Digital Inclusion Index (DII) – Measuring ICT Supply and Usage to Support DI Implementation Planning Policies

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Abstract. In a context where efforts are being made to increase access to computers and the internet, other barriers have become more visible: besides the physical and economic barriers, psychological, cognitive and linguistic barriers have gained relevance in the debate on digital inclusion, since they can also interfere in the intensity and quality of an individual's use of these technologies. The relevance of these aspects is quite evident in our Brazilian society, due to our social-economic structure, in great part formed by people of low income, with little or no literacy, and by people with disabilities. In spite of this, a large proportion of existing indicators represent primarily physical access to ICTs and the technological aspects of producing and spreading these technologies. An assessment of the scope of the data currently collected reveals that few indicators reflect psychological, cognitive and usability/accessibility barriers. With the objective of filling the existing gaps, we have proposed a new metric for gauging digital inclusion that will delineate its most diverse aspects and thus contribute to the elaboration of government policies that will effectively stimulate the development of an information society.

Keywords: digital inclusion, index, measuring, public policies.

1 Introduction

The conditioning factors for the complete assimilation of the benefits of Digital Inclusion (DI) transcend the existence of a computer or an Internet connection. In fact, it is of the utmost importance that indicators be adopted to reflect the characteristics of the diverse barriers to DI, particularly those that prevent total use of more complex information communication technology (ICT), such as the internet.

The objective of this paper is to propose an alternative way of measuring digital inclusion using a new index based on the concept of the different barriers to DI, as shown in Figure 1. We have used a layer model to clearly explicit the different kinds of DI barriers that must be treated. The model was formulated based on Brazilian circumstances considering the social-economic, cultural and educational profiles.

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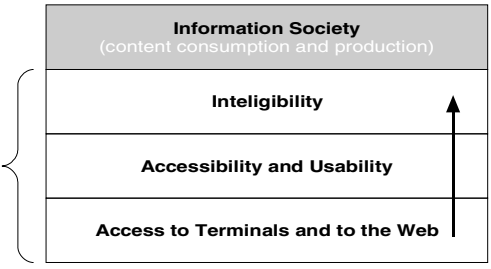

Source: Holanda and Dall'Antonia (2006)

Fig. 1. Barriers to digital inclusion

Overcoming these barriers enables individuals to obtain the main benefits of the digital world, as represented in Figure 1 by the Information Society layer. This layer consists of total fruition and production of electronic content and services for educational, professional and entertainment purposes, as well as citizenship-related activities.

When considering all the physical, cognitive, psychological, social-economical and cultural DI barriers, the layer model can be useful in the formulation and assessment of policies and in the planning of actions to overcome these hurdles. Using indicators to reflect these barriers is an objective way of establishing goals and assessing the efficiency of proposed actions to achieve them. In a group, these indicators provide a synthesis of the country's current digital inclusion index.

The existence of gaps is what motivated the need to create a Digital Inclusion Index (DII) in the first place. To achieve this objective, indicators reflecting each layer of DI barriers were selected. Furthermore, aspects related to ICT supply and demand within each layer model were taken into consideration. These aspects can be determined by analyzing both individual/home accesses and collective/public accesses.

Broadband scope/coverage in the towns and cities and how important this service is to the development of each region must be observed in the Access layer. In the Accessibility and Usability layer, the issue of supply and demand can be determined based on the amount of access points with accessibility resources and the number of potential people to be qualified for ICT usage. The Intelligibility layer must be assessed considering also supply and demand, taking into consideration the number of qualified people using the services and the availability of electronic services with adequate language in each region. Finally, in the Information Society layer, a supply/demand analysis is important to portray the growth of internet usage and to determine the demand for different services. In short, assessing the supply will show ICT availability for the population regarding: coverage, scope, adequate services, terminals and equipment, and public access points. On the other hand, measuring demand will determine if the population is prepared and qualified to take full advantage of ICT services, assessing the level of interest they show in making use of these services.

These indicators were chosen to help formulate DI implementation policies, and to verify how efficiently and effectively these policies will achieve pre-established DI goals.

2 Existing Indexes and Their Adherence to the Digital Inclusion Layer Model

A survey was made of the indicators and indexes most commonly used to describe the diffusion and use of ICTs in society. Each one of the evaluated systems presents indicators that reflect, in different degrees, the barriers to DI illustrated in Figure 1.

In Table 1, there is a summary of the assessment of these metric systems according to the representativeness of each DI layer. This table demonstrates that access availability is the layer best represented by existing metric system indicators, followed by the fruition layer. The other barriers are poorly represented. The greatest gap can be observed in the Accessibility and Usability layer. This is explained by the difficulties encountered in gathering pertinent information. As for the intelligibility aspect, although indicators regarding educational level can be found, they become much scarcer when it comes to reflecting efforts at achieving digital literacy and adapting language for the general public.

Table 1. Overview of metric systems according to their representativeness of the DI layers (Legend: Y = yes; N = no; P = partially)

		Does the metric system contemplate DI?													
DI layers		GDI	INEXSK	ICTDI	Infostate	DAI	CAIBI	DOI	Eurostat	Core ICT ind.	NRI	SIBIS-DIDIX	BISER	Digital poverty	IDI
Information Society	Content Prod.	P	P	N	P	N	P	N	P	P	P	P	P	N	P
	Content Fruition	Y	P	P	P	P	P	P	Y	Y	P	Y	Y	Y	P
Intelligibility		N	P	N	P	P	P	N	P	P	P	Y	Y	N	P
Accessibility and Usability		N	N	N	N	N	N	N	N	N	N	P	P	P	N
Access Availability		P	P	P	P	P	P	Y	Y	Y	Y	Y	Y	P	Y

The diversity of indexes arises from the context and the objectives of their creation. For instance, while some systems focus on ICT diffusion among a country's population, others emphasize the dimensions of electronic commerce. However, none of them represent all DI aspects satisfactorily.

3 Digital Inclusion Index

To make up the DII calculation formula, besides the criteria of choosing indicators according to their representativeness of each DI layer, their collected values and the weight of each layer and each indicator were also used. To attribute weights to the layers of digital inclusion barriers and their respective indicators, the AHP (Analytic Hierarchy Process) methodology was used.

The following formula was used to calculate the digital inclusion index:

$$0 \leq \sum_{j=1}^{4} b_j \sum_{i=1}^{nj} p_{ij} Indicator_{ij} \leq 1 \quad (1)$$

Where:
0 represents digital exclusion and 1 full digital inclusion
pij is the weight of indicator i of DI layer j
bj is the weight of the DI layer

Each layer and their respective indicators are presented next, together with the weights attributed by the AHP methodology. The current values of the indicators were also estimated in order to calculate the sub-indexes of each layer and the DII.

1. Access layer (Weight: 0.30): Proportion of the population covered by local broadband internet providers (Weight: 0.29; Current value: 0.78); Proportion of homes with broadband (Weight: 0.49; Current value: 0.10); Public access points (telecenters and LAN houses) for every 100 inhabitants without internet in the home (Weight: 0.22; Current value: 0.01). Calculation of Access Sub-Index: 0.28.
2. Accessibility and Usability layer (Weight: 0.20): Public access points with accessibility resources for every 100 inhabitants with disability or illiteracy (Weight: 0.19; Current value: 0.0); Proportion of internet users with disabilities over proportion of internet users without disabilities (Weight: 0.23; Current value: 0.0); Proportion of illiterate internet users over proportion of literate internet users (Weight: 0.38; Current value: 0.15); Proportion of general e-services with accessibility and usability (Weight: 0.19; Current value: 0.31). Calculation of accessibility and usability sub-index: 0.12
3. Intelligibility layer (Weight: 0.14): Proportion of people with at least one internet skill (Weight: 0.40; Current value: 0.36); Proportion of functional literates (Weight: 0.20; Current value: 0.68); Proportion of general e-services with adequate language (Weight: 0.40; Current value: 0.55). Calculation of intelligibility sub-index: 0.50.
4. Information Society (Weight: 0.36): Proportion of individuals who used the internet in the last three months (Weight: 0.67; Current value: 0.34); Diversity of services (Weight: 0.33; Current value: 0.71). Calculation of the information society sub-index: 0.46.

   Calculation of the Digital Inclusion Index (IID): 0.34.

To verify the behavior of the DI index in the face of future alterations that some of the indicators might undergo, a sensibility analysis was made of one indicator of each DI layer – always considering the indicator with the greatest weight.

Two effective indicators from the United Kingdom and two from Brazil were used as reference values for this analysis. Their values were doubled, while all the others maintained their respective values. The indicators chosen to receive doubled values were: Access: proportion of homes with broadband internet; Accessibility and Usability: proportion of illiterate internet users over proportion of literate internet users; Intelligibility: proportion of people with at least one internet skill and Information Society: proportion of individuals who used the internet in the last three months.

As mentioned previously, the DII is 0.34 and with the variation of the selected indicators, the following results were obtained:

When altering the indicator "Proportion of homes with broadband internet" from 0.10 to 0.63, in compliance with the United Kingdom indicator, the resulting DII is 0.42.

When doubling the indicator "Proportion of illiterate internet users over proportion of literate internet users" from 0.15 to 0.30, and doubling the indicator "Proportion of people with at least one internet skill" from 0.36 to 0.72, the resulting DII is 0.36.

However, when altering the indicator "Proportion of individuals who used the internet in the last three months" from 0.34 to 0.72, in compliance with the United Kingdom indicator, the resulting DII is 0.43.

4 Conclusion

Doubling the current value of indicators caused a less significant impact on the DII index than when using indicators with UK data. However, the "Proportion of homes with broadband internet" is an indicator that will very likely suffer alteration over time, since an investment in broadband internet is a priority for Brazil, as it is in other developing countries. Currently, according to United Nations data, although Brazil is the fifth largest cell phone and internet market in the world and the number of Brazilians connected to the web is high in absolute numbers, internet penetration in the country is still considered low. Based on projections that network data traffic will increase and that the world of internet is becoming increasingly dependent on high speed access networks, it is clear that there is a demand for this market and a real need for more investments on the part of the service providers. Another indicator that caused an expressive impact on the result when its value was altered was "Proportion of individuals who used the internet in the last three months." It is safe to assume that this alteration will occur sooner or later, since with the need for investment in infrastructure and the demand for broadband internet, the number of users and frequency of access should also increase.

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