Revisiting the Access Rainbow

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Abstract

The Access Rainbow offers a 7-layer socio-technical model for universal access that has been widely discussed in community informatics (CI). For the 20th anniversary issue of The Journal of Community Informatics, we explore what this public interest model of universal access foreshadowed as critical issues about AI and other emerging information infrastructures. Looking forward, we challenge CI scholars to continue to leverage the Access Rainbow model to foreground human rights issues, and to continue the empowerment-oriented work associated with CI scholarship and activism in datafied and algorithmically intensive domains.

Keywords: universal access; artificial intelligence; human rights; information infrastructures

Introduction

While the first wave of dot com businesses, and later web 2.0 and big data, have all been positioned as potential drivers of massive economic growth, at present it is artificial intelligence (AI) that is receiving much hype (Pringle, 2017; Desmyter, 2024; Rhinesmith, 2023). In their *Recommendation on the Ethics of Artificial Intelligence*, UNESCO (2021) notes there are multiple and changing definitions of AI. They describe AI as "systems which have the capacity to process data and information in a way that resembles intelligent behaviour, and typically includes aspects of reasoning, learning, perception, prediction, planning or control" (UNESCO, 2021, p. 10). Consistent with this, but avoiding the misleading connotations of "intelligence," throughout this piece we regard AI not as "artificial intelligence," but as referring to "algorithmic intensification." Algorithmic intensification is a longstanding feature of the expansion of computational systems into all aspects of contemporary society. While businesses are currently striving to monetize their exploitation of data and AI, emphasizing empowerment for communities is an alternative pathway more consistent with community informatics (CI). For the 20th anniversary issue of *The Journal of Community Informatics* (JoCI), we explore what the "Access Rainbow," a public interest model of universal access from CI, foreshadowed as critical issues about AI and other emerging information infrastructures (Clement & Shade, 1996; 2000).

The Access Rainbow offers a 7-layer socio-technical model for universal access that has been widely taken up in CI scholarship (see figure 1). Originally conceived during a period when policymakers focused on commercializing the internet, the Access Rainbow model highlights

the principle that universal access is "…an essential human right, and communication and public access as a public good, must be emphasized" (Clement & Shade, 1996, online). The Access Rainbow is a conceptual and rhetorical intervention from CI related to community empowerment, which foregrounds public interest perspectives related to information infrastructures that were missing from the predominant technical and commercial perspectives on internet development in the 1990s. Rather than directly opposing those forces, the rainbow model provocatively incorporated and supplemented the multi-layered architecture (e.g., TCP/IP and the Open Systems Interconnection (OSI)) models that underpin digital networking systems to this day.[i]

In articulating an explicitly pro-societal perspective, the Access Rainbow sought to broaden the prevailing policy discussion by highlighting the importance of issues such as inclusion, participation and equity in the formative development of the public internet. We contend that these issues need to be re-amplified as AI promotion and use is intensifying. This piece begins by revisiting the origins and structure of the Access Rainbow and situating how AI fits within the model, before examining what its focus on the public interest and human rights foreshadowed as critical concerns about AI and future information infrastructures. We conclude by challenging CI scholars to leverage the Access Rainbow in any manner that is helpful to engage in scholarship and activism to continue to foreground human rights as AI and emerging infrastructures are designed, deployed and regulated.

The Access Rainbow revisited

Conceptually, the Access Rainbow provides a "social/technical architecture for information infrastructure access" (Clement & Shade, 1996, online). The Access Rainbow grew out of the community-oriented information and networking scholarship by both Clement, a computer scientist, and Shade, a communications scholar. Clement's community-based public access research began in 1974, when he served as the lead programmer on a project to install a computer terminal in the lobby of the Vancouver Public Library to help patrons access services from community-based organizations (Clement, 1981; 1995). Shade meanwhile completed her doctoral dissertation and later a book on gender, community and the social construction of the internet (Shade, 2002). Clement and Shade began collaborating in the mid-1990s based on a shared commitment to promoting the public interest in the development of ICTs, and the Access Rainbow was developed from their work together.[ii] Smith met and began studying with Clement and Shade after using the Access Rainbow as part of their master's thesis to explore citizens' diverse experiences with government-provided health information from a community health center waiting room (see Smith, 2006; Balka, 2012).

To review its structure, the Access Rainbow consists of 7-layers, which should be considered a permeable, spectrum of colours that represent socio-technical aspects of infrastructure (Clement & Shade, 2000). The top and seventh layer encompasses governance

and policy. This layer explores "how is the whole structure to be governed?" how will "participative public policy making" create accountable system and uphold rights? (Clement & Shade, 1996, online). The sixth layer envisions "literacy/social facilitation," which includes public support for digital and other literacies (online). The fifth layer considers "Service providers… the organizations that provide network access to users[,]" including internet service providers, schools and libraries (online). The fourth and middle layer of the rainbow addresses the content and services that are accessed. This is where the rainbow model begins to overlap with and consolidate the layers found in more technically oriented reference models. The third layer of the rainbow addresses software and tools. Nearing the bottom of the rainbow, the second to last layer refers to devices. The bottom layer consists of carriage facilities, which relates to transmission conduits (e.g., cables) and related protocols for carrying messages (e.g., routing instructions and content) that enable services to operate.

Figure 1: The Access Rainbow

The Access Rainbow served as foundational to Clement and Shade's later collaborative CI scholarship related to community networks, community wifi, and Aboriginal operated networking possibilities in Canada (see for example Clement et al, 2012), but looking forward, the model can continue to useful in relation to a range of information infrastructures.

Where does AI fit into the Access Rainbow?

A conceptual model for infrastructure is helpful to understand communication systems when it fits a variety of contexts. The layers of the Access Rainbow have indeed assisted to explain information infrastructures from the past and present across a range of contexts including

parents and families' ICT access experiences (Clark, Demont-Heinrich, & Webber, 2005), national spatial data infrastructure (Georgiadou, Puri, & Sahay, 2005), rehabilitation possibilities in prisons (Magassa, 2011), smart mobility (Sourbati & Behrendt, 2021) and even pandemic connectivity (Smith, 2021).

Understanding the spectrum of colours present in the Access Rainbow, many AI applications can be viewed as belonging to the third to fifth layer as software, content, and services. For example, various generative AI systems that create text, images, or audio-visual content are accessed through a website or app. An end user may input text-based prompts to produce an output in their desired media format. Of far greater significance than placing AI within the rainbow, however, is articulating what the model has to offer for better understanding contemporary information infrastructures involving AI, especially the policy and governance issues they raise.

What the Access Rainbow foreshadowed as critical concerns

Looking back to the original conceptualizations of the Access Rainbow, there were three major areas where the model foreshadowed issues that are of vital importance to current debates about AI, and the intensified use of algorithms in society.

1. *Universal access debates were just the beginning*

The conceptualization of the Access Rainbow articulated that societal debates about informational infrastructures were still nascent. In an early draft of the Access Rainbow, Clement and Shade (1996) noted that "[w]e are just beginning what is certainly going to be a long process of social and technological innovation…[to] apprehend the risks and opportunities posed by the rapid advances of information technologies" (online). Although the rainbow model most explicitly focusses on issues related to accessing information infrastructures, Clement and Shade (2000) explained that this is "not an end in itself. Access simply enables further, more rewarding activities that can only partially be specified beforehand" and they invite their readers to consider: "1) Access for what purposes?; 2) Access for whom?; and 3) Access to what?" (p. 36).

Indirectly, Clement and Shade have also echoed these questions while raising public interest concerns associated with a wide range of information infrastructures. Their scholarship and activism related to broadband connectivity, ICTs for development (ICT4D), gender in internet policy, municipal wifi, identification systems, educational technologies and so-called smart technologies and cities are just a few of the examples where foundational ideas from the Access Rainbow have been deployed or diffused (Clement et al., 2012; Powell & Shade, 2006; Shade, 2003; Shade, 2016; Community Wireless Infrastructure Research Project, 2008; Smith et al., 2011; Shade & Singh, 2016; Smith & Shade, 2018; Clement, 2018). Increasingly, many of these contexts include AI, such as biometric facial recognition systems, predictive analytics based on machine learning, or autonomous technologies.

2. *Infrastructures are interwoven*

In introducing the Access Rainbow, Clement and Shade (2000) noted that "digital networks will be increasingly interwoven with these other networks in complex and mutually redefining ways" (p. 37). In their 1996 work, Clement and Shade detailed that universal access "implies an extension of the sensibility of POTS (plain old telephone service) in telephony, which is rooted in the notion that people living in outlying rural areas should get the same basic telephone service as those living in more densely populated urban or suburban locales" (online). Cumulatively, Clement and Shade's ideas show synergy with Star's (1999) argument that "[i]nfrastructure does not grow de novo; it wrestles with the inertia of the installed base and inherits strengths and limitations from that base" (p. 382). Ethical and social problems such as bias, exploitation, invasive surveillance, oppression, violence, political manipulation, and environmental harm that have been perpetuated through the internet, may remain unsolved as AI is deployed. Simultaneously, AI may help scientists design pharmaceuticals for rare diseases or predict natural disaster to facilitate preparedness to save lives. The Access Rainbow model thereby foreshadowed that AI would become interwoven with both the problems and possibilities of the internet and all infrastructures which precede it.

3. *Human rights must be foregrounded*

With the Access Rainbow, Clement and Shade (1996) foregrounded the importance of human rights in the development of socio-technical infrastructures. The same calls were echoed globally, as early as 2003 in aspirational ways. For example, the people who assembled for the World Summit for the Information Society (WSIS, 2003) declared a "common desire and commitment to build a people-centred, inclusive and development-oriented Information Society" and stated their support for the Universal Declaration of Human Rights (see also CPSR, 2005). Stronger international policy linking internet access to human rights came in 2016 when the UN adopted to statement that interlinked the experiencing of human rights to internet access.

Organizations like UNESCO (2021) position human rights' pivotal role in relation to AI regulation by nation states. Recent work from CI that leverages the Access Rainbow to understand infrastructures that are increasingly involving AI, demonstrate the importance and multi-faceted aspects of this work. Sourbati and Behrendt (2021) explain that smart transportation technologies, leveraging AI, including trip updates and autonomous vehicles are potentially significant for the e-inclusion of older adults. Smith (2021) also recently used the Access Rainbow to explore pandemic connectivity for school aged children in Ontario, Canada during periods when schools were closed. She raised concerns about intensifying the entrenchment of big tech companies within school boards; big tech is of course now actively seeking markets for products that utilize AI to predict or automate. It is probable that CI scholars will need to continue to articulate and foreground the importance of human rights in relation to AI and ICTs for the foreseeable future.

Discussion and conclusion

The Access Rainbow has demonstrated some past, present and future relevance for fostering understanding of public interest perspectives that relate to information infrastructures. We would be remiss in revisiting the Access Rainbow, if we did not acknowledge that the model is imperfect and that it has received critiques. In considering universal access in Africa, the model was flagged by Oyedemi (2004) as overly "Western" and to be missing "some socio-cultural and political-economic situations of most developing regions of the world…" (Oyedemi, 2004, p. 94). Eubanks (2007) noted that while the Access Rainbow is "extremely well-developed, multifaceted, [and] holistic" it remains "caught in the distributive paradigm" (p. 4). Having worked with low-income women in the US, Eubanks called attention to a wide range of issues —daycare availability, stopping gender-based violence, freedom from excessive surveillance, and accountable data usage—as varied components of "a more just and sustainable information society" (p. 4). Furthermore, Eubanks called for a multi-faceted "high-tech equity agenda" that addresses interlinked issues, including those not typically addressed through the provision of ICT access (p. 10). In honour of the 20th anniversary of JoCI, we invite CI scholars to remain not only cognizant of critiques of the Access Rainbow, but to revisit it to consider whether it can helpfully inform any scholarship or activism related to AI, emerging information infrastructures, or high tech equity.

To reflect upon this question ourselves, we see the core sensibilities of the Access Rainbow embedded within our past and present work. We believe CI scholars *can* and *will* continue to find ways to leverage the foundational ideals of the Access Rainbow. CI scholarship and activism can continue to foreground human rights, in pursuit of the public interest and community empowerment-oriented possibilities, as AI, and other emerging information infrastructures are designed, deployed and regulated. While universal access debates and the digital divide may have been the beginning of the CI field for many readers of this journal, the empowerment-oriented work of the field continues in domains including, all areas of high tech, data saturated and algorithmically intensive activity.

Acknowledgements

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Footnotes

i Layered architectures for the TCP/IP and OSI reference models are outlined in numerous sources, including Wikipedia https://en.wikipedia.org/wiki/Internet_protocol_suite and https://en.wikipedia.org/wiki/OSI_model

ii Clement and Shade convened workshops in the 1990s on universal access policy with funding from Industry Canada. Much of their work was conducted as Canada's Information Highway Advisory Council (IHAC) was convening and advising, with e-commerce business interests dominant (see Clement et al., 2012 for more background context).