Connecting the Digitally Disconnected: Challenges and Opportunities for Research and Policy

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Abstract

ICTs (Information and Communication Technologies) are increasingly seen as a necessary development tool. While digitally connected communities of the Global North benefit from modern ICTs to access endless information sources, collaboration opportunities and platforms to reform social processes, access to appropriate ICT infrastructure and resources remains a challenge for many Global South communities. In this era of digital connectivity and globalization, those who are not digitally connected are newly marginalized and disadvantaged. Not having access to or the capacity to utilize modern ICTs systematically silences the voices of the digitally disconnected and gives rise to exclusion and inequality. Considering the significance of digital connectivity needed to achieve the Sustainable Development Goals (SDGs) among economically developing communities, this article aims to unmask the complex challenges associated with the traditional, model-building approaches towards development and deployment of ICT tools around the world in general and the Global South in particular.At present, there are significant obstacles that widen rather than narrow the gap between theory and practice, thereby increasing the 'digital divide'. An unreflective approach which assumes ICTs are good for development may lead to practices that have the opposite effect: entrenching rather than eradicating marginalization. If ICTs are to serve the greater societal good and assist in achieving the sustainable development goals (SDGs), then research must not only serve profit-making interests; it

must also inform state-level policy making through theoretically informed, critical, reflective and engaged inquiry.

Keywords: ICTs for Development, Digital Connectivity, Digital Divide, ICT in Education, ICT Research

Introduction

From banking to e-governance, education and health, increased access to ICTs is drastically changing the way developing communities of the Global South connect with each other and the rest of the world. As the efforts to achieve the Sustainable Development Goals intensify, ICTs are regarded by many as a necessary tool for development. For others, however, ICTs are not without controversy or contention (Singh et al., 2018).

There is no single universal definition for the term 'ICT', which leaves room for speculative conclusions that are based on subjectivity. Information Technology (IT) and Information and Communication Technologies (ICTs) are the technologies that can be used to store, access and communicate information in different shapes and formats. These terms can be traced back to World War II, when the scope of research and development in the field of information technology was mostly limited to state-owned military apparatuses. The invention of the integrated circuit (IC) made it possible to reduce the size of computing devices and contributed to the development of personal computers. This was a stepping stone that changed the way information would be treated around the globe. The private sector took the lead in research, development, and distribution of information technologies and from the mid-1970s onwards, computing power became increasingly affordable and accessible. These tools proved to be an excellent means to increase productivity and reduce the margin of human error across various avenues of development, including the business, engineering, health, and defence sectors. Suddenly, it became possible to perform complex calculations that were previously considered chaotic. For many, these technologies became indispensible. With the emergence of the internet and smartphone technologies, the scope of information technology widened, and the term ICTs expanded to accommodate the communication component of information technologies. These ICTs transformed economic market processes and social communication behaviour across the social order that had access to these technologies.

Some parts of the world became progressively digitally connected while the rest of the world became increasingly isolated.

Today, there is some ambiguity in the literature as to which technologies are classified as ICTs. For the purpose of this paper, the term ICTs will include the older ICTs, i.e. radio, television, media disks and wired communication networks, as well as the modern ICTs, i.e. computers, all forms of internet, smartphones, audio-visual devices, software applications and communication gadgets.

While these ICTs are seen as a promising tool for enhancing globalization, collaboration, and mutual growth, the promise of a digitally-connected, modern world must face the realities of the free market, technocapitalism,[1] and profit-oriented service delivery combined with poverty and inequality. In the past three decades, entrepreneurial innovation in the ICT sector thrived in a capitalist system and resulted in an incredible amount of wealth accumulation. Many technology entrepreneurs accumulated more wealth than many economies of the Global South. Today, the top five technology giants are collectively worth more than most economies in the world. Access to appropriate ICT infrastructure and resources is a challenge for many Global South communities, but merely having access to resources may not be enough. Meaningful integration of ICT tools into local systems could potentially face uncertainties due to issues such as local knowledge levels, compatibility with local services, integration with local knowledge sources and the absence of local support systems.

Rapid developments in ICTs over the last two decades have prompted not only the question of what role these can play in development, but also of whether developing countries can, in fact, 'cope without them' (Adera et al., 2014). Failure to reasonably cope without ICTs does not necessarily mean that the only way forward is to blindly follow the same ICT infrastructure development trajectory as other communities using model building approaches. Across the globe, the roadmap to building ICTs for development infrastructure is highly dependent on the development ideologies of development agents in decision making roles.

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[1] In many parts of the Global South, access to various ICTs including basic telephony, television, and the Internet is provided by state-owned corporations. These enterprises often operate using for-profit models for service delivery, which limits their ability to prioritise underserved areas and communities. See: Dewenter and Malatesta (2001) and Lin et al. (1998).

This article discusses the underlying factors behind the uneven growth, adaption, and distribution of ICTs and the impact of this disparity on development in general, and education in particular. It also examines theoretical models of various related initiatives from different regions of the world to identify some patterns of success and lessons learned. A critical practical application of ICT for research and development is to inform policy change at the state level; however, this process faces numerous obstacles that continue to widen the gap between theory and practice. Without aligning ICTs with local development goals and local interests, simply eradicating digital disconnection may not only result in unintended effects, it may in fact further entrench marginalization (Singh et al., 2018). In support of this argument, this article proceeds as follows. The next section describes the digital divide. This is followed by two sections which discuss ICTs for development and education. A short conclusion rounds off the presentation arguing for better alignment between ICT research and state-level policy making.

The Digital Divide

Adaptation and transition between older, high-modern ICTs and late-modern ICTs is slow among poor communities[2] around the world. This is commonly referred to as 'the digital divide' (Huffman, 2018). As the world leapfrogs forward to become more digitized, highly disseminated and deeply embedded methods of storing, accessing and sharing information are becoming increasingly obsolete in economically prosperous communities. In this era of digital connectivity, those who are not digitally connected are the newly marginalized and disadvantaged. While this digital divide is primarily observed among economically-disadvantaged communities, the effects of digital exclusion influence different social groups in different ways, and in some instances this divide can be to the detriment of the primary and fundamental rights of some relatively isolated groups across both the Global North and the Global South: from the elderly and low-income families to indigenous communities and people with learning and physical challenges (Winter and Boudreau, 2015; Duplaga, 2017; Huffman, 2018).

[2] This paper will use the term poor, developing, marginalized and rural interchangeably to indicate digitally-isolated communities of the Global South and Global North with reduced or no access to modern ICTs due to resource constraints.

Status of the digital divide

At the global level, the digital divide is progressively shrinking due to on-going improvements in digital connectivity and the increased availability of digital devices. Currently (in 2019), 53% of the global population had access to Internet connectivity compared to 48% in 2018 (ITU, 2019). This leaves approximately 3.6 billion people who are still disconnected from the Internet and modern ICTs. Table 1 shows that the majority of the digitally-disconnected population live in the least developed countries of Africa and Asia. In the least developed countries (LDCs) of the Global South only 19% of people are digitally connected in 2019 (ITU, 2019).

Despite the decline in the digital divide at the global level, the digital divide continues to widen at the bottom of the income pyramid. Affordability remains a key reason as the digital connectivity cost relative to income is increasing in most countries. Moreover, the progress on decreasing the digital divide is inconsistent and not inclusive. For instance, in almost two-thirds of countries globally, women are lagging behind men in making use of the Internet. Moreover, in some regions of Asia-Pacific and Africa, the gender digital divide is not narrowing but growing. Availability and use of the Internet is a good indicator of digital connectivity. The Inclusive Internet Index (Table 1) illustrates the current status of the digital divide in the world.

This Index score is based on availability (quality and extent of available digital infrastructure required for accessing the Internet); population's ability to afford digital connectivity (cost of internet access relative to income and the level of competition in the local Internet marketplace); availability of relevant digital content (existence and extent of local language content and culturally-relevant content) in the country; and population's readiness to access the Internet (capacity to access the Internet, including literacy skills, cultural acceptance, and supporting policy).

Table 1: The Inclusive Internet Index 2019

Rank		Score / 100	Rank		Score / 100	Rank		Score / 100
100	Congo (DRC)	29.3	66	Philippines	64.6	32	Ukraine	78.3
99	Niger	33.0	65	Nigeria	64.8	31	Brazil	79.7
98	Malawi	36.6	64	Kenya	67.1	30	Greece	80.3
97	Sierra Leone	38.0	63	Indonesia	67.2	29	Netherlands	80.5
96	Liberia	38.5	62	Morocco	67.4	28	Hungary	80.7
95	Guinea	40.3	61	Dominican Republic	67.9	27	Romania	80.8
94	Mozambique	42.5	60	Tunisia	68.0	26	Bulgaria	80.9
93	Burkina Faso	43.0	59	El Salvador	68.4	25	Belgium	81.4
92	Madagascar	43.1	58	Sri Lanka	69.4	24	Estonia	81.5
91	Mali	43.2	=56	Iran	69.7	=22	Austria	81.6
90	Sudan	44.8	=56	Peru	69.7	=22	Taiwan	81.6
89	Ethiopia	45.5	55	Panama	70.2	21	Ireland	81.7
88	Benin	48.0	54	Ecuador	70.6	20	Italy	81.8
87	Angola	50.4	53	Mongolia	70.7	19	Russia	81.9
86	Zambia	50.5	52	Jordan	70.8	18	Germany	82.7
85	Uganda	51.5	=50	Kazakhstan	71.9	17	Israel	82.8
84	Namibia	53.2	=50	South Africa	71.9	16	Chile	83.4
83	Senegal	53.4	49	Oman	72.2	15	Australia	83.6
82	Côte d'Ivoire	54.7	48	Uruguay	72.3	14	Switzerland	84.1
81	Botswana	56.1	47	India	73.2	13	Portugal	84.2
=79	Rwanda	56.2	46	Costa Rica	73.3	12	Japan	84.3
=79	Tanzania	56.2	45	Mexico	73.4	11	Poland	84.6
78	Venezuela	56.9	44	Vietnam	73.7	10	France	84.9
77	Pakistan	57.8	43	UAE	74.2	9	South Korea	85.1
76	Cameroon	58.1	42	China	74.3	8	Spain	85.2
=74	Cambodia	59.3	41	Czech Rep.	74.7	=6	Canada	85.3
=74	Myanmar	59.3	40	Turkey	75.0	=6	Finland	85.3
73	Algeria	59.6	39	Saudi Arabia	75.3	5	U.K.	85.4
72	Nepal	60.9	38	Kuwait	75.4	4	Denmark	85.9
71	Bangladesh	61.9	37	Qatar	75.5	3	United States	86.3
70	Ghana	62.8	36	Thailand	75.7	2	Singapore	87.3
69	Egypt	63.5	35	Colombia	76.1	1	Sweden	89.5
68	Jamaica	63.9	34	Malaysia	76.2			
67	Guatemala	64.3	33	Argentina	78.2			

Source: Intelligence Unit, The Economist, retrieved from https://theinclusiveinternet.eiu.com/

Digital divide and poverty

Some recognize ICT tools as a means to reduce poverty and inequality while others consider them a means to promote growth (Rislana et al., 2018; Mbuyisa and Leonard, 2017). Heeks (1999) suggests that there are two continuums of views; ICT utopians, who believe that the new ICTs have mostly positive impacts such as income creation and improved service delivery around the world, and ICT doubters, who associate ICTs mostly with negative impacts such as unemployment and growing social exclusion. Twenty years beyond Heeks' observations, this division between utopians and doubters is ever more entrenched (Asongu and Nwachukwu, 2018; Stucke, 2018).

There is a noticeable relationship between the digital divide and income poverty. The Declaration of Principles of the World Summit on the Information Society (Tunis 2005) makes repeated reference to the use of ICTs for alleviating poverty and how a lack of investment to establish ICTs for development infrastructure can be a barrier to a community's economic development. Another form of poverty is the poverty of information and opportunities. Sen and Clapp (2000) reason that "development is a process of expanding the real freedoms that people enjoy". Without opportunities, it is unlikely for real freedoms to exist. The theory of technological determinism further supports how the digital divide in a connected world may hinder the social, economic or political change within a community. Through digital tools, digitally connected communities have better access to endless information sources, collaboration opportunities and platforms to reform social processes, while digitally isolated communities face increased marginalization of freedoms due to reduced opportunities and dependence on obsolete technologies. Economic poverty among digitally isolated communities confines them to investing in ICT infrastructure at an inadequate rate. Globally, the adaption of digital technologies and transitioning to digital network infrastructure for information flows such as market information, trading and knowledge sharing contribute to this vicious cycle of poverty and isolation. Thus, isolation and absence of digital infrastructure continue with no end in sight. Moyi (2003) points toward the lack of access to physical resources and infrastructure and stresses the importance of "prioritizing information flows via pre-existing networks of communication." However, as economically prosperous communities are promptly abandoning older ICTs and analogue methods of communication and transitioning to faster and

more advanced and digital systems, the existence and realities of the rural poor are often forgotten (OECD, 2019).

Lack of access to ICTs influences all economic activities; however, one of the more deprived sectors is rural micro-enterprises which greatly rely on their active participation in national/regional/global trade markets. For Duncombe (2006), microenterprise plays a central role in sustaining the livelihoods of the rural poor and not having quick access to ever-changing market trends, product knowledge and information on available opportunities in a highly globalized and digitized trade market obstructs the economic activity and growth potential of rural micro-enterprises. Mumporeze and Prieler (2017), in a case study of Rwanda, illustrated the gendered aspects of this divide.

The digital divide and inequality

Since the end of the Cold War, most developed and developing countries have experienced a surge in economic and social inequality (Piketty, 2013). The timeframe of this disparity is parallel to the rise of ICTs. The relationship between the digital divide, access to affordable ICTs, and inequality is complex but explicit. Just like any other form of privilege, it is often challenging to recognize digital privilege without experiencing how a lack of access or skills to use ICT tools contributes to age, gender, and class-based social inequalities. This raises questions and challenges the for-profit model of providing access to primary ICT tools.

Some see ICTs as an enabling environment that can bring the poor into what they call the 'information age'; however, "when no action is taken to confront the growing digital divide, ICTs are argued to entrench inequalities further and to potentially lead to social exclusion" (Adera et al., 2014; Fang et al., 2019). The Internet, since its early years, has been seen as a democratizing force. Poor ICT skills seem to correlate with an increased risk of becoming marginalized, "an outcast of society" (Kaarakainen & Kivinen, 2015). Communities rely more and more on the use of ICT tools for decision making and to make their voices heard. From small decisions such as where to shop, to decisions that have a long-term societal impact such as supporting a specific social movement and advocating for certain rights, ICTs are increasingly becoming powerful tools with a substantial impact on how societies function and change. Data collection for making policy-level decisions and academic research have also become increasingly reliant on ICT tools, and not having access or the capacity to utilize

these tools systematically silences the voices of those who are marginalized and gives rise to exclusion and inequality.

ICTs for Development

From banking to e-governance, education and health, increased access to Information and Communication Technologies (ICTs) is drastically changing the way rural communities of the Global South connect with each other and the rest of the world. In different ways, these tools have the potential to impact a community's development. ICTs can act as an enabler to improve a community's quality of life and economic well-being as well as contribute to global efforts towards achieving the Sustainable Development Goals (SDGs). As efforts to achieve the Sustainable Development Goals intensify, ICTs are increasingly seen as a necessary tool for development (see, for example, the WSIS-SDG Matrix available at https://www.itu.int/net4/wsis/sdg/ accessed 29 November 2019).

The extensive reach of ICTs is seen as a powerful tool for activism, and new ICTs are rapidly reshaping the way activists around the world communicate and collaborate. In today's world, data is considered by some to be 'the new oil' (*The Economist*, 2017), echoing Castells' (1999) earlier observation that we have entered the information age where ICTs are the functional equivalent of electricity in the industrial age. Castells argues that although the capitalist notion of development is not a recent trend, capitalist structures and processes have significantly changed over time and 'the new brand of capitalism is driven by the new ICTs, which have tooled the development of new productivity sources, of new organizational forms, and of a new and global economy'. As reported in *The Economist* (2017), the five most valuable listed firms in the world are Alphabet (Google's parent company), Amazon, Apple, Facebook and Microsoft. There is, however, some scepticism in the research literature when it comes to outlining the link between access to ICTs and development. This was especially so in the late20th and early 21st centuries (see, for example, Röller and Waverman, 1996; Colecchia and Schreyer, 2002; Bedia, 1999; and Jalava and Pohjola, 2002). This notion of uncertainty is based on the argument that most of the research demonstrating a strong link between access to ICTs and growth uses examples of developed communities, and ICTs may not be a means to development end when it comes to developing communities. Statistics that show higher use of ICTs in developing countries could be due to the higher availability of disposable income and consumerism (Forestier et al., 2002, in Adera, 2014). These

research findings, however, are reasonably out-dated and may not be an appropriate lens with which to assess the impact of current, transformational ICTs such as high-speed wireless Internet and smartphones. Also, how ICTs impact multi-dimensional poverties and non-economic forms of development is not often a central focus of research, although belief in its value for development is popular both in the private sector, national government planning and international organizations (Tjoa and Tjoa, 2016; Mata and Pont, 2016; see also the website of the UNESCO Chair in ICT4D at https://ict4d.org.uk/).

Nevertheless, 'ICTs are often placed at the centre stage of development and seen as having either detrimental or highly beneficial impacts on the position of developing countries' (Adera et al., 2014). Two decades ago, Castells (1999) argued that "the essential role of ICTs in stimulating development is a two-edged sword". On the one side, the ICT pessimist, the digital divide and the inability of a community to keep up with changing ICTs is regarded as a reason for their slow economic progress. On the other side, the ICT optimist, developing countries are 'empowered' through the adoption of and investment in new ICTs which 'enables them to advance through stages of development rapidly'. Adera et al. (2014) argue that between this ICT optimism and pessimism is a more neutral stance where 'ICTs are assigned a less significant role in determining the future of developing countries and the poor, but simultaneously are seen to play a role in supporting efforts to reduce poverty or deprivation'.

It is critical to recognize local needs and readiness as well as the rapidly changing nature of ICTs to avoid investing in redundant ICTs. One example is the higher availability of wireless telephone networks in many parts of North Africa and East Asia where previously there was no analogue communication network. The UAE's direct transition from low-speed ISDN (Integrated Services Digital Network) to ultra-high-speed FTTP (Fiber to the Premises) is one example of avoiding obsolescence by skipping out-dated medium-speed communication technologies, i.e. copper-based phone lines and DSL (Digital Subscriber Line) that are considered out-dated but still used in many of Global North communities.

ICTs and Education

What is the role of ICTs in the post-industrialization era education system, which some would call the information age? It is a question that begs to recognize how industrialization changed the education system in the past. Kivinen et al. (2016) argue that the

industrial-age model of mass education was mainly constructed to produce the kind of adults needed to work in its assembly-line environment, in which 'time was to be regulated not by the cycle of sun and moon, but by the factory whistle and the clock' (Toffle, 1970). This model of school education was not focused on nurturing critical thinking or knowledge creation but on producing trained factory workers using what Toffle (1970) called a 'factory model idea of assembling masses of students (raw material) to be processed by teachers (workers) in a centrally located school (factory)'. Without going into any further critique of the industrial era education model, it is significant to conclude that to be successful in the 21st century requires 21st-century skills[3] and the education needs of the post-industrial information age may not be the same as those of the past industrial age. This transition, which can be addressed by new policies, adequate investment, and new technologies, has proven to be rather slow in most parts of the Global South as well as in many parts of the Global North. 'A growing number of educational theorists today have become convinced of the existence of an urgent societal need for a new approach to learning that can pave the way for a 21st-century reform of educational practices' (Kivinen et al., 2016).

Integration of ICTs in education is transforming traditional school classrooms into globally-connected learning spaces. This integration is fundamentally altering education delivery models. As access to ICTs and ICT-based information banks becomes increasingly available, the industrial-era concept of school classrooms and traditional interpretations of schools as the exclusive places to 'transfer' knowledge is becoming questionable. Kivinen et al. (2016) reason that '[i]nternet-centred developments in ICT have made it evident that the container metaphor of the mind, with its implied view of education as filling pupils' heads with knowledge, is out-dated'.

Availability of virtually limitless information through the internet or access to modern ICTs does not necessarily always result in knowledge. Humankind has, over time, created a tremendous amount of knowledge that is now easily accessible in the form of information.

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[3] 21st century skills include subject-specific as well as a number of soft skills that are considered critical to be successful in the 21st century. P21's framework for 21st century learning is an excellent source of information on 21st century skills and how teachers and educationalists around the globe can incorporate 21st century skills into curriculums and classrooms. See: http://www.battelleforkids.org/networks/p21.

Turning that information into knowledge is an emergent challenge of the information era education system. Kivinen et al. (2016) maintain that just because more people have access to a large amount of information does not mean that people today necessarily have 'better knowledge for their actions than people in the past had for theirs'. The U.S. Department of Education (2017) identifies a digital use divide, arguing that access to ICT divides people into active learner and passive consumer pathways. This supports Kivinen et al.'s (2016) observation (quoting Bereiter and Scardamalia, 2014) that 'knowledge is produced through "purposeful acts of creation", those of building up new structures of ideas – designs, theories, or perhaps solutions to problems – out of other (simpler) ideas'. They define the difference between information and knowledge and argue that information is knowledge only when it has been appropriately 'organized into one's dispositions and enables one to better adapt the environment to one's needs or one's aims to the situation' (Kivinen et al., 2016). Regarding the question of what role ICTs can play in education and, more specifically, how ICTs facilitate the conversion of information into knowledge, the role of ICTs in education can be divided into four primary categories as: teaching tools; learning tools; a learning environment; and a learning subject.

ICTs as teaching tools

The concept of using technologies in the classroom (educational technologies) to improve the quality of teaching is not new. Historically, the use of technologies in the classroom can be traced back to the 17th century when the magic lantern[4] was introduced into the classroom. Throughout history, teachers have used a number of related technologies in the classroom including radio, television, various forms of audio players and overhead projectors. Technology depends on and coevolves with social practices and institutions (Hakkarainen, 2009) and use of any technology in education has always remained highly inconsistent among different communities, whereas many classrooms in today's world still use very little or no technology at all due to various socioeconomic reasons.

[4] First introduced in the mid-1600s, magic lantern was also known as *Magin Catacoprica*. With an aim to increase student engagement, this device was used in the classroom to project media on the wall and create the illusion of moving images by rapidly changing slides of pictures. See: http://www.magiclanternsociety.org/.

The ICTs for education in the 21st century are wide-ranging and well designed for providing opportunities for the teacher to adapt to 21st century pedagogical practices through more impactful use of electronic information. Using electronic simulations and animation to clarify abstract concepts, displaying practical and localized examples on the screen to ensure students are in a position to relate learning content with real-life, providing individualized virtual tutoring, increasing on-going assessment through options such as online quizzes, displaying recorded lessons for reinforcement of knowledge, and virtually breaking large classrooms into small groups to promote group-based and project-based learning are just a few examples of how modern ICTs can change pedagogy in the classroom.

These technologies can potentially change the role of the teacher; however, changing the role of the teacher should not be seen as undermining the importance of teachers in the classroom. Gert Biesta (2014) argued that 'human beings are thoroughly social, so education, too, is largely communication and participation in cooperative undertakings, where the teacher has a key role as the more experienced participant'.

Teachers around the world, especially but not only in the Global South, face multiple challenges when trying to incorporate modern ICTs in the classroom (Uluyol and Sahin, 2016; Padayachee, 2017; Gil-Flores et al., 2017). Many classrooms of developing communities are multi-grade classrooms, and many classrooms do not have sufficient space and furniture. Access to localized, curriculum compatible, reliable, relevant and working ICTs is a fundamental challenge for many; however, there are often deeper issues in the classroom that include teachers' workload, willingness to learn a new tool, classroom size, capacity and the quality of learning material. Facilitating the learning process in the classroom using a technology tool can be frustrating for many teachers, especially when they were taught differently, using a different method. This transition towards pragmatist concepts of teaching and learning promoted through modern ICTs is unlikely to happen through limited teacher training courses or workshops, possibly requiring institutional restructuring of how teachers are trained. Teachers are the authority in most classrooms, and when a teaching tool has the potential to negatively impact a teacher's confidence or when the tool is not compatible with a teacher's pedagogical philosophies, it can potentially have a detrimental impact.

ICTs as learning tools

Educational technologies are not just classroom tools that teachers use to teach the existing curriculum using a new, ICT-assisted pedagogy. These tools can be used for giving students an opportunity to experience a more practical based learning and possibly enable personalized learning opportunities.[5] Kivinen et al. (2016) argue that we should start thinking of them as 'tools to learn' which are naturally interesting and engaging for the students and thus offer them opportunities to learn by doing.

Language software, educational games, and interactive geographic information banks are a few examples of how ICTs can eradicate out-dated classroom practices such as rote learning (U.S. Dept. of Education, 2017). Kivinen et al. (2016) suggest that 'ICTs should be tied to the pupil's own current interests so as to make learning as engaging as possible and not a matter of practice-detached, conscious contemplations' (see also, Bernacki & Walkington, 2018; Dobler, 2015; Garrido & Onaindia, 2013). This opportunity, however, requires the development of culturally and linguistically appropriate learning content that mirrors the community's indigenous ideologies, culture, and knowledge (Winter and Boudreau, 2018). Communities around the world follow various approaches to preserve, manage and transfer knowledge from one generation to another. For categorization purposes, we can divide these indigenous knowledge banks into formal and informal information banks. While generic ICT tools have shown some success in digitalizing the formal information banks of some local communities, the application of ICT tools as the primary source of information conservancy and delivery faces the challenge of compatibility with informal indigenous knowledge (Kinoshi and Akintunde, 2014). In many cases, excessive dependence on ICT tools that are not designed locally can be a threat to inter-generational transfer of indigenous knowledge (Rupcic, 2017).

[5]According to Patrick, Kennedy and Powell (n.d.), 'Personalized learning is tailoring learning for each student's strengths, needs and interests – including enabling student voice and choice in what, how, when and where they learn – to provide flexibility and supports to ensure mastery of the highest possible standards.' See also https://www.edelements.com/personalized-learning for a wealth of information related to personalized learning.

ICTs as a learning environment

Scardamalia and Bereiter (2006) reason that 'learning is first and foremost an active process, a matter of doing things not passive'. Leaving behind the factory-model education system and the promise of providing high-quality education that promotes active learning, critical thinking, and physical action through pragmatic learning faces numerous challenges in practice. These challenges in developing communities include but are not limited to access to schools, availability of teachers, teachers' training level, community perception of education, out-dated curriculum, lack of investment in the education sector and funding constraints (Padayachee, 2017). Purpose-built learning platforms, Web 2.0 tools, and comprehensive learning models (devices that combine hardware and learning materials together to create a relatively more independent learning environment) are emerging as a shortcut to move away from one-way transmission of knowledge. These ICTs create an environment for interactivity and enrich teaching and learning processes in the classroom. However, the scope of these tools goes a step further and frequently encourages independent, personalized learning that facilitates an action-based, practical approach towards education.

ICT-based learning environments such as Connecting Classrooms[6], iEARN Collaboration Centre[7], mobile learning initiatives and access to MOOCs (Massive Open Online Courses) are a few pertinent examples. These platforms provide openings to meaningfully connect school communities and individuals around the world and create a shared learning experience for all by making effective use of generic ICTs, i.e., computers and the internet. These platforms provide an enabling environment where discussion is possible among peers, practical activity is encouraged, and students are not just learning about the world through theories, but are able to absorb first-hand information through action and interaction. Bereiter and Scardamalia (2014) consider this variety of learning platforms as an 'environment that promotes "design thinking", where the teachers'

[6] SchoolsOnline is a British Council project that provides a collaboration platform and facilitates electric connections among the Global North and the Global South schools. For more information, see schoolsonline.britishcouncil.org/global

[7] iEARN provides collaboration opportunities to schools across the globe. It promotes project-based learning among schools to encourage awareness of global and local issues including Sustainable Development Goals. Further information can be found on their website iearn.org

role is to assist students in (collaboratively) developing a mind-set of curiosity and questioning, one of striving for better explanations, ideas, and understanding, by means of designing better theories and models'.

Another category of ICT-based learning environment is the environment provided by devices such as OLPC (One Laptop per Child) XO 1 also known as the $100 laptop.[8] These devices were developed with an ambitious goal to eradicate the digital divide through affordable, rugged computing devices paired with learning tools and software intended to promote design thinking, critical thinking, pragmatic learning, and various other 21st century skills. The concept of this programme, as explained by Warschauer & Ames (2010), was to 'develop and distribute a low-cost "children machine" that would empower youth to learn without, or in spite of, their schools and teachers'. Various evaluation reports (Hewagamage et al., 2011; Thapa & Sein, 2018) reveal that such programmes, with their ambitious goals, have shown some degree of success in various parts of the world, but they often tend to misconstrue the challenges of education among developing communities. These programmes also face similar challenges as any other ICT-driven learning tools, e.g. availability of culturally and linguistically appropriate learning content, and the jury is still out on the exact effectiveness of such programmes. Nevertheless, these programmes, when tailored to local needs, can have an impact on school education. In addition, frequent medium and large-scale human displacement is a sad reality of today's world. Such precarious situations make access to quality education a big challenge (Rhema and Miliszewska, 2012; Wright and Plasterer, 2010). Comprehensive education ICTs like OLPC can potentially help fill this gap for millions of school-age children around the world who are unable to benefit from the traditional school system due to displacement.

ICTs as a learning subject

ICTs literacy, the ability to effectively choose and use ICT tools in various settings is a critical transferable skill in today's world. This skill is essential for accessing electronic information, communicating

[8] One Laptop Per Child (OLPC) is a non-profit programme that was initiated in early 2005 by MIT. For additional information on OLPC, please see their website one.laptop.org

electronically, increasing work productivity and making productive use of available ICTs to inform different aspects of development.

Kivinen et al. (2016) argue that the contemporary work environment and use of ICTs for development require community members that are skilled in and comfortable with using ICT tools as a habit, and school education systems should integrate ICTs training to develop such habits. They discuss the importance of habits and argue that 'an important evolutionary function of habits is the economising of energy, enabling the organism to perform its daily activities more effortlessly'. Developing these habits is critical to adopting an inquiry-based learning approach and to converting the vast amount of raw information available on the web into valuable knowledge.

Development of these habits faces a unique challenge in practice: Compared to other literacies (i.e., reading, writing, numeracy), ICT literacy is highly ephemeral due to the rapidly shifting dynamics of ICTs. Issues of ICTs knowledge obsolescence is not only observed in the developing communities of the Global South, but having a current level of ICT literacy and information assessment skills has become a global issue due to the consumerism focused nature of ICT research and product development, continuous upgrades, updates, product terminations and the short life of ICT products.

ICTs for Development and the Role of Research

Differences between the ICTs for development researchers and research users (end users as well as practitioners and policymakers) are vast, and collaboration, meaningful engagement and transfer of research knowledge between researchers and research users is a critical and well-recognized challenge. Researchers also face the issues of 'communicating findings to the right audiences, in the right language and using the most suitable medium of communication' (Harris, 2016).

A critical practical application of ICTs for development or any other development research for that matter is to inform policy change at the state level. However, this process faces numerous obstacles that continue to widen the gap between theory and policy / practice. 'The pathway from research to policy has been described as overwhelmingly complex' (Jones et al., 2013 in Harris, 2016). These challenges are not just limited to the ICTs but can be seen across most international development areas as well. According to Harris (2016),

there is a clear divide between development researchers and policy-makers, which underpins the traditional view of the link between research and policy. He quotes Stone (2009): 'it seems that researchers, practitioners, and policy-makers live in parallel worlds with different values, languages, time frames, reward systems and professional ties'.

Harris (2016) states that 'despite claims in published accounts that research findings will be useful in guiding governments, aid agencies, NGOs and communities toward desirable outcomes with ICT4D projects, little evidence that this actually happens is offered.' These gaps widen in ICTs for development research as rapid growth and the fast pace of changing technologies make the process of knowledge transfer to inform policy decision increasingly difficult. As a result, private sector tech corporations and service providers continue to operate with an essentially self-governing model which focuses less on community well-being and more on corporate profits and wealth accumulation.

ICT for development research is primarily done in the Global North by scholars with very little or no understanding of the socio-cultural values and political structures of the end-user communities in the Global South, and these differences act as a barrier to engagement. Processes and channels used to bridge the gap between research findings and policy development remain vague. How the research work is shared and communicated matters. Interestingly, many of the ICTs for development research findings are rarely shared using ICT platforms such as social media and web 2.0 tools. Harris (2016) argues that cited publications and journal articles are more highly regarded than other forms of communication that may achieve any influence on practice or policy and this gap influences researchers' intent and motivation to find better communication methods and channels to advocate policy change. Most of the research about and development of ICTs for development tools used in developing countries are not performed by researchers who live and work in such communities.

Additionally, 'scholars of developing communities also face the challenge of theorizing for the mainstream, the global academic audience' (Joia et al., 2012). This gap fails to prioritize the realities of the poor and diverts attention away from the core question of development, i.e., what does development mean to the communities who are, ostensibly, meant to benefit from development policy and practice? In many cases, this gap undermines the significance of

indigenous practices and creates the potential for cultural misinterpretation and possible loss of indigenous knowledge banks (Winter and Boudreau, 2018). Joia et al. (2012) argue this gap does not exist because indigenous researchers lack research and development capacity but mainly because they are systematically isolated while corporations profit from trade and pretend to solve inequities by selling to the ones at the bottom of the global economic pyramid.

Conclusion

ICTs are often presented as the key to poverty reduction, the solution to reduce inequalities, and a transformational tool for economic development and lifting the poor out of poverty. This promise of change is similar to the change promised by industrialization. If appropriately embedded in locally-grounded social practices, ICTs can meaningfully connect digitally disconnected communities with the rest of the world, thus becoming a potential catalyst for progress and inclusion. However, ICTs cannot be a solution to multi-dimensional poverty and inequalities, as underlying causes of poverty and inequalities are often highly complex and local.

From making high quality education available among remote communities using MOOCs to the use of big data to better coordinate disaster relief activities, ICTs are powerful tools that can assist states, societies and communities around the world in achieving their particular Sustainable Development Goals (SDGs); however, unaccompanied ICTs do not necessarily carry the potential for positive change. ICTs are an apparatus, a tool. The effectiveness of any tool depends on its relevance, how it is used, who is using it and the skill set of the user. To align ICTs with local development goals, the gap between ICT research findings and public policy must be reduced. Only a more informed state with timely access to unbiased, evidence-based research can understand the complexities of ICTs, thereby increasing the chances of meaningful policy changes. At the same time, private sector interests in profit making must be tempered with objective inquiry into the developmental problems facing particular states and regions. The success of ICT researchers, who often receive research funding from the state, should be linked to improved public policy and practice rather than knowledge production or profitmaking. We must ask the questions: Which ICTs? For what purpose? For whom? What kind of future dependency might they create? Who stands to profit from them? How might we ensure the sustainability of those initiatives? If we do not have satisfactory answers to these questions, eradicating digital

disconnection may not meaningfully bridge the digital divide. On the contrary, it may deepen and worsen the problem. The challenge for researchers is to see beyond the 'new, shiny object' that is ITC and tie comparative case studies to critical and reflective theoretical analysis (e.g. Avgerou, 2010; Fang et al. 2019; Winter and Boudreau, 2018). In fact, ICT4D is no longer so new, and critical studies are emerging to challenge the dominant discourse of ITC as a panacea for underdevelopment. It is time to bring critical reflection closer to public policy in support of sustainable, equitable and economically efficient development.

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