman 2004, Rains 2008, Agarwal et al. 2009).

In spite of calls for theoretical works that explore the underlying mechanisms shaping digital divide (Van Dijk 2006), attempts to understand these mechanisms are scarce. In particular, most of the research on digital divide has remained at a descriptive level, emphasizing the demographics of income, education, age, gender, and ethnicity on material access to ICT (Hoffman et al. 2000, Kalichman et al. 2002, Valadez and Durán 2007). A systematic investigation of the interrelation of the underlying concepts behind shaping digital divide has yet to receive significant attention.

To address this void, this study seeks to develop a sound theoretical understanding of the dynamics behind digital divide. We build upon the theoretical lens of access gaps
proposed by Van Dijk (2005) (Van Dijk 2006). The model of access gaps explains the cumulative role of four types of access gaps including motivational access, material access, skills access, and usage access in shaping digital divide (Van Dijk and Hacker 2003, Van Dijk 2005). While this model provides an appropriate theoretical grounding for linking access gaps to digital divide (Hargittai and Hinnant 2008, Hargittai 2010, van Deursen and van Dijk 2011), it does not explain the potential interrelations between access gaps (e.g., if there is a link between “skills access” and “motivational access”) as well as how these gaps interact and shape digital divide as a whole.

For this, we seek to build upon the model proposed by Van Dijk (2005) and expand the focus to understand the dynamic interrelations between different types of access gaps and digital divide. In particular, the research question that guides our enquiry asks: “how different types of access gaps interact and shape digital divide?”

A qualitative methodology, revealed causal mapping (RCM) (Narayanan and Fahey 1990), is employed to discover and analyse cognitive structures related to access gaps and interrelations among them. Revealed causal mapping is a subcategory of cognitive mapping where respondents reveal their causal assertions about a domain specific phenomenon through interview or focus groups (Nelson et al. 2000a, Nelson et al. 2000b). This methodology lends itself into construction of revealed causal maps that represent network of causal relations that are embedded in explicit statements. Thirty-two participants discussed access barriers over eight same-gender focus groups. The focus groups’ processes were guided by the model of access gaps proposed by Van Dijk (2005), but they were designed to evoke new concepts and linkages.
Analysis on the collected data leads to identifying new concepts as well as causal linkages between access gaps and related concepts. We provide two valuable theoretical contributions. First, this study establishes a theoretical model that advances our understanding of the dynamics shaping digital divide. Second, the undertaken approach contributes to a more subtle understanding of the nature of different access gaps. Specifically, access gaps are not independent concepts but they are shaped through complex dynamic interaction with each other. Our results help individuals and policy makers have a better understanding of the underlying mechanisms through which access gaps (i) are implicated and (ii) contribute to inequalities in the access to and use of ICT.

The remainder of this paper is organized as follows. Section 2 discusses digital divide literature and provides the theoretical grounding for this study. Section 3 outlines the research methodology including the data collection and analysis procedures. Results of data analysis are outlined in Section 4. We discuss research and practical implications in Section 5, prior to stating research limitations in Section 6, and offering directions for future research in Section 7.

2. Theoretical Background

2.1. Digital Divide & Access Gaps

The term digital divide was first coined in an official publication by the US Department of Commerce’s National Telecommunications and Information Administration in the middle of the 1990s (Van Dijk 2006). Initially, digital divide referred to the inequality of technological opportunities, in terms of the gap between “those who do and those who do not have access to new forms of information technology” (Cammaerts et al. 2003). The
technological orientation of this early digital divide definition led to several attempts in the equalization of technological opportunities in the form of physical access to the ICT (Van Dijk 2006, Hohlfeld et al. 2008). The use of the term digital divide at the turn of the 21st century highlighted “digital inequality in the Information Society” on the political and academic agenda.

From 2001 onwards, the extant literature suggested the appearance of new expressions such as “redefining the digital divide” and “going beyond physical access” (Hargittai 2002, Gurstein 2003, Selwyn 2004). These expressions aim to reframe the overly technical concept of the digital divide and to pay specific attention to social, mental and cultural factors that contribute to inequalities in the access to and the use of ICT (Warschauer 2002, Valadez and Durán 2007). In other words, technology access should be seen as a process that is driven by several social, psychological and technological factors. As a result, digital divide gradually became understood as “the gap between ‘individuals’, ‘households’, ‘businesses,’ and ‘geographical’ areas at different socio-economic levels with regard to both their opportunities to access information and communication technology and to their use of Internet for a variety of activities” (OECD 2001). This definition refers not only to the ICT access but also to the ability to develop an appropriate use of the technology. For example, two individuals might have equal access to ICT, but limited IT skills can impede one from the appropriate and strategic use of technology. Following Van Dijk (1999) that proposes the multifaceted concept of access (Van Dijk 1999), Van Dijk (2005) offered a cumulative and recursive model of successive kinds of access to digital technologies. This model (Figure 1) explains how digital divide is shaped by four divides of motivational, material, skills, and usage access. As shown, material access is proceed by
motivational access and succeeded by skills access and usage access (Van Dijk 2005). The successive aspect of the model suggests that the effective access to technology is dependent on four types of access including motivational access, material access, skills access, and usage access. Accordingly, digital divide is the result of gaps in these four access areas. The recursive aspect of the model suggests that when the full process of technology appropriation is completed (usage access), a new innovation arrives and the process starts again.

![Figure 1. Access & Digital Divide & Outcomes (Van Dijk (2005))](image)

The concept of “motivational access” refers to the wish to have a computer and to be connected to the ICT. The factors explaining motivational access divide could be both of a social or cultural and a mental or psychological nature (e.g., low levels of income, low levels of education, computer anxiety, lack of time). The concept of “material access” comprises physical access and other types of access that are required to reach complete disposal and connections such as conditional access (subscriptions, accounts, and pay-per-view). The major contributing factors to “material access” can include: income, education, and occupation. “Material access” is succeeded by having motivation to have ICT. The concept of skills access is divided into possessing three types of skills: (1) operational
skills: the capacities to work with hardware and software, (2) information skills: skills to search, select, and process information in computer and network sources, and (3) strategic skills: capacities to use computer and network sources as the means for particular goals and for the general goal of improving one’s position in society (van Deursen and van Dijk 2009). Skills access succeeds by motivation to use ICT and access to ICT (through try and error work with ICT). Education is a critical factor that can affect “skills access”. The concept of “usage access” is about the differential use of ICT applications in daily practices. This could include both the actual use of ICT as well as “active versus passive use of ICT”. Active or creative use of ICT is about contributions to the Internet (e.g., publishing a personal website, creating a weblog, posting a contribution on an online bulletin board, newsgroup or community). Usage is largely linked to demographic characteristics of users and technical connections (e.g., social class, education, age, gender and ethnicity, effectiveness of the connection). “Usage access” is also succeeded by the motivation to use ICT, material access, and having appropriate skills.

The general impression is that while physical access gaps are more or less closing in the developed countries, the skills gap (in particular, information skills) and usage gaps are growing (Mason and Hacker 2003, van Dijk 2012). It should be taken into account that developing counties such and Iran and China still experience physical access gaps due to several factors such as low-speed Internet and limited access (Giroux 2009, Ameripour et al. 2010, Cross 2010).

2.2. Interrelations between Access Gaps

There are few studies that point to the existence of interactions between access gaps (Barzilai-Nahon 2006, Wei et al. 2011). For example, based on the concept of different
types of access, Wei et al. (2011) studied digital divide among school students by following the three-level digital framework proposed by Dewan and Riggins (2005) (Dewan and Riggins 2005). Wei et al. (2011) established a model that links three hierarchical levels of digital access divide (equivalent to the concept of “material access”), digital capability divide (equivalent to the concept of “skills access”), and “digital outcome divide” (knowledge outcome & skills outcome). Their findings shed light on the relationship between “material access” and “skills access”. More specifically, their results showed the relationship between digital access divide and digital capability divide (e.g., students without home computers had lower computer self-efficacy even when they had IT access in schools) as well as the relationship between digital capability divide and digital outcome divide (e.g., students with lower computer self-efficacy had poorer learning outcomes).

Another example that points to the existence of interactions between access gaps is the literature on operationalizing and measuring digital divide (Barzilai-Nahon 2006, Vehovar et al. 2006). For example, Barzilai-Nahon (2006) drew attention into causal interrelations between various indicators of digital divide (e.g., socio-demographic, accessibility, use, infrastructure access, affordability, and social and governmental support) (Barzilai-Nahon 2006). As an example, Barzilai-Nahon asserted that accessibility (“material access”) may affect Digital Divide Index directly, but it also has indirect impacts through use indicator (“usage access”). Causal relations between indicators of digital divide concur with the concept of dynamic interactions between access gaps.

While such studies point out interactions between access gaps, knowledge they provide is still fragmented with limited analyses based on and contributing to rigorous theoretical perspectives. Against this backdrop, we focus our enquiry by asking “how
different types of access gaps (motivational, material, skills, and usage) interact and shape
digital divide? “We address this research question to develop a theoretical account that
explicates the mechanisms that generate digital divide (discussed in the Result section).

3. Research Methodology

We employed a qualitative methodology, revealed causal mapping (RCM) (Narayanan and
Fahey 1990), to investigate cognitive structures that explain how access gaps interact and
shape digital divide. RCM is a variant of cognitive mapping where respondents reveal their
causal assertions about a phenomenon through interviews or focus groups (Narayanan and
Fahey 1990). RCM demonstrates the network of causal relationships that are embedded in
explicit statements of individuals about their environment (Nelson et al. 2000a), and, it is a
well-recognized method among Information Systems researchers for studying cognitive
perceptions in different settings such as gender studies, knowledge management and
RCM is therefore a suitable method for revealing the network complexity of the causal
interrelations between different access gaps.

We use empirical descriptions from eight focus groups to provide inputs for
analytical generalization (Yin 2009) or in another words generalizing from empirical
material to theory (Lee and Baskerville 2003). To ensure the quality of the descriptions and
the validity of our generalizations, we follow Yin (2009) recommendations and use
procedures that involve multiple sources of evidence as well as member checking (Yin
2009). In terms of multiple sources of evidence, we collected data from Thirty-two
participants within four similar contexts (public primary schools), with sixteen females and
sixteen males. Following the guidelines proposed by Nelson et al. (2000a), a three-step
process was followed to evoke the revealed causal map. These steps were: (1) data elicitation (site and sample selection), (2) construction of revealed causal map, and (3) analysis and validation of the revealed causal map.

3.1. Data Elicitation

An empirical investigation of four primary schools (School A, School B, School C, School D) in Iran was conducted. Data was collected through focus-groups sessions where individuals discussed the dynamics through which different access gaps shape digital divide.

In particular, thirty-two individuals participated from four primary schools. Together with the Principal Manager of each school eight students were identified and recruited (eight students per school). In the following, either their mother or father was chosen for this study (random choice). Per school, four men and four women participated. Therefore, sixteen men (from four schools) and sixteen women (from four schools) participated in this study. Participation was voluntary and participants were assured of confidentiality.

After recruiting participants, one of the researchers conducted two same-gender focus groups in each school (in total: eight focus groups in four schools). Each session lasted from sixty minutes to ninety minutes. The language of the focus groups was Farsi. The sessions were recorded and transcribed into a document. One of the researchers, fluent in both Farsi and English, translated the documents to English. The length of the documents ranged from 5335 to 8343 words. Both researchers were fluent in Farsi and this facilitated data collection and analysis.
In average, respondents were 39.35 years old (females: 36.3 years old and males: 42.4 years old); 22% of the respondents had diploma, 49% had undergraduate education, and 29% had postgraduate education. The patterns of education in females and males were different- 67% of the females had at least undergraduate education, whereas more than 90% of males had at least an undergraduate degree. The demographics (e.g., gender, education, age) suggest that the sample can be regarded as the representative of a relatively young (average age of 39.35 years old) and educated sector of the Iranian society (more than 78% of the population had at least undergraduate education). The selected schools are located in Iran. Iran was chosen as a context where the access to and the use of ICT encounter several challenges. There were three reasons that guide the choice of primary schools for data collection. First, the schools include a mixture of individuals (parents) with different demographics such as age, education and income for participants. Second, overcoming digital divide for parents of these students is in particular important, because the next working generation is brought up by them, and it is important for these parents to be active participants of the Information Society. Recent studies in this area have targeted the context of schools (Wei et al. 2011). Therefore, the context of data collection (primary schools) can be regarded as an important target for research on digital divide. Third, we had access to these primary schools and this choice facilitated data collection and member checking processes.

Respondents were asked about their experience in working with ICT and the barriers they have faced regarding the access to and use of the ICT. In this research, we framed our questions to focus on the Internet, rather than ICT in general. The focus groups were guided by the digital divide literature and the model of access gaps, yet they were
designed to evoke new concepts and linkages. The researcher asked open-ended questions such as: “what are the problems that you have faced regarding access to Internet?” “What are the problems that you have faced in using Internet?, “and “Have you experienced any barrier that inhibits the effective use of Internet?” Based on the responses to these questions, probing questions were asked to elicit further information.

3.2. Construction of the Revealed Causal Map

Four steps were followed to derive the revealed causal maps from the transcribed interviews. This procedure (Nelson et al. 2000a) is detailed in below:

**Identifying causal statements and linkages in transcripts:** The transcriptions were systematically examined to identify causal statements. Causal statements are statements that imply an explicit cause-effect relationship. These statements can be identified by using specific keywords such “so”, “if-then”, “because” and so forth. Consistent with Nelson et al. (2000a), all the causal statements and linkages were recorded in the actual language of the interviewees. Using the generated coding scheme, the identified causal statements were broken into “causes” and “effects”. For example, in a statement such as “It is challenging for my family to buy access to high-speed Internet. I think it is expensive for any average family. So it makes sense that I am not motivated to invest in the Internet”, the phrase “I think it is expensive for any average family.” was treated as the cause statement, and “I am not motivated to invest in the Internet “was considered as the effect statement.

**Development of coding scheme:** We then developed a coding scheme by grouping frequently mentioned words together and developing concept labels. Coding scheme summarizes the meaning of a phrase in a word or word group (concept
label). Based on the concepts that emerged from the phrases captured in the language of the participants, one of the authors developed concept labels. As an example in the phrase

"I think it is expensive for any average family. So it makes sense that I am not motivated to invest in the Internet”, the cause statement was coded as “High-Level Costs of Getting Access to ICT” and the effect statement was coded as “Motivation to Get Access to ICT”. In another example, cause statement was coded as “No Work-Related Requirements to Use ICT” and effect is “Operating Skills”: “I am a teacher in guidance school with very little IT knowledge. My work doesn’t require me to do anything with computers. So I don’t have that much exposure to the Internet to learn how to work with computer and the Internet.”

Appendix states some more sample quotes.

The other author read the material to verify their face validity and assess the parsimony and coverage of the coding scheme. Scott’s pi (Scott 1955) was calculated in order to estimate the reliability of the coding process. A heuristic for content analysis is to require a reliability coefficient of approximately 0.75 or more when using pi or alpha (Holsti 1969). For this study, Scott’s pi was 0.93 indicating an acceptable level of reliability. Where disagreement occurred, the discrepancies were resolved through discussion; thus the potential authors’ biases were controlled and managed.

**Constructing raw revealed causal maps:** Next, we replaced the causal statements with the appropriate concept labels as developed in the coding scheme. This resulted in developing eight revealed causal maps for each focus group session.
Aggregating revealed causal maps: The eight revealed causal maps were aggregated by adding together the concepts and linkages of each causal map. The union of all concepts and linkages from the individual maps were placed on the final aggregate model. As the concepts emerged from the participants, the point of redundancy represented the point at which further data collection would not provide additional concepts (Armstrong et al. 2007). The point of redundancy was computed by aggregating the concepts mentioned by each participant. No new concepts were elicited from the sixth focus group, so redundancy was reached by the sixth session. This suggested that the sample of eight focus groups was sufficient to capture the relevant concepts in the sample.

Analysis and validation of revealed causal map: According to Armstrong et al. (2007), the two aspects of “content” and “structure” should be considered in analyzing revealed causal maps. The content analysis consists of identifying and defining the concepts contained in the domain under study. We used member checks to validate the concepts and linkages in the aggregate revealed causal maps. Similar to internal validity in confirmatory studies, the objective of comprehensive members’ checks is to test for interpretive accuracy and to check credibility and trustworthiness of the results (Guba and Lincoln 1985). This was done by going back to the original participants and asking their opinion about the concepts, constructs, and linkages that we represented on the maps.

The structural analysis involves analyzing the linkages between the concepts. It focuses on key measures from social network analysis: (1) reachability measure, (2) centrality measure, and (3) density measure. Reachability is an indicator of the total strength of the
connection between constructs (Knoke and Kuklinski 1982); it is calculated as the sum of the direct and indirect effects of one construct on another. For this research, we used a 0.2 reachability cut-off because it allowed for a maximum inclusiveness of concepts within the constraint of map readability. For example, the reachability of the linkage between “High-Level Costs of Getting Access to ICT” and “Motivation to Get Access to ICT” is 0.05. “High-Level Costs of Getting Access to ICT” has only direct effect on “Motivation to Get Access to ICT”. This linkage has been stated 11 times out of the total 202 stated linkages, and the reachability of this linkage is equal to 0.05 (11/202). Centrality is an indicator of how central or important a construct is to the map (Nadkarni and Narayanan 2005); it is calculated by dividing the number of direct linkages involving the construct to the total number of linkages in the map. For example, centrality of “High-Level Costs of Getting Access to ICT” is 0.04 and it is calculated as 1 (direct linkages to this construct)/28 (total linkages in the model). Constructs with higher levels of centrality are directly involved in more linkages of the map. Density is an indicator of the interconnectedness of the constructs in the map (Nadkarni and Narayanan 2005); it is calculated by dividing the number of links among constructs to the number of constructs in the map.

4. Results

The research question asks: “How different types of access gaps interact and shape digital divide?” We address this question by analyzing dominant themes that were emerged from our empirical investigation. As a result, we present an empirically-based theoretical model as in Figure 2. This is followed by a discussion of the findings in regard to the research question and the theoretical and practical contributions of the study.
4.1. Theoretical Model

We analyzed the empirical data from eight focus groups sessions to investigate salient concepts that are cognitively associated with the barriers to access to and use of IC. This resulted in developing a theoretical model (Figure 2), which reveals 22 concepts and the linkages between them. In the next section, we elaborate the theoretical insights.