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Introduction to WebSci'20 Workshops

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Abstract

It is our great pleasure to welcome you to the virtual workshops associated with the 12th ACM Conference on Web Science (Web-Sci'20). This year, the conference theme is "Making the Web Human-Centric? New Directions in the Web and AI." As the workshop chairs, we selected workshops that exemplify this theme to complement the conference contributions. The theme of making the Web more human-centric is especially fitting this year as the workshops are held in the worldwide COVID-19 pandemic backdrop making the Web an ever more human-centric medium for work, play, communication, and many other societal necessities. Furthermore, the COVID-19 pandemic and the racial injustice riots that erupted in some parts of the world have forced Web Scientists to examine new directions for the Web and AI. These workshops span topics ranging from inequality, AI on the Web for social good, personalisation and community, explanations for AI, cybercrime and cybersecurity, data immortality, and evolutionary thinking for the Web.

CCS Concepts

• Information systems \rightarrow World Wide Web.

Keywords

AI on the Web, Social Good, Collective Intelligence, Bias, Data Ethics, Digital Inequalities, Education, Misinformation, Social Connections Internet Politics, Health and Wellness, Cybercrime, Digital Humanitarianism, Climate Change, Global South & Globalization

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1 Introduction

Many countries around the world are currently (as of June 2020) experiencing a lockdown and travel restrictions due to the COVID-19 pandemic [1]. In North America and many European countries, people take to the street and protest against institutionalized racism and police brutality [4]. At the same time, we witness the overrepresentation of black and minority ethnic groups amongst the victims of COVID-19 [3]. Digital communication, primarily through

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the Web, provides the crucial infrastructure for the communication of policies and protests, and it allows the tracking and tracing of COVID-19 infected members of the population, protestors, and law enforcement authorities. Social inequalities – organized, whether it is between Global North and Global South, class, race and ethnicity, or gender – are reflected in digital inequalities. While there are high hopes to use Information Communication Technologies (ICT) and AI for good – for example, in the contest of ICT for Development (ICT4D) and digital humanitarianism – there is the risk that digital inequalities perpetuate or even exacerbate existing social inequalities [5].

2 Overview of the Workshops

The tension and ambivalence between "Using AI for good" and the risk of perpetuating (digital) inequalities and the ethical and methodological challenges of investigating these processes are explored in seven highly impactful workshops selected for the WebSci'20 conference. We have put forth a summary of each of the workshops that will be part of this year's conference.

2.1 Digital (In)equality, Digital Inclusion, Digital Humanism

This workshop organized by Hans Akkermans and Anna Bon, brings together ongoing research on the Digital Divide on the Web. Several billion people, especially in the Global South, do not have access to the Internet and the Web due to many reasons including the lack of affordable infrastructure, poverty, low literacy, lack of digital skills, and language barriers. In the Global North, due in part for some of the same reasons as in the Global South, but also because the Web is used as a centralized surveillance machine, there are digital inequalities and power disparities that must be addressed. The workshop program includes papers that highlight use cases on AI for sustainable development, responsible production, education, data sovereignty, climate information for the unconnected, digitalized welfare, multilingual symbolic support, and even emoji design keeping the indigenous cultural values.

Website: https://w4ra.org/2020/03/27/digdivdighum

2.2 Using AI for Good

This workshop organized by Samantha Kanza, Will McNeill, Jeremy Frey, and Samuel Adam, who are part of the AI3SD Network+ (Artificial Intelligence and Augmented Intelligence for Automated Investigations for Scientific Discovery), looks explicitly at the ethical and societal implications of using AI in scientific discovery. Several invited talks in the workshop will discuss the ethical and societal issues centred around using intelligent technologies with an interdisciplinary focus between scientists, social scientists and technical experts. The workshop papers examine the possibilities

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Workshops & Tutorials

as well as the risks of applying machine learning algorithms to large linked data sets, especially since predictions might exclude or misrepresent consequences for minority groups, they might be harmful and dangerous. This workshop aims to answer essential questions such as 'are we conducting studies ethically?,' and 'what ethical codes can we put in place for scientific discovery research to mitigate against ethical and societal issues?' in the context of Web Science.

Website: https://sites.google.com/site/ai3sdusingaiforgood

2.3 Personalisation and Community

This workshop organized by Clare Hooper, Mark Bernstein, and Mark Weal aims to bring together web scientists engaged in usercentric endeavours such as user modelling and community connections in Web Science, healthcare, and education. The workshop seeks to explore human connections online and the mechanisms of fostering such connections. This is particularly important in the healthcare and education sectors, as the current COVID-19 pandemic illustrates. Some of the work included in this workshop looks at improving emotional well-being and behaviour change. This interdisciplinary workshop brings together many core Web Science themes, including the use of Web Science for social good, social connections and influence on the web, education online, and online health and wellness.

Website: https://qa.ayogo.ws/pc20

2.4 Explanations for AI

This cross-sectoral and multi-disciplinary workshop organized by Niko Tsakalakis, Laura Carmichael, Sophie Stalla-Bourdillon, Luc Moreau, Dong Huynh, and Ayah Helal discusses the critical methodologies and principal technical, legal and organizational challenges for generating computable explanations and their benefits. The workshop considers the perspectives of software designers, implementers, and those who are subjected to automated decision making and thus raises essential questions for "Design Justice [2]." The organizers aim to build an international network of people focusing on explanations for AI, and an agenda to drive this work forward.

Website: https://git.soton.ac.uk/nt1n16/exAI2020

2.5 Defence, Cybercrime and Cybersecurity

This interdisciplinary workshop, organized by Stuart Middleton, Anita Lavorgna, and Ruth McAlister, explores the socio-technical challenges of employing AI technologies in defence counter-terrorism investigations, and other criminological investigation [6]. The workshop brings together academics and practitioners and raises essential methodological and ethical questions concerning the analysis and data mining of vast volumes of web-based and web-generated data concerning trustworthiness, bias, and error. Papers in this workshop highlighted the need to incorporate human judgment in order to open the "black box AI." Contributions in this workshop address challenges around socio-technical AI systems in defence from a practitioner's perspective, information extraction as a sociotechnical approach for criminological investigation, and the decoding of the black box as interpretable methods for post-incident terrorism investigation.

Website: https://www.southampton.ac.uk/~sem03/STAIDCC20.html

2.6 The Secret Life of Immortal Data

This symposium organized by Kate Lyle, Anneke Lucassen, Lisa Ballard, Faranak Hardcastle, Mark Weal, Adriane Chapman, and George Konstantinidis brings together speakers from multiple disciplines and industries, to discuss the life-cycle of data. The panel will discuss the ethical, social, and legal challenges of working with large volumes of personal data bringing together different disciplines, contexts, and perspectives. The event considers emerging forms of personal data that persist beyond their initial construction, which raises many important questions such as definitions of data, ownership, determining consent in an uncertain future, and ethical and responsible use of data for purposes beyond its intended use. *Website: https://www.southampton.ac.uk/cels/news/events/2020/07/ immortaldata.page*

2.7 Evolutionary Thinking for the Web

This workshop, organized by Maria Priestley, Thanassis Tiropanis, and Tim J. Slucking considers analogies between biological and technological evolutionary thinking to the development of digital media and the Web. This is relevant for the spread of online (mis)information ("fake news"), cognitive bias, echo chambers, and filter bubbles. The goal of this workshop is to discuss how evolutionary approaches can inform our understanding of the Web at present, as well as methodological challenges and opportunities to shape its evolution into the future.

Website: https://mpriestley.github.io/workshop

3 Conclusion

These workshops are highly relevant in the times of COVID-19 and ongoing protests against racism and promise to develop tentative answers for the "new normal." The common threads in the workshops are 1) the need for multi-disciplinary and multi-sectoral collaboration of academics, practitioners and pracademics, 2) the centrality of questions of how to prevent or minimize bias, exclusion, and inequality, and 3) the importance of methodological, ethical and legal considerations. The presentations and discussions in many of these workshops will be used to prepare summaries either as white papers or as notes on the official Web Science blog to be disseminated more widely. We hope that you look forward to these workshops as we do and thank the workshop organizers for their contributions.

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Digital (In)Equality, Digital Inclusion, Digital Humanism

Summary of the Web Science Workshop DigDivDigHum-20

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ABSTRACT

From its inception, the World Wide Web has been intended to be a force for social good. But there are many barriers and obstacles, a situation commonly characterized as the Digital Divide. Several billion people especially in the Global South do not have access to Internet/Web for reasons of lacking (affordable) infrastructure, poverty, low literacy, lack of digital skills, language, etc., and are thus digitally excluded. Also in the Global North, despite being technologically "advanced", we see severe digital inequalities and power disparities, in part for the same reasons and in part due to the Web being exploited as a centralized surveillance and moneymaking machine, controlled by big parties such as states and big (tech) corporations, thus creating further inequalities and exclusion. This paper summarizes the main themes and insights from ongoing research presented and discussed at the WebSci'20 Workshop on Digital (In)Equality, Digital Inclusion, Digital Humanism.

CCS CONCEPTS

• Information Systems; • World Wide Web; • Web Applications; • Social Networks; • Social and Professional Topics; • User Characteristics; Computing / Technology Policy; • Applied Computing; • Human-Centered Computing;

KEYWORDS

Digital Divide, Digital inclusion on the Web, Overcoming barriers for the underprivileged, AI for sustainable development, Collaborative ICT4D technosocial innovation, Digital Humanism

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1 THE WEB: TO SERVE HUMANITY

From its inception, the World Wide Web has been intended to be a force for social good, as an open and free space for all for information and knowledge sharing and for informed public democratic debate: see for example the ACM Turing Award lecture by Tim

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Figure 1: The Turing Lecture by Tim Berners-Lee at Web-Sci'18, VU Amsterdam, 29 May 2018 [1]

Berners-Lee at WebSci'18 [1] (organized by the present authors, cf. Figure 1). In other words, the Web is "to serve humanity" [2, 3].

Nevertheless, there are many barriers and obstacles to this ideal [4], a situation commonly characterized as the Digital Divide. Several billion people especially in the Global South do not have access to Internet/Web for reasons of lacking (affordable) infrastructure, poverty, low literacy, lack of digital skills, language, etc., and are thus digitally excluded.

The "fringes of the Web" are not just a matter of the Global South. Also in the Global North, despite being technologically "advanced", we also see severe digital inequalities and power disparities, in part for the same reasons and in part due to the Web being exploited as a centralized surveillance and money-making machine, controlled by big parties such as states and big (tech) corporations, thus creating further inequalities [5–7]. For many underprivileged and disadvantaged communities, the digitalizing world exacerbates already existing social, economic or democratic-political inequities and exclusion mechanisms.

2 TACKLING THE "FRINGES OF THE WEB"

The WebSci'20 Workshop on Digital (In)Equality, Digital Inclusion, Digital Humanism aimed to bring together ongoing research on the Web and the Digital Divide from different perspectives. First, in line with the above, it seeks to be an encouraging place for work rooted in the Global South, as both topics of interest for and authors from the Global South are underrepresented in Web Science, but it also welcomes work addressing matters of the Digital Divide and underprivileged communities in the Global North.

Second, there is a research need, not just for scientific analytical work concerning problems and issues, but also for constructive

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research regarding solution directions on *what to do about* the problems associated with the Digital Divide. Apart from empirically grounded (case) studies and theoretical analyses of mechanisms behind digital inequalities, the DigDivDigHum Workshop also is seeking, in view of recent initiatives such as DigitalHumanism [2] or Tim Berners-Lee's SOLID initiative (https://solid.mit.edu/), programmatic or solution design-oriented work from multiple disciplines, and concrete experiences on what scientists and professionals can *do* to help redress matters of digital inequality and exclusion.

3 INSIGHTS FROM RESEARCH ON DIGITAL DIVIDE AND DIGITAL HUMANISM

The DigDivDigHum-20 Workshop at WebSci²20 contained three keynotes and 10 peer-reviewed research paper presentations, all included in the present Proceedings.

Mirjam de Bruijn, professor of Anthropology and Contemporary History of Africa at Leiden University, discusses her extensive field research into the ways social media are intertwined with recent processes of radicalization in Sub-Saharan Africa, thereby nuancing and debunking widespread oversimplified clichés surrounding the notion of radicalization.

Leen Zevenbergen, social entrepreneur and impact investor (a.o. in AI, already in the 1980's) addresses the critical question how AI for social good and for Sustainable Development can be provided with a solid business case.

Richard Heeks, professor at the University of Manchester, present his views on the future of ICT for Development (ICT4D). His claim is that a paradigm shift regarding ICT4D is currently taking place that brings to the fore matters of social justice with renewed strength.

Munyaradzi Mawere and Gertjan van Stam (Greater Zimbabwe University), in *Data Sovereignty, a Perspective from Zimbabwe*, develop the concept of data sovereignty from a decolonial, African perspective, as a counterweight to current exploitative surveillance practices of data science and technology.

Francis Dittoh, Victor de Boer, Anna Bon, Wendelien Tuyp and André Baart (University for Development Studies UDS, Ghana & VU Amsterdam, Netherlands) in *Mr. Meteo: Providing Climate Information for the Unconnected*, shows how innovative technology (recently awarded an Internet Society prize) is needed and can be developed for data and knowledge sharing in rural areas of Africa where web access is absent and will continue to be so for the foreseeable future.

Amelia Morris, Lizzie Coles-Kemp and Will Jones (Royal Holloway University of London, UK) in *Digitalised Welfare: Systems For Both Seeing and Working With Mess*, discuss the effects and issues stemming from the digitalization of welfare systems. They do so for the United Kingdom, but it is interesting to compare that with other recent studies [6, 7], showing that the Digital Divide is also a significant problem in the West. The authors also clearly point out that taking appropriate responsibility by societies and states is an urgent matter, and how matters of human dignity are at stake.

Chu Hiang Goh and Narayanan Kulathuramaiyer (Universiti Sains Malaysia & Universiti Malaysia Sarawak) in *Developing an* Indigenous Cultural Values Based Emoji Messaging System: A Socio-Technical Systems Innovation Approach, show how existing, considered "universal", standards for emoji systems are in fact culturally biased, and discuss ways how to redress this.

Mónica Eva Pini (Universidad Nacional de San Martín UNSAM, Argentina), in *Digital Inequality in Education in Argentina – How the Pandemic of 2020 Increased Existing Tensions*, reflects on very recent experiences regarding the COVID-19 pandemic, outlining how the digital divide is widened and how digital inequalities increase disproportionally for the poor.

Ms Shalini and Ankit Tewari (Ministry of Human Resource Development, India & Universitat Politecnica de Cataluña, Spain), in *Sustainable Education in India through Artificial Intelligence: Challenges and Opportunities*, argue that AI can fill existing gaps in the Indian educational system, in particular in the ongoing massification and needed scaling up of higher education in India.

Robert Bwana, André Baart, Victor de Boer, Francois Lenfant, Néne Morisho, Michelle Westermann-Behaylo and Marcel Worring (University of Amsterdam, NL & Pole Institute, DR Congo), in *Developing a Crowdsourcing Application for Responsible Production in Africa*, discuss ways, including forms of crowdsourcing, to make global supply and production chains more transparent, accountable and sustainable.

In Power Inequities: Observations on the Development of Information and Communication Technologies, from an African Place, Gertjan van Stam (Masvingo, Zimbabwe) analyses the (often non-direct [8, 9], symbolic) power mechanisms at play in ICT4D, criticizing the appropriateness of the still common idea (in the West, that is) that ICT4D is about bringing ICT to the underdeveloped world or similarly, that solving the Web digital divide is mainly an issue of providing (affordable) Internet access.

Ea Draffan, Chaohai Ding, Mike Wald and Russell Newman (University of Southampton, UK) discuss *Multilingual Symbolic Support for Low Levels of Literacy on the Web*, and propose that recent AI techniques can help improve readability of web content. It is interesting to note here that several papers in this workshop touch upon the importance of language and speech, in other words, multilinguality and multi-modality, as key issues in satisfactory Web access and resolving the digital divide.

Finally, Anna Bon, Jaap Gordijn and Cheah Wai Shiang (VU Amsterdam, Netherlands & Universiti Malaysia Sarawak UNIMAS) explain why *Digital Inclusion Requires a Business Model Too*, and do so on the basis of detailed business value network analyses of community service projects carried out in Sarawak, Malaysia.

4 INCREASING THE DIVERSITY, INCLUSIVITY AND EQUITY OF THE RESEARCH AGENDA

Taken together, the papers from this DigDivDigHum-20 workshop in Web Science bring up some important general points. Science and technology research, including academic and scholarly work, has a hang for addressing "advanced" issues. This bias leads to an underexposure and underrepresentation of issues, views and voices from the Global South and from underprivileged communities. In other words, this bias itself has an excluding effect. It also underlines that the digital sciences of Internet and Web are not yet so truly global in outlook and agenda as their self-image purports to be.

The papers in this workshop however show that issues from the Global South and from the underprivileged side of the digital divide are no less "advanced", in that they are at least equally challenging and complex, not only in a societal but also scientific and technological sense. Thus, big strides are still to be made to make the science and technology research agenda better cater for increased diversity, inclusivity, and equity. We hope this workshop and its proceedings offer a small contribution to this.

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ICTs, Social Media and Tendencies of Radicalization in the Sahel

[Keynote Web Science Workshop DigDivDigHum-20]

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ABSTRACT

The African Sahel has become a stage for increasing violent conflict since 2009. It is probably no co-incidence that the upsurge of these conflicts went together with the increase in digital connectivity in the region. In this paper I explore the relationship between radicalization, conflict and access to ICTs and social media in the Sahel. First I sketch how the social landscape has changed due to the advancement of the 'digital highway'. We will see how the socalled hybrid organization, the democratization forces of the digital have influenced the formation of trans-national communities and through these influenced conflict dynamics. The second part of the paper explores the increase in violence and the potential role of the digital networks in the upsurge of this violence. Radicalization in different forms (ethnic, religious, national) is an important effect of the information flows that travel the digital networks and that seems to influence the increasing (ugly) violence.

CCS CONCEPTS

• Information Systems; • World Wide Web; • Web Applications; • Social Networks; • Applied Computing; • Law, social and behavioral sciences; • Anthropology; • Human-Centered Computing; • User characteristics; Collaborative and Social Computing;

KEYWORDS

Radicalization, Sahel, New ICTs, Conflict

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1 THE SAHEL TURMOIL AND THE APPEARANCE OF ICTS

The present work is the result of on-going research in the central and west Sahel (de Bruijn 2018, 2019 [1, 2]), mainly in Chad and Mali.

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Figure 1: The term 'radicalization' immediately evokes images of extremism, Muslim fundamentalism, and violence, but we need to develop a different, broader understanding of radicalization [1, 2]

The turmoil in the Sahel has been analysed as a resource war, part of criminal networks, related to the effects of climate change, the absence of the State and hence space for criminal networks and Jihadi groups to take over (Gaye and Serigne 2018 [3], Raineri and Strazzari 2015 [4]). In these analyses so far, little attention is given to the role of the new connectivity that have become also in the Sahel, an important factor in social and political life. In this short article I will delve into the possible role of new ICTs (mobile telephony and social media) in socio-political changes that have at least exacerbated if not also been at the roots of the presentday turmoil. I will focus on the wherewithal (Jackson 2013 [5]) of one social and ethnic group: the Fulani in Central Mali that will illustrate the two points I want to make: 1. The further ethnicization as a form of radicalisation, enabled through ICTs, 2. The increasing violence as a consequence of information flows that also leads to radicalisation. I will only sketch tendencies, that are still part of on-going research (see www.nomadesahel.org).

2012 was the start of the war in Mali that was a consequence (a.o.) of the fall of Gadhafi in 2011. The Tuareg who were under Gadhafi came back to Northern Mali with arms and were one of the forces to relaunch the liberation war for the Tuareg, soon this war was hijacked by jihadi groups and gradually it became a chaotic turmoil where the absence of the State led to the emergence of militias, self-defence groups, the upsurge of local conflicts etc. (Leccoq e.a. 2013 [6]). The military approach of the international community in collaboration with the national armies has had no real effect on the

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situation, instead violence has only increased and the area of turmoil has expanded to other Sahelian countries and recently also to the southern West African States like Ivory Coast and Ghana (Promediation 2020 [7]). Central Mali got involved as a 'battle ground' in 2015 when the Fulani organised under the banner of Hamma Koufa, a Muslim Fulani preacher, and started to claim their security in the region. As a consequence, a local Jihad became a reality (Sangaré 2016 [8], Jourde, Brossier and Cissé 2019 [9]).

The Sahel-Sahara has always been a region of mobility. The middle age trans-Saharan trade routes are today still important trading routes (often for criminal networks, like the International Jihadi networks). The region has been driven by mobility also through the lifestyles of the population who live of the whims of pastures for their animals and of the scarce rains for the growth of their millet crops. Mobility and travelling are part of these societies and communication, being informed is crucial. This may be one of the explanations for the quick acceptance of mobile telephony in the region. The first mobile telephony masts were planted around 2006, and it took another few years for the communication signals to reach also to the remote areas where the herdsmen live in mobile camps, or where the itinerary farmers dwell during the rainy season (Keita et al. 2015 [10]). From 2000 to 2019 the coverage of mobile telephony rose from 0 to 115% in Mali (ITU statistics). Affordable smartphones were introduced through the Chinese markets, facilitating connectivity via mobile internet. From 2009 the use of mobile internet was on the rise also in the Sahelian countries. Sahelians who are connected to the internet often connect through Facebook using its light version that does hardly use bytes and is pre-installed in these phones. Illiterate nomads are on WhatsApp and use the audio function to send their messages.

2 EMANCIPATION OF THE NOMADS

The Fulani are hierarchically organised, as many other Sahelian societies. The nomads who herd the animals (goats and sheep, cattle and camels) are one social group. They belong to the 'free' social layers, like the elites (religious and political). The unfree are the slaves and the castes. Today slavery does no longer exist, but former slave groups still belong to a different (subordinate) social layer in the Fulani society. In some parts of Mali slavery still continues to be part of the hierarchical construction. These (former) slaves continue to depend on the elites (Pelckmans 2011 [11]). In this hierarchy the nomads were free, but dependent of the elites, who were the guardians of the pasture areas, and also the intermediaries between the nomads and first the colonial and now independent states. Corruption has entered these relationships. For instance, accessing the Innerdelta of the Niger, which is crucial pasture area for the dry season, was only possible by bribing these elites (in coalition with the state) who control these lands. Such exploitative relations were accepted in the existing hierarchies.

However, in the course of the 1990s nomads gradually entered the 'modern' world, through animals' trade relations/markets, sedentarization (also due to droughts of the 1980ies), and becoming part of the capitalist economy. This brought them in contact with urban life. They started to send their children to school, probably in some areas mainly Koranic schools. With the advancement of 'democracy' some of the nomads entered politics and became followers of political parties that were not shared by their elites. We can depict this development as an emancipatory process. Some nomads turned into leaders who became aware of the exploitative situation they were in, and the role their elites were playing.

This emancipation of the nomads needs to be better understood, but it seems to be a crucial factor for the developments that we have seen over the past decade. It should also be noted that these urban and political relations that were new for the nomads were enhanced through the new modes to connect through mobile phones.

3 ETHNICIZATION AND ICTS: MOBILE COMMUNITIES

One of the consequences of 'easy' communication is that people will unite in new ways. If we consider most of the Sahelian societies as network societies, as a consequence of their mobility and the spread of families over geographical space (de Bruijn, van Dijk and Foeken 2001 [12]), then we can imagine that communication density may have an influence on the form of this family network. A study on Cameroonians who lived in South Africa, Europe and Cameroon shows these dynamics. In such family network the ties between family (in the large sense of the word) become stronger with the aid of communication. New ICTs lead to a constant flux of information between the families spread over the world, and it also makes communication (increasingly) affordable. They literally become the glue of society (Vertovec 2004 [13]). Hence international mobile communities that are based on family and ethnic linkages are formed (Nyamnjoh 2014 [14]). Such a process has also happened in the Sahel, where nomadic societies have used mobile communication to unite. The Fulani nomads in various parts of the Sahel do have family ties, that they sometimes link back to a shared history, and certainly to a shared language. Easier communication has made contact between these groups easier.

An important moment in the development of the turmoil in central Mali was the gathering of Fulani nomads from different parts of Mali, Burkina and Niger to discuss the insecurity in the region and develop a strategy for the future to avoid falling into civil war. They had been able to gather 1000 nomads, inform the authorities (national and international) and organise a central prayer (duao) during which they also opened the discussion about their position in the region and the insecurities they faced. They felt abandoned by their elites, who they considered as being part of the evil they were living through, and they felt abandoned by the State who had allowed their marginalisation for decades (in fact since independence). During this meeting they demanded for help. Without the mobile telephone this would not have happened. The meeting showed the unity of the Fulani nomads in the Sahel. And some of these nomads, who acted as their leaders had a clear discourse on their marginalisation (in the film 'Hopeless' this process is followed and the meeting filmed: https://voice4thought.org/watch-onlinehopeless-biographies-of-radicalization/).

The outcome of the meeting was a big disappointment for the nomads, because they did not receive any protection, nor any other assistance of the (inter)national community. But the meeting did give them a sense of unity and a common enemy in fact. It was for some a sign that they had to rely on themselves and they turned ICTs, Social Media and Tendencies of Radicalization in the Sahel



Figure 2: Stills from the online available film 'Hopeless' referred to in the text

their eyes to the protection of the, by then well implanted, Jihadi groups in the region (Sangaré 2019 [15]).

4 INFORMATION FLOWS AND RADICALIZATION

Then, 2015, was already the period of good connectivity in the region, and smartphones were part of the equipment of many youth of the nomads. The preaches of one of the main figures in the Fulanijihadization, Hamma Koufa, were circulating in the phones. His preaches were the counter discourse: he did reveal the nomad's marginal position vis-à-vis the Modern State (including their elites), and the devastating influence of the French (international community) and he would celebrate the Fulbe nomads unity and their strong history in relation to the Sahelian Jihads in the 19th century. He referred to the Diina, the Maacina empire that was a Muslim empire build on a Jihad. The nostalgy to go back to such position of hegemony for the Fulbe resonated with the present-day marginalisation that they feel. Furthermore, the Jihad propaganda from Al Qaida and other internationally based groups would also circulate in these phones (Galy Cissé 2019 [16]). Such messages must have influenced choices of the youth to join the self-defence groups that turned into Jihad groups and followers of Hamma Koufa.

From 2017 violence in Central Mali was really on the rise (Human Rights Watch 2020 [17]). The main victims were Dogon and Fulani who have a shared history in the region. Their relationship can be summarised as the relation between farmers and herders, and tensions between these livelihoods had been rising for decades, also due to climate change. These old conflicts flared up under the new opposition that was created with the arrival of the Jihadi groups. The Malian army was not neutral in this conflict. On social media the various groups have united in ethnically led platforms where they post the most horrific photos and the most terrible accusations from one to the other. These messages do raise the ethnic awareness that seems to be deliberately fed by hate speech. It exacerbates the oppositions between these groups and incites to violence.¹ Violence that easily becomes mortal in a region where weapons are easily available, and the local authorities fail to protect the population. As a consequence, many people flee central Mali and seek refuge in urban areas, or in southern regions, some cross the border to Burkina Faso. The number of deaths in such ethnic clashes is rising every day.

5 CONCLUSION

Communication can be a weapon in war, as it is power (Castells 2009 [18]). Those who control the communication channels do have the power. With the advancement of new ICTs power in the social networks were assumed to become more democratic. These new ICTs would give power to people without a voice. The story we have related in this article does follow this logic. Indeed, access to easier communication makes the organisation of horizontal networks, such as the nomadic Fulani, easier. The relations that people forge through these new ICTs are their own choice. It has led to the existence of stronger unity between ethnic groups transcending national borders. The power of such networks then also changes, and may change the political landscape. In central Mali this is what has happened.

The power of the network is next to communication between people, also based in the information that flows in the network and is received and interpreted (Gleick 2011 [19]). Information flows in highly opposite war areas however can become a violent arm. It is not the first time that communication has been the core in the occurrence of extreme violence. The Rwanda and Sierra Leone examples have become common knowledge and a warning for future possible developments in war regions.

These two 'effects' of ICTs on the turmoil in the Sahel can be summarised as influencing people in their choices in war. As such they have to adopt the ideas of one of the sides in the conflict and when they internalise these they radicalise. Such radicalisation can be ethnic, social, political or religious. It may be a necessity for survival (de Bruijn (ed.) 2019 [1, 2]).

It is time that the factor communication and the role of new ICTs will be taken into account for the understanding of the Sahel turmoil and probably instead of fighting the conflicts militarily we should start to develop a strategy to fight through communication.

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¹With Mamadou Togola we are working on an analysis of these processes on various social media. They are part of the PhD project of M. Togola that he will fulfill at Leiden University.

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From the Digital Divide to Digital Justice in the Global South

[Keynote Web Science Workshop DigDivDigHum-20]

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ABSTRACT

As we shift paradigms in the relationship between digital technologies and international development, many issues will need to be rethought. In this paper, I look at the changing nature of the relationship between digital and inequality in the global South; in particular tracing the re-scoping from concerns just about the digital divide and exclusion, to broader concerns about digital justice that also cover adverse incorporation into digitalised development systems across economic, political and social spheres.

CCS CONCEPTS

• Information Systems; • World Wide Web; • Web Applications; • Social Networks; • Social and Professional Topics; • Computing / Technology Policy;

KEYWORDS

Digital divide, Digital development, Digital justice, Digital inequality, ICT4D 3.0

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1 ICT4D PARADIGM SHIFT

In recent years, there has been talk of a paradigm shift emerging in the relationship between digital technologies and international development; typically referred to either as moving from "ICT4D 2.0" to "ICT4D3.0", or more generally from "ICT4D" to "digital development" (Bon & Akkermans 2019 [1], Heeks 2020 [6]). Various dimensions of the paradigm shift can be identified: changes in the nature of the technologies being used in the global South; changes in the salience and presence of digital data in development processes; changes in the demographics of digital users; etc.

Out of these dimensions of change, one can then identify changes in a number of development issues. The one discussed here will be that of digital inequality; originally understood in terms of the digital divide; something which, historically, has been a central digital problem for the lower-income countries of the global South.

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Initially defined in terms of lack of access to digital technologies, the digital divide has extended over time to include lack of ability to afford the technology, and lack of ability to effectively use the technology (Heeks 2018 [5]). But the problem remains framed in terms of exclusion.

As digital intensification during the Covid lockdown has demonstrated, the digital divide remains a potent constraint on development. However, growing digitisation in recent years has meant that growing numbers of citizens in the global South are no longer excluded from digital systems and processes:

"We can thus talk seriously about the existence of a digital "nervous system" for development. This is a pervasive digital infrastructure in which most development organisations from international agencies through government departments to small communitybased organisations have internet access—often broadband internet access—and in which most individuals in developing countries have digital mobile phone access." (Heeks 2020 [6]).

From this, a new challenge emerges. Not exclusion but "adverse incorporation", defined "as operating 'when powerful, connected people command resources from which they draw significantly increased returns by coordinating the effort of outsiders whom they exclude from the full value added by that effort' (Tilly, 1998, p. 10 [12])." (Phillips 2013: 176 [11]). As the definition indicates, adverse incorporation is a key mechanism by which inequalities are maintained and increased: as those with power and resources gain more from development systems than those who are adversely incorporated.

We can see evidence of adverse incorporation into digitalised development systems – and consequent exacerbation of inequalities – across economic, political and social spheres. For example:

- The so-called "thintegration" of African small enterprises into digitalised global value chains, where gains are made by lead firms in the global North at the expense of those small enterprises (Murphy & Carmody 2015 [10], Foster et al. 2018 [4]).
- Use of digital technologies to provide the state with increasing means to surveil and control its populations (Creemers 2018 [2]).
- The way in which growing use of mobile phones can be associated with an increase in violence against women (Hobbis 2018 [9]).

2 SOCIAL JUSTICE

The battle against the digital divide and for digital inclusion must continue via technical and social innovation to make digital more ubiquitous, more affordable and more usable. But alongside this, concerns about digital equity must also include a battle against adverse digital incorporation.

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Figure 1: Conceptual Model of Digital Justice for Development (adapted from Heeks & Shekhar 2019 [7])

This will first mean countering the current adverse digital incorporations. An example here would be the Fairwork project, which seeks to address inequalities between capital and labour as workers are adversely incorporated into the digitalised labour market of the platform economy (Fairwork 2019 [3]). Or use of mobile phones as a platform intervention seeking to prevent gender-based violence (Yankah et al 2019 [13]).

It will also mean designing "advantageous digital incorporations": those with a specific pro-equity focus. Pro-equity uses of digital technologies have been a mainstay of the ICT4D field for many years. The insight provided by adverse incorporation, however, is that incorporating marginalised groups into development systems typically leads to growing inequality due to the unequal structural basis of those systems (Hickey & Du Toit 2013 [8]). Advantageous digital incorporation can only occur, then, if digital interventions in some way address underlying structural inequities.

This takes the debate away from the language of technology and design and into the realm of social justice. As the Figure 1 model demonstrates, it takes the focus away from the practices and procedures of digital development systems – what one may call procedural digital justice – and towards the need to impact the wider institutions, structural relations, digital rights and episteme that surround such systems. Only by impacting those can we move from adverse to advantageous digital incorporation, and deliver digital justice in the global South.

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AI for Sustainable Development: What's the Business Case?

[Keynote Web Science Workshop DigDivDigHum-20]

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ABSTRACT

The world is rapidly changing — due to many inequalities in our neoliberal society, but also due to the current Covid crisis, to be followed by a severe economical crisis. These crises will enlarge the already existing inequalities all over the world. In particular the inequalities between rich and poor, between literate and illiterate people, and between North and South. This crisis is the cause of great stress.

In 2006 a new type of company was established, called the B Corp. This new legislation started in the US (currently in 40 States) and protected the company from the existing shareholder-driven mentality. Instead of working for shareholders only, companies were going to work for all of its stakeholders. The legal form for this was the Benefit Corporation, but existing companies could also select to perform an impact analysis, called the BIA (Benefit Impact Analysis). With this analysis companies could qualify to become a certified B Corp.

After 14 years since its inception, there are now around 3,000 B Corps worldwide and around 5,000 Benefit Corporations, mainly in the US. Examples of well-known B Corps are Patagonia, Ben & Jerrys, Danone, Triodos Bank and African Clean Energy (ACE).

Besides this development of a new kind of company that uses the slogan "Business as a force for good" there is also another trend going on in the world, having to do with the exponential development of technology. The speed in which technology develops surpasses the adaptability of the human brain to every new step, also causing stress in the world.

Knowing that technology can be used for good and for bad, and that both directions cannot very well be influenced or steered by governments, we can only hope that technological developments "for good" are faster and more numerous than the bad ones.

Now, the Business as a force for good and the Technology as a force for good seem to come together and could potentially support each other. If we can define profitable business "for good" and that business is a technology business helping to solve the abovementioned inequalities, we are making a big step in the direction of a better world.

This keynote describes these two developments in more detail, trying to come to a definition of a profitable business case using technology (especially AI) to improve the lives of many.

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CCS CONCEPTS

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Computing / Technology Policy; • Human-Centered Computing;

KEYWORDS

Business, AI for social good, sustainable entrepreneurship

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1 THE AUTHOR

Leen Zevenbergen was, after his high school in The Netherlands and in Texas, trained as an economist and accountant. He holds a masters degree in Business Accounting from the Erasmus University in Rotterdam.

After his graduation he quickly discovered that being employed (at Philips Corporate Accounting) was not the way forward for him. At age 24 he started his first company, called Bolesian. This was the first Artificial Intelligence company in The Netherlands.

Being the master of his own destiny he started another 20 companies after this first one, among them companies in areas like Virtual Reality and Computer Graphics (based in Silicon Valley. Most companies were technology oriented, in software (Escador), in renewable energy (Solarus.com) and in Education (Ubiquity University).

In between creating and starting companies, Leen Zevenbergen managed several large multinationals in many countries, companies like Pink Roccade and Origin.

Following his first book "Rip off your necktie and dance", Leen Zevenbergen wrote two other books about both entrepreneurship ("T'is Groen en groener wordt het niet") and sustainability "Sustainability @ the Speed of Passion!" His latest book is "Once upon a Future" about the current and future crises, he wrote together with Ruud Veltenaar: Ruud Veltenaar & Leen Zevenbergen. Once Upon A Future. 2020. Bertram + de Leeuw Uitgevers, Haarlem, The Netherlands. ISBN: 978-94-6156-264-7..

Having been Chairman of Social Venture Network Europe and being Co-Founder of B Lab Europe makes him one of the European leaders in the field of sustainable entrepreneurship.

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Data Sovereignty: A Perspective From Zimbabwe

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ABSTRACT

This paper applies a trans-disciplinary analysis on the issue of data sovereignty, from an African perspective. The paper interrogates the residence of data and the African prerogatives for its processing. Harvesting from experiences in Zimbabwean health systems, this paper suggests that African governments can steward the collection and appropriate use of data resources, applying the principles of data sovereignty.

CCS CONCEPTS

• Information Systems; • World Wide Web; • Web Applications; • Social Networks; • Social and Professional Topics; • User Characteristics; Computing / Technology Policy; • Applied Computing; • Human-Centered Computing;

KEYWORDS

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1 INTRODUCTION

In African contexts, issues of sovereignty - whether social, political technological or otherwise - are pregnant and contested concepts, subject of ongoing discussions. The foundations of the systems of the nation-state and the articulation of concepts of national sovereignty are a result of non-African histories. The Westphalia accords came to pass without African involvement in the towns of Münster and Osnabrück in 1648. These accords set the foundations for the demarcation of autonomous states in Africa. Colonial, bilateral and multilateral agreements established the state boundaries, drawn up outside of Africa, without any African consent or representation. The social and political realities in Europe resulted in the demarcations that exist in Africa, up to the present time. They were solidified in the General Act of the Berlin Conference, in 1884-85. This confirmation of the arbitrary borders authorised Europe's Scramble for Africa. Founding nationalists in Africa imported the resulting bondages through the principles of the Organisation

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of African Unity (OAU) – the precursor of the African Union – that emphasised the inviolability of colonially-inherited African borders.

Sovereignty in the African contexts is a two-pronged enterprise, existing both in the context of the nation-state and as existing in so-called traditional systems, guided by narratives of identity and culture. The guardians of the nation-state are the national governments in Africa. Their powers are often vested in a democratically elected President. In the so-called traditional structures, authoritative guardianship resides in the Chieftainship.

In this paper, we focus on the state as a core unit for regulatory powers. Nevertheless, with Olayode Kehinde Olusola [32], we concur that this unit of analysis remains inadequate to address the full scale of multiple realities existing in contemporary African politics. In this paper, we choose to limit the interrogation to the perspectives from a nation-state because information and communications technologies seem exclusively and narrowly conceptualised to exist in the legal frameworks set in nation-states and omits any reference to customary laws.

There is a clear void for critical literature on the storage, African agencies in the harbouring and processing of digital data, the use of data from Africa, and the growing exploits of data platforms outside of Africa. Datafication in the Global South, Linnet Taylor and Dennis Broeders [43] show, are resources to an avaricious informational capitalism that fuels new power structures propelling "digital representations of social phenomena and/or territories that are created in parallel with, and sometimes in lieu of, national data and statistics." (page 229). In this paper, we approach the subject matter by interrogating the consequences of the *positionality* (location) of information. Also, we assess what is *at stake* in the handling of digitised information while reflecting on the issues of sovereign choice and agency in Zimbabwe. Underlying questions are "who benefits in contemporary platforms?" and "who's interests are technologies, data, and platforms serving"?

We conceive 'data' as things known or assumed as facts that are the basis of reasoning or calculation, and, therefore, subject to philosophy and contextuality. The framings of the constitution of quantities, characters, or symbols in the fields of calculation and computing, invariably negate philosophies, ontologies, and epistemologies from Africa [39]. Definitions appear set in a normative epistemology that assesses the benefits of an action by its essentialised results. Such an epistemology is foreign to most African communities. It omits the dynamic and integral nature of African epistemologies [3] and the relational qualities of 'things' [24]. Data sovereignty refers to the self-determination of individuals and organisations – and, we argue, countries and communities – concerning the use of their data [13].

It is from our African positions, set in a complex context of competing philosophies and practices affecting sovereignty and

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accountability that we discuss the issue of data sovereignty. We derive our empirics from the Zimbabwean setting, where the authors have been studying and working for the last decennia.

2 METHOD

This paper is located within a decolonial research paradigm, recognising the primacy of community [40], heritage, and conviviality [31]. We focus critically on the development and evolvement of models and theories from Africa. These bearings need to be wrestled from a non-African ontological and epistemic hegemony. To achieve this, we utilise the method of Living Research [42]. For this paper, we adhered to the method by:

- invitation to develop this paper by specialists in various Ministries and professional societies in Zimbabwe, who called for this research and asked for its execution;
- 2. guidance by the introduction and recommendations of critical offices and persons in Zimbabwean academia and in health;
- developing the concepts, proposals and execution processes within the context of and with the communities of practice in Zimbabwe, specifically within Zimbabwean Universities and the Zimbabwe Ministry of Health and Child Care, through methods of co-creation;
- regular monitoring and looping of the ongoing development of the research in the (geographical) location of the communities concerned;
- disclosure of the progress of the study in Community-of-Practice meetings in diverse settings, in and outside of Zimbabwe;
- co-development, discussions, and write-ups, continuously communicated in the community, who subsequently encouraged dissemination further afield (as, for instance, through this paper) and to audiences elsewhere;
- 7. being fully synchronised with relevant Zimbabwean authorities.

This paper draws from previous work in African settings and beyond Africa (in that sequence), both in literature and the experiences of implementing and reviewing eHealth and related activities in Zimbabwe over the last 15 years. Our speciality encompasses research in development studies, social anthropology, philosophy, culture studies and decoloniality. We deem the intersectionality of the lived experiences, and a quest with, in, and for theory allows participation while observing [6].

3 DATA, PLATFORMS, ALGORITHMS AND ICTS

Data-processing, technology-using industries purport their activities as a-political or a-historical: as purely *mechanical*. Nevertheless, these performances are political as the constitution and handling of data set in a particular set of ideologies and politics, and associated measures of success. The composition of data is set extraneously, like the data handling processes that are framed by foreign designs. The production of data and their computing is contingent on choices on what to include and what to omit. Technology producing companies embed decisions in their plans and choose what information to process and whatnot. In the current digital world, such choices appear to be made mostly made in the United States of America's Bay Area. That context is particularly blind to other forms of identity or culture than that are common in a dominant capitalistic, white, male, management class. The handling of data is subject to hegemonic master narratives, where the range of ideas tolerated in public discourse – known as the Overton window - is firmly centred along with neo-liberal ideas on wealth creation. These ideas inform government-policies to mainstream private market competition in an embrace of capricious capitalism.

From her investigative and autoethnographic research and intersectional critique, Safiya Noble [30] argues that algorithmically based digital platforms are reliant on broad cultural power dynamics. The result is algorithmic oppression. She convincedly makes the case that a single view on identity that fuels the design thinking of technology handling industries can result in material forms of abuse.

For the conceptualisations of data, contemporary narratives borrow words from natural phenomena. Such metaphors are attractive and go well in conversation. The nature of data is conceptualised as *flowing*. When assessing the magnitude of data – especially in big data – we *fathom depths*. And, the location of data is perceived as seated or gathering in *clouds*. Of course, these narratives frame – reify – the constitution of data and its existence, affecting the way of thinking, looking, and, subsequently, actions. In Africa, however, data does not flow proportionally because there are black holes in the information society [20]. The fathoming of big data is obsolete as most data is not harvested. Data-clouds do not gather because data centres are scarce. Some of the widely-used internet protocol implementations are unconducive for the transfer of data over huge distances [14].

Digital platforms are designed mechanisms for extracting and using data. They provide the architecture and infrastructure for digital intermediation between different groups of interlocutors. Platforms place themselves in a position in which they can monitor and obtain all the interactions between these groups. Platforms accumulate economic and political powers [36]. Dominant digital platforms rose from the opportunities of an unregulated World Wide Web and a libertine Internet [9]. After leaving developments to the private sector, large non-African companies claim to own the - mostly public-funded - knowledge and infrastructures. They seek to usurp and privatise the intellect developed in 'the commons' in areas such as agriculture, plants and food, financial methods of doing business, and on the algorithms that drive the digital revolution [26, 35]. The wholesome outsourcing of Africa's data to digital platforms governed outside of the African continent has already allowed for scandals like Cambridge Analytical. This company used data from Kenya as a laboratory for insidious political meddling, for instance, affecting the 2013 and 2017 presidential campaigns [17].

Algorithms are the hegemonic tools of quantification in societies [11]. The term algorithm applies to any sequence of actions that lead from inputs to outputs. Algorithms, however, are mostly known as (complex) mathematical functions that produce numbers that, presumably, are coherent with outcomes/scores/chances in a homogenised, contemporary society. These mathematical functions are inductive or reiterative, where computer programmers code Data Sovereignty: A Perspective From Zimbabwe

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algorithms, or where algorithms develop themselves, as through Machine Learning/Artificial Intelligence. The British mathematician Hanna Fry [10] argues that algorithms have four distinct functions:

- They prioritise, for instance, which posting is shown on the top of lists (for example, by Facebook);
- They classify, where, for example, potential criminals are identified in the general public (for example, face recognition at UK police, in Booth [5]);
- They associate, matching prospect products to your history (for instance, by Amazon);
- Filter, where specific patterns are filtered out for transfer of particular objects (for example, in noise-cancelling head-phones).

There is a wealth of evidence that suggests that these functions are biased to Western situations, and, therefore, are not informed by African settings. For instance, the faces of people of colour are not readily recognised [15]. Neither do search-results give references to contributions to the Body of Knowledge from Africa. From Africa, one is confronted with a persistent white-washing of the imaginary in digital platforms [1]. In combination, algorithms act as an integral part of a super-colonising toolbox for oppression [41].

Algorithms do make the (Western) news where they appear score individuals, for instance, in the social scoring of people for creditworthiness or criminality. The narrative of 'the surveillance society' is persistent and growing [47]. Issues of privacy are subject of debate, especially when algorithms score people upon their propensity of reaching a special status (as a defaulter or criminal, as per previous examples). Civil rights movements argue that these discussions are not thoroughgoing to capture the gist of what they should. In the meantime, government agencies appear to react irritated as algorithms are seen more and more as helpful in delivering on their mandate when viewed in the framing of sovereignty as a Responsibility-to-Protect [45].

4 THE SILENCING OF THE AFRICAN VOICE AND INTERESTS

The leaking of data from Africa does not feature on the global agenda. This appropriation of such an African resource by non-Africans can be regarded as an additional means of plunder from Africa [21, 37, 41]. This preying is somewhat shocking given that data security is a top priority in many parts of the Global North. Worse still, the African context for ICTs has got specific parameters that are mostly absent - neglected - in Euramerican literature. Why this is the case remains a cause of great concern and indeed, an issue that warrant careful examination. It underscores the skewed nature of global security. The master narrative emphasising the need to protect human security allows the global elite and neoimperial 'masters of data' to mine African data willy-nilly without paying regard to equity and security concerns of the people of Africa [12]. The critical question that arises here is "Why African security interests should be conflated with the security interests of rapacious global capital and elites, some of whom induce shocks that generate insecurities for Africans?" [29]. Here below, we provide some selected examples that are part of a long list of issues and reasons why African voices and interests around the question of data production and consumption matter:

- The non-conduciveness of (Western) technologies for general use in Africa, as the design neglect Africa's substantial *latencies, scarcity* of bandwidth leading to ubiquitous *congestion*, and the sumptuous *variety* of hard and software;
- The metaphysical and epistemological discordance of Western philosophy, for instance, with its anthropocentric focus on an individual instead of the African emphasis on community and communal expressions.
- The competing perspectives on any activities in Africa, for Africa, for instance, in the field of Digital Health.

In previous work, Mawere et al. [20] show the persistent existence of 'black holes' in the information society. Black holes are prevalent, especially in African environments where lack of electricity or internet connectivity is a common feature. Consistently, literature positions Africa as incapable. As an example stands the proclamation of The Economist [44] on its front cover: "Africa, a hopeless continent". In the academy, this master narrative is undergirded by writings of David Hume, Emmanuel Kant, Georg Hegel and Lévy-Bruhl, among others. This claim of inadequacy causes Africa to be vulnerable and, indeed, to be a subject for the surveillance society. Voices affirming African agency and its sovereignty on how to deal with data and the continent's other resources, with its choices of what data to produce, what data to process, and what data to omit, are positioned as 'in opposition of the greater good'. We argue that this positioning and characterisation is nothing other than nefarious overtures of the same force as the hegemonic overtures in colonial Africa. It is out of such realisation that demand for 'own sovereignty', for instance, done by the Office of the President of Tanzania, are framed as (geo-) political positions, opposing 'free flow of information', as proof of 'dictatorial tendencies' [8] that should chunked out of the continent once and for all. The prioritised agency of transnational cooperations to judge which characteristics are a suitable indication for categorisations can be likened to the prioritisations proposed by Western institutes in their self-appointed mission of 'civilising Africa'. One wonders how this can be possible and whether this is not an anomaly. Elsewhere, Mawere [18] questions the legitimacy of the West positioning itself to oversee the execution of democracy and institutions in an Africa which they once colonised. Concerning the practice of African Studies, Mawere argues that contributions remain suspicious as long as Africans do not lead such a field of enquiry. On the same note, we argue that as long as Africans do not administer the security of African data, then African sovereignty remains fragile. Given the issue above, the use of international digital platforms, therefore, surpasses problems of privacy and mistakes in the entry of data, or their handling, processing and analysis. We reiterate that these are nudging issues of sovereignty.

Algorithms can exist of mathematical calculations but also quantified behavioural observations, for instance, using swipe data, location data, sequence and timing of inputs. Due to the machinecomponent of digital platforms, algorithms assess using lines of computer-language. Here, 'if/then/else' or iterative 'for' statements feature for each variable used in the algorithm. In contemporary platforms, algorithms can be nested and assume complexities, much like the real-life, embedded and nested health systems. Algorithms, of course, are fruitful to sift through massive amounts of data. Such 'big data' analysis is crucial in complex systems like health systems. Real-life examples show that algorithms are upcoming in health analysis, for instance, in the assessments of tuberculosis in chest X-rays, or the assessment of moles for melanoma. However, the critical concern is that algorithms are potentially disruptive if practised outside the contextual cultural, moral and epistemological parameters of a people where they are deployed. An example is Google, who (mis-)scored flue-epidemics [16]. There is no knowing if these kinds of scorings did not continue, and the Snowden revelations [12] give ample indications that these might well be taking place.

5 DISCUSSION

In this paper, we grapple with the issues of positionality, choice and, poignantly, 'who benefits'. When reflecting on contemporary practices of digital platforms, we recognise an underlying ontological, political shaping of the digital world that disempowers African meaning-making and sovereignty. We agree with Sabelo Ndlovu-Gatsheni and Brilliant Mhlanga [28] that many of the attributes ascribed to 'Africa' are "rooted in Western modernity, a product of deliberate actions of Westerners and their ideologies of coloniality of power" (pp. 5). Africa's borders and contemporary essentialistic reductions of African achievements are cases in point. Throughout literature, (the use of) digital platforms appear set in a Euromerican narrative, void of African inputs. As a result, it is not surprising that when exploring data and technologies from an African positionality, the outcomes that are presented as authoritative knowledge appear to provide little embodied knowing. Embodied knowing - described through oratio - is a manner in which many in non-Western setting recognise information to exist [23]. This clash of paradigms is amplified by the forceful disposition of hegemonic, Western-based philosophies and the epistemic violence that goes with that. As a result, data, platforms and algorithms developed outside of African influence are potent actors in knowledge politics.

Annemarie Mol [25] positions *ontological politics* in the conditions of the possibilities one lives and how practices of interaction shape them. In a digital world, data-platforms and their (data extraction) facilities set the conditions. Aligned with the thinking of Catherine Boone [4] we argue that the operations of foreign digital platforms are, in effect, an importation of administrative ideologies and structures from super-colonial metropoles. These imports are sovereignty-disempowering in Africa. The hegemonic building blocks of the digital world, however, are not permanent and multiple realties do exist. To open the road towards data-sovereignty in Africa, active anthropologic research and technical developments must recognise local ontologies located in African philosophies. Such research can craft (the use of) technologies that make sense in African epistemologies, cf. [7].

The digitising world relies upon a rationalising – thinking in categorisations, processes and systems – of the social. This rationalisation involves negations of social values and moral argumentations [27]. For example, Ubuntu – a crystallisation of African philosophy, current in many African societies – stands against the capitalistic philosophy of competition, nor aligns with people being regarded individualists about which information can be gathered to 'define

the person' [22, 34]. Globally, platforms are at the forefront of 'the new revolutions', with the seats of Artificial Intelligence (AI) and the Internet-of-Things (IoT), the latest frontiers in software and hardware taking centre stage. The development of these platforms is driven in the West, and it is people located in the West that decide whether or not projects take place or shape (for an example in 5G mobile developments, see van Stam [38]). Most developments, therefore, can be seen as a political statement that should influence the (bilateral) relationships between Africans and non-African institutions (and countries).

The benefits of network effects, where the value of a network grows quadratically with the number of participants (Metcalfe's law), have led to some digital platforms acquire state-like characteristics. They govern their digital domain through state-like means of punishment and reward, adjudication of disputes, and moderation of content. Subsequently, these digital platforms engage in statelike negotiations (e.g. Facebook's proposed introduction of Libra currency). These positions are based upon the privatisation of semiautomatically captured data. This capturing is negotiated, executed and monitored for contractual and legal compliance that is based upon norms and values mostly foreign to many African communities. US-centric standards, corporate responsibilities, the primacy of 'markets', and, most significantly, an unapologetic profit-motive govern the modelling of leading, contemporary digital platforms. Such motives are contrary to the 'modern' gospel of human security and freedom often preached by the Global North. That narrative appears to invoke the same innuendoes as those cited by colonialism. No wonder Kwasi Wiredu [46] argues thus: "We live in times marked by a certain [...] anomaly in a cultural flux characterised by a confused interplay between an indigenous cultural heritage and foreign cultural legacy of a colonial origin. Implicated at the deepest reaches of this cultural amalgam is the superimposition of Western conceptions of the good upon African thought and conduct." The statements by Wiredu are critical in this digital age. The data extraction by commercial, opaque transnational companies and non-accountable non-African institutions from African environments seems to be threatening sovereignties in the African continent. These statements by a respected African, thus, challenge us to re-imagine and rethink data mining in Africa by outsiders, to make sure that it is not "part of the colonial legacy exerted towards plundering, siphoning and expatriation of African riches" [19].

As the custodian data on health for the people of Zimbabwe, the Ministry of Health and Child Care in Zimbabwe is to harness whatever is at its disposal within precincts and dictates of the laws of Zimbabwe. Transnational companies, however, are not bound to such requirements, which then raises many questions about data sovereignty. We note that even public global institutes like the World Health Organisation (WHO) has fallen prey to transferring data supplied by sovereign states to US-based digital platforms [2]. This outsourcing is unacceptable practice if issues of personal and national data sovereignty and security as well as ethics are to be taken into account. Information-sharing arrangements between platform conglomerates and the government of their jurisdiction facilitate wholesale surveillance, bypassing constitutional constraints [33]. International corporate platforms are profit-seeking entities. The acceptance of their operations depends on a narrative of public authority, as said, having gained geopolitical influence comparable

to states. Geopolitical practices, for instance, summons for discussions in the European parliament, show how the involvement of digital platform operators is considered necessary in talks on sovereignty. Platforms can pursue (geo-)political goals. And, although public platforms argue that the involvement of 'human in the loop' should avoid unethical behaviour, such a human is mostly not – if ever – located in an African country, nor accountable to African sovereignties. Therefore, the 'human in the loop', for instance in the case of WHO's outsourcing of national health data to calculations performed on digital platforms the USA, is compromising data sovereignty. Of course, Zimbabwe, as most – if not all – African countries lack the leverage to impose regulations on most powerful digital platforms.

From the precept of sovereignty, one must recognise the existence of choices to be made by Africans. From her studies, the previously cited Safiya Noble [30] advocated "I am trying to make the case, through mounting evidence, that unregulated digital platforms cause harm" (page 166). The contemporary situation grew from super-colonial behaviours, through imports from outside African sovereignties and, therefore, is a product of history. In a decolonised setting, where a focus on community is prime, alternatives do prevail. These alternatives, of course, come with specific interferences. However, current norms and values in the discourse surrounding digital platforms are overtly Euramerica-centric. As mentioned, contemporary, hegemonic data-platforms engage in a privatisation of the commons. The results of data machinations are positioned as private property instead of a public good. The balancing of all goods and bads involved in the production of data and its manipulation in digital platforms is complicated and needs simultaneous balancing of national, sovereign priorities (in local development, for instance). With this paper, we call for facing these issues and running the gauntlet from a position of African agency.

Data sovereignty is the concept that digital data is subject to the laws of the country in which it is processed. In this paper, we argue, however, that this understanding of data sovereignty is narrow as it excludes other stages through which data pass through. We, instead, stress that data sovereignty concerns that digital data is subject not only to the laws of the country in which information is processed, but also where they originate and are ultimately used. Colonial history provides ample examples of how external categorisation, analysis, measurements, and systems can result in cruel and barbaric effects.

Technological sovereignty features need ongoing, sovereign assessment and the sovereign handling of its political aspects. An example is the existence of back doors for the National Security Agency (NSA) to assess the content of data stored in digital platforms located in the USA [12]. There is a need for the development of strategic options that align with the norms and values, local principles, and moral arguments current in African communities. A conversation is needed on the use of digital platforms, public and private registers, and information flows to the national government(s). The handling of data profiles and the processes of their computing can be embedded in national consensus first, and international consensus second. Information and communications infrastructure and technology are subject to the laws, needs and interests of the country in which producers and users reside. In this regard, data sovereignty or information sovereignty sometimes overlaps with technological sovereignty. Their distinctions are not clear cut. Technological sovereignty also refers to the subjection of information to the laws of the country in which the data subject is a citizen, where the information is stored or flows.

With a few notable exceptions as, for instance, Tanzania, an African timidity in confronting the onslaught on its data and technological sovereignties can be linked to the "Westphalian 'curse' and worship [of] the 'old ghost' of Berlin that opposed any radial potential to alter the post-colonial spatial order inherited from colonialism." [28]. When adhering to the principles of Ubuntu, the goal is not technological protectionism but a convivial sharing of resources. However, a blind following of the abstractions coming from mesmerising, Euramerican-centric computer science or other sciences with that single orientation should be avoided. Sovereignty necessitates countries and communities to retain the powers on their societal developments. It requires conversation on what is considered ethical behaviour (ubuntu), and negotiations on what is happening with local information, whether or not in digital formats.

EU's General Data Protection Regulation (GDPR, article 22), in force since 2018, mandates a 'right to explanation' of all decisions made by automated/AI systems. This duty is borne by data controllers (i.e. any persons who determine the purposes and means of the processing of personal data). This example vindicates the need for all outsiders interested in fishing data from countries like Zimbabwe to explain in full their motivations and the machinery involved. Fulfilling the demands for stewardship in Zimbabwe, there is a need to validate national sovereignty over data that is mined within the confines of the boundaries of African states. This validation includes, for instance, digital platforms and technologies used in the health sector. For the case of Zimbabwe, this means that:

- There is a need for a mind-change in the current relying on foreign developed or based digital platforms and depending on their processing of data;
- 2. The scoring-algorithms performed on data in digital platforms must be subject to scrutiny and public oversight;
- Scrutiny of the need for the harvesting of data from Zimbabwe, to demand keeping Zimbabwean data in Zimbabwean locations and to be used for local use in national value systems;
- 4. There is need for 'certification of algorithms' that serve authoritative functions in public institutes, for instance, in public health;
- 5. There is need for international laws that maintain the sovereignty of data generated in a country regardless of where said data is located to mitigate the issue of foreign platforms.

The processes for data being 'fished' or taken out of Zimbabwe are to be scrutinised for their implications from the cultural, epistemological, moral and security perspectives.

6 CONCLUSIONS

We are living in the age of data platforms that, we have shown in this paper, harvest and extract information on individuals, communities, and their respective geographies. This harvesting happens without much regards to the sovereignties of Africans. In the face of global concerns on issues of national and human security, data

mining invokes a lot of questions surrounding the critical issue of data sovereignty, especially when extended to once colonised nations such as those of Africa. The current Western nurturing of digital platforms necessitate critical academic scrutiny from a variety of philosophies. The necessity to unthink the soothing narratives utilised in super-colonial practices, set in paradigms rooted in Westphalian thought, is crucial to expose the colonial impositions and an 'Africa failing' tale. It is in this light that we have sought to examine the intricacies and implications surrounding data sovereignty and how these could be navigated and dealt with in a manner that does not invoke memories of imperial exploits.

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Data Sovereignty: A Perspective From Zimbabwe

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Mr. Meteo: Providing Climate Information for the Unconnected

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ABSTRACT

A majority of the world remain unconnected to the World Wide Web due to issues like low literacy and relevant information. This study presents Mr. Meteo, a system that provides weather information via voice calls in local languages to rural farmers in Ghana. The study used an interdisciplinary approach to identify relevant informational needs and socio-economic implications, and early end-user and stakeholder involvement. Mr. Meteo was deployed in Bolgatanga, Ghana and represents a novel design in terms of actual web data access to rural areas. The positive feedback from farmers, and stakeholder's interest in continuity, shows this approach to be an appropriate method of development and implementation of information systems for rural areas; successful due to end-user and stakeholder involvement, focus on existing technologies, the use of voice technologies to mitigate the problem of illiteracy, and information relevance to end-users. This paper presents the methodology and results of this novel, practical, local-context ICT4D project, that has produced a viable information system for rural communities.

CCS CONCEPTS

• Information systems → Multimedia content creation; • Hardware → Hardware reliability; • Software and its engineering → Software development methods; Software prototyping; Collaboration in software development;

KEYWORDS

Web Access, Digital Divide, Interdisciplinarity, Literacy, Voice Technologies, Climate Change, Sub-Saharan Africa

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© 2020 Copyright held by the owner/author(s). Publication rights licensed to ACM. ACM ISBN 978-1-4503-7994-6/20/07...\$15.00 https://doi.org/10.1145/3394332.3402824 **1** INTRODUCTION

1.1 Digital Divide

In the past 28 years, the World Wide Web has greatly changed the way the world communicates and has metamorphosized the various aspects of life that are directly or remotely connected to it. The concept of a global village has been aided by the effective communication and access to information that the World Wide Web has provided. The problem remains however, that a large population of the world remain unconnected to the World Wide Web (even remotely). A United Nations report [1] in 2017 shows that of the 7.6 billion people in the world, 3.58 billion (48%) are using the internet. Admittedly, this is a step up from the previous year's value of 45.9 percent, however, certain regions retain very high numbers of unconnected. Only 39.4% of Africans are connected to the internet; meaning about 800 Million Africans have no internet access. In addition, there is an added disparity in gender access in developing countries, especially Africa [15]. The reasons;

1.1.1 Lack of Infrastructure. The lack of adequate infrastructure in Sub-Saharan African countries plays a major role in the issue of connectivity for the unconnected. Admittedly, some systems exist and work well to some extent in certain countries, however, there is an internal urban-rural divide which means even further deterioration of services in the rural areas [3]. This is clearly seen in the areas of electricity and internet connectivity which are less available and reliable in rural communities as opposed to urban communities [4].

1.1.2 Affordability. Regardless of infrastructural problems, there are systems that work and are available, if not fully reliable. In Ghana, voice and internet services have national-wide coverage [5], but the cost of hardware required to access some of these services (mainly internet) and the cost of services, remain unaffordable to many in both rural and urban areas. As such, these technically feasible services remain financially unfeasible [4].

1.1.3 *Literacy.* The issue of literacy remains a barrier to the delivery of information in the current World Wide Web formats. Ghana has a literacy rate of 76.67% ¹. However, the rural north, which happens to be a major food source for the country, has its literacy rate lower than 30% ²[6]. Currently 80 percent of online content is available in only 10 languages, which only around 3 billion people

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¹https://data.worldbank.org/

²https://uil.unesco.org/

speak as their first language [7]. In addition, information available online is heavily biased towards text and thereby discriminates against those who cannot read and write [4].

1.1.4 Relevant Content. The literate, avid internet user does not require (and mostly does not seek out) random information that is irrelevant to their livelihood. A major barrier to connecting the unconnected has been that they do not find the information, even if available, to be locally relevant enough to warrant the effort to gain access to it [2]. The availability of information relevant to the livelihood of the end-user is a viable incentive to get connected.

1.2 Climate Change

An example of possible relevant information is climate and weather information. This is because there has been overwhelming evidence of climate change in recent years; increasing global temperatures, rising sea levels, increased ocean acidity and increase in extreme natural events are but a few obvious indicators [8]. Moreover, local farmers are aware of climate change and have attested to the need for modern scientific knowledge to augment their indigenous climate knowledge [9]. In Ghana, fairly accurate seasonal (regional) rainfall forecast is available from the National Meteorological Services ³ mostly online and during Television Weather Reports (in English). Less accurate, but usable daily and weekly local forecasts are also available through a combination of satellite data and local weather stations which feed open weather sources online. This information however, hardly ever reaches rural farmers.

1.3 ICT4D 3.0

Developing ICT systems in low-resource environments requires a vastly different approach from the methodology utilized in high-resource environments. Known issues (see Section 1.1, 1.2) combined with unknown contextual issues regularly result in unsuccessful ICT4D deployments. Design shortcomings in numerous ICT4D systems leads to delays, high rates of project extension and restructuring, and high failure rates [10]. This study presents a novel, practical, on-the-ground application of an iterative, adaptive and collaborative field research methodology (dubbed ICT4D 3.0) [4].

2 PURPOSE OF STUDY

We know ICTs can make an impact in access to information [2], however, clear cases of development methodologies are still lacking. The purpose of this study is to do exactly that; implementing an earlier developed methodology (ICT4D 3.0) [4] in a case study.

This research answers the question of how ICTs can provide rural communities in developing countries with regular access to up-todate information, from the world wide web, peers or organizations?

- Considering the level of infrastructure in these rural areas, what ICTs are feasible and what are the implications of the disruption that may result from the introduction of these technologies?
- How can we technically influence affordability and financial sustainability of the system?

- What are the methods of determining relevant information for these communities?
- What measures can be taken to circumvent the issue of illiteracy in the delivery of information?
- How can these systems be maintained and further developed within the local context?

These questions are answered by presenting a novel, practical, real-world, local-context use of appropriate ICT4D methodology, that has produced a viable information delivery system for rural communities.

3 METHODOLOGY

This study used a collaborative, adaptive and iterative methodology (see Figure 1) to identify and tackle the issues from a sociotechnical standpoint [4]. The methodology works iteratively to gain an in-depth understanding of the context from the end-user and stakeholder perspective, elicit and assess their needs vis-a-vis the available technologies and possible ICT solutions, build a specific use-case with its functional and non-functional requirements, assess the financial sustainability of the project with design adaptations (where possible) to mitigate any financial issues, and finally build and deploy with evaluations that are iterative.



Figure 1: ICT4D Methodology [4]

3.1 Research Area

The research focuses on Northern Ghana which covers about 40% (97,000Km2) of the nation's surface area). It has a total population of 5 Million and by contrast has a far lower literacy rate compared to the national rate (see Section 1.1.3). This area is selected for our case studies because its rural areas fit the targeted group; being an agriculture-production region, having impact on the nation's food security, but being more deprived of infrastructure, and with higher illiteracy rates.

3.2 Context Analysis and Needs Assessment

3.2.1 An Interdisciplinary Approach. Contextual information was initially obtained from a collaborative workshop, ICT for Food and

³https://www.meteo.gov.gh/gmet/

Water in Ghana - Collaborative Research by VUA and UDS, which was organized in Walewale, Ghana by Vrije Universiteit's Web Alliance for Regreening Africa (W4RA) team, together with a team of researchers from the University for Development Studies, Tamale, Ghana. The team consisted of a multi-disciplinary group of experts in rural economics, animal science, tropical agronomy, irrigation, microfinance, sustainable land management, gender, value chain development and ICT4D. With some existing work (notably among these being the Digivet Animal-Health Application [11]) as guidelines, the workshop brainstormed around the various technological possibilities for information delivery systems related to food and water security. Subsequently, the Savanna Agricultural Research Institute (SARI), located in Tamale, Ghana, which is working directly with local farmers in the region, provided further insight in the areas of meteorology; the local outlook and understanding of climatic conditions, and communication; language and information dissemination in the local context.

3.2.2 An adapted Living Labs Approach. The above-mentioned workshop in Walewale, Ghana, which formed the starting point of this study, took on an adapted Living Labs approach and accordingly included end-user involvement from the get-go. Workshop participants visited Guabuliga, east of Walewale, a community of about 2000 inhabitants who live from rain-fed agriculture and livestock, where the discussion continued with the inclusion of 50 to 60 members of the community. The idea of the Mr. Meteo application originated from the rural community during this focus group discussion. Upon giving a general overview of the possibility of information being sent to them, climate information was mentioned specifically and they indicated that this was because climatic conditions had changed from the norm over the years. Subsequently, climate information had been a recurring theme in most communities thus leading to the creation of Mr. Meteo as a use case for providing information to the unconnected.

3.3 Use-Case and Requirement Analysis

As an understanding of the context began to form, the authors began to elicit stakeholders and end-users on the needs of the system, in an iterative fashion. An assessment of the local infrastructure, by field visits and interviews with SARI and other organization, pointed to the unavailability and/or unreliability of certain ICTs that could have been in consideration. Internet access in the rural areas of the northern sector of Ghana were found to be unreliable at best and often slow or unavailable. In contrast, mobile telephony and radio reception was found to be available and more reliable. In addition, all end-users owned or had access to a mobile phone (Ghana has a mobile penetration of 130.9%, [12] owing to the fact that a sizable number of people have more that one phone or use multiple sims on one phone). Other research has found very little to no use of SMS and little to no use of smartphones in the rural areas of northern Ghana [6]. These findings have been further verified during this study. Further assessment of the issue of literacy revealed that, endusers would be open to voice-based information delivered in their own local languages.

3.3.1 Key Idea. An analysis of the above resulted in fine-tuned key idea - To build a system that provides weather information via voice

prompts in local languages over voice calls to rural communities in northern Ghana. Members of rural communities will be able to call in to a local mobile number, upon which the system will answer and read out the weather forecast in their own local language (see Figure 2).



Figure 2: Sketch of Intended System

3.3.2 Actors and Goals.

ID	Actor	Description
1	User	Call phone number to get weather forecast
2	Weather Source	Relay Weather Forecasts
3	NGO/Company	Manage Users
4	NGO/Company	Record Voice Fragments for new languages
5	Support	Monitor system; maintenance

3.3.3 Key Requirements. Following information obtained from rural communities as well as considering the technologies available, the following are the key requirements of the system;

Must Have

- Weather forecast source
- Interactive Voice Response (IVR)
- Local Language(s)
- Regular Weather Updates
- Storm Alerts

Should Have

- Temperature data
- Wind speed data

Could Have

- Subscription-based service
- Short-Range Radio (FM) Transmission of information

3.3.4 Non-Functional Requirements.

- Maintainability Local developers should have the ability to maintain, adapt and replicate the system with relative ease.
- Availability Users must have the ability to reach the system. As such, barring mobile network issues, the system must be hosted on a platform that will be available at all times.
- Scalability The system must have the ability to scale to different locations and for any number of subscribers.

- Reliability The system must ensure that forecasts are as accurate as possible.
- Usability The targeted user group creates a requirement of simplicity in the user interface
- Cost-Effectiveness The whole system must work together to be financially sustainable

3.4 Feasibility and Sustainability Assessment

The feasibility and sustainability of the system is assessed by considering the technical and business/socio-economic feasibility as well as possible goal conflicts, dependencies and preconditions required for the system to function as a whole [4]. These issues were discussed in interviews with stakeholders at various levels of the study. Technically, the simplistic nature of the design makes Mr. Meteo feasible. The design focuses on affordable hardware, opensource software and does not require additional technical purchases and/or skills from the end-users. Socio-economically, discussions with stakeholders has shown that effective information flow, to and from rural communities has been an ongoing struggle and therefore this provides them with a way of not only saving time, but also delivering information they would have hitherto not been able to. Grandiose systems, like large radio transmitters, often become a financial sink and render most deployments financially unsustainable. Mr. Meteo therefore uses low-cost hardware and open-source software (see Section 3.5.1). Preconditions for the system to work include hosting capabilities required from stakeholders. These capabilities include basically power supply, internet access and access to local telephone network. The end-users are required to have a mobile phone. These preconditions and all dependencies were met and there were no goal conflicts.

3.5 Development and Testing



Figure 3: Kasadaka Hardware

3.5.1 Kasadaka. Mr. Meteo is built on the Kasadaka Platform [13] [14]. The Kasadaka ("talking box" in a number of Ghanaian languages), enables the development and hosting of voice-based information services, targeted at rural sub-Saharan communities. The hardware and software of the platform are catered to the specific contextual requirements as found in these areas. The hardware forming the foundation of the KasaDaka platform is the Raspberry Pi (see Figure 3), which is a low-resource computer based on an

ARM processor. The Raspberry Pi runs a Debian-based Linux distribution. To provide the Raspberry Pi with connectivity to the local mobile phone network, a USB 3G modem is used. The total costs of the hardware is around \$70. The Kasadaka runs a stack of applications that provide the different functions that are required for voice-based interactions. Asterisk, an open-source telephony exchange application is used in conjunction with chan_dongle (an interface to phone modems) and VXI (a VoiceXML interpreter), to provide the voice-based interactions through the local GSM network. [13]

3.5.2 Development and Testing. The system was built on the Kasadaka in Tamale, Ghana in collaboration with Cowtribe ⁴, a company that provides veterinary services with the use of ICT-driven technologies. Audio fragments were recorded locally (in Gurune, the



Figure 4: UML Sequence Diagram - Weather Information Update

major language in Bolgatanga, Ghana, for which no Text-to-Speech (TTS) nor Automatic Speech Recognition (ASR) exists), and sent to Tamale where it was converted to the appropriate formats and integrated into Kasadaka. Fragments to support an additional language (Dagbani, also with no TTS and ASR) were recorded in Tamale, to provide a control test case and proof of scalability in terms of language. The structure of the Mr. Meteo application is set up in a way that welcomes the user to the service and then proceeds to the weather forecast for the current day as well as the subsequent day. A total of roughly 5 hours (excluding the time for recording voice fragments) was needed to completely setup the system. The resulting system was deployed and evaluated in several iterations, using a local Ghanaian Network Provider (MTN) and soliciting feedback from Cowtribe, SARI and selected participants. The system is setup to retrieve data (see Figure 4) from Darksky Weather API⁵ for the specific GPS Coordinates (retrieved at the community and verified on Google Maps). Parsing of the data indicates which

4https://www.cowtribe.com/

⁵https://darksky.net/

²³

voice fragments should be accessed during calls into the system. When a user calls in (see Figure 5), Mr. Meteo automatically picks the call and immediately plays a welcome message followed by the predetermined voice fragments. To aid simplicity and in accordance with the particular context, user input is not required for receiving weather information (e.g. for language selection), since all callers to the specific system speak the same language.



Figure 5: UML Sequence Diagram - Call Management

3.5.3 Challenges. Internet access, which is not always available and reliable was sometimes an issue during testing and could be a challenge with subsequent regular use by end-users. A solution to mitigate this was to always retrieve a 7-day forecast (the system provides end-users with a 2-day forecast). This provides a backlog of data in the event the system is unable to reach the internet. Future plans to solve this challenge also include working on alternative means of data transfer to the Kasadaka (e.g. SMS). A major challenge faced involved the availability and readiness of stakeholders and organizations for field tests, workshops and interviews. Budget cuts, unforeseen changes in planning and busy schedules were among the few barriers faced by stakeholders and organizations that contributed to a slower development cycle than expected. A solution to this challenge in this study was to collaborate with a number of stakeholders so as to enable continued work in the event that any organizations had setbacks.

4 DEPLOYMENT AND RESULTS

Mr. Meteo was piloted to a group of 50 farmers from 4 communities in Bolgatanga in the Upper East Region of Ghana in collaboration with Cowtribe during one of their regular field visits. Due to the wide distances between communities, Cowtribe collaborated with partners in Bolgatanga to have farmers transported to a central location from the 4 communities. Farmers came along with their animals for veterinary tagging. The study used a semi-structured focus group discussion before and after the introduction of the system. It was found that 100% of farmers owned their own mobile phones and used them regularly to make calls of which more than 50% were said to be related to farming and livelihood. In contrast, none of the farmers used the SMS features on their phones, although they are all aware of the function. Additionally, all farmers owned (or has access to) a radio set. Farmers needed little introduction to the system, since Cowtribe has existing mobile-based communication systems for farmers albeit manual and expensive to maintain, and more importantly, farmers' view were previously solicited during the design phase. Farmers tested the system by calling into the phone number; those who did not call personally, listened in on others' calls. A focus group discussion and some individual interviews with farmers and members of Cowtribe was held afterwards to ascertain the success of the pilot and to receive feedback on usability and any possible concerns.

4.1 General Impressions

Due to the methodology used in this study (which involved endusers and stakeholders), it was expected that the general impression of the finished system would be positive. This was the case, with there being enthusiastic reception of Mr. Meteo by both farmer and stakeholders.

4.2 Stakeholders Perspective

Cowtribe found the system to be "innovative and needed". The company was eager during the development period and contributed immensely to its success. Cowtribe is also eager to scale up the system in terms of additional languages for other communities, other relevant content (being a veterinary-centered company, they are also interested in information pertaining to animal health) and a future plugin system related to community (Ham) radio transmission (see Section 6).

4.3 Farmers Perspective

100% of farmers gave positive feedback on what they thought of Mr. Meteo. Most considered the system to be "good" and "helpful" and at least 90% indicated that it is a system they would use regularly with the rest indicating that they would be less inclined to use it during the middle of the dry season, but more towards the end (to know when the rains would start) and during the rainy season (as expected; to know the trend of the rains). In terms of cost implications, about 90% of farmers interviewed are willing and able to make calls into the system to retrieve weather information, however a few showed reluctance due to the cost of calling in. Furthermore, some farmers suggested a subscription-based service. Farmers also indicated that they would also be interested in information like disease outbreaks, human and animal health, farming practices and information on their children's schooling.

5 CONCLUSION

5.1 Infrastructure

Infrastructure in the rural areas of Ghana are lacking, but there are ICTs that are available, reliable and in use; namely radio and mobile telephony. This study focused on these available technologies as opposed to the introduction of new infrastructure which results in expensive and extremely disruptive implementations. The focus on technologies already in use resulted in lower cost of implementation and being more acceptable by the rural farmers.

5.2 Affordability

In addition, the study utilized the Kasadaka; low-cost hardware with open-source software, to implement the system. This resulted in a low-cost system that was feasible to deploy and will be financially sustainable in terms of maintenance and usage costs. Cowtribe and SARI are interested in scaling up of the system, and this is partially due to the fact that scalability has been made feasible due to the affordability of the hardware and low running costs.

5.3 Relevant Information

Determining relevant information for dissemination can be erroneously assumed to be trivial. Lessons from this study shows that an iterative, adaptive and collaborative field research methodology with early involvement of end-users provides a great determinant of what information may be deemed relevant to rural communities. Stakeholders indicated that adoption of these systems by the endusers can rely heavily on this and as such, as learnt from this study, should be considered a top priority.

5.4 Literacy

With regards to illiteracy, the study found the use of text-based systems not feasible in the context of rural northern Ghana, where people are unable to read and write. The ready adoption of mobile telephony and the pre-existing oral-based communication culture informed the use of a voice-based system. The added value of utilizing local languages merged to circumvent the issue to illiteracy. Granted, this presented an increased complexity due to the need of translations and language recordings, which is not always trivial; technical words and numbering systems are often somewhat problematic to handle although feasible in the long run.

6 FUTURE WORK

The continued development and scaling up of Mr. Meteo are considered imperative for all stakeholders. In the spirit of the iterative nature of our design methodology, the results of this study will form the basis for further development. In collaboration with Cowtribe and SARI, the current system will be expanded in terms of language and reach. Additional hardware will be procured to enable the system reach more communities and also deployed to regions that speak other languages. In addition, Cowtribe will like to explore the build of a system around the same design to, alongside climate information, facilitate the dissemination of veterinary-based information to aid animal farmers in rural communities. Another future modification is the transmission of pre-recorded audio over FM frequency using the Raspberry Pi. The general concept is to setup a device within a community, utilize Kasadaka to call as admin and leave recorded messages which the system will then transmit over a pre-determined FM frequency. This will be useful for delivering variable information which may have been hitherto cumbersome to create pre-existing voice fragments for (e.g. Mr. Meteo - Seasonal Forecasts, Disease Outbreaks, Other alerts) In addition, use cases that only require concatenation of pre-existing voice fragments (e.g. Mr. Meteo -Daily Updates) can also be triggered by SMS containing code for the required concatenation. This implementation (dubbed RadioNet) has already taken place in conjunction with SARI and The Internet Society 6

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Digitalised Welfare: Systems For Both Seeing and Working With Mess

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ABSTRACT

Digital welfare does not operate in a vacuum, but rather transforms non-digital and unofficial spaces of welfare provision. The digitalisation of welfare occludes the complex reality of poverty and erects digital barriers to accessing welfare. Digitalised welfare has not abolished face-to-face support, but has relocated it to unofficial sites of welfare. The apparent efficiency and simplicity of the state's digital welfare apparatus, therefore, is produced not by reducing the 'messiness' of welfare, but by rendering it invisible within the digital framework. In this paper we compare two approaches to welfare digitalisation and identify three considerations for welfare service design that might reduce the digital barriers, re-build a sense of self-efficacy and increase service accessibility and inclusion.

CCS CONCEPTS

• Human-centered computing → User studies.

KEYWORDS

welfare, digitalisation, food bank, universal credit

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1 INTRODUCTION

The 'Digital by Default' strategy set out to move public service delivery online and make digital interfaces a core means of interaction between people and the state. From the beginning, the strategy was intended to raise the quality of service, *and* to reduce the public deficit [29]. Digitalisation squared the circle of improving government services while cutting budgets. Universal Credit, the UK's digitalised welfare system designed to simplify the welfare system by combining many payments into one and to incentivise graduation into paid employment, reflects these twin priorities. Universal Credit has come under extensive criticism for failing to meet either of these goals. On the one hand, costs appear to have spiralled [33]

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and on the other, the implementation of Universal Credit has potentially raised the barriers and challenges to accessing the system and made it harder for individuals to obtain benefits to which they are entitled. For example, in May of 2019, the British newspaper the *Observer* reported that over a million households - roughly 60% of all claimants - were receiving less than their full entitlement [22]. These negative outcomes have increased the need for more informal local welfare spaces located in community centres, food banks and churches.

This paper presents two ways in which welfare has been digitalised in the UK. We compare the centralised digital system of Universal Credit with a local semi-digitalised provision of food banks and identify three considerations for welfare service design that might reduce the digital barriers, rebuild a sense of self-efficacy and increase service accessibility and inclusion.

2 RELATED LITERATURE

The digitalisation of welfare, and in particular the creation of digital interfaces for the access of welfare, raises concerns about the creation or exacerbation of 'digital divides'. Digital inclusion is not simply a question of digital resource distribution but also of whether this resource can be effectively used by such individuals, who risk becoming an excluded digital underclass [21, 25, 26]. Alston [3, p.13] highlights "the least well off are far more likely to be severely disadvantaged by out of date equipment and time-consuming and unreliable digital connections". Digitalised welfare demands 'self-efficacy' to independently manage access to systems, processing complex information and making decisions as to what and how to communicate with the state. Poverty often undermines that self-efficacy. Firstly, poverty manifests in complicated ways which individuals often find difficult to render 'legible'' to the service, or evidence digitally. Secondly, poverty is psychologically exhausting. One study found that just imagining financial stress " had the effect of making [individuals'] IQ drop by between 13 and 14 per cent. That is the same impact as going without a night's sleep" ([28] as quoted in [24]). Moving away from face-to-face interaction and human relationships in welfare service delivery towards digital interactions exacerbates both effects, at the same time rendering the needs of claimants invisible to the system [20].

Scholarship highlights how digital exclusion thereby reinforces multiple dimensions of existing social inequalities [37]. For example, Watling [44] and Easton [13] have explored inclusion and exclusion within digitalised welfare, noting social resources are essential - yet often overlooked - assets in the long-term success of technology. Watling [44] noted that the government's promise that "no one will be left behind [in digitalisation] runs contrary to the reality for those already alienated from virtual lifestyles." In ICT4D

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literature Kleine [23] and Oosterlaken [34] advocate a capabilities approach to this challenge that examines the broader informational, technological, and *relational* (i.e. social) capabilities that underpin the use of technology.

2.1 The Digital in Universal Credit

In 2018, UN Special Rapporteur on Extreme Poverty and Human Rights Philip Alston led a team to examine extreme poverty in the UK. The study report described digitising welfare as a "*nationwide digital experiment*"upon the "*most vulnerable*" in society [2, p.7]. The Good Things Foundation, a British digital inclusion charity, described in their testimony to this UN study [15] the range of such barriers, including: technical errors in the application process resulting in delayed payment, a lack of the digital footprint to use the verification system, GOV.UK Verify, and missing communications from the welfare providers.

Digitalisation has not only changed the method of welfare delivery but has also substantively changed the *content* of welfare delivery. The delivery of Universal Credit incorporates automatic Risk-Based Verification (RBV) which assigns claims a probability of being fraudulent, and so-identified low-risk claims are fast-tracked, with greater attention being given to 'riskier' cases [11]. RBV collects data from a variety of digitalised sources. For example, the UK's tax authority's, (HMRC), Real Time Information (RTI) system supplies details of income tax payments, and those who are claiming welfare through Universal Credit but who are also in work have their welfare payment automatically adjusted accordingly. RTI also identifies people who have not declared (or have underdeclared) income from earnings or pension payments, and reports from landlords and partners about claimants budgeting and digital skills [11].

The digitalisation of welfare also provides the opportunity for a more strict delivery of the conditions under which welfare is accessed and provided. Social researcher, Pantazis, [36] suggests that the 'racheting up of conditionality' in Universal Credit stems from the assumption that 'jobs existed if only people could be bothered to actively look for them,' positioning low-paid work as simply a 'bad choice'. However, digital design is key to the bread and butter of access: claimants are required to upload specific forms of data to demonstrate compliance with the conditions of welfare payment, digital checking of data determines how claims are processed and sanctions imposed. In turn, that design embeds values, conceptual categories, and normative judgements in ostensibly 'technical' detail: for example, RBV and identity checks reflect a very particular image of what claimants are like, what they might do, and what needs to be done to encourage them into behaving as the system intends.

2.2 Food Banks

In contrast to the national centralised structure of Universal Credit, food banks in Britain are decentralised and local. In 2019 there were some 2,000 food banks in the UK, of which over 600 were independent of even the loose coordinating structure of the Trussell Network [14]. Food banks work in particular communities and areas and claimants interact with food bank staff face-to-face and use digitalisation for its administration and outreach. Although formally separate from the state, they are a vital component of the social system, more broadly conceived, for the amelioration of destitution. For this reason they can be conceived of as a distantbut-vital branch of the 'shadow' or 'hidden' welfare state [17, 19].

Food banks provide emergency food to those identified as at risk of 'food poverty'.¹ There is an emerging scholarly consensus that the implementation of Universal Credit has led to a steep rise in food banks [7, 10, 16, 46]. In 2017, the Trussell Trust & the University of Oxford, published a report which concluded that food bank users are those "who have been most affected by recent welfare reforms," particularly those with disabilities, single parents, and large family households [27, pVII]. In a further report, the Trust found 30% increase in food bank referrals where Universal Credit has been rolled out for at least 12 months" [1, p.5], and attributed much of this was due to the five-week waiting period that Universal Credit imposes. Only 37% of their sample waited for their Universal Credit payment for six weeks or less but 20% waited for 7 to 12 weeks, and 8% for 13 weeks or more. One respondent commented "I have been waiting four weeks for one payment of benefit for food without the food bank I would literally starve" [1, p.7].

Sanctions² are a key cause of food poverty. The Child Poverty Action Group's report [38] on understanding food banks, affiliated with Oxfam GB and the Trussell Trust, found that 20-30% of their sample said that their "household's benefits had recently been stopped or reduced because of a sanction" [38, p.10]. Indeed, food banks and other charitable groups note that "systemic reform [...] is needed to stop families falling into the hunger trap" [46].

As Garthwaite [16, p.35] notes, there is a "substantial lack of awareness of how food banks actually work and what it is they do," and that contrary to popular belief, claimants cannot simply walk into a food bank to collect food. Rather, once the food bank has received donations from the public, volunteers assist in sorting and storing food. If a person is in need of emergency food, they are assessed by front line professionals (for instance, GPs, probation officers or Citizens Advice Bureau workers) and given vouchers which are taken to a food bank to be redeemed for three days emergency food.

The insecurity that leads people to food banks has a detrimental impact on mental and physical health. Thompson et al [42] find that food poverty exacerbates existing health problems and causes new ones, particularly in terms of "providing adequate care and nutrition to children," due to the "lack of access to adequate fresh food, food storage and cooking facilities." It is these levels of deprivation that further make difficult the complex decision making needed for successfully accessing digital systems by depleting levels of self-efficacy and confidence [9].

3 RESEARCH AND METHODS

To examine the interaction between centralised welfare provision and local welfare provision, we spent time in food banks and community kitchens over a month-long period at the following sites:

¹The Department of Health defines food poverty as 'The inability to afford, or to have access to, food to make up a healthy diet.' [31]

²Penalties imposed on claimants who do not meet conditions such as attending job centre meetings

- Wimbledon and Worcester Trussell Trust food banks, that deliver emergency food to people in the community three days a week. One researcher volunteered in the Worcester food bank assisting in organising the donations and shadowing staff as they spoke to clients, two or three times weekly for a month, organising food parcels and the stockroom. During this time, the researcher engaged with approximately twenty volunteers, two senior food bank managers, and approximately twenty clients across both sites, to have conversations with individuals people awaiting food parcels.
- *Southwark Know Your Rights*, a community hub located in Bermondsey that offers free advice to people who are on Universal Credit. One researcher attended a Know Your Rights session, which involved twelve people applying to Universal Credit.
- *The Lighthouse Project*, a community hub in Woking run by volunteers that offers creative projects to support vulnerable people in poverty, ranging from painting to relaxation sessions. One researcher attended a 'Nurture session', which was led by a yoga instructor to help the participants understand the importance of sleep, and to learn breathing techniques to assist in relaxation.

Our methodology is ethnographic. O'Connor and Baker define ethnography as being "distinguished by the use of participant observation alongside other methods" that "allows for researchers to share experiences with their research participants to understand and empathise with their world views" [35, p180]. Therefore, our findings are rooted in "immersed practice and distanced reflection." [45, p2730]. Information gathering was a mix of observation, accidental encounters, and unstructured interviews.

After visiting a site, we compiled detailed notes that followed the same pattern: what the researcher did and saw, conversations had overall feelings about the space and what had happened. Maynard and Purvis recommend that ethnographers keep a research diary throughout [30, p1]. This involves detailed notes of "everyday activities and social interactions," [40, p.196]. Once fieldwork had been completed, we followed a thematic analysis, coding data into thematic categories to identify consonances and dissonances [4, 5]. As in our previous research, this meant that "narratives were aggregated [...] and relationships between the individual themes were explored" [8, p5].

4 FINDINGS

Three preliminary themes emerged from our analysis:

- What is takes to access Universal Credit
- How food banks operate differently
- What communities can and can't do

The analysis provides a clearer picture of the interaction between centralised and local welfare provision and sheds further light on some of the unintended limitations of a centralised digitalised welfare system.

4.1 Hurdles to Accessing Universal Credit

4.1.1 *IT Poverty.* Many did not have access to internet at home, creating an obvious block to the first stage of applying to Universal Credit. As the Wimbledon food bank manager noted: *"when the*

bills are racking up, WiFi is the first to go." Members of the Southwark Know Your Rights group emphasised the stress of applying to Universal Credit online. They described the situation as one of *"TT poverty,"* both in terms of a lack of technology and the skills to use it. Uniformly, the online interface of Universal Credit was described as complicated, particularly for people with learning difficulties. The website was held to not signpost the process of applying itself, nor how to speak to anyone if they had difficulties. For example, a man with extreme dyslexia explained that he found it impossible and many had made mistakes in the forms and online submissions, resulting in delayed payment and sanctions.

4.1.2 No Support. No participants felt that the limited face-to-face support from the state welfare agencies resolved issues with their online applications. This was because the service representative is reading the same screen as the claimant, and often "don't have the knowledge" to properly advise or assist them with the online process, nor the authority to interrupt the functioning of the digitised process. This led some participants to ask: "if they can't do it, how are we expected to?" At best, a service representative can give claimants a meeting (usually three weeks later) with another member of staff to assist with their online application. But the second meeting is invariably stymied by the same problems as the first, and a three-week delay on payment would be catastrophic for many. The lack of support of face to face support when completing Universal Credit claims often resulted in claimants asking for help from food bank workers who may not have the necessary welfare knowledge. The Wimbledon Food Bank manager expressed that often users needed help with their Universal Credit applications but that she was not necessarily best placed to support the individual: "I'm in a situation where I've not had to go onto Universal Credit, but actually if you asked me to do it today, I am sure it will be a very hard process."

This illustrates that problems with digital services cannot be overcome simply by retaining face-to-face meetings if a structural consequence of digitalisation is that individuals working for or alongside the state *also* understand the system's inner working less, and their space for the exercise of discretion has been drastically curbed.

4.1.3 Suspicion. Claimants see the digital hurdles of Universal Credit as part of a broader set of 'delay tactics' aimed at punishing anyone trying to access welfare. They pointed out that Universal Credit online applications demand repeated re-proving of their status as in need. The obvious message they take is that the government regards them as dishonest and permanently looking for opportunities to defraud the public purse. As one stated, "*it feels like the first question they ask you is: when did you start lying to us?*"

This was felt particularly keenly by those participants with longterm health issues or disability, who must nonetheless engage in repeated complex processes to secure payment. One respondent in Southwark described how the online system quantified and ranked his illnesses. He has anxiety and depression, as well as an under active thyroid. When he received medicine for his thyroid problem, his online capability assessment stated that his illnesses were "half fixed." This creates obvious and dangerous incentives not to seek treatment for conditions until it becomes unavoidable.

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4.2 The Logic of a Food Bank

Food banks provide a service that needs to be designed in such a way that it can be clearly scaled up to meet demand. There are many steps taken before an individual accesses food parcels:

- Food is donated at a pick-up point (such as a supermarket);
- Food is collected and organised at the bank;
- Identified and processed clients picks up a voucher from a GP or job centre; and
- Client 'trades' the voucher for a parcel at the designated bank.

It was observed that digitalisation had been introduced to monitor clients: when a person comes to the food bank, the unique code from the voucher is inputted into a computer system which tracks how often someone collects a parcel. However, the food bank's digital make-up is more flexible than Universal Credit; rather than provide summary decisions which must be enacted, the digital system ultimately only makes indicative recommendations which are subject to human discretion.

Across all sites, volunteers at the food bank attempted to develop workarounds in which the process could be experienced as *'machine-like'* or cold. This explains many apparent *'inefficiencies'*, such as devoting staff time to always making sure recipients had a place to sit, offering hot drinks, and so on.

Administering and managing donations is an area that needs structure and process in order for food banks to be effective in delivering their main service. The service design needs to be adjusted to the particular risks and constraints of the context in which the service is delivered. For example, in Wimbledon, the collection point and organisation stations are in the main church hall, with a stockroom in a smaller room next door. The stockroom fills and empties with unpredictable waves of donations. Staff must navigate boxes of donations stacked precariously on top of each other, piles of plastic bags, and a system where different sizes of box correspond to different parcels (so a family of four would get three bags in one box, and so on). Whilst the volunteers are very well organised and swift in their decision making, the layout and lack of space and time means attempts to 'zone' these spaces functionally often breaks down. On one occasion, volunteers spilled out to place unprocessed donations and prepare packages in the church hall, where recipients were waiting. This is a problem not least because it makes it easier for donations to go astray. As the manager stated:

"please get these toiletries into the stock room, there's too much temptation here as that's like £40 worth of stuff."

The design of the service is also shaped by how the service user is conceptualised. As in Universal Credit, the logic of a food bank is constrained by the need for efficiency, but what efficiency *is* is conceptualised very differently. For example, the inclusion of a cafe in the Worcester Branch reflects an understanding that within the constraints of a service claimants must be treated with kindness and supported with care if a sense of self-efficacy and agency is to be engendered. Obviously these are not institutions with money to burn, so kindness and empathy must be provided efficiently. It is unhelpful to think of these values as opposed: instead, we should ask efficiency of *what*, and for *whom*?.

The conceptualisation of the service user plays out in the spatial design of the food bank; in the Worcester branch, the volunteers set up a cafe at the front of the warehouse. When clients entered in to wait for their food parcel, they can sit in a comfortable setting, drink a hot drink and eat cakes brought in by the volunteers. The donations in the warehouse are (usually) hidden from view for the clients, and the room is brightly decorated, with jazzy tablecloths and vases of flowers. These should not be thought of as inefficiencies. The work of the volunteers in cultivating this space is justified by the need to make food bank users feel at ease. This was also true of the Lighthouse Project, who emphasise the importance of having attractive and comfortable spaces for clients to relax in. This space was decorated with large sofas and tapestries. The appearance of the space was explicitly linked by the manager to the need to undermine internalised media characterisations of welfare recipients as "unworthy scroungers."

4.3 Community Action

There is only so much a food bank can do. For many, collecting a parcel of food chosen for you by someone else can feel demeaning and embarrassing. Scholars have noted how the interactions and status hierarchies in a food bank can induce deep shame, rage, and low self-esteem [6]. One respondent described how degrading it felt to receive food chosen by somebody else. One with a physical disability had to queue for several hours at a soup kitchen, an experience she found *"dehumanising,"* but felt unable to vocalise her distress because she felt she was *"supposed to be grateful."* Another highlighted how he had been given out-of-date tins from the food bank, but having no other option, *"of course"* he ate them.

This suggests there are real limits to how much the organisers can create positive experiences through their structuring of the space and the interaction. Ultimately, people in this position have very little agency, and are routinely subject to the choices of strangers. Many find this exceptionally damaging to their dignity. Due to the nature of the food donated, it is often difficult to get *"proper"* meals. The Wimbledon manager explained:

I go to schools and [...] I give them a parcel for one person. I then say: make three meals per day. You need your breakfast, lunch and dinner. Now, the parcel is good, don't get me wrong. We've got a lot of donations and we've got a lot of donors. However, making manageable foods that you would eat on a day-to-day basis is a little bit hard depending on what your parcel looks like. So, when you've got these kids telling you that one of your meals is going to be carrots - tinned carrots - with rice, and that's as good as they've got, I'm like wow this is what the clients see. It's not through a lack of wanting to do [...] it's never done maliciously. It's just what can happen when you've got through two thirds of the food.

As ethnographers have long noted, meals are deeply important symbolic activities, codes freighted with social relations and implicit meanings [12]. Here, the ordered patterns of what constitutes a *`proper*' meal run up against the logic of the bank. The food bank usually has ample pasta sauces, pasta, soup, crisps, biscuits, noodles and cereals. These items will not go off quickly, are easy to put together with minimal equipment and meet requirements for a somewhat *'balanced'* diet. Without fresh ingredients conventionally regarded as key, the donations produce a *'strange'* combination of food when clients are trying to make 'rounded' meals, which they experience as a further transgression on their dignity. One volunteer suggested that the food bank needs to be modelled on a supermarket, where people can come in and see aisles of food that they can then choose food from. However, having reflected, she noted it may be more degrading to have to check how many items people have. Nonetheless, the current system feels like a hand-out, despite their best attempts to restore feelings of dignity.

5 DISCUSSION

The findings unsettle a number of assumptions about both Universal Credit and food banks: in the case of Universal Credit the simplicity and efficiency is no longer obvious. It is neither simpler nor more efficient. Nor are food banks spaces of *'pure'* compassion freed from the malign effects of technology, bureaucracy, and social hierarchy.

5.1 Outsourcing Complexity

A simpler and more efficient welfare system is a worthy aspiration. Our findings indicate that in attempting to make Universal Credit simple, its digital interface does the reverse. As the field observations and the testimonies of the food bank managers reflect, this approach to welfare occludes the *messiness* of poverty and the process of obtaining welfare, but does not obviate it. Tricky identities and unusual personal circumstances are erased in the digitalised system, often unjustly declaring a person fit-for-work. The way in which Universal Credit may push people *into* poverty is similarly rendered invisible to the state but is highly visible to local points of welfare delivery such as food banks.

The inability of the state to see this messiness is unlikely to be an intended part of the system design. The government's Digital Service Standard [32] requires that all digital products be checked before implementation to make sure they are driven by a full understanding of users, and be grounded in ongoing user research. This was not, however, the experience of our participants. It is worth noting that the Service Standard was amended in July 2019³ to substantially bolster benchmarks around simplicity and accessibility. This suggests a substantial temporal gap between the original stated aims of digitalising welfare and its manifestation in concrete operating procedures. This starkly illustrates the mutually reinforcing relationship between technology and bureaucracy theorised by David Graeber [18] and shows how reforms aimed at *'rationalising'* and simplifying processes generate more inefficiency, misunderstanding, and error.

5.2 Food Banks as 'Messy' Sites

The upshot is that food banks and community groups respond to the displaced 'messiness' of Universal Credit. In particular, food banks act as an unofficial fourth emergency service, providing *"compassionate, practical support to people in crisis"* [43]. Although access to the food bank is ultimately a mechanical process: the allocation of an inert scarce resource (food) with a relatively defined value

- which can and has been subjected to very complex algorithmic decision-making [e.g. 39] - is packaged and structured as process in order to feel like precisely the opposite.

The digitalisation of Universal Credit is intentionally faceless: that is a consequence of the required aura of dispassionate rationality and smoothly disembodied technical function. Within that structure, it places the responsibility for claims onto welfare recipients. In consequence, claimants also bear the costs when the digital design of Universal Credit missteps. Unlike previous incarnations of welfare, it shrinks physical spaces to challenge or persuade the state otherwise, nor any space for communal action in forming relationships, searching for employment, and receiving support. All the groups that took part in our study emphasised the importance of such spaces for learning, negotiation, and support. What these groups then attempt to provide is an alternate interface in the forms of spaces which reproduce some of these functions; the volunteers' effort to provide claimants with 'nice' surroundings the jazzy tablecloths in Worcester, the artwork at the Lighthouse, and so on - are designed to challenge or at least supplant the logic of Universal Credit. They try to recast vulnerable individuals in a dignity-restoring system of care and support, albeit with only partial success.

5.3 Lessons For Welfare Service Design

As Strong notes, the food bank space is emblematic of "the downloading of austerity onto individuals and communities," wherein the impact of the cuts to welfare "are founded and play out" [41, p211]. This means that, unlike the digital interface of Universal Credit, food banks/community groups are reacting to people's needs faceto-face whilst using digitalisation to scale the service and make it more efficient. However, whilst volunteers act with compassion and attempt to restore agency, people experiencing food poverty feel a lack of control and choice. Nevertheless, there are, perhaps, lessons to be learned from the face-to-face elements of food bank service provision that might be translated into digital welfare service design. If implemented, these design features might help to make the messiness of welfare claiming visible to the state and, at the same time, also reduce the digital barriers, rebuild a sense of self-efficacy and increase service accessibility and inclusion.

- *Choice*: offering meaningful choice that service users can meaningfully action is a key challenge. The data gathered from our study sites illustrate how choice is an important means of building and maintaining self-efficacy and a sense of agency.
- *Relational spaces*: welfare delivery relies not only on efficient tasks but also on the relational network to support that service and through which self-efficacy and agency of service users can be engendered. A social space, digital or physical, offers a space where people can meet, not as service users or service designers, but as people sharing experiences of a system. It is a space where people can develop mutual support and co-develop responses to the challenges of accessing welfare.
- *Media with meaning*: a common theme across from the field studies was the importance of *nice* materials through which to deliver the service. This is as true of digital materials as

³Available at https://www.gov.uk/service-manual/service-standard

it is of physical materials. Respect, care and trust can be communicated through the selection of materials. Care is reflected in the effort taken to choose materials that respond to food bank users as people, not claimants. Respect is reflected through the listening and then responding to the needs to the food bank claimants. Trust is conveyed through the making available of materials that have a higher value.

6 CONCLUSION

'Digital by default' does not replace the mess of poverty with simplicity and ease for those in poverty, but it does render that mess invisible to the state. That mess is relocated to unofficial spaces of welfare, such as food banks, who seek to work in ways which return dignity and agency to individuals. In doing so they are a vital component of the overall system. Acknowledging and designing for the mess of poverty in digital welfare systems is potentially an important means of reducing digital barriers, rebuilding a sense of self-efficacy and increasing service accessibility and inclusion.

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Developing an Indigenous Cultural Values Based Emoji Messaging System: A Socio-Technical Systems Innovation Approach

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ABSTRACT

Digital divide remains a major concern among indigenous people despite the rapid increase in mobile phone penetration. Beyond the appalling participatory gaps, the devaluing of humanity in the digital era is seen as a much bigger threat. This paper addresses the emerging challenges that are putting indigenous communities at a great disadvantage. The use of emoji in social media and its prominence as a visual language for delivering emotional expressions, gestures and action in a speedy manner is fast becoming a way of life. The universality of emoji poses a major problem to the sustainability of the indigenous cultural values as it imposes western cultural and social behaviour hegemony on the indigenous society. Interactions with remote rural communities in Borneo over the past twenty years have revealed the devastating effect that such an outside-in communication medium has on their cultural resilience. Diversifying the emoji design in adopting a local cultural flavour alone, as described in current literature, will not address the issue effectively. Without considering the whole socio-technical system at a macro-level, the dangers relating to the aggravated disconnect to their rich traditional way of life cannot be averted. We posit a holistic socio-technical systems innovation approach with the participatory involvement of the indigenous community. In this paper, we demonstrate the modeling of complex systems that embed the socio-cultural context without compromising cultural values.

CCS CONCEPTS

• Human-centered computing; • Interaction design; • Systems and tools for interaction design;

KEYWORDS

Emoji, Co-Design, Socio-Technical Innovation System, Indigenous Communication System

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1 INTRODUCTION

The use of instant messaging is now pervasively covering all aspects of our daily life. Emoji has become the prominent visual language in delivering emotional expression, gesture and action in a speedy nonverbal and non-text endeavour. Emoji are capable of avoiding misunderstanding of the text message content while directing attention to optimum and improved communication among speakers. However, the use of the universal pictograph standard, designed using Unicode, posts problems of ambiguity when it comes to users from different geography, language and cultural backgrounds. As a result, people from a distinct cultural background may interpret the same emoji differently and use it differently in contrast to the original meaning of its design.

2 THE CHALLENGES OF EMOJI USE IN SOCIAL MEDIA

In recent years, the use of mobile phones and instant messaging service (IMS) within indigenous community has been on the increase. The challenges posed by social media to the sustainability of the indigenous cultural identity can be described along the following multi-dimensional perspectives:

2.1 Ambiguity

The problem of ambiguity in using the standard Unicode emoji is getting more attention due to the isolation of the indigenous community from the outside world, on top of the varied backgrounds within the community. The visual cue provided in the standard emoji looks promising due to its nonverbal and non- text nature. Yet, it can be at times incompatible owing to the missing gesture, human action and emotional expressions according to specific cultural intent. As discovered by Ekman [[5]] from his famous study with the Papua New Guinea indigenous group who were never exposed to the modern culture, some facial expressions are universal, while there are other emotions that are culturally determined. His findings showed that: Fear, Disgust, Anger, Sadness, Enjoyment are universal emotions, while pride, guilt and respect, are mainly

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Table 1: Oroo' Visual Symbol



Image courtesy of Franklin George.

culturally determined. This indicates that the current core emoji is insufficient to represent all the emotional expressions of human beings; there is a strong need to discover and code the specifics for an indigenous group.

2.2 Natural Language

Emoji resembles the form of communication typical of a natural language. Indigenous communities traditionally rely on the visual symbolism as a means of communication. Marcel Danesi [[3]] associated this form of communication to prehistoric art. Prehistoric pictographics as found in cave drawings, is an intuitive form of communication and expression of human emotions. The natural pictographic and visual symbolic form of emoji allows it to be easily adapted to remote rural communities of indigenous people, particularly if it has been aligned with their cultural values.

Similarly, symbolic languages have been used by remote nomadic communities living in the rain forest of Borneo. Penans are one such nomadic community living in the Malaysian Borneo state of Sarawak who are still holding on to their sign language called Oroo' [[18]]. The on-going research work carried out by the Institute of Social Informatics and Technological Innovation [[19]] with a community of Penans who have been settled in the village of Long Lamai has unlocked the tremendous potential for rediscovering the indigenous knowledge relating to this dynamic form of visual communication. Oroo' is therefore seen to be representative of the age-old know-how [[15]] of this indigenous community. They construct Oroo' visual signs using twigs, leaves and other natural resources, and are able to effectively communicate within the challenged settings of the vast rainforests. The diverse range of messaging, that includes storytelling constructs, makes Oroo' a powerful medium that could be the basis for a future symbolic messaging service. Table 1 shows an example of an Oroo' visual symbol which comes from our Penan Legacy Symbol Archives [[10]]. The Oroo' sign also has an inherent meaning which says that, "You are invited to put up a night in this hut."

The use of the natural symbolic visual language of such indigenous communities is becoming challenged as the use of mobile phones and global instant messaging service (IMS) proliferates. The universal code of emoji represents the invasion of foreign visual symbolic language upon these indigenous communities, especially the younger generation who are attracted to the use of electronic devices such as mobile phone and tablets. Current efforts to map the historical past and cultural heritage of the Penan community has revealed the potential devastation the community will suffer when the roots of their indigenous knowledge become threatened.

2.3 Universal Emoji Code

The universal form of emoji code tends to post a challenge in sustaining local cultural identity. It puts an argument of "Who created the emoji? Who is the targeted user?". It has been associated with the issue of western imperialism against the minorities, or what has been described by Rampley [[12]] as a process of visuality of popular culture from the western world. This has also raised the question of indigenous group unconsciously (through the influence of popular culture) being persuaded to adapt and learn to communicate the way modern people do. Efforts are therefore needed to conserve cultural identities allowing the natural way of communication via the use of a culturally sensitive emoji, which they share and understand.

2.4 Shifting Indigenous Identity

While there are many positive aspects to this rapid development, universal emoji code can also lead to intergenerational tensions as young people explore new patterns of behaviour, and older people come to terms with new cultural challenges. The study by Kral [[7]] on the indigenous youth in Western Australia discovered that there are significant identity and perception shifts across generations. This shift is seen to be intertwined with the use of new media communication technologies, where the younger generation is embracing a global digital culture in exploring the generativity of multimodal forms of communication and meaning-making in the new media platform. At the same time, these developments pose a generation divide between the young and older generation of the indigenous community whereby the youths are dislocating the routine, their roles in social interaction and challenging the authority of elders. The notion of indigenous communication which enables the indigenous knowledge transmitted from generation to generation is also being tested.

This has posed a contradiction from a systematic innovation point of view whereby, on the one hand, the youths become fascinated by the use of new media communication technology which provides an opportunity for them to learn new knowledge in the realm of ICT4D to bridge the gap of digital divine. On the other hand, this leads to an identity shift for the indigenous community. Developing an Indigenous Cultural Values Based Emoji Messaging System: A Socio-Technical Systems Innovation Approach

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Forms of Indigenous Communication	Function	Knowledge
1. Folk Media	Storytelling	Folklores, plays, dance, song, festival celebration.
2. Indigenous Organisation	Discussion	Organisation activities of religion group, tribe gathering, tribe
		leader meeting.
3. Economic Relationship and Service	Share information	Farming activities, hunting activities, trading, healer sharing
Supplier		information about diseases.
4. Deliberate Instruction	Instruction	Tribe leader and elderly's instruction. Parenting, how to eat,
		how to cook, how to behave.
5. Unstructured Channel	Chatting	Spontaneous and informal conversation about hobbies,
		entertainment, gossip.

Table 2: Five Forms of Indigenous Communication

The development of the new indigenous 'cultural values' based emoji messaging system should look into the problem in these multiple dimensions and the complex integration of the problem by embracing a socio-technical system approach rather than adopting a single dimension as most researchers have done previously.

3 INDIGENOUS COMMUNICATION SYSTEM

The development of the Indigenous 'Cultural Values' Based Emoji Messaging System needs to be seen both as a social as well as a technical process. The methodology used should enable the analyst to understand the culture and values of the people who are likely to use the system and to design the system so that it matches their needs [[17]]. The five forms of indigenous communication as posited by Mundy [[9]] include: (1) Folk media, (2)Indigenous Organization, (3) Economic Relationship and Service Supplier, (4) Deliberate Instruction, (5) Unstructured Channel. The details presented in Table 2 allow the modeling of contextual complexities within the community setting.

Indigenous communication is evolutionary in its design. Knowledge embedded is preserved, handed down, and shared. It is an aspect of culture which can only be appreciated by its people who are the insiders in a social research context. A designer who is an outsider would have a problem in developing a computer-mediated communication system which imitates the indigenous knowledge communication system as can be seen in most ICT4D research. This imposed the issues of etic, emic and pseudo-etic as described in social-cultural system studies [[6]]. As first introduced by Kenneth Pike [[11]] in 1967, Etic refers to the approach in the study of the indigenous communication system from outside the cultural system. In contrast, the emic refers to the perspective as used for the study of an indigenous communication system within the cultural system by the local community member. Pseudo-etic [[16]] then describes the use of concept and system initially developed in another context and assumed to be relevant to the indigenous community. This can however be problematic as the system developed does not share the same basic values, knowledge and communication as the indigenous people.

Etic and *emic* approaches can be regarded as complementary, or a continuum [[2]; [4]] with respect to each other if it is applied cohesively with the involvement of both the designer and the indigenous group. Figure 1 demonstrates the development of the new indigenous *cultural values based emoji messaging system* taking



Figure 1: Functioning Model of Etic, Emic and Pseudo-Etic Relationship

into account the involvement of the insider who has the role of making the design decision in a co-design process. Participation and collaboration of stakeholders in a socio-technical innovative system is crucial.

4 CULTURAL VALUES BASED EMOJI MESSAGING SYSTEM

Adopting the socio-technical systems innovation approach in creating the *cultural values based emoji messaging system* provides a holistic solution to the complex problem of indigenous communication in the local society with the use of emoji as a vital element in social media technology. As mentioned in the earlier section, the complex problem of localised cultural design alone cannot be the best solution for this problem. Hence, there should be a holistic approach which is able to integrate the social and technical development of the indigenous community while sustaining cultural values at the same time. The proposed socio-technical systems can provide the right solution in this matter. We have adapted a systems structuring paradigm based on the Theory of Inventive Problem Solving (TRIZ) [[14]] in our modelling of socio-technical systems. The four critical components of a minimal socio-technical systems model will thereby be shaped as (1) Control System, (2) Systems Resources, (3) Transmission, and (4) Working Unit. The adaptation of the TRIZ model has been the basis for the socio-technical systems innovation approach as described below:

4.1 Design Principles for Control

The design principles for control will determine the parameters to be controlled for the macro system that we are proposing. The design parameters characterize the shared cultural values based on co-creation model. The identification of local cultural values and the formulation of design principles involve all stakeholders, whereby, the designer plays the role as a facilitator instead of a creator. This will allow a participatory process where "creativity designers and non-designers work together" [[13]]. The designer, as the holder of knowledge and expertise, facilitates the indigenous people to identify and formulate design principles in a local context according to social needs.

4.2 System Resources

The system resources component provides "fuel" to the system. Three essentials resources in the system being identified are emoji dialogue structure, communication protocol and the Oroo' symbols. It will provide the structure and contents to the new cultural values based emoji system. Archiving and digitalisation of these resources such as the Oroo' symbols require the full commitment of the Penan elders who are experts in the area. Adopted from the earlier research in a similar area [[18]], Oroo' visual language symbols and the communication protocol will be analysed and restructured to make it feasible for the proposed cultural values based emoji system. In the innovation perspective, this shows a paradigm shift from the traditional top-down innovation, which involved the designer and researcher in developing an innovative system to a bottom-up innovation [[8]]. This ensures that all the stakeholders are committed to participating in the process of innovation system development, and the design decision made is no longer an individual top-down approach but a collective accomplishment especially from the Penan elders as resource person.

4.3 Transmission/Flow

The way the emoji is being used in instant messaging service (IMS) play an important role in this component. Gestures, navigation cues, values-based interaction and storytelling constructs allow the transmission of the Oroo' symbols to serve as the cultural values based emoji. Values play an important role in this socio-technical system, in determining the decisions to be made in a system development [[1]]. The intangible form of value might be hard to measure and detect, but it can be brought within the design and development process by involving the indigenous people in design decision making and testing of the prototype which would subliminally be determined by their own value. These cultural values will transmit through the use of the cultural values based emoji.

4.4 Working Unit

The main interaction component, the working unit, would be the cultural values based emoji system. An indigenous visual symbolic language that is co-created by the Penans, provides a sense of ownership and responsibility through the interactions to sustain their cultural value and way of living. At the same time it also provides them with an opportunity to communicate effectively through social media the way the rest of the world does. The working unit then provides support for future interaction models.

The design of engineering system model for a socio-technical system therefore connects the capacity of the community to dynamically build a knowledge-based, culturally sensitive resources as building blocks, flows coherently to empower the natural interaction language that is managed by the community.

5 CONCLUSION

In this article, we have drawn attention to the hegemonic problem of universal Unicode emoji design and its challenge to the sustainability of the indigenous cultural values. Current research approaches tend to be inadequate in addressing the complex social problem of indigenous communication. A socio-technical systems innovation model has been presented as a holistic approach that would be able to provide a space for the indigenous people to selfcreate, own and use the emoji system to sustain their cultural value and identity from generation to generation.

This approach goes in line with the ICT4D 3.0 world view by breaking the monopolisation of emoji creation and selection through the dynamic homegrown bottom-up emoji approach. In this way, the agenda of shaping technologies can be in accordance with cultural values and needs as opposed to allowing technologies to shape humans.

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Digital Inequality in Education in Argentina

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ABSTRACT

This paper – as a part of a broader research on the policies and practices of digital literacy in relation to inclusion-, seeks to identify the central tensions in teachers' practices related to the use of digital technologies in education. In Argentina, these tensions have increased, the moment when the pandemic compelled the educational system at all levels, to switch from the physical to the virtual classroom. Despite the recent date of these events, in this study we aim to reflect on the first findings. We will continue this research through interviews and reports analysis, in the coming period.

CCS CONCEPTS

 Social and Professional Topics; • Computing / Technology Policy; • Human-Centered Computing;

KEYWORDS

Digital technologies, teachers work, pedagogical practices, inequalities

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1 INTRODUCTION

1.1 The context

"In the days of COVID-19, the unforeseen oversupply of virtualization amplified doubts, resistance and questions". [11]

This paper – as a part of a broader research on the policies and practices of digital literacy in relation to inclusion-, seeks to identify the central tensions in teachers' practices related to the use of digital technologies in education. In Argentina, these tensions have increased, the moment when the pandemic compelled the educational system at all levels, to switch from the physical to the virtual classroom. Despite the recent date of these events, in this study we aim to reflect on the first findings. We will continue this research through interviews and reports analysis, in the coming period.

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© 2020 Copyright held by the owner/author(s). Publication rights licensed to ACM. ACM ISBN 978-1-4503-7994-6/20/07...\$15.00 https://doi.org/10.1145/3394332.3402827 The end of 2019 in Argentina marked a peak in economic reforms, which started in 2015 and includes the abandonment of public services, the increase of unemployment, the reduction of domestic consumption, the external debt, and the increase in income inequality, became critical. These late neoliberal policies carried out a structural reform of the State, resulted in large transfers of income to the richest sectors, a capital flight, the flourishing of financial capital, the flexibilization of the labor market at the service of private interests, and above all, a decisive bet on the communicational, the marketing to the change of imaginaries and the common sense of society through the mass media [7].

In education, the government worked to build a market-friendly ideology, with mass media guiding the education agenda, expanded through the Internet, the symbolic colonization of educational discourse by economic categories and criteria, and the private appropriation of the public sphere, the reduction of the education budget, included salaries, equipment and supplies for schools and universities, and dismantling all training programs on ICT for teachers. Likewise, the government 2015-2019 tried to limit the acquired rights of teachers and educators, using the mass media to depreciate the position of teachers and educational organizations, using evaluation methods in a competitive and punitive way [3] [2].

The increase in inequality had an impact on the levels of failure and dropout of the students. The public school became the school "for the poor". Children and adolescents were deprived of teaching materials. Moreover, social and cultural deprivation prevented them from equitably carrying out the training processes in the formal education space [10].

In recent years, there has already been intense institutional and social pressure for the use of ICTs in education. Adequate educational resources, and spaces for teaching or collaborative work have not been provided, causing an increase in the individual workload [4] [9].

1.2 ICT discourses

Regarding ICT, there are socially circulating meanings, linked to their instrumental use, technical neutrality and a high valuation of the benefits inherent in their access. However, this is a field of a discussion that needs to be expanded, from a historical, social and cultural perspective, that includes the cognitive, emotional and contextual aspects that come into play in a digital environment with a pedagogical sense. This study is connected to digital humanities, since digital education is one of the fields where corporations are imposing their agenda, especially in disadvantage sectors [8].

ICT assimilates the dominant discourse (governments and corporations) with common sense. This means that discourses on digital technologies only partially consider some aspects and distort or hide others, see Figure 1. For example, the considered indispensable use of ICT is celebrated as an inherent positive contribution to the problems of education. It is common for digital technologies to

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Dominant discourse	What is hidden	
Inherently good	Negative effects: cyber-addiction, individual	
	control, data manipulation, computer crimes, etc.	
An essential way to	This kind of transformation does not occur per se,	
improve education and	since the key is the pedagogical use.	
solve learning		
problems.		
Well managed by	Children use devices to play, to bond, and to	
children and not by	explore what is related to their preferences. But the	
teachers (native /	tools to learn, select and interpret everything that	
immigrant	comes across the screens should be provided by	
contradiction).	adults. Digital gap.	
Carriers of educational	arriers of educational Education is not renewed through technolog	
innovation	unless we put it at the service of renewed	
	pedagogical projects	

Figure 1: ICT discourses and hidden problems

be seen as an essential means of improving education and solving learning problems, regardless of the fact that there are no single devices that solve the problems of education, the vast field of commercial interests behind these proposals, and the digital social gap between young people. This masks the negative aspects, such as cyber-addiction, individual control, incitement to consumerism, data manipulation, being exposed to unwanted sites and computer crimes [2].

The concept of innovation in education as a synonym for the use of technologies hides the fact that education is not renewed through technology, unless we put that tool at the service of renewed pedagogical projects.

Children and young people are usually considered to know everything about digital technologies and devices since, unlike teachers, they were born in the digital age (native / immigrant opposition). However, children use the devices to play, to socialize and to explore everything related to their preferences. But the tools to learn, select and interpret what comes through the screens is what adults / teachers should teach.

Much of this discourse was directed against teachers, since, showing only positive aspects of ICTs, they built an image of traditional teachers, attached to their old knowledge, without commitment to the life of young people, etc. that the media reproduced. The teachers, in turn, many did what they could but, without sufficient resources, resisted the pressure to join in such unequal conditions as best they could.

At the end of 2019, the opposition to the neoliberal government won the elections in Argentina, through a front with considerable popular support, but amidst a terrible economic crisis and national debt. Despite this, the Ministry of Education was filled with officials who came from and knew public education well, thus opening up a horizon of favorable expectations. And then the pandemic came, and did make technology an indispensable means to allow schools' work go on, with a very heterogeneous background on the kind of tasks that were necessary to face the situation.

2 THE 2020 SCHOOL STAGE

Upon taking notice of the pandemic, the 2020 school year was about to start (March to December). Classes began in schools, but on March 16th, compulsory social isolation policies were established to curb infections, based on the lack of vaccine or cure for COVID19.

When classes were interrupted due to the exceptional situation, all teachers had to respond, without plan or preparation, to give continuity and virtual support to the learning processes started and to come. Like a bomb exploding in their hands. Scholars could afford to debate about the rights of teachers, the rights of students, workload, materials and content, commodification and big data, etc., instead, in schools, let's get to work, with all the conflicts, experiences and inexperience that were available, with the support from the Ministry of Education.

The situations to respond to are innumerable. The context described above does not account for the enormous variation in situations that teachers must respond to in their usual task, now multiplied. Those who have students with Internet connectivity, work from home, sending instructions to parents and mothers so that they can collaborate with their children, prepare and put materials online with different contents and activities for primary school children, or for several different high school courses¹, or Secondary and Higher Education, all at once and most with little or no experience in that type of tasks, activities that will later have to be corrected, take online exams, and all the administrative work – amid the discomfort of being isolated, having to take care of themselves and their family, and the discomfort of the students

¹In Argentina most teachers work on several courses and/or schools

Before pandemic	With pandemic
Pressure to use ICT technologies. Innovation discourse.	Increased pressure. Necessity, obligation
Individual work with large groups	Greater workload required by virtuality
Womens work: salaried work + domestic work	Womens work: salaried work + domestic work + children at home
Inequality in the Access to connectivity and the Internet. Segregation and overcrowding.	Poor children lose the possibility of the right to education

Figure 2: Teachers work before pandemic and with pandemic

themselves. As always, for the most part women have to share work with housework, but now all at home with children without school.

The teachers' strategies to guarantee continuity of the education are diverse: from WhatsApp and Facebook groups to uploading materials to Drive or sending them by email. There are those who create blogs with Blogspot or through the Wix platform. During the first days, Google Classroom seemed to be the most used option and put all teachers in the quick task of searching for tutorials to familiarize themselves with this route (the use of personal data by this company merits extensive debate itself) [5].

And those who do not have access to connectivity, cell phone or another device? The (dis)connection, digitization, is a new dimension of inequality and the coronavirus crisis only accentuates it. They lack that possibility, as so many other rights. The pandemic does not create socio-educational differences, they pre-exist this crisis, and with it inequalities and tensions increase. Teachers who teach in peripheral areas, where many do not have the Internet, go to schools to organize and distribute bags of food and in those same bags they put the printed task for their students. Many rural school teachers distribute homework home by home.

One should not forget that, in this context, young people are affected by social problems intertwined with inequality; to the same condition of monetary poverty, the overcrowding situation is added as a conditioning factor for carrying out school tasks at home (Kaztman, cited in [5]). Figure 2 synthetizes the aggravation of the problems due to the crisis.

What is evident here, in addition to the increase in the workload of teachers due to the volume and characteristics of the virtual materials, is the prevalence of the instrumental meaning of technology and, in urgency, the prevalence of tools, applications and programs, instead of cultural meanings, of the exploration of new ways of connecting with the knowledge, learning and cultural expressions of young people [9].

3 FINAL REFLECTIONS

In this unprecedented situation due to its characteristics, we observe increased tensions around the teaching task in virtualization, which the pandemic imposed while making its inconsistencies visible. This leads to two important questions: on the one hand, the perspective of the recognition of the tasks and the rights of teachers, who saw their rights cut and their working conditions worsened in the last four years, and the right of young people to education. The lack of resources finds some groups at a more obvious disadvantage, causing an increase in the differences between the learning of those who are or are not connected, that is, the digital divide reflects and deepens other inequalities.

On the other hand, the possibility of taking advantage of the opportunity for teachers to carry out, and make students carry out, a critical and productive appropriation of digital resources. From a pedagogical dialogue option, teachers need co-training and collaboration in institutional work, both with peers and with young people. Faced with the heterogeneity of the student population, teachers need to develop strategies and use resources that have a direct influence on improving pedagogical work, make better use of available resources and promote work in the area of production and selection of materials of support for teaching, especially that carried out by the students themselves.

Some proposals explore the educational potential of digitally building what they call the "third space": a porous space between WebSci '20 Companion, July 6-10, 2020, Southampton, United Kingdom

school and media culture, since learning with digital media is located in that arena of the daily struggle that is where the creation of a new popular culture is at stake. In these days of isolation and social distancing, teachers and students "will be what we do with what the networks and the media wanted to do with us." [6].

It is necessary to broaden the spaces for public debate on the different forms and hegemonic discourses and to mobilize in defense of public education, to deepen the criticism of the modes of production, circulation and naturalization of discourses that put technologies (corporations) in the center of the educational process.

Precisely because ICTs and the media are not neutral and are managed by large economic groups, it is that part of our cultural struggle must aim not to exclude ourselves nor exclude young people from understanding new languages, and from a critical perspective to a celebratory vision of all technology and all novelties. It is the responsibility of the education system to provide essential resources to interpret, understand and question the messages that saturate children's daily lives, but at the same time, the tools to be active participants in the culture of the media [1].

How else to question the permanent messages that invalidate teachers and promote the advantages of autonomous learning with computers? The devices have to serve to increase the understanding of the meanings. It is a fundamental task to analyze and answer media discourses that disqualify teachers teaching work and public education, holding educators accountable for everything bad that happens in school, and attack their unions.

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Sustainable Education in India through Artificial Intelligence: Challenges and Opportunities

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ABSTRACT

Education and Artificial Intelligence (AI) can be complimentary to each other. Over the period the state of education in India has been influenced by some good reforms in education system and its implications are immensely towards positive side. AI being the latest technological advancement can be an approach for sustainable, smooth and transparent solutions. AI enabled technology can fill the existing gaps in the present education system. This paper traverses the key issues of the Indian education system with the objective of proposing some solutions which are inspired by the AI innovations having the sustainability as a significant part of it.

KEYWORDS

Education, Artificial Intelligence, Sustainability, Transparency

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1 INTRODUCTION

Indian education system is going through a phase of change. Apart from this it has various issues related to planning, recruitment, governance, etc. The access targets has been largely covered in the primary and secondary education, but in higher education it is in initial massification stage. It is one of the sectors in India, which is in dire need of some interventions based on smart machines and related technologies.

Artificial Intelligence is increasingly becoming a part of our daily lives. Its magic is being tapped in many sectors. In case of India it has already intervened in the intelligence, security, and banking areas. One area which really needs it is education. Though some start-ups has come up with some innovative ideas; but the crucial thing is to understand the demand side of it. In other words, it is pertinent to know what exactly is the ecosystem of education

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in India and what are the relevant issues it is facing. AI will be a nothing less than a boon for the Indian education sector. It is the need of the hour to give opportunity to various AI platforms and systems to innovate for the existing problems of Indian education sector.

This paper is exploring the role and intervention AI can play in the Indian education system along with a sustainable approach; to further the agenda of acknowledging the existing concerns thematically, in order to cover the different functions which happens in educational institutions and the related organisations to it. The paper is divided into four parts. First part deals with the literature review or the related work which has been done in the combined field of AI and education. Second talks about the ecosystem of Indian education system, where various existing issues have been thought upon. Third section is trying to understand the scope of AI in education. Final and fourth section has covered the challenges and opportunities which may come upon in this field.

2 RELATED WORK

Education sector has been undergoing many changes and facing various challenges in its overall functioning. AI is one of the latest and radical technological intervention in the field of education. In this section literature relevant to the paper has been presented and thoroughly discussed.

2.1 Artificial Intelligence and Education: A Winning Combination

This subsection is canvasing the role artificial intelligence has been playing in resolving some of the issues of education sector.

The data driven support for the stakeholders of education will help in their growth and development [5]; however, it has been asserted in one of the study that by the application of statistical models and analysis educational institutions can experiment with their data to get an idea regarding the learning experience of the students and how improvements can be done in future; which can be further measured in the domain of efficiency and effectiveness[6].

In the same league Ifenthaler et al. (2019) opined that the static and dynamic information regarding the learners can be utilized for further enhancing the learning environment. It can also help in assessing it for getting the real-time modelling, predicting and optimizing the learning process. It will smoothen the process of educational decision making about learners [17]. Further, in another study it has reflected that the Artifical Intelligence in Education

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(AIEd) is basically a research field which imbibes an interdisciplinary approach; i.e.; it includes the contents of psychology, pedagogy, sociology, linguistics etc. to understand and reflect upon through a solution which caters all probable interdisciplinary issues related to ecosystem of education[23].

Chassignol et al. (2018) have reflected that by using the AI based applications such as, Intelligent Tutoring Systems, Learning Management Systems students can be given continuous feedback regarding their performance and it helps to ease the assessment of students. Personalised educational contents can also be made which can cater the individual needs of the students and can efficiently evaluate their performance [7]. AI today is working with many stakeholders for publishing, sharing and accessing the Open Educational Resources (OER) has been discussed in a study of Meca et al. (2019). It also discusses that there are many factors on which the academic performance is based and evaluation should be done in coherence with that. They have given a methodology which can perform the task of students' evaluation and can correlate it with their performance. It includes 30 socio-economic and economic variables along with the final numerical grades; which is represented in two data sets for further analysis[24].

AI based learning can also create collaborative learning platforms based on the learner models. This is usually done via online group interaction. Intelligent Virtual Reality (IVR) uses game based learning environment. Virtual agents act here as teachers, facilitators or students' peers [26].

A report named Horizon Report 2019 Higher Education Edition states that there is probability of 43% growth in the AI for education from the period 2018-2022, having specific choice for the AI based teaching and learning applications [3]. Intelligent Tutoring System (ITS), is an important aspect of the AI based use of education technology. It helps in personalised tutoring. It is based on the learner models, algorithms and neural networks; which creates a specific learning path for the student by engaging itself with the specific needs of the student. This is possible in most of the virtual classrooms for the students. Also it can be attached to a common platform for learning via social interaction i.e. peers.[18]

2.2 Education, Sustainability and Artificial Intelligence: The Need of the Future

This subsection is discussing the sustainability factor linked to the induction of Artifical Intelligence in education sector

UN in its report Transforming our world: the 2030 Agenda for Sustainable Development (2015) stated as, *Quality education: Obtaining a quality education in the foundation improving people's life and sustainable development.* Similarly, Akcapinar et al. (2019) have supported this by saying that through AI there are good probable chances of minimising the daily tasks of teachers which eventually supports the teaching-learning process and enhances the learning experiences of the students[2].

Cedric Villani in his report of 2018 (being chair of the French committee) stated that education needs transformation[34]. Also, Tuomi et al. (2018) in the report *The Impact of Artificial Intelligence on Learning, Teaching, and Education* discussed the different aspects related to learning and AI [32]. In one of the position document of Organisation for Economic Co-operation and Development (OECD) in 2018 it has been discussed that there is need to transform the education through technology; which has also been covered in the Sustainable Development Goal 4 (in September 2015 it was adopted by the United Nations). AI is being addressed by the communities in multidisciplinary way, UN, European Union and many other organisations have been funding researches on it, having the significant target of making AI useful for the education.

It is an emerging industry, and will have a bright future; de la Higuera (2019) discussing the report of UNESCO Information and Communications Technology (ICT) competency framework for teachers of 2018 stated the 6 aspects of a teacher's work are scrutinised with respect to a goal of making use of ICT for better teaching: A1 Understand ICT in Education: how ICT can help teachers better understand the education policies and align their classroom practices accordingly; A2 Curriculum and assessment: how ICT can allow teachers to better understand these questions but also intervene and propose new modalities; A3 Pedagogy: how the actual teaching itself can be positively impacted through the informed use of ICT; A4 Application of Digital skills: how to make use of the new skills acquired by the learners to support higher -order thinking and problem solving skills; A5 Organisation and administration: how to participate in the development of technology strategies at different levels; A6 Teacher professional learning: how to use technology to interact with communities of teachers and share best practices[13].

2.3 Artificial Intelligence and Indian Education Sector

This subsection is presenting the current status of Artificial Intelligence in the Indian education sector.

Artificial intelligence is already there in various manufacturing and services sector in India and has proved as a game changer. In recent years it has started touching the education sector also; but it has not reached to the level of disruption and radical change [29]. There is ample of scope that AI will be a boon for the education sector as well in India going by the size of the market which it can provide to improve the learning and life outcomes for students.

In the document of National Education Policy (NEP) -2019, the Ministry of Human Resource Development (MHRD), Government of India has envisaged that AI will play a very significant role in the coming years of Indian education system; right from the kindergarten to the PhD level of education. AI will strengthen the current working force and the resources available in the Indian education system[28].

The AI in Indian education system has recently emerged; its wider use will definitely bring out significant changes in the overall experience of the students. It will affect every aspect of the education, from governance to the experience of teaching and learning[8]. Massification, especially in higher education sector of India has been happening in recent years (though it is already there in school education), will be a booster for the induction of AI in various areas of functioning of educational institutions because of workload.

AI can play a very prominent role in Indian education system in providing feedback and guidance to the students, learning analytics, evaluation of curricular material for their quality, adaptive learning etc. There is huge potential to infuse the AI in various domains of education sector creating a unique experience for learners[4]. Sustainable Education in India through Artificial Intelligence: Challenges and Opportunities

There is lack of teachers in the education sector of India. *Data from research firm Tracxn recommends that more than 300 Indian startups use AI in their core product. About 11% of them are a part of the educational sector.* With the coming time it is going to take up the pace in market through customisation, data crunching and through various modifications in present structure of functioning of education sector [15].

3 INDIAN EDUCATIONAL ECOSYSTEM: AN OVERVIEW

An important aspect of the needs in education sector is the variation it possesses. To accommodate the diverse requirements of the educational organisations, first approach is to understand it thoroughly. This section will give a glimpse of the issues which Indian education system is facing.

Recruitment of students in the presence of inadequate infrastructure with high student-teacher ratio ¹ creates difficulties for the teachers and academic staff in performing their duties effectively [30]. While one reason for this skewed ratio is the shortage of teachers in India and since most of the academic interactions happen in face-to-face format, it severely affects the quality of such interactions. This process requires a complete overhaul change in the teaching-learning activities happening in the educational institution.

While there is a dire need to divert most of the attention of policy makers and other stakeholders involved towards lowering the student-teacher ratio, technological interventions with the emergence of modern methods such as artificial intelligence have an ever increasing role to play. In this context, focusing on providing personalised learning experience for the students can be a good option. Another good step can be making the Open Educational Resources (OER) available for the students in accordance with their needs, further linked to their continued evaluation and assessment.

Another major issue is the alleged unfair recruitment of students. Most of the interdisciplinary subjects can be applied by students of any background (stream); entrance exams usually include Multiple Choice Questions (MCQs) following with an interview. Teachers have experienced that majority of the students do not have the required intent and zeal to undertake and proceed with the interdisciplinary programs, as the screening process of using the objective method of MCQs and interview is not enough to understand their intent of choosing a particular course or program. If there will be an AI based platform which can gather the data based on some variables from the applicants when they apply for the program; it can significantly improve the process of understanding their intent in a less biased and transparent way.

Guidance and counselling of the recruits/students in an educational institution is a determining part in maintaining their worklife balance. There is already massification going on in the Indian educational institutions which represents students from different religious, caste and ethnic groups which is leading to more inclusive educational campuses. With the increase in Gross Enrolment Ratio it is being estimated that in coming time it will be more from the category of first-generation learners. In this inclusive nature of the educational campuses there is also need of proper guidance and counselling[33]. Students do face a lot of professional and personal issues in their work-life which needs a healing approach to counter those issues. For example, if a student is facing issues in his/her personal life it may get reflected in the grades. But most of the time it does not get into the notice of administration/teachers. A conducive platform which will be able to track the issues students are facing in personal and professional life and also their mental health will be very useful for initiating the guidance or counselling process. There is need to consider the relevance of guidance and counselling services in the educational institutions of India. Policy makers have to give importance to this for improving the overall experience of students in the educational campuses.

Conducting examinations for the students and doing evaluation accounts in the list of functions which educational institutions have to carry out. It is a very hectic and lengthy work for both the teaching and non-teaching staff; and needs some new ideas through which it can be made less tiresome and can be conducted in less time than the existing one with transparency. Also, the examination system which is pen-paper based (usually happens at the end of the session or end of the semester) cannot evaluate the students properly; and the process of grading the students based on their performance is not transparent enough too. The existing system of examination in Indian educational institutions needs drastic revision, otherwise major issues related to execution of whole examination process will persist[14]. Academic community and policy makers have to be more cautious about it and must look for the proper remedies and alternatives. It is important to focus on continued evaluation; and through the intervention of some technology.

Quality assurance in the educational institutions requires a lengthy process of monitoring and evaluation of their performance, involving lots of paper work, which many times leads to corruption because of minimum or no checks and balance on the whole process. This whole process is related to funding also. There are ways and methods which state that quality has to be linked to funding of the educational institutions. In India, National Assessment and Accreditation Council (NAAC) keeps the track on the quality issues of the higher educational institutions in India and based on the recommendations of the team's appraisal report grading is done[11]. But there are many said and unsaid complaints regarding the biasedness of the team members. For this there is need of a system/platform which based on variables of different quality parameters (which can give a holistic picture of the performance of the institution) can assess the performance and allot the grades with transparency.

The interaction in the classroom between teachers and students is a significant part of the educational institutions including university education. This is the model that has effectively been in force for about 1,000 or 6,000 years depending on whether one sees Bologna or Nalanda as the initial reference point; also Classrooms above a certain size can become ineffective.... Teaching-learning process in the educational institutions, a pressing issue which students usually face is which course/paper to choose? They hardly get a platform where they can get answers to their probable queries related to their choice. Many times they go ahead for the choice either by the peers pressure/influence or sometimes by consulting their teachers,

 $^{^1\}mathrm{A}$ report of India Today news portal mentioned about the student-teacher ratio in India, where it said that India is behind Brazil and China in maintaining student-teacher ratio

subject to their availability for discussion or interaction separately. Students will definitely like a platform which will provide them answers to their queries for the selection of course/paper. So, with time and the changes that are taking place in the educational institutions regarding the increase in the strength of students there is need to discover other alternatives in terms of educational technology for the interaction between teachers and students[27].

Student loan system in India mostly caters the need for technical courses. Many times students face issues in getting their loans sanctioned from the institution. It is usually based on the criteria of low income of parents/guardian; but this criterion alone is not enough for sanctioning and continuing with the scheme. Hence variables related to their performance in academics and other nonacademics can be utilised for keeping the process more efficient and transparent. A technological platform which is transparent and efficient in covering this issue will be a boon for this.

Planning is another dimension which lacks efficiency at present in Indian education system. At the level of regulatory authorities, they are not able to advice the concerned educational institutions to update their curriculum regularly. It is because they are either overburdened by other works or the people who are taking care of it are not much competent to understand these issues. A platform which can identify the issues, that whether the curriculum is updated or not? Since how long it has not been updated? And also can focus on the contents of the curriculum which is no more relevant. It can suggest to the educational institutions that what is to be removed, replaced or updated in the curriculum content.

Administrative procedures of educational institutions plays a crucial role in their functioning. For example, it includes the applications (as part of grievances, leave etc.) submitted by the students or other stakeholders of the institution. However, since there is a hierarchical decision making involved, the students usually face harassment not only in terms of time taken for the overall process but also in terms of the embarrassment they face on daily basis for their applications to get processed. It is important to address these issues through some technological innovations and making the administrative processes convenient and transparent for the students.

Performance and accountability of teachers in educational institutions has to be ensured for the proper functioning of the teachinglearning process. It is also significant for the career growth of the teachers, through Academic Performance Index (API) scores it is evaluated. But the API score process is not smooth; teachers specially taking up the undergraduate classes have a very hectic schedule and do not get time to fulfil all the criteria of API score. Summarily, there is disenchantment for the API score process amongst the teachers. Also, the process of getting the feedback of students is very old and mostly pen and paper based, many times not transparent[10].Further Das and Chattopadhyay (2014) said, In a system which thrives on malpractice, and the inherent problem of quantification of academic performance, increasingly, teachers are resorting to alternative means to accumulate points that are best described as unfair. There has been a proliferation of journals, most of which lack credibility. Paying for publication has become common. The participants in a seminar are now more interested in certificates for participation and presentation rather than active engagement in meaningful deliberations. The renewed vigour among teachers and

young researchers to publish is explicable by the need to score points. Though the API seeks to curb malpractices, in reality, there are an increasing number of cases of rampant abuse of the system[10]. If there will a better technological platform to replace this process or do some innovations within this API score process it will fetch satisfactory results for evaluating the performance and accountability indicators.

Macro level administrative issues are existing where there is need of proper coherence and coordination amongst various regulatory bodies, educational institutions and policy making bodies. For example, if a new course has to be started the particular department of the concerned educational institution has to take approval from various regulatory bodies; organisations and the process is so complicated that many times the funds which are supposed to be allotted for the same gets diverted for some other work because of the delay in launching of course by the department (because of the lengthy and tiresome process of getting the approval). The department has to wait for the funds for one or more years. There are several other issues which arise out of the consequences of not having coherence and coordination amongst various regulatory bodies, educational institutions and policy making bodies. A system devised for resolving this issue of coherence and coordination amongst various regulatory bodies, educational institutions and policy making bodies will be an advantage for smooth and transparent functioning of the system.

Non-teaching work of teachers is one of the prominent duties or organisational tasks which they have perform in the educational institutions. It may be related to evaluation, some paperwork for the students, weekly/monthly reports, order and procurement of study materials, interaction with parents, etc. Much valuable time of the teachers goes into these non-teaching activities. If these activities and functions can be processed through the AI based systems it will be a boon for the teachers and they can get more time to focus on their activities. AI systems can do give a first-line interaction with parents and provide access to resources for proper feedback as per requirements.

4 SCOPE OF ARTIFICIAL INTELLIGENCE: THE ROAD TO FUTURE

In the context of the Indian system of education there is enormous potential for modern disruptive technologies to make an impact. While one of the reasons is the emergence of straightforward rule based procedures which simplify most of the ambiguity in administrative procedures, there is absolutely no doubt that the rise of data leading to data driven policy making has brought the idea of analytics at the centrestage. We will attempt to explore the potential of artificial intelligence as one such emerging and disruptive technology in the domain of education by viewing it through the spectrum of various pillars supporting the educational ecosystem.

4.1 Recruitment

In India, for the Joint Engineering Entrance (JEE)- Main April 2019 exam, a total of 10,51,508 candidates had registered. For Paper 1, 935741 candidates registered and for Paper 2, 115767 number of students registered. Each of these individuals will be acting as unique individual data points with information distributed across many attributes such as personal attributes (for e.g. age, gender etc), performance attributes (for e.g. marks scored in each of subjects and under different topics), demographic attributes (for e.g. place of residence, place of examination etc.) and many such features. The idea of having such a massive amount of recruitment information while at once leads to analytics for data driven policy making to improve performance of under-performing demographic regions as an example, it also calls for utilising the data gathered to create personalised recommendation systems to aid during the recruitment. Such a recommender system has enormous potential to reduce the dropout rates from higher educational institutions where students mostly suffer from the lack of interest about the assigned course or program and institutions suffer from the double dilemma of deciding the criteria for prioritising students for various courses and then monitoring their performance for any possible transfer.

4.2 Guidance and Counselling

Some challenges that still pose grave threats to the healthy functioning of an educational ecosystem are the phenomenon of dropping out and committing suicides. While in India, the dropping out still remains at large a significant problem, the suicides have also been emerging as a serious concern. There are various reasons for the dropout ranging from socio-economic attributes to lack of interest in education. To get the early warning regarding the dropouts can be taken into consideration for countering this issue of dropouts. As many as variables can be formulated to make a system which can track and predict the early warnings regarding the students who can dropout in future so that maximum retention can be achieved. While predicting these phenomena remain at large in the hands of academic instructors directly in contact with the person at risk, technological solutions emerged recently have drawn the attention towards some early warning methods using artificial intelligence and machine learning models based on the academic performance and extracurricular data of the person-at-risk. In this context, methods similar to the one adopted by the US Army, known as Army STARRS[20] shed some light. Similarly, there have been some success in predicting dropouts in the Massive Open Online Courses (MOOC) [22]. Such methods are highly scalable and maybe adopted in the context of educational institutions as their worthiness is already proven in e-learning context. However, it is a well known fact that such early warning systems are effective only when there is a significant participatory effort from all the stakeholders involved in the interaction. It is therefore necessary that mutual trust building must be encouraged simultaneously than mere functioning of the technological interventions deriving intelligence out of such interactions.

4.3 Examinations

While there is already a significant amount of progress in adopting some of the best practices for conducting examinations for various examinations and appointments, there is still a long way to go. At the present, the limits of technological interventions are restricted to the domain of objective question answering based on multiple choice questions where optical mark recognition methods are already deployed and operating since long, however, there is not much done for evaluating subjective question answer based schemes which still constitutes a major chunk of examinations conducted in the country. The recent advances in Natural Language Processing (NLP) powered by fast computing capabilities of the cloud have already lead to creation of frameworks which are able to generate question-answering models. Such models once trained on the examination-specific corpus may act as model answers of questions and the candidate answers may be scored on the basis of similarity of content with the model answer. It will not only reduce the workload of the academic staff but also has the potential to improve the quality of examinations where individuals can be evaluated on both objective as well subjective standards which at the present seems difficult to enormous time and material resources needed to conduct subjective examinations.

4.4 Teaching and Learning

The idea of a course recommender system based on the skill, past performance of the student and the majoring subject as features is long debated but still awaited by the students in institutions of higher learning specifically. The application of machine learning algorithms for recommending courses in e-learning based environments has already been a major success [1, 9]. Such systems take into account the historical course selection records by the student. Now, when most of the institutions have already adopted to their own enterprise resource planning platforms [35], these intelligent systems have the potential to build robust models using the data of such platforms. These systems have the potential to improve talent management where students will chose the courses they may study based on their career track and majoring subject instead of following only their peers while enrolling for semester courses.

4.5 Finance

In the recent years, a huge boom in the digital payments and credit issuance has been observed. One of the reasons behind that is the emergence of various Application Programming Interfaces (APIs) providing a variety of validation data about an individual's attributes. The providers of such APIs range from governments and huge corporate to even emerging startups. Such an ecosystem has facilitated the approval and sanction of credit cards using machine learning methods which is one of the reasons behind the digital payments being popular [12, 21, 31]. Educational institutions have a huge potential to benefit from the arrival of such technologies as they may go digital for their student finance procedures which includes deciding most relevant candidates for scholarship sanction and renewals, prioritising students for decision making for granting financial aid etc.

4.6 Planning

Generally, the idea of planning is considered a participative process. However, due to lack of adequate infrastructure and resources, it remains restricted in the hands of the top brass to plan for the entire organisation which goes against the ideas of participative and decentralized planning. Artificial Intelligence has immense scope to make planning more inclusive by considering the reviews and feedback which institutions receive in-house or from external sources and analyse them to make demands of every stakeholder visible. Such a process utilising Named Entity Recognition tools of Natural Language Processing can be deployed for making and updating topics and courses in syllabus based on student demand or to decide which areas to allocate more resources for the infrastructure development of the institution. With the rise in the demand of explanability mechanisms, such tools will not only promote inclusiveness but also ensure transparency.

4.7 Administration

Routine administrative procedures also have a lot of scope to gain from the recent advances in artificial intelligence. For example, the application of artificial intelligence for making smart decisions about sanctioning loans has already been implemented and being used by many bank administrations [16]. Therefore, the idea of having a smart system that can decide the sanction of student applications for leave, course change or even foreign exchange seems feasible and relevant. Most of the organisations already have in-place procedures to process such applications digitally which makes available a huge volume of data for training sophisticated machine learning algorithms if there is a need to go beyond the simplified rule based decision making. Now, although it appears exciting to hear about the automation using the data, it must not be forgotten that in such administrative procedures, the most important phenomenon is the idea of human accountability. Therefore, while implementing such mechanisms, it must be assured that systemic accountability is ensured along with a human in the loop mechanisms to periodically review the grievances against the automated systems.

4.8 Accountability and Performance Monitoring

Almost all of the educational institutions have a practise of reviewing the capabilities of the academic staff in terms of post-semester reviews in which all the stakeholders participate how had been the part of the specific educational ecosystem. In such reviews, often there are questions based on both quantitative as well qualitative indicators. While the quantitative responses are fairly easy to analyse, the qualitative responses are often extremely difficult to understand in an environment where deadlines are rigid. For example, it is a difficult to analyse polarity of the textual reviews about a particular faculty teaching a specific course but it becomes worse when we attempt to make a sense of bad reviews only in order to create target the deficiencies and eradicate them by drafting guidelines for all the academic staff. Now, such difficulties can be addressed by involving the sentiment analytics based polarity scorer which can be coupled with entity extractors to extract specific reasons for the criticisms or appreciations. It can not only improve the present system but will also make the system more fair, accountable and transparent. However, even such systems are not fool proof by assuming that decisions are made by computer which is generally assumed to be unbiased. Since, it is the data based on which the decisions such as sentiment scoring are made, it is therefore essential to identify and mitigate any human bias in the data before it is used for modelling.

5 CHALLENGES, OPPORTUNITIES AND CONCLUSIONS

While we have discussed some of the major challenges in the education system in the context of India, such challenges are equally valid for most of the developing economies. The ideas of having applications of modern technological advances in artificial intelligence pose a great hope for making educational sustainable not only for India but for the world as a whole. However, in order to exploit most from this available opportunity, we need to have institutional frameworks along with government interventions. In other words, for developing algorithms for smart decision making, either based on rules or driven by data, we need either well established rules for decision making or extensive amount of data for training models.

In the context of India, the Government of India has adopted to institutional frameworks which allow for structured formats for data collection across a wide spectrum. Such interventions have led to the creation of National Institutional Ranking Framework (NIRF) [25], Unified District Information System for Education (UDISE) [19] (initiated in 2012-13 integrating DISE for elementary education and SEMIS for secondary education is one of the largest Management Information Systems on School Education covering more than 1.5 million schools, 8.5 million teachers and 250 million children) etc. Further, the adoption of National Strategy on Artificial intelligence by the National Institution for Transforming India (NITI Aayog) is another welcome step in this regard.

However, despite having such huge data-sets and policy based interventions, the procedure for applying artificial intelligence is not as simple as it appears. There are inherent challenges associated with artificial intelligence algorithms which must be addressed. Some of them are described here-

- (1) Privacy and security
- (2) Fairness and Bias Correction
- (3) Interpretability and Transparency
- (4) Governance, Accountability and Legal Frameworks
- (5) Human Resource and Finance

It is therefore important that we must begin the debate on the ethics and safety of intelligent systems instead of merely developing large scale applications which are designed without considering human rights and issues of public importance.

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Developing a Crowdsourcing Application for Responsible Production in Africa

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ABSTRACT

With modern supply chains spanning the globe, materials or components that companies use in their products may be sourced from areas prone to injustice and human rights abuse. A major challenge stakeholders face is the gathering of accurate data regarding producers in these areas. In this paper we introduce CARPA, a web application designed to gather reports on incidents and initiatives related to responsible production through crowd-sourcing. We describe its user-centric iterative process of development as well as its design and how this is influenced by the application context. Finally we discuss the challenges faced and the way forward.

CCS CONCEPTS

• Information systems → Crowdsourcing; • Human-centered computing → Accessibility design and evaluation methods.

KEYWORDS

crowd-sourcing, user-centered design, progressive web application

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1 INTRODUCTION

Modern supply chains span the globe with companies and individuals from different countries each providing materials or producing some component part. This can sometimes include producers and suppliers who operate in countries or areas with weak institutions or low governance. Producers in such areas may be prone to suffer greater injustice therefore addressing these problems was seen as an important enough concern that responsible value chains, which entails, among others, offering decent work conditions, fair wages and transparency throughout the Value Chain, was included as part of the United Nation's Sustainable Development Goals (SDGs) [3]. Besides the SDGs, companies have also been encouraged by public pressure and stakeholders to ensure that their products are made in a responsible manner, ensuring that they do not source materials from or produce in areas of conflict or injustice. At the same time, these companies and their supply chains are a dependable source of income in said areas where alternate means of income are hard to find at an individual level and at a national level [14].

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The challenge associated with production in areas of low governance or areas described as 'post-conflict' is the potential for mistrust between stakeholders in the area [9] brought about by periods of conflict or abuse of civilians. This has led to difficulties gathering empirical data in such areas [7] as there is no single source of potential information seen as impartial or unbiased. For this reason, new methods of gathering data in low-governance areas are needed.

The rapid adoption of mobile and Web technology is one such method. It has allowed individuals to access information previously difficult to obtain, as well as engage in communication with people in their immediate environment and beyond [15]. Therefore in areas in which institutions may not be able to assist in problem solving and enforcement, individuals might rely on community or crowd-based remediation and problem solving instead, enabled through technology.

The CARPA project has set out to do just that. Through developing a Crowd-sourcing Application for the Responsible Production in Africa (CARPA), the project aims to engage local stakeholders

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in areas of low governance in order to facilitate discussion and promote dialogue within communities and with stakeholders in order to help provide a resolution to incidents as well as keep track of a number of metrics related to the areas the application operates in. Although initially users will be from NGOs, local government organisations, and local community leaders, the CARPA application is intended to be opened up to all interested parties, including companies and investment funds, in future updates. This allows for cross-organisational collaboration in the resolution of incidents which occur in the shared community or environment.

The CARPA application is intended to be free to use and remove barriers to its adoption to encourage its use for local stakeholders in low-governance areas. It is designed to have minimal hardware requirements in order to run on the user side as a large number of mobile phones bought in less-economically developed areas tend to be cheaper and therefore computationally less powerful and suffer from storage and bandwidth restrictions. The application is also designed to be easy to navigate to allow adoption by those who may not be highly technologically literate. In the following sections we describe the iterative design process and identify challenges in developing crowd-sourcing applications in low-technologically literate and low-governance areas. These include challenges around user authentication, application usability, and the application platform.

2 THEORETICAL BACKGROUND

In this section we introduce the concepts that act as a foundation for our paper and its associated project.

2.1 ICT4D

Information & Communication Technology for Development (ICT4D), is the term given to research and projects involving the use of ICT with the goal of socioeconomic development, most commonly targeting those of lesser material wealth in less-economically developed countries. ICT4D encompasses a variety of fields of research [16] with varying areas of attention and differing measures of outcomes. ICT4D 2.0, as an upgrade to ICT4D, encourages the use of mobile communication and technology as there is a wider spread adoption of such technology in developing countries [8].

The CARPA project is designed with a particular focus on reaching end users on their platform of choice, initially through the use of mobile apps alongside a website and thereafter through its transformation into a progressive web applications to be compatible with any web-enabled device. The application is initially designed for use in sub-Saharan Africa, with a focus on Mali, Democratic Republic of the Congo and Rwanda. CARPA is not intended to be a solution to the challenges the users will face but rather as a platform for the users themselves to provide solutions. This form of problem solving is best described by the term crowd-sourcing.

2.2 Crowd-sourcing

Crowd-sourcing in general can be defined as an application or project which enlists a number of humans to come together to solve a problem. Projects which are said to be taking advantage of crowd-sourcing are those which achieve or explicitly address certain criteria[6]. Crowd-sourcing projects take into consideration user recruitment, the contribution of these users, the combination of these contributions in order to solve the problem, and the evaluation of users and their contributions [5].

CARPA differs from typical crowd-sourcing applications in that it is not the creators or owners of CARPA who outline the problem which needs to be solved but rather users themselves can report a problem or incident onto the CARPA platform. Furthermore, CARPA differs from other incident reporting tools in the crowdsourcing space in that the application is designed not only to crowdsource the reporting of incidents but also their resolution through the discussions which are open to users as well (cf. [11]). Users can contribute to these discussions based on previous experience, professional knowledge, or a combination of the two.

With users being a central part of the success of the CARPA application, a user-centric design approach is most likely to succeed.

2.3 User-centred design

Recent literature has promoted a greater involvement of end users in the development process of ICT4D projects [2, 4]. Said involvement should be regular and form a prominent part in justifying the design decisions taken.

User-centred design (also referred to as human-centred design) can be referred to as: "an approach that puts human needs, capabilities, and behavior first, then designs to accommodate those needs, capabilities, and ways of behaving" [10]. The CARPA application had to be designed with users in mind, especially given that many users in our ICT4D application context might not be familiar with a variety of (crowd-sourcing) applications. The CARPA application undergoes cycles of development, some which occur over period of months while others can be considered rapid-prototyping, whereby changes are made in a short amount of time based on user feedback to address issues raised. This cyclical approach allows us to quickly make changes and updates to the application and test these changes on potential end-users in regularly scheduled workshops.

3 APPLICATION DESIGN AND DEVELOPMENT

In the following section, we describe some of the major design considerations of the CARPA application as well as describe the cycles of development it has undergone to reach its current version.In each cycle, a variety of design changes were made to increase functionality and usability.

3.1 Application design outline

The language of the CARPA application is important to its success as users feel more comfortable using a language they are familiar with. For this reason the CARPA application allows users to select between English and French user interfaces. These two languages were chosen as they are the more predominant international languages spoken in western and central Africa. There is also consideration for including translations into local languages as a future development.

As the CARPA application is intended to be open to the general public, the content they provide needs to be verified and, if necessary, moderated. Upon registering an incident users are encouraged to provide supporting evidence in terms of images or Developing a Crowdsourcing Application for Responsible Production in Africa

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supporting documents. The addition of supporting media is encouraged throughout the discussion until a resolution is found. Should a user deem a post or discussion to be inaccurate throughout the discussion process users can report posts for review by CARPA moderators.

Due to the sensitive nature of the discussion which may take place within the application, user privacy is something which is taken into consideration. In order to accommodate this users who raise incidents or add contributions within the application can choose to use their real name, as shown in Figure 1, or can use a self-chosen pseudonym, Figure 2, to hide their identity should they feel their safety would be threatened.

CARPA

Report new incident

Using this form you can add a new incident to CAR is not already in CARPA. If you wish to contribute tc "Discussion" section of the incident.

Title

Please give your incident a title, which summarizes the incident

Description

Please describe the incident, as detailed as possible

Post using real name (Robert Bwana)

Figure 1: Screenshot of CARPA while using real name to raise incident.

3.2 Application design challenges

One recurring challenge is that of *user authentication*. CARPA as an application is intended to be open to stakeholders with different backgrounds and with different objectives including, but not limited to, incident reporting, incident resolution, monitoring of incidents, moderation of discussions, and reporting of new initiatives. These can range in size from private individuals and self-employed producers to multinational enterprises and national government agencies. It is necessary to identify and authenticate different users in a convenient manner which caters to respective capabilities and use cases while maintaining an appropriate level of security.

A second challenge is related to the *application platform*. In order to ensure the intended audience has access to the CARPA application it is necessary to ensure that it is accessible via multiple platforms and on a variety of devices. An early assessment showed that the majority of the prospective users are in possession of smartphones and therefore we look at deploying the application to this platform (cf. [12]).

CARPA

Report new incident

Using this form you can add a new incident to CAR is not already in CARPA. If you wish to contribute tc "Discussion" section of the incident.

Title

Please give your incident a title, which summarizes the incident

Description

Please describe the incident, as detailed as possible

```
Post using your pseudonym (roro)
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Figure 2: Screenshot of CARPA while using pseudonym to raise incident.

3.3 Cycle 1

This cycle commenced with the project kickoff workshop held in May 2018. The design decisions made in this cycle were based on standard development practices and the experience of the CARPA project team. This cycle concluded with the workshop held in Mali in March 2019 whereby the application was presented to a group of prospective users for testing and to gather feedback.

3.3.1 Users and user authentication. In this first iteration of the CARPA application, users were authenticated using self-selected usernames and passwords. These would be chosen by the user upon registration and would be needed to log in to the CARPA application. This method was chosen as it is a tried and trusted method of authenticating users and could be implemented without complication.

3.3.2 Application Platform. The app was initially designed as two modules: a mobile application and a website. The mobile application was written to be released on the Google Play Store for Android-based devices and on the Apple iStore for iOS-based devices. Figure 3 shows a screenshot of the homepage once a user has logged in featuring a list of incidents which have been raised. The website was intended to provide an administrative view of the application as well as quantitative elements of the application.

3.4 Cycle 2

The second cycle began once the feedback from workshop 2 was gathered in Mali. This saw the most sizeable changes in the CARPA application based on the comments and suggestions received from the workshop participants as well as from observations by the CARPA project team in attendance of how the application was being used by the participants. The changes made to the application WebSci '20 Companion, July 6-10, 2020, Southampton, United Kingdom





Beating at Kebua mine

A worker at the mine was beaten after he protested against working in bad conditions. He was hit by the chief of the mine and did not get paid that day.



Figure 3: Screenshot of CARPA app sample homepage showing incidents as items on a scroll-able list.

were presented and tested in another workshop of potential users held in Kigali, Rwanda in September 2019.

3.4.1 User authentication. During the workshop, we observed that the username and password combination was not ideal for a number of participants. Either since too simple passwords were used or participants forgot login credentials frequently. It was also noted that participants had difficulty with the process and concept of requesting password resets through email. For these reasons an alternate user authentication method was considered.

This new user authentication method was that of a token-based authentication. Users would enter their mobile phone number and an SMS containing a 6 digit token would be sent by the CARPA application to their number, provided the mobile phone number was a valid one and of an already registered user in the system. The user would then be required to enter the token sent via the 2nd channel into the CARPA application to authenticate themselves. This was designed as a simpler alternative which would no longer require the user to remember login credentials. This approach was implemented into the system to be tested in the following workshop.

3.4.2 Application platform. Based on feedback of the first workshop, CARPA was re-engineered as Progressive Web Application (PWA) [13], with a standard interface across all platforms. This meant a common interface and a common platform for all users. The use of a progressive web application would mean a reduced data storage footprint on the users' mobile devices which was observed as a challenge during workshop 2. As progressive web applications are downloaded similar to traditional web pages this would solve the storage-space problems encountered. Figure 4 shows an image of the CARPA application after being re-engineered as a progressive web application.

Additionally, as progressive web applications are treated similar to traditional web pages the use of PWAs would allow the CARPA application to be updated on the server side with requiring the users to download the updates to the application, a concern which they raised during the workshop.

3.5 Cycle 3:

The third cycle began with the feedback obtained from workshop 3 held in Kigali in September 2019.

3.5.1 Users and User authentication. With the token based system, users who were able to receive the token via SMS reported a simpler login experience. The only problem encountered was that users who had travelled from a different country encountered problems with receiving the SMS when sent to their local mobile phone number. This may result in users not being able to access the CARPA application if they are outside of their usual country and not able to receive SMS where they are. It was therefore necessary to introduce an alternate channel which could be received universally. It was decided to allow for users to select to receive the token via email rather than SMS. Figure 5 shows the CARPA application login page where users can select which channel they wish to use to receive the login token.

3.5.2 Usability evaluation. In addition to focus group discussions, we also conducted a quantitative study into the usability of the application. For this, we used the System Usability Scale (SUS) [1]. In total, 21 participants (14 in the first and 7 in the second workshop) judged usability of the application using the 10 SUS questions. This resulted in a SUS score of 81.7, which indicates a high perceived usability. While the setup of the evaluation (only one system tested, in a workshop setting) does not provide us with conclusive evidence of the usability, the outcome matches the overall very positive response in the focus group discussions.

3.6 Cycle 4

The fourth cycle began with the conclusion of workshop 4 held in Gisenyi and Cyangugu, Rwanda in March 2020 and is at the time of writing still in progress. In the two workshops the system was demonstrated and prospective end users were allowed to interact with the system. Next, they were asked to register for the platform and test out several of the function of the application. They then were asked to perform a series of user tasks using the

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Figure 4: Screenshot of CARPA progressive web application sample homepage.

system, including. 1) Browse the application; 2) Report an incident; 3) Contribute to other incident; 4) Reply to a report from another participant and 5) add an image to an incident report. Participants were then asked to reflect on the platform and the usability of the application.

3.6.1 User authentication. Now, when unable to receive an SMS, users were able to log in using the alternate email channel when shown how to do so. For users who were comfortable with accessing emails this was not a problem, however there were a few users who found it cumbersome to have to log in to their email accounts on their smartphones while also switching to the CARPA web application in order to enter the token. It was agreed that we would look into further authentication options which would be suitable based on the complaints that they raised.

3.6.2 *Usability.* Having experienced the application, users requested the addition of filters in the main newsfeed. While users can currently select the incidents and initiatives they themselves have raised, they requested the addition of a filter of the general posts so that they can find posts which they feel would be more relevant to them or to which they can better contribute.

4 DISCUSSION AND CONCLUSION

In this section we discuss the lessons learnt during the development process so far as well as the next steps for the CARPA application and project.

4.1 Design decisions

Through the cyclical approach to the development of the CARPA application, we have been able to benefit from the first-hand experience of users and involve them in the development process. This has resulted in changes in the application, both major as well as minor. The regular interaction with users has allowed us to understand their expected interactions with the CARPA application as well as their suggestions for further improvements.

The most notable change brought about was in the application platform. Whereby initially the CARPA application was written as a mobile application, the problems encountered with bandwidth and storage space resulted in the change to a progressive web app. This new platform requires less storage space and updates can occur on the server-side instead. In order for ICT4D projects to succeed, they must take into consideration or take advantage of the infrastructure in place in their environments [8]. The use of progressive web applications in these environments could remove barriers in the adoption of the projects. A more structured comparison of mobile WebSci '20 Companion, July 6-10, 2020, Southampton, United Kingdom



Figure 5: Screenshot of CARPA login page showing the multi-channel login option.

applications versus progressive web applications is an interesting area for future research.

User authentication remains a challenge. While username and passwords may have seemed straightforward when initially designing the system, through interactions with users this assumption was proven false. Despite the further attempts to find an ideal authentication method, this still remains an important aspect of the CARPA application which needs to be completed. It may therefore be necessary when designing applications for less technologically-fluent users to consider alternative authentication schemes.

4.2 Future work

The CARPA application will be continuously improved in next development cycles. Firstly, a suitable authentication system needs to be implemented which is secure and easy to use. This remains the biggest challenge in terms of the fundamental design of the CARPA application. Various authentication schemes are to be considered which will then be implemented and tested with the users once again.

Due to the intermittent Internet failures in some of the environments in which the CARPA application is expected to be used, various other methods of interaction with the CARPA application are being investigated. One such method is the use of Interactive Voice Response functionality to allow phone calls to act as an input method into the application. Another method which has attracted interest is the use of text messaging and chat applications to interact with the CARPA application. Besides the inherent challenges in these technologies, we will have to consider how the ethos of crowd-sourcing and discussion-based problem solving can be managed when using such methods of interaction. Users reported that despite the low numbers of cases being reported at the moment, it can still take some time or an inconvenient amount of scrolling until an incident related to their area of expertise or their geographical area appears. Filters are therefore planned to be introduced to allow users to filter the incidents and initiatives to their preference. An automated filtering can also be considered based on prior user contributions in order to maximise the benefit a certain user can have in the problem solving process.

To further expand the accessibility of the CARPA application, sub-modules are being considered to compliment the application with a non-text-based input and output interaction system. These include, but are not limited to, the use of images and icons to complement written instructions and descriptions as well as the use of a voice-based system to allow interaction by users who may not be as textually literate.

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Power Inequities: Observations on the Development of Information and Communication Technologies, from an African Place

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ABSTRACT

Using power to achieve political goals is not a new strategy. This paper unpacks observations about the use of power in the development of information and communication technologies (ICTs) in Africa. This analysis shows the use of unequal powers by non-African academics, development actors and technical experts (including the power to set the agenda, fund and build), embedded deeply in the current structures of ICT development for Africa. It also looks at how benefits accrue to non-local development actors and outlines some of the unmitigated risks for Africa.

CCS CONCEPTS

• Information Systems; • World Wide Web; • Web Applications; • Social Networks; • Social and Professional Topics; • User Characteristics; Computing / Technology Policy; • Applied Computing; • Human-Centered Computing;

KEYWORDS

Politics, power, ICT, Africa

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1 INTRODUCTION

The advantages and blessings of information and communication technologies (ICTs) are well established in the literature and understood by the private sector. The development of ICTs has been heralded as a driver of economic growth, a revolutionary force in learning, a factor in the increase in productivity through what is called the 4th Industrial Revolution, and an important part of the management of health, including the management of pandemics. Some advocate for access to ICTs to be seen as a human right. Such narratives extol the benefits and opportunities provided by ICT for the connected. Solutionists argue that 'unconnectedness' needs to be (urgently) solved by ICT developments so these benefits can be imparted to all.

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However, there is an array of other voices that claim that ICTs are increasing inequality, sustaining digital imperialism, and providing a new vehicle for colonialism, a vehicle that enables the extraction of personal information and surveillance, and that facilitates the privatisation of the benefits and socialisation of the costs.

Power structures are deeply embedded in the current ICT structures and wielded to gain political advantage at all levels. Here, power is regarded as the capacity or force to influence events, in this case in ICT development. In this paper, I assess the wielding of power by foreigners, those who influence events in geographical locations and situations they were not born into and do not live permanently. I provide a preliminary reflective analysis of my experiences with geo-technopolitics in Africa and observations about foreign actors enacting their (open or hidden) political goals through interactions in knowledge systems (like conferences) and in the development and operation of ICT artefacts. Geo-technopolitics emerge when ICT equipment, knowledge systems, and extraneous models of intervention are imported for use outside of the context in which they were conceptualised and designed.

The aim of this paper is to bring observed power-enactments by foreign experts to the fore. The paper does not deal with the underlying structures of hegemonic power embedded in ICT systems and their governance. It is hoped that the paper will provide an (uneasy) checklist, augmenting discussions on ethical behaviour in ICT development.

In the sections that follow, I first describe the method used, after which I identify and provide insights into the observed wielding of power by foreigners. Subsequently, I provide an analysis of the agency of these powers, structured according to frameworks provide by Burawoy and Appiah. In the final part, I discuss these agencies with respect to the African environment, followed by some brief conclusions.

2 METHOD

For the past 20 years, I have lived in Zambia and Zimbabwe and travelled extensively in Africa. I have disclosed my various positions in previous works, especially when assessing foreign solutions imported into Africa [33]. For this paper, using Burawoy's extended case method [6], I have analysed over 10 years of participant observations during national and international conferences in Africa, Europe, and the United States of America. Between 2010 and 2020, I attended over fifty conferences in various disciplines, of which over twenty focused on ICT; other conferences pertained to mechanical engineering, mathematics, energy, and health (full list of conferences available at http://www.vanstam.net/gertjan-van-stam).

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I augment my observations with reflections on 10 years of conversations on the subject of the use of power by foreigners with academics in their African working environments.

I did not keep numerical records of the frequency of the incidence of the observations presented in this paper. The observations relate to a varied mix of foreign actors. Some are quite conscious of their privileges and actively avoid using their power, others wield a selection of them; there is also a limited – but quite visible – group that actively use them, whether consciously or not.

The observations shared in this paper were reflected upon with African and other non-European and non-American peers. In discussing these sensitive issues, I used an interactive approach, which Franz Fanon describes as follows: "I took advantage of a certain air of trust, of relaxation; in each instance I waited until my subject no longer hesitated to talk to me quite openly – that is, until he was sure that he would not offend me" [11], p. 128.

3 OBSERVED POWERS

This section presents the different kinds of powers I observed being used by foreign stakeholders engaged in ICT development in Africa.

Power to categorise. A dominant hegemony depends on universalism, an ideology that is based on the existence of a universalised, representational scheme. In pursuit of universalism, powers are used to impose homogenous, Eurocentric categories in conversations about ICTs and their design. These categories are disconnected from African realities or inputs [30], for example 5G. The subsequent labelling of identities and activities is socio-political, as it happens according to these categorisations.

Categories are described mainly in English, but also in French, Spanish, and Portuguese. These languages are not commonly spoken in Africa, erasing conceptualisations and contributions described in Africa's widely spoken languages. As a result, the power to categorise crowds out the development of local, African conventions [5] and the use of indigenous languages.

In contemporary ICT development, categorising powers are manifested in algorithms and artificial intelligence. These algorithms are known not to serve the subalternised, because of the lack of input from under-sampled majorities in the training datasets [14].

Power to fund. In ICT development, especially when framed as aid, powerful Northern-based institutions and elites are in charge of funding [22]. For instance, well-endowed universities and international institutions act as gatekeepers for access to extraneous funders and research. As a result of pillage and plunder [20], in Africa, many ICT professionals are not able to meet the basic expenses of ICT development. Therefore, cooperation, programme design, and implementation require 'dancing to the tune of money'. At the same time, financial risks are assessed by non-African agencies - such as Standard & Poor's, Moody's, and the Fitch Group in a financial and economic system that is linked to a non-African world, set at the Bretton Woods Conference in 1944 in New Hampshire. For projects funded by non-African funders, priority setting in relation to what should be funded, and subsequent expense approval, is mostly undertaken outside of Africa and aligned with non-African interests.

Power to travel. Many foreign ICT professionals, whether researchers or developers, carry passports that allow them to travel at will. Although certain (African) countries require visas, and thus declaration of the purpose of visit, visitors can easily declare their purpose of travel as 'holiday' and gain entry. African ICT professionals carrying African passports often do not have such freedom of movement [24]. Visa application procedures demand trips to embassies located in capital cities or neighbouring countries. Often, procedures demand paternalistic oversight, requiring reference letters, disclosure of personal information about finances and social accounts, and even a guarantor.

Power to demand entitlements. Entitlements are often claimed on the basis of previous achievements claimed by foreign ICT experts and the fact that they have condescended to visit the less-endowed. Entitlement and opportunism lead many foreigners to (accept to) sit in the front row or at the high table at conferences and the like, making a clear public statement about who the powers holders are.

Power to speak first. Often attributed to class and status, as if geo-classifications are natural, foreigners are often seen to take the opportunity to speak first. Possibly because they are trained to fight for 'speaking time' or due to a need to prove their worth, visiting professionals are quick to ask leading questions. Local etiquette may demand careful timing in relation to when to contribute to community deliberations, according to position and perceived status; the first speaker often sets the playing field while the last speaker provides the summary of proceedings and outcomes, when all have contributed.

Power to set the agenda. In line with the saying, 'the one who pays the fiddle calls the tune', those in positions of power are used to setting the agenda. Agenda setting is a political act that determines the topics of discussion and the frame for negotiations. Agendas, whether ICT research agendas or the contemporary subjects of ICT discussions, are set from 'seats of power', outside the African continent. Through agenda setting, foreigners organise and control conversations. In Africa, the focus is mostly on the 'continuous present moment' [32] while stewardship over achievements from the past and the ongoing present are the main areas of attention. Foreign agenda setting, however, is often linked to actions for the creation of an envisioned future and priorities described in economic or monetary terms, productivity and efficiency, according to Eurocentric understandings.

Power to survey. In many situations, digitisation allows the indiscriminate transmission of real-time, or semi-real time, information about people and their environments. This information can be meta-data, but also specific data on what happens socially, economically, or in health and education. The processing of this data provides political power to intervene in line with non-African priorities. The process of counting and measuring feeds into surveying and surveillance, providing inputs for regulatory powers.

Power to make visible. By processing data sets that reside in platforms outside the African continent, non-Africa based researchers and developers act upon their deductions. Publications are done without African scrutiny, sometimes with the omission or negation of contributions by African authors [e.g., 4]. Such publications *speak about* instead of *converse with*, or describe what is *done for* instead of *done with*, communities. Researchers in Westernbased universities are observed to rely on Western-based ethical assessments and their Western-judged reputations, and send papers Power Inequities: Observations on the Development of Information and Communication Technologies, from an African Place

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to Western-based journals, which are peer-reviewed by Westernbased colleagues. This *making visible* is done without submission to – or the permission of – Southern-based colleagues, peers, or authorities.

Power to represent. Foreign professionals have been seen to manage, control and combine information flows by representing information from one geographical location in another geographical location. As such, they set themselves up to act as a 'clearing house' and 'management centre' for information, amassing information from which they claim the privilege to represent. Such representations often appear unaligned with local, morally-guided practices for managing knowledge 'properly', which involve respect for the gatekeepers that guard, for instance, moral taboos [23].

Power to apprehend and build. Systems of partnerships and mentorships are set up for non-African based professionals to have quick and easy access to the most current, emerging ideas. These come through international hackathons, innovation prizes, and mentoring offers. With little cost, Western partners are seen to learn from Africa and use their technological advantages to build technologies and solutions. This power and ability pre-empt the development of basic capacity to produce in Africa, allowing non-African experts to position themselves as sites of organisation.

Power to socially control. Through reference to homogenised global institutional rankings of universities and corruption indexes, delegates from those institution are observed to exert considerable social control. Self-proclaimed supremacy leads to asymmetries of power in partnerships, for instance, in research [16], and a 'failing Africa'/ white saviour' narrative.

In practice, the distribution and display of the observed powers is highly variable, depending on the circumstances. For instance, they are less pronounced when significant African powers are in the vicinity, for instance, when a high-ranking minister is in the room. However, the display of power is more pronounced in conferences, where like-minded foreign individuals often flock together and 'highjack' proceedings. In general, it seems that in health science the powers described in this paper are less pronounced. However, in meetings and conferences with a technical or mathematical orientation, the powers appear to be actively wielded by foreign professionals. It seems that, the more 'material' the subject or the more set in a belief system of universality (one-size-fits-all), the more the powers are expressed.

4 ASSESSMENT OF OBSERVED POWERS

In this section, I assess the powers observed using three schemes of categorisation.

Categorising powers. To structure reflections on power, Burawoy proposed four categories: domination, silencing, objectification, and normalisation. Drawing from my previous work, Figure 1 presents the assessment of the observations along these headings [32].

Of particular interest is Kwame Appiah's observations regarding class, taken from his experience in Ghana (Asante Kingdom), the United Kingdom and the United States [3]. When matching his views with the observations presented here, one can imagine international class distinctions. This is 'Orientalism', as described by Said [28]. 'Geo-politics' is the focus on the interests of (Western)

Power	Explanation	Example	Mediation
Domination	Effect of	Rhetoric of the	Being inert
	prolonged and	struggles between	
	surreptitious	centres and	
	power struggles	peripheries	
Silencing	Ideology in the	Orations by	Restricting or
	interest of	persons from non-	refraining from
	dominant elites	local authorities	speaking
Objectification	Assessment	Enforcing norms	Using long-
	informed by	in situations	term, oral
	oriental/external,	where there are	means of data
	natural and social	dynamic and	collection
	categorising	integrative	
		epistemologies	
Normalisation	Reducing the	Judging activities	Using trans-
	world to	using extraneous	disciplinary
	categories	categorisations	approaches

Figure 1: Burawoy's four categories of power and their mediation

Power base	Description	Example	Mediation
Belief	Essentialistic	Body-of-knowledge	Orthopraxis
system	views of the	framed by experience	(acting right)
	benefits of ICTs	and beliefs valorised	
Sovereignty	Institutions, procedures and	Echo chambers of normative knowledge	Value epistemologies
	govern sovereignty	conferences	
Colour	Segregation based	Race and location-	Conversations
	distinctions	and affirmation	
	distilletions	dominance and	
		resistance	
Class	Created social	Orientalistic	Intersectionality
	hierarchies	generalities about	
	sustaining in-	them and us	
	groups and out-	enmeshed in social	
	groups	fabric	
Culture	Community	Exchange, adoption	Respect
	building to live life	and assimilation of	
	with others	practices	

Figure 2: Appiah's identity categories and their mediation

countries and their elite, as framed in Eurocentric philosophies and ideologies. When analysing power-wielding using identity frames, with their 'in-groups' and 'out-groups', as described by Appiah, the following emerges (Figure 2).

In the third assessment, I match the powers described with the main interrogative words that are important in terms of the circumstance and control of human action (Figure 3).

Future analysis could review how the powers described in this paper map onto ideologies and are subject to cultural filters set by *modernism*, or ideas on what *development* entails. In relation to the latter, for instance, there is a notion that the developing world lacks certain ICTs to be able to become *like the developed world*.

5 DISCUSSION

Fanon vividly describes the trauma inflicted by continuous and demeaning powers, describing cases where so-called 'black' people were categorised as inferior (or worse) by actors embedded in a dominant imperialistic culture [10]. Nancy Murphy and George Ellis present on the moral nature of the universe [25]. The existence WebSci '20 Companion, July 6-10, 2020, Southampton, United Kingdom

Ŀ.			
	Interrogation	Power	Aim
	Why	Agenda setting,	Fits Eurocentric agendas that yield
		front seat, speak	benefits for the already powerful
		first	
	Where	Travel	Priority for actions where powerful can
			travel (cities or nearby rural areas);
			action taken where the powerful decide
			'a certain lack' should be alleviated
	What	Categorisation,	What fits a universalised scheme gets
		surveying, funding	done, what does not is made invisible;
			where money flows, things get done
	When	Funding, agenda	Activities are set by funding patterns,
		setting	fitting foreign conceptualised agendas
	Who	Make visible,	Those recognised as suppliers of
		represent	information and data for foreign experts
	How	Social control,	In line with Eurocentric valorised
		make visible	methods
	With what	Build	Using methods and activities that can
			be controlled and done outside of Africa

Figure 3: Powers and their aims

of such a moral grounding is corroborated by the work of Zimbabwean philosopher Munyaradzi Mawere, his many collaborators, and others.

The use of power is the subject of much study in the field of political science. On the geo-politics of the power bestowed by technology, Iginio Gagliardone describes its existence in Ethiopia [12]. Linnet Taylor and Dennis Broeders argue convincingly how datafication yields more power to the powerful [34]. In view of the oppression of African research and development, the esteemed Ugandan researcher Mahmood Mamdani urges us to examine foreign involvement in technologies for power and profit [18].

In previous works, I described exploitative behaviour as a product of the 'terrible three': orientalism, imperialism and colonialism [32]. As such, the powers and unmitigated risks described in this paper are harbingers of the continuous exploitation of African resources. This exploitation, among other things, constitutes epistemic violence, which can only be countered by insisting on matters of attitude and morality, beliefs and values, and sustaining a multiplicity of knowledge systems [31]. In ICT, an Orientalistic view entails the implicit or explicit contempt of non-Western contributions, resulting in social and scientific exclusion, discrimination, hostility, patriarchy, disenfranchisement, and objectification. The powers identified in this paper appear to be closely linked to neoliberal views, capitalistic markets and tech-solutionism, which are, in principal, undemocratic and often benefit non-African private actors. This interlinking with imported systems stifles the finding of ICT solutions aligned with the collective behaviour of non-consumers that aim for mutual support and solidarity. Power shapes the technologies that exist and that will be developed.

The use of powers described in this paper is a significant ethical problem. Their inappropriateness becomes obvious when one turns the narrative around. None of the observed powers would be acceptable behaviour by an African when interacting outside of her/his continent. However, foreign actors get away with such behaviour in line with their partial perspectives. Worse still, the powers described here provide the benchmarks against which ICT developments are measured. The powers are reminiscent of pervasive and historical – in other words, colonial – ways of interacting. The underlying ideologies and belief systems blind moral offenders to their own offences.

The benefits of these powers. The use of the powers described in this paper align with a supremacist hegemony that brings their users many benefits. For instance, the dominance of non-indigenous African languages provides political advantages to non-African players [19]. The wielding of these powers diminishes the agency of 'the other'. Such a theft causes trauma in ICT experts in Africa [10]. The trauma is amplified by an ICT-development environment saturated by non-African supremacy that does not value (and actively devalues) inputs from Africa. The result is a psychological colonisation.

The imbalance in power results in the accrual of the benefits of ICT developments to actors outside of Africa. The engine for this accrual is an ongoing coloniality in professional circles (like universities) and the acceptance of neo-liberal and capitalistic framings [27]. Accepting foreign domination allows for the import of dominant, foreign thought systems as well as having to pay rent for information that might well have be apprehended from Africa. This apprehension of power and overruling of local agency can work against the people being (mis)represented [26]. In this way, a periphery is created and sustained that can only hope to supply raw data [13, 18].

With the ability to move at will in Africa, non-African stakeholders can take information from one part and test and develop it in other areas. In such a way, non-African ICT professionals keep control of ICT developments, worldwide, and manage the benefits for themselves and their local industries.

Self-denial and stigma. Withstanding the powers presented in this paper is disposed of by those powers as subversive. These objections are amplified through the narrative of a 'failing Africa', or bifurcations such as classifications like 'traditional' and 'modern'. As regularly and emotionally pointed out by respondents in their African workspaces, the result is structural self-denial by many in Africa, a feeling or sense of subordination arising from decennia of being bombarded by the narrative of 'failing', of not 'being good enough', and stigmatisation.

Witnessing an individual eagerness to publish, the research groups in the West seem to be engaged in a 'Game of Thrones' competition for 'who is best'. Research offers for PhD candidates from Africa in Europe or the United States (e.g., in digital health information system [DHIS] studies in Norway, or ICT4D training in England) complicates matters significantly. When reviewing technical presentations done by presenters from Africa under non-African supervision, one senses a degree of hypocrisy when hearing African realities filtered through non-African, Eurocentric frames. When confronted, the presenters claim they would lose their position, being non-compliant, whether or not what they presented made sense for Africans themselves, cf. [15].

Possibly, this self-denial paves the way for undeserved privileges (of perspectives) to be expressed. Reflecting over 10 years of observations, it appears that a certain apathy has taken hold. An apathy that does not confront whitewashing or the self-exaltation of non-Africans in their international exploits. There seems a level of resignation to the idea that ICT researchers and developers in Africa do not deserve the opportunities that are being denied to them, that Power Inequities: Observations on the Development of Information and Communication Technologies, from an African Place

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developments are 'better being taken up' by non-Africans, in non-African countries.

Coloniality. Colonialism is pervasive in ubiquitous computing, as it is embedded in industrial capitalism and part of a knowledge enterprise that depends on Eurocentric valorisation [9]. The domination of foreign powers, pursuing their national, political and commercial interests, gives the illusion of freedom and perpetuates colonial gestures. The presence of coloniality – long-standing patterns of power that define relations seeking valorisation in Euromerican centres [17] – appears to desensitise the interlocutors to the power-laden manner of interactions.

Context projections. The wielding of power can be viewed as the projection of 'the powerful' of their own ICT-enabled and infused environment onto African societies – as if what exists outside of Africa will naturally come to Africa too. Non-African experts are trained and (mostly) work and live in technological societies that focus on serving individuals, using technology 'to amplify human intent' [35]. Thus, strongholds of claims of utility link in with the supremacy of individuality, a sentiment that is not echoed in most parts of Africa.

In Africa, technological societies are scarce. For instance, everyday life for many people is not aligned with a connected world. In the meantime, many of the powers described in this paper can only function within a technological society. These powers, thus, work when one accepts narratives of scarcity and lack of agency.

Countering disempowering powers. Accepting claims to superiority of non-African experts in relation to ICT development in Africa results in indignity, discrimination and the dehumanisation of local experts. This result negates 'other ways of knowing' in ICTs. It was possibly for this reason that Zambia-trained Michael Burawoy argued for a reflective approach, which he likened a 'kamikaze' to existing theories [6].

Undeserved powers separate people and result in the misalignment of conversations with those in an African context. As a result, many ICT-development outcomes appear unsustainable in an African place. These issues bring up questions of relevance about the infusion of non-local perspectives, as their utility is controversial. This issue was already raised by Ahmat *et al.* [1] in 2014, who questioned the relevance of a foreign-inspired ICT4D research agenda.

Using the powers described reinforces bifurcations and promotes thinking in bifurcated constructs such as centres and peripheries, design and use, users and non-users. These divides erase, ignore, and transcend the specifics of technological encounters in ICT in Africa. For the non-African researcher, they hamper the emergence of a local understanding of ICT in, for instance, rural African communities, cf. [22]. These issues were frequently expressed to me by many colleagues in Africa, however, they find remarkably little employ in the literature on technology [31], where reflection on the effects of the powers enjoyed by foreign ICT experts are rare. In all likelihood, the wielding of the observed powers prevents those who wield them from seeing the historical and political setting of ICT 'development assistance'. In relation to digital welfare, the Special Rapporteur on Extreme Poverty and Human Rights, Philip Alston, in his report to the UN General Assembly concluded, among other things: "in order to reduce the harm caused by incorrect assumptions and mistaken design choices, digital [...] systems should be

co-designed by their intended users and evaluated in a participatory manner" [2].

I have marvelled at the confusion experienced by African participants during international conferences when observing the behaviour of dominant, non-African delegates. This confusion is most visible in settings framed by development narratives. The concepts and personal behaviour of many non-African participants do not measure up. Representative of sentiments expressed to me on various occasions, I quote one participant from an island in the Pacific looking back to attending an international ICT conference in Africa, who asked rhetorically:

"Why did I come here? I have seen no recognition of the works by non-Western ancestors. I have seen Western professors joggling for access to areas where they were not born nor do live. I have seen professors using the event to jostle for position among themselves. I have seen disrespect for non-Western contributions. In the meantime, contributions from Southerners seem to speak to Eurocentric audiences only, not to the context where I am living in. I have found little to bring home to justify the investment of my community to bring me here, unfortunately." (Personal communication, African capital, 2019)

I have observed several pockets of resistance, mostly outside of the natural sciences. There is a demand for the emancipation of polyvocality, diversity and multiple perspectives in ICT. These are, for instance, inspired by feminism concerned with the operation of power and patriarchy [7]. Objections to the powers that seek to universalise can be witnessed in works on counter narratives on economic life [29] or situated knowledge, also in engineering [21]. Of course, any set way-of-knowing tends to obscure other-waysof-knowing.

Ethical conflict mediation through orientation. With the bifurcation of the natural and social sciences, it appears that many practitioners and students in ICT development have turned a blind eye to demands for ethical behaviour. Technical opportunities and narratives of underdevelopment and perceived ignorance seem to limit many an outlook. However, whether or not an ICT intervention should take place is a valid question that should appear on the agenda of natural science experts. Actually, during my education to become a skilled engineer, I was never required to attend a class on the ethics and question the 'creation of technology'. There appears to be an active resistance and, possibly, resentment towards engaging with the ethical implications of power-distances embedded in the dominant practices of technology creation.

Power is contingent on the acceptance of the structures that harbour them; for instance, notions of individual ownership or capitalistic economic systems, which are alien to many in Africa. Therefore, accepting the powers of these systems allows for the appropriation of agency by the systems that espouse them. However, there are hope-giving exercises that aim for ethical behaviour. An example are the Principles for Innovation and Technology in Development developed by UNICEF, or the minimum ethical standards in ICT4D research [8, 10]. It is telling, however, that the editors of the latter are Western-based researchers, who ultimately report to Western universities. WebSci '20 Companion, July 6-10, 2020, Southampton, United Kingdom

6 CONCLUSIONS

By exposing the imbalance of power and unmitigated risks involved in embodied interactions in ICT development, I hope to illustrate that 'bringing ICT to Africa' is not merely an issue of the translation or adaptation of technologies from the West to Africa, but one that requires dialogue and the constructing of a conversation in which all can grow in understanding. A communicative action is needed that aims to create equality in relationships, with the understanding of the existence of various normative systems. To counter debilitating powers, space must be allowed for alternative ideas to the hegemonic ones. The aim must be a common, shared value system. There is urgent need to foster respect (and African self-respect) for African input in ICT development.

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Multilingual Symbolic Support for Low Levels of Literacy on the Web

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ABSTRACT

Although literacy rates around the world have increased and there is an expectation that individuals who access web pages will be able to read their content, this is not always the case. The barriers that may be faced can be linked to the way the system is designed and content is written. There may be complex language or a layout that is dense, cluttered and lacks clear markers regarding the key points being made.

Many organizations have provided guidance for web developers and authors offering suitable ways to ensure those accessing a website or service will have a pleasurable experience. However, it appears that there are still websites hosting pages with dense text, convoluted instructions and little support for those with low levels of literacy. When considering poor reading skills, the cause may be due to many factors including a lack of education, sensory and /or intellectual impairments and specific difficulties such as dyslexia. This means that the vast majority of online content may be hard to understand for a significant proportion of the world's population. Moreover, these individuals may also lack digital skills, with little realization that assistive technologies and the availability of supportive access strategies can be helpful in these situations.

This paper aims to introduce the idea of enhancing readability of web content by using artificial intelligence (AI) techniques, such as linked data, natural language processing and image recognition to make available a wide range of automatically mapped multilingual symbols that can be used to clarify text content. In the past only a few symbol sets have been mapped and it was not possible to consider their appropriateness for text to symbol translations in a wide range of languages and cultural settings.

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CCS CONCEPTS

• Human-centered computing \rightarrow Accessibility theory, concepts and paradigms; • Information systems \rightarrow Personalization.

KEYWORDS

readability, literacy support, multilingual symbols, artificial intelligence

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1 INTRODUCTION

As recently as 2017, UNESCO were reporting that "750 million adults – two-thirds of whom are women – still lack basic reading and writing skills". The benchmark for the 86% of those from age 15 and over who "can both read and write with understanding" is based on "a short simple statement on his/her everyday life" [7]. This does not seem to be a particularly high measure for an essential skill, with so much information being found online. UNESCO admit that many countries gather data about rates of literacy in different ways and there remains a concern about the standards achieved.

The issue arises when considering the amount of text that often appears on web pages without illustrations to aid understanding. There are over a billion websites available to online users¹, but content providers should note that readers tend to scan for key points [8] rather than read an entire page. These human behaviors have not changed according to the Nielsen Norman Group and their recent research has also shown that "reading patterns, are very similar across languages and cultures"². Because people generally scan read web pages the importance of their readability in terms of ease of understanding and coping with the layout presented has become a much discussed area. It is included as a requirement in the W3C Web Content Accessibility Guidelines (WCAG 2.1) at level AAA, the highest of the three levels of compliance, which means that this requirement is often overlooked. However, the success

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¹https://news.netcraft.com/archives/category/web-server-survey/

²https://www.nngroup.com/articles/how-people-read-online/

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criteria for 3.1.5 Reading Level states "When text requires reading ability more advanced than the lower secondary education level after removal of proper names and titles, supplemental content, or a version that does not require reading ability more advanced than the lower secondary education level, is available."³ The techniques mentioned for offering supportive access strategies include the provision of:

- a text summary lower than secondary level
- visual illustrations, pictures, and symbols to help explain ideas, events, and processes
- a spoken version of the text
- text that is easier to read
- sign language versions of information

When considering reading skills, as opposed to literacy skills, which may encompass writing and spelling as well as numeracy, there are a range of complex strategies that need to be acquired. These include decoding skills, processing speeds for letter sound fluency as well as phonemic blending, sight word recognition and comprehension [1]. Education is key to gaining these skills as well as having the sensory and /or cognitive ability to cope with the content. Assistive technologies such as those mentioned in the WCAG techniques list, for example screen reading for those with visual impairments and text to speech for individuals with dyslexia, can also be very helpful.

But when reading is so difficult, that the words on the page are not understandable, the use of images, icons and symbols can aid comprehension. These images can be used as a form of text to symbol translation to suggest a concept or highlight a key point. This process is one that the authors have been exploring, as this has not been achieved in a way that is customised to allow for a user's preferred language and culture. Symbols can be highly personalized to represent local environmental settings, as well as being linguistically appropriate. The types of ideographic or pictographic symbols used by those with complex communication needs have been used in the past for this purpose [4]. In fact, individuals who have severe speech and language impairments may depend on these types of augmentative and alternative forms of communication (AAC) where the symbols are their language. The gloss or label to which the symbol concept is linked provides the text to speech output on a speech generating device or the symbols are used on a paper based communication chart and the user indicates their needs and ideas by pointing to them and a communication partner can read the labels. This linking of symbols to written concepts across languages and cultures means that several symbol sets have to be mapped to offer different choices to the wide range of potential users. This aim brings with it many challenges when considering the context of a word in any language on a website and attempting to find a matching symbol.

The vocabularies of the various symbol sets are small in comparison to the number of words used in English. Adult vocabulary test takers know from 20,000–35,000 words⁴. There are up to 12,000 -14,000 symbols in some freely available pictographic symbol sets, but only two sets have been mapped based on an international standard, so interoperability between sets is rare. The work carried out by Mats Lundälv and colleagues [2] highlighted these issues when they introduced their Concept Coding Framework (CCF) using Blissymbolics⁵ and ARASAAC symbols⁶. This work has since been taken up by a group of researchers developing ways of personalizing web pages to suit user needs. The fact that Bliss characters and words form both a Universal Character Set with a growing list of unique numerical identifiers for individual concepts, as well as a lexicon-based encoding ISO standard (ISO-IR 169), provides a robust base from which the authors of this paper can work. The link with the development of the 'Personalization Semantic Explainer'⁷ forms the backdrop for offering enhanced interoperability between freely available symbol sets, with an increased number of languages. The aim will be to support, not only AAC symbol users, but also those with low levels of literacy who find it hard to read content on web pages.

2 METHODOLOGY

The initial goal is to enhance web content readability by providing symbolic representations of keywords found in the text on web pages. This requires the linking of various symbol sets so that individual symbols can be mapped with their concepts into one global repository. This will provide a universal and accessible way for those supporting struggling readers to search, select and change symbols, based on preference and cultural background. An API will be provided that allows a user agent to present the symbols to a web page reader when required. Several machine learning techniques will be used to improve individual symbol interoperability.

There are several steps in the proposed symbol mapping approach, which is presented in Figure 1. Text gloss or label preparation is the first step to process all extracted symbol labels from different symbol sets by using NLP techniques. This process includes text cleaning, removal of special characters, handling of ambiguous meaning, spelling correction and the extraction of parts of speech (PoS). Once the label preparation has been completed, the second step is to map the label text to the concept entities in ConceptNet⁸.



Figure 1: Symbol interoperability improvement framework

⁵https://www.blissymbolics.org/

⁶http://www.arasaac.org/

⁷https://www.w3.org/TR/personalization-semantics-1.0/

⁸http://conceptnet.io/

³https://www.w3.org/TR/UNDERSTANDING-WCAG20/meaning-supplements.html ⁴http://testyourvocab.com/blog/2013-05-10-Summary-of-results

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ConceptNet is the knowledge graph version of the Open Mind Common Sense project, which provides the underlying source of information for symbol label mapping [6]. Compared with other lexical databases, ConceptNet provides semantic relationships between common concept entities with 78 different languages, including English, French, Arabic, Spanish, Urdu, Serbian and Chinese. With the advantages provided by the knowledge graph, the entities can be mapped based on their categories, functionalities and properties by using semantic linking. Examples of potential links include synonyms, a-form-of, part-of and related terms. These semantic links of concept entities can also be aggregated or grouped, based on inference and reasoning. Moreover, ConceptNet also provides the multilingual word embedding model, namely Numberbatch, which is built from the ground up, combining the advantages from other popular word embedding models (e.g. Glove [5] and Word2Vec [3]).

The use of ConceptNet and word embedding provided a semantic similarity measurement between different symbols, which was at the heart of the process used in the early stages of the repository development. However, preliminary results showed that there were a few problems with the current approach. For example, the label for the symbol 'car' also produced the symbol for a horse and cart and a carousel when using the ARASAAC symbol set as a test search. Neither result would have been helpful in a text to symbol translation, where a specified form of transport was required.

A decision was made to include image recognition as a supporting strategy to provide an increased amount of data directly related to the visual representation of the symbols. The early stage results have showed that some objects in the symbol picture can be detected and recognized by computer vision algorithms. The example demonstrated in Figure 2 shows how objects in the horse and cart symbol have been detected and recognized, such as wheels to denote a form of transport, but when the symbol for 'car' is analyzed the word is found with 62% certainty as well as the wheels. As result, the proposed approach will be used to improve symbol



The work on the harmonization of the various symbols sets is still in progress. Nevertheless, the authors have discovered that depending on a solely semantically based linkage of concepts can lead to symbols not being found, due to failures when different parts of speech are used, but are derived from the same concept. A symbol for the verb 'to be' in the present tense 'is' would be found, but not 'was' or 'will'. However, these may be selected by an AAC user with a modifier, such as an arrow in one direction for past and in another direction for future. Another issue that occurred was where a label had multiple words, where only one should have been used to represent the concept, such as 'it'. These two problems happened with 17 percent of the 100 frequently used core words in English, published online by Hill and Romich⁹ and used by AAC professionals. 17,388 symbols were mapped to ConceptNet and the full results have yet to be analysed. An initial scan through the concept list showed that confusions for potential users would arise where there were two or more symbols for one label. This was especially so if this was a homonym e.g. the word 'can' i.e. to be able or 'can' as a tin can. If a word like 'make' is used in a sentence, this could also be represented by different symbols, one meaning 'it is a requirement' - to make someone do something and another for 'the ability to create something'. This is obviously a problem that occurs in automatic language translation, but to a lesser extent, because context can be taken into account. As only a few symbols are usually used to signify some of the key words in a sentence, each one has to be as representative of the actual meaning as possible (Figure 3). Therefore, whereas initial work using ConceptNet with semantics produced a 70% chance of a good symbol to label match, the proposed combination of machine learning algorithms including word embedding and image recognition using deep neural networks has the potential to offer increased accuracy for text to symbol matches.



image_2020_04_24T16_17_49_995Z.png

Figure 2: Symbol Image recognition (Google Vision AI)

interoperability across different symbol sets and also contribute to the enhancement of web content readability for end users.



Figure 3: Sample text from Wikipedia supported by a choice of four different symbol sets in four languages

⁹https://aaclanguagelab.com/resources/100-high-frequency-core-word-listwords

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There are several limitations to these ideas including the lack of freely available symbol sets with sufficient vocabularies and so in the course of the trials the intention is to include more symbol sets developed in different languages. This would allow for an increase in training data for the ConceptNet and word embedding approach, as well as improved results when using image recognition. In Figure 4, a symbol for park or playground resulted in only one element of the image being picked up and tagged as 'packaged goods', but there are several other symbol sets available with similar images that could be incorporated in the process. The use of image recognition and pattern classification will also improve symbol clustering for topic categorization and future research on context sensitive text to symbol and symbol to text work.



Figure 4: Playground or park recognized as packaged goods

However, there remain concerns around complete multilingual mapping, which also needs to be addressed, as some of the Concept-Net lexicons are incomplete, as are the culturally sensitive symbol sets with translations. This has an impact on less frequently used languages and it has also been found that some of the translations already available for the symbols sets are not always accurate.

4 CONCLUSION

Over several years researchers have attempted to harmonize AAC symbol sets that would allow for interoperability, meaning they could be used for text to symbol and symbol to text translations with ease. Invariably there has been the inescapable realization that much of the work entails human endeavor with a considerable amount of understanding to cope with the various differences between each symbol set. However, with the increased use of artificial intelligence some of the hurdles can be overcome. It is also accepted that there has already been a considerable amount of work carried out to ensure the standardization of Blissymbolics and the mapping against the ARASAAC symbol set, along with recent work on 'standard semantics to enable user-driven personalization'. Building on this work and using the latest AI techniques it should be possible to present stakeholders with a means of using a group of freely available harmonized multilingual AAC symbol sets for content clarification. Furthermore, the results of this work aim to support those with complex communication difficulties by providing chart building support using the linked symbol sets from the repository. This will mean users can access free symbols of their choice for use on assistive technologies and those supporting struggling readers

or individuals who have low levels of literacy can access symbols to explain key words on the web.

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Digital inclusion requires a business model too

Sustainability analysis of value webs in rural Sarawak

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ABSTRACT

In this paper we discuss how to improve business sustainability of services for digital inclusion through value modeling and analysis using the e^3 -value method. Two questions come up: is this method understandable and useful in practice for ICT4D practitioners and developers, and is this method instrumental for development of sustainable services for digital inclusion? To answer this, three ICT4D student projects were carried out, that aim to improve digital inclusion in communities in Sarawak, Malaysia. Results show that the e^3 -value method is easy to learn and use in practice. It is instrumental (i) for visual conceptualization, facilitating discussion and co-construction of different business scenarios; (ii) it allows to assess potential profitability in the value web; (iii) for optimization of the system design (iv) to analyse strengths and weaknesses in the value network in terms of digital inclusion.

KEYWORDS

Digital inclusion, low resource environments, value webs, e^3 -value methodology, business sustainability

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1 INTRODUCTION

As the recent global crisis is showing us vehemently, digital inclusion is now more important than ever before. Digital inclusion refers to idea that everyone has access to information and communication technology (ICT), and more importantly, that everyone can provide and use services provisioned by that technology. Unfortunately, large part of the world population, about 3 billion people, are still digitally excluded. Often, these people live in low-resource

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© 2020 Copyright held by the owner/author(s). Publication rights licensed to ACM. ACM ISBN 978-1-4503-7994-6/20/07...\$15.00 https://doi.org/10.1145/3394332.3402832 environments, where nevertheless many useful applications of ICT, often information services, can be envisioned. Examples of information services for digital inclusion we developed in the past include messaging services, weather monitoring services, trading services, and services for citizen journalism [1]. These are in line with the Sustainable Development Goals, notably SDG10, the goal to reduce inequalities.

ICT-services need a business case, which justifies why the ICT service at hand should be developed and offered at all. We formalize such a business case in terms of a conceptual model using the e^3 -value language [3], and call the resulting model the business model of the *eco-system*. The business model shows all relevant actors (economically independent parties) as well as what they exchange of *economic* value with each other. A business model is *viable* if all actors can create a profit by participating in the business model. An eco-system is a collection of actors that work cooperatively and competitively to satisfy customer needs [8, 11]. Taking an ecosystem perspective leads to inclusion of all required actors for the business case, and not just a single enterprise providing a service. It makes it possible to analyze the effects for all actors in the value web.

Many digital inclusion projects are funded by national or international development agencies or private donors (e.g. the Worldbank, UNESCO, USAID, DFID, SIDA, Postcodeloterij etc). Donor funds are valuable to kick-off digital inclusion projects, but as at some point in time donor funding will stop, the project should then become 'self-supporting' in the sense that it generates sufficient cash-flow to keep the service up-and-running after donor funding disappears. In practice, this is often problematic. Many donor-funded projects are designed according to global policies, and not directly by the actual service needs of the to-be included beneficiaries. Donorfunded projects for Digital Development have a track record of not surviving after the project period [4, 6, 7]. Once donor funding is not available anymore, the technology becomes useless because the funds required to operate and maintain it are not taken care of anymore.

In this paper we argue that in order to achieve *financially sustainable* digital inclusion, the eco-system and its business model of the inclusion project should be understood, and moreover should convince that each actor in the eco-system can participate in a financially sustainable way. Ideally, the design and analysis of the business model should happen at the beginning of the digital inclusion project, and not in the aftermath, because the business model significantly influences the design of the system's architecture.

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In sum, when we talk about business sustainability of projects for digital inclusion, we have three things in mind: (i) that the envisaged solution keeps running after the end of a pilot phase/ initial funding phase (ii) that it can exist/survive as a service over a longer period of time (with or without input financing) or (iii) that it is adopted/adapted/diffused and starts to expand in number of users, i.e. that it becomes part of an eco-system.

This may be different, depending on the sector. For example: ICT services in the educational and health domains may always have to rely on public funding schemes, whereas projects for social entrepreneurship will have to look for customer funds. Given the lack of sustainability of many projects for digital inclusion in low-resource regions in the world, the question is, how to develop for sustainability, knowing that success of a service depends on a combination of the immediate benefit a service brings to its user/customer, and on its affordability.

We have used an eco-system, and business model-oriented approach for digital inclusion in three projects in Sarawak, Malaysia. To make this paper self-contained, in Sec. 2 we summarize the e^3 -*value* method for business modelling of eco-systems. In Sec. 3, we present the setup and contexts of these projects. Sec. 4 illustrates the projects. Finally, Sec.5 provides a discussion and our conclusions.

2 VALUE MODELING

To understand and assess value models (informally called business cases) of ICT-services, which are offered in eco-systems - networks of actors who create value for end-users – the e^3 -value value modeling method was developed. This method was inspired by the dot.com bubble in 2001, a period in which many new ICT-services were set up, a large number of which without solid business case, which led, in various cases to bankruptcy. Over the years the e^3 value method has been applied in a variety of sectors and industries. It proven useful for the development of commercial ICT services, amongst others in the field of Internet Service Provisioning (ISP), energy supply, clearing of intellectual property rights, and government services like e-customs. Recently the e^3 -value method has been applied for sustainability evaluation of digital inclusion projects in poor regions of the world. Since digital inclusion projects in the Global South are situated in a completely different setting, this is an additional validation for the e^3 -value methodology.

Fig. 1 briefly explains e^3 -value for a project we executed in Africa. Actors (profit-and-loss response parties or end-users who want to enjoy services to satisfy a goal) are represented as rectangles (e.g. Telco). If there are many actors of the same kind (e.g. Customer, Village Reporter), we use the notion of market segments, depicted as three stacked actors. Actors may have a need (visualized as a bullet eye), for example the customer has the need to do an announcement, e.g. that he lost his cow. To satisfy a need, actors, and thus also market segments, can exchange things of economic value, called value objects with each other. For example, the customer receives the right to place a (broadcast) announcement via the radio, and pays money for this to the village reporter. This reporter is a representative of the radio station, who broadcasts the announcement and pays a fee. Value objects are exchanged via value ports, as visualized by triangles that connect the value transfers. These represent the willingness to transfer (in terms of ownership or grant

the right to enjoy the service outcome) the value object from the one actor to the other, provided that there is a *reciprocal* transfer that compensates the providing actor with someone else of higher perceived value. Reciprocity is modelled by the concept of *value interface*, depicted by the rounded rectangles, enclosing the value ports. The value interface prescribes that in case of a value transfers, *all* other ports should transfer value objects too, or none at all. The double bullet eye in the FB (voice platform) service provider models that no additional value transfers are considered anymore. Value transfers relate to actors, whereas the *dependency path* relates to value interfaces, needs and boundary elements inside an actor. If that path is followed, starting by the need and ending at the boundary element, and traversing to the next actor by means of the value transfers, all required value transfers to satisfy a particular customer need can be found.



Figure 1: An e^3 -value business model of a broadcasting ecosystem for announcements in Africa

In terms of sustainability assessment for the eco-system in Fig. 1, a few observations can be made.

- (1) In order for parties to be sustainable, the fee to be paid by the village reporter by the radio station should be lower than the fee to be paid by the customer to the village reporter. If this is not the case, the village reporter will not generate a positive cash flow, as he has only outgoing cash flows, and hence the business model will not be sustainable.
- (2) The money that the village reported earns by collecting announcements from inhabitants of the village he lives in, should at least outnumber the fee he has to pay to the Telco for having and using a mobile phone subscription.

The model shows the importance of considering the business case *at the beginning* of the use case development. In the case the project would be donor-funded (e.g. by subsidizing the village reporter), the project would possibly survive the pilot phase, but fall apart apart once donor funding ends, because the village reported would suddenly stop to receive an income.

The e^3 -value method can be used to make *qualitative* observations about financial sustainability, like above, but all elements in the business model can also be quantified. For example, the number of customers can be estimated, the number of times they want to do an announcement, and the fees to be charged. In practice however, it takes already some effort to produce a correct qualitative model, which then can be followed by a quantitative model. Digital inclusion requires a business model too

3 SETUP AND CONTEXT

The past few years, we had the unique opportunity to explore new business models for digital inclusiveness in Sarawak, Borneo, Malaysia. A group of about twenty master students from the Netherlands and Malaysia, were divided into groups of 5-6 students. Each group had to explore and design an information service to improve digital inclusiveness of the poor in Sarawak.

One of the first steps was to envision (which is actually the creative and usually the hardest part) for which they had to develop a business model using the e^3 -value methodology. Before they started, they were lectured for two hours about the e^3 -value method for business model design of eco-systems. Also, during execution of the method, they were actively supervised by us. At the end, they had to deliver a report, amongst others including the e^3 -value model for their case, as well as a textual explanation. We were interested in the following questions:

- Can the students, within a limited time period of four weeks come up with a reasonable e^3 -value of the case at hand? In this same period, they also had to come with an ICT design and working prototype supporting the eco-system they had designed. Specifically, we are interested if the model is syntactically correct, if the model is from an e^3 -value modelling perspective complete, and finally if the model is an adequate representation of the application domain at hand.
- Is the *e*³-*value* method instrumental in developing a service addressing the digital excluded persons? In other words, does it help to make these models, and what is its added value in the development of services for digital inclusion?

4 THREE CASES FROM THE FIELD

In this section the use of the e^3 -value method in three ICT4D student projects is discussed: Bannatree [10], Appong [5] and Majunet [9], carried out in one month, two of which in 2018 and one in 2019. The projects were carried out according to a collaborative, iterative, adaptive method which is dubbed ICT4D 3.0 [1]. They consisted of one month of context analysis, needs assessment, requirements analysis, prototype design and testing, evaluating and business sustainability analysis, i.e. the full life cycle of information system development. The sustainability analysis was only one of the various tasks of the project [2].

4.1 The Bannatree project

This project consists of design and deployment of an information system to increase the income of banana farmers in Sarawak, Malaysia by enhancing efficiency in the banana value chain. In Sarawak, Malaysia, the government has started a contract farming program as a means of improving export of local products, while increasing the standard of living and income of farmers. Contract farmers plant and harvest bananas called 'pisang sekaki', which are sold to a small local factory, where they are being processed into banana chips for export. A brief context analysis showed that, coordination between farmers and factory and planning are inefficient due to lack of timely and accurate information. Poor planning leads to harvest loss, unnecessary waste of product and disinvestment, especially for the farmers. The BannaTree application consists of a platform to balance supply and demand between farmers and factory, and enhance planning.

Case description. As the main purpose of the project was to facilitate the governmental project to support contract farmers, the costs of the envisaged platform would be, in its start-up or pilot phase, covered by the government, as a government-funded ICT-project. However, if the platform leads to increased efficiency and production while leading to a higher income for the farmers and factory, a clear business case for the banana factory would exist. The students built three different models of the current situation (without information system), the (government-funded) pilot situation and the envisaged sustainable situation.

The constructed model. Figs. 2 and 3 represent two alternatives with respect to the Bannatree eco-system. In Fig. 2 the assumption is that the project is of interest to the people of Sarawak and hence the government funds. In the second model (Fig. 3), the factory funds.

The model for the Bannatree project is not a free and open value network, hence, not a classical example of a value network in which independent actors interact to provide a service to the market. Still, the model provides insight in the value network and makes it possible to conceptualize the process in terms of value exchange and operational goals of each actor.



Figure 2: An e^3 -value business model for the Bannatree project with government funding.



Figure 3: An e^3 -value business model for the Bannatree project funded by the factory.

Quality of the model. The two e^3 -value models for the Bannatree project (Figures 2 and 3) are syntactically correct. In terms of completeness, a so-called *cardinality dependency element is missing*. WebSci '20 Companion, July 6-10, 2020, Southampton, United Kingdom

Concretely, one (cardinality) banana results in many (cardinality) chips. This is not adequately represented in the models.

Although the models are not very complicated from a business perspective, there is however a complex story behind it of diverging interests between the different stakeholders, that is uncovered by the process of construction of the models. Through knowledge elicitation interviews of the developers with the stakeholders, during the analysis of the case, the e^3 -value methodology helped to clarify these diverging interests to the farmers. Additionally, the model showed through various scenarios that the dependency of the contract farmers on a single point of sales holds a risk for them of being exploited.

Is the model instrumental in addressing digital inclusion? The e^3 -value method in this project gave room for discussions about the barriers experienced by the contract farmers in the value network. Although the e^3 -value models for this use case are very simple, analysis and group discussions about the different business scenarios provided insight into the – sometimes conflicting – operational goals of the different actors, and the implications for the most vulnerable actors. The ethical aspects of the process were discussed and considered.

4.2 The Appong project

Case description. Gula apong is a traditional Malaysian sugar, produced in the public mangrove forests, along the shores in Sarawak, Malaysia, by independent smallholder farmers. They do the harvesting of the juice from Nipa palms in the forests. Gula apong is produced and packed manually at home, in the small suburban communities and sold locally. A farmer produces on average 20 kg gula apong per day. This gives a family a modest but steady income. Since the local demand for gula apong seems to exceed current production, the government of Sarawak wants to stimulate production, as this type of small-scale farming has a positive effect on the conservation of the forests [5] and provides poor communities with an income. To do this, the government needs more insight in the extent of the mangrove forest that are used for production and the area which is not being exploited. With this information, the government will be able to assign new producers to the unused areas in the mangrove.

From the perspective of the farmers, and given the local demand for gula apong, the community-based sales is inefficient. The sales is dominated by middlemen who buy at the community and sell the gula apong at a much higher price. A (mobile) digital platform that could replace the middlemen, might help to connect buyers and producers directly. The Appong platform consists of a combined mobile web-shop and monitoring system to analyse the business case. The web-shop aims to increase sales of gula apong. The monitoring facility allows the government to monitor the commercial process in order to support and expand the production area for gula apong.

The constructed model. The e^3 -value model for the Appong use case, see Figure 4 showcases the interaction between consumers, producers, and service providers. It demonstrates that Appong platform can provide a web-shop service, which in turn will give gula apong producers bigger market visibility. Producers have to



Figure 4: An e^3 -value business model for the gula apong value chain.

pay a fee or subscription to get access to this service (to help the project remain sustainable). The middlemen are left out of the model, as the platform assumes such a role.

Quality of the model. The model is syntactically correct and in terms of completeness, it gives an impression of the high-level ecosystem business model. If the model would be put into operation, it would useful to include more actors in the model, e.g. the government, who has a societal interest in the gula apong production, and e.g. payment service providers.

The rounded rectangles inside the actors are in e^3 -value called value activities. These activities are not just operational activities that we know from process modelling, but require that at least one actor can execute them in a financially sustainable way. This requirement holds for nearly every displayed activity, except for the 'Appong service subscription'. This activity could better be merged with the 'Gula Apong Production' activity as the 'Appong service subcription' is only a cost (and not a revenue) activity for the 'Gula Apong Production' activity to do its work.

Is the model instrumental in addressing digital inclusion? As in the Bannatree project, the methodology to construct the e^3 -value models was instrumental to analyse the network of stakeholders, their operational goals in this business. The methodology also made room for discussions about different future scenarios, that might provide the farmers with a better market position, about the current barriers (e.g. lack of digital access, a middlemen dominated market due to digital exclusion of the communities in rural Sarawak.) Discussions with the stakeholders showed that the platform, when scaled up, would also facilitate better cooperation between gula apong producers in Sarawak. This shows the advantage of e^3 -value method to inform decisions in future business development.

4.3 The Majunet project

Case description. The Majunet project aims to improve income of women in small communities in Sarawak, who are starting up a

new value activity: packaging of local farming products for export, through user-centered design of an efficient, web-based management information system that also functions as a communication platform for different internal and external stakeholders of this business. The business analysis for the Majunet project has therefore a larger scope than just the envisaged information system.

The constructed model. The e^3 -*value* model for the Majunet project is exemplar for a donor-funded project (in this case the local government of Sarawak is the donor). It shows the value activities of all suppliers and their operational goals but it still lacks customers. The envisaged packaging business could run only because there is donor funding involved, which can be useful, also as a learning project. The e^3 -*value* model is useful as a thought experiment, in which different future business scenarios can be evaluated, with donor funding and without.



Figure 5: An e^3 -value business model for the Majunet project and platform.

Quality of the model. The model in Fig. 5 is syntactically correct but not complete. Specifically, it lacks customer needs, boundary elements and dependency paths. As a result, the model does not represent which value transfers happen as a result of a customer need. Therefore, the model is only useful for a global understanding of the business model of the eco-system, for doing qualitative observations, but does not allow for quantitative analysis. Also, it lacks the distinction between market segments (many actors of the same kind) and individual actors For example, the actor 'employees' should have been modelled as a market segment because the eco-system includes many employees instead of just one.

Is the model instrumental in addressing digital inclusion? The e^3 -value model in the Majunet project should be considered as

a first model that should mature further. From the three cases discussed in this paper, the Majunet case exploration had to start with just a vaguely articulated business idea. The other two cases started with already a better defined business idea, and hence are therefore more refined. So, this model plays a slightly different role, namely the very first exploration of a business idea for digital inclusion. It does at least show the main actors involved as well as the services they provide to each other, which was not at all clear at the beginning of the project. The model also covers a larger scope than the development of an information system in the narrow sense. It makes the students reflect on the total value chain, and ask the important questions to the stakeholders, to understand the different interests of the stakeholder groups (business partners, government, workers).

5 DISCUSSION

The three student projects, carried out in a community-service learning setting in rural Sarawak, achieved their (learning) goals, which were ambitious given the context, which is novel and unfamiliar for many of them. The project reports show that the concept and use of the e^3 -value method was easily picked up by the students. The e^3 -value method provided them with a light-weight, easy to use approach to analyse sustainability of emerging value webs in low- resource environments. It made them aware of the wider perspective, beyond the user-centered interface design. By visualizing the stakeholders in the network and showing their value exchanges, it made them able to analyse stakeholders' goals. This revealed potential conflicting interests, as shown in the Bannatree project. By doing the analysis in a co-creative setting - involving also stakeholders: farmers, local experts, government) - the method facilitate the discussion about project goal and interests, as shown for the Bannatree and Appong projects. The models allow to compare different scenarios. This can be used to inform decision-making, for example how to act when donor-funding would stop, as in the Bannatree and Majunet projects. The analysis reveals strengths and weaknesses in the value network, for example in the Bannatree project, the vulnerable position of the contract farmers, or the role of the middlemen in the Appong project. This allows to jointly think and discuss the complete ecosystem. In the given examples the quantitative analysis function of the e^3 -value analysis tool was not used, but in the future this can lead to better predictions of potential profitability in the value network.

An important aim of this analysis is that it will provide insight to influence actual decision making, and that it may lead to the implementation of better, feasible, but also more inclusive business models. An important question is in particular how this is (to be) done, and how it will benefit most vulnerable of the actors in the network. This obviously requires some more time than in the above described one month projects for a full information system development life cycle. This is on the list for the near future of this ongoing research program in ICT for Digital Inclusion.

6 CONCLUSION

The three projects from Sarawak have shown added value of using e^3 -value as a methodology for analysis of sustainability of emerging value webs in low resource environments. The e^3 -value method,
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as used in the three field pilot cases from Sarawak, was easy to learn in a short period and could be used and applied to the cases in the field practice. The method has shown to provide (i) a visual conceptualization of the value network that facilitates the discussion and allows co-construction of different business scenarios, (ii) insight in value for each of the stakeholders in the network; (iii) to inform decision-making as to select the best possible scenario and optimize the service from the stakeholders' perspective (iv) give insight in strengths and weaknesses of a value network in terms of digital inclusion. This shows that it is instrumental and can be added as an integral part of development of sustainable services for digital development.

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