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RESEARCH ARTICLE



Digital development, inequalities & the Sustainable Development Goals: what does ‘Leave No-One Behind’ mean for ICT4D?

Franz-Ferdinand Rothe ^a, Leo Van Audenhove ^{a,b} and Jan Loisen ^a

^aImec-SMIT, Vrije Universiteit Brussel, Brussels, Belgium; ^bCoLAB, University of the Western Cape, Cape Town, South Africa

ABSTRACT

The United Nations’ Sustainable Development Goals (SDGs) place great emphasis on inequalities and pledge to *leave no-one behind*. For the field of digital development, this objective presents a particular challenge. While digital technologies can be utilized to reduce certain inequalities, they are also linked to reproductive mechanisms, reinforcing existing inequalities. In the context of an increasing digitalization of development, particular attention must therefore be paid to the link between digital inequalities and the quest to leave no-one behind. This article analyses the integration of intersectional inequalities in the SDG framework and the resulting need for coherent policies, and demonstrates the parallels between this challenge and the reproductive nature of digital inequalities. On this basis, we argue that the issue of digital inequalities should be mainstreamed in development programming in order to avoid worsening existing inequalities through digital development. Moreover, we discuss recommendations for a potential post-2030 agenda succeeding the SDGs.

KEYWORDS

ict4d; sustainable development goals; inequalities; digital development

1. Introduction

When the Sustainable Development Goals (SDGs) were launched in 2015, their central mantra was synthesized in their tagline: *Leave No-One Behind* (Klasen & Fleurbaey, 2018). More than a catchy slogan, the notion of leaving no-one behind captures the agenda’s cross-cutting objective to reduce inequalities and prioritize the most marginalized groups. This represents an underlying value that sets the SDGs apart from their predecessors, the Millennium Development Goals (MDGs), which failed to incorporate the issue of inequalities (Stuart & Samman, 2017). In fact, in the context of the MDGs, well-intended development efforts often reproduced and worsened existing inequalities by failing the most-marginalized and benefitting so-called *low-hanging fruits*, meaning those who were comparatively somewhat better off (Bhatkal et al., 2015). In order to truly leave no-one behind, development efforts in pursuit of the SDGs must therefore pay particular attention to minimizing the reproductive and reinforcing effects it may have on inequalities.

This challenge proves particularly relevant for the field of digital development, also known as ICT4D (Information & Communication Technology for Development), meaning the use of digital technologies in pursuit of the SDGs¹. While digital technologies bear an inclusive potential, research also shows that digital inequalities, which are often embedded in traditional inequalities, shape to which degree one can actually benefit from these technologies (Helsper, 2021; Ragnedda, 2018;

CONTACT Franz-Ferdinand Rothe  rothe.franz-ferdinand@vub.be  Imec-SMIT, Vrije Universiteit Brussel, Brussels, Belgium
¹Clearly, not all actors in the field support the framework of the SDGs. In the context of this article, however, we look at digital development efforts that pursue the SDGs.

van Dijk, 2005). In the context of an increasing digitalization of development processes, this may mean that certain groups who are already disadvantaged are at risk of being excluded even further. We will therefore argue that the promise to leave no-one behind requires digital development programming to pay particular attention to the processes by which it might reinforce the very inequalities that the SDGs seek to eradicate.

In order to discuss the implications of the SDGs' novel focus on inequalities for digital development programming, we need to understand how the two interact. Therefore, we first of all unpack and contextualize the inequalities that are at the core of the SDG framework. In Section 2, we present an original qualitative document analysis of the latest *SDG indicator framework* (United Nations, 2020), mapping and analyzing the horizontal, spatial, and vertical inequalities that the SDGs aim to tackle. By coding explicit references to disadvantaged groups in the SDG indicators, we not only take stock of the different types of inequalities that are embedded in the framework but, moreover, demonstrate their interactions and interdependencies. This allows us to better understand the different dimensions of inequalities at play and how they are mainstreamed throughout the SDG framework.

In order to analyze our findings and discuss the implications for development programming, we bring into conversation two fields of literature that are not commonly discussed in conjunction: intersectionality and policy coherence. Analyzing the SDGs' integration of inequalities through the lens of intersectionality aids our understanding of how multidimensional inequalities in different development sectors mutually reinforce and reproduce each other as they overlap (Kabeer, 2016). This reproductive nature of different forms of inequalities therefore calls for holistic and coherent development programming that takes into account their potentially reinforcing impact on inequalities across the different areas of the SDGs (Stuart & Woodroffe, 2016). Here, the literature on integrated development and policy coherence allows us to link the theoretical notion of intersectional inequalities with research on policymaking in the context of the SDGs.

In Section 3, we outline the complex interplay between *traditional* and *digital* inequalities. In particular, we apply the notion of *digital capital* (Ragnedda, 2018), which describes, in a Bourdieusian understanding, the various forms of capital that are required in order to benefit from digital technologies. This approach places particular attention to processes through which unequal distribution of traditional capital is reproduced and reinforced in the digital realm. On this basis, Section 4 will bring together the two previous sections and translate the complexity of leaving no-one behind into the digital realm. By discussing digital capital against the backdrop of our document analysis, we carve out the parallels between the processes of digital inequalities and the SDGs' approach to tackling intersectional inequalities. Thereby, we show how digital development processes can interact with the traditional inequalities at the core of the SDGs and may constitute new reproductive mechanisms, reproducing inequalities and thus potentially undermining the quest to leave no-one behind.

The article therefore shows how (a) the central importance of inequalities and leaving no-one behind in the SDG framework, (b) their dependency on coherent development policies, and (c) the reproductive nature of digital inequalities, present a complex challenge for digital development programming. Thus, we hope to spark and inform a wider discussion on how to best address this challenge in order to use digital technologies for sustainable development, without excluding those that are already marginalized and most likely to be left behind. By demonstrating the potential incoherence between the digitalization of development and the SDGs' underlying goal to reduce inequalities, we will argue that the underlying mantra of leaving no-one behind must be understood as a call to mainstream the issue of digital inequalities throughout any digital development programming. Moreover, we will discuss how this challenge could be addressed when designing a potential follow-up agenda, following the SDGs in a post-2030 context.

2. Inequalities and sustainable development

The relationship between inequalities and development is intricate and its conception has evolved over time. Until recently, inequalities did not receive significant attention in international development (Chancel et al., 2018) and domestic inequalities, meaning inequalities within countries, were seen as national issues rather than a global challenge. While certain dimensions of inequality, such as poverty, education or health, represent classic development objectives, they have traditionally been looked at in *absolute* terms, such as the focus on a universal poverty line, largely neglecting their *relative* dimension (Freistein & Mahler, 2016). The traditional binary approach of, for example, people above or below the poverty line, did not pay particular attention to structural inequalities and the relative deprivation of particular groups vis-à-vis others.

When, in 2015, the United Nations launched the SDGs, they were recognized by many as a milestone, as they placed the matter of inequalities center stage (Winkler & Satterthwaite, 2017). Their cross-cutting mantra to *leave no-one behind* and their integration of specific inequality-related goals marked the first time that the international community officially recognised reducing inequalities as a common task (Kuhn, 2020). During the years of participatory consultations that led up to the SDGs (van Bergeijk & van der Hoeven, 2017), numerous groups advocated for including different forms of inequalities into the new set of goals (Gabizon, 2016), which finally caused the issue to gain traction. In particular, the emphasis shifted as it became clear that the neglect of inequalities represented a crucial shortcoming of the MDGs, which failed to benefit those most marginalized and thereby contributed to increased inequalities (van der Hoeven, 2017).

More than a desirable development objective in and of itself, inequalities were gradually acknowledged as a key challenge in order to reach any of the SDGs' goals, seeing that they represent underlying drivers for a wide variety of today's development challenges. As authors like Chancel et al. (2018) and Pandey et al. (2020) demonstrate, we see negative downstream effects of inequalities on issues all across the SDG agenda. Gender inequalities, for example, represent a major hindrance in reaching many of the social, economic and environmental targets. Taukobong et al. (2016) and Hepp et al. (2019) illustrate the negative impact of gender inequalities on issues including poverty, education, growth, health or climate change. These downstream effects, in turn, reinforce both gender and other inequalities, as it is often the most marginalized groups that are hit hardest by, for example, climate change (UN DESA, 2018b).

This *vicious cycle* is also at the core of the relationship between income inequality and today's development challenges. Authors like Stiglitz (2012) or Wilkinson and Pickett (2010) demonstrate the negative impact of income inequality on sustainable growth and economic stability. Pandey et al. (2020) further highlight the adverse effects of income inequality on issues such as food security or political stability. Moreover, recent research on the nexus between inequalities and environment (Baek & Gweisah, 2013), confirms the hypothesis that income inequality drives environmental degradation and climate change. These examples illustrate how inequalities affect all four pillars of sustainable development – social, economic, environmental, and political (Sachs, 2015) – meaning that the success of the entire SDG agenda depends on addressing inequalities (Klasen & Fleurbaey, 2018). This explains the instrumental rationale which, after decades of neglect, landed inequalities at the core of the SDGs' guiding principles (Jolly, 2017).

This new focus on inequalities has significant implications for digital development programming. If we consider the issue of inequalities as key to the success of the SDGs, this should likewise call for a strong focus on digital inequalities in the context of an ever-increasing digitalization of development. In order to discuss these implications, however, we need to first shed light on what the centrality of inequalities means concretely, and what it implies for development policy and practice. While many voices stress the shift in narrative, there is little literature on how exactly inequalities are integrated into the SDGs, and how they operate within the system of targets they encompass. We therefore present an original analysis of the UN resolution on the 2030 Agenda for Sustainable Development (United Nations, 2015), as well as the SDGs' latest indicator framework (United Nations,

2020). In this analysis, we map out the integration of different types of inequalities and analyse how they interact with the rest of the agenda. This will allow us to better understand not only the types of inequalities and marginalized groups that are embedded in the SDGs, but more structurally, the processes that drive them and their implications for development programming.

2.1 Leaving no-one behind? unpacking inequalities in the SDGs

In their ambitious narrative, the SDGs call for development that *leaves no-one behind* resulting in the well-established principle that “no goal is considered to be met unless it is met for everyone” (Kabeer, 2016, p. 55). The notion of *leaving no-one behind* is repeatedly stressed throughout the UN declaration (United Nations, 2015; see also van Bergeijk & van der Hoeven, 2017) and reinforced through numerous pledges to *combat inequalities* as well as the recurring addendum *for all*, which complements nearly all of the SDGs’ social goals and targets (decent work *for all*, access to justice *for all*, sustainable energy *for all*, etc.). While these examples illustrate a shift in narrative, we must look beyond the cosmetics of language if we want to discuss actual consequences for development programming. Clearly, the declaration’s language matters, as the SDGs’ potential for transformation is essentially discursive (Freistein & Mahler, 2016), yet their actionable implications lie primarily in how they are embedded in the goals and targets themselves.

Most obviously, the SDGs feature an overarching goal to reduce inequalities within and between countries (SDG 10), which covers a rather comprehensive range of targets. The goal *inter alia* calls for eliminating discriminatory laws, increased income growth for the bottom 40% of the population, as well as social and political inclusion, regardless of age, sex, disability, race, ethnicity, origin, religion or status. This wide scope of SDG 10, while aspirational, comes at the cost of depth and many of the respective targets remain rather vague (Pandey et al., 2020), often lacking clear and measurable indicators (Vandemoortele, 2017). Yet, as we are going to show, SDG 10 is not necessarily the most significant way by which inequalities have found their place in the SDGs. Many of the aspects of inequality covered in this goal reappear throughout several other goals, where they gain further substance and become more actionable and measurable.

In order to identify the SDGs’ approach to inequalities, we must therefore look beyond SDG 10 and scrutinize their integration across the whole of the SDGs. In what follows, we present the findings of our in-depth document analysis, unpacking the types of inequalities that are embedded throughout the SDGs’ targets. Rather than merely identifying and mapping out the various types of inequalities and marginalised groups that are highlighted within the SDGs’ targets, we apply the lens of intersectionality to discuss how these multidimensional inequalities reproduce one another and how they interact with the network of targets that make up the SDGs. In this context, we will use the notion of policy coherence in order to discuss the implications for development policy and practice. This discussion will first and foremost revolve around non-digital aspects of inequalities in the SDG context and will lay the groundwork for us to, later, draw out the parallels between research on digital inequalities and the SDG agenda, in order to identify the challenges for digital development.

2.1.1 Mapping inequalities in the SDGs: equality for whom and equality of what?

The SDGs are made up of 17 goals, which encompass a total of 169 targets. Many of these sector-specific targets mainstream the objectives of one goal across other goals. With regard to inequalities, these sector-specific targets highlight marginalized groups that must receive particular attention throughout the targets and indicators of the SDGs. In practice, this can take different shapes. In certain cases, the target’s wording explicitly refers to these groups, such as Target 2.1, which calls to “double the agricultural productivity [...] of small-scale food producers, in particular women, indigenous peoples, family farmers [...]” (United Nations, 2020, p. 2). In other cases, the groups are highlighted through disaggregated indicators, such as indicator 8.5.2, which calls for disaggregated data on “unemployment rate, by sex, age and persons with disabilities” (United Nations, 2020, p. 8, italics

added). These targets promote, for example, gender-sensitive approaches in development areas that are not, primarily, about gender equality.

To gain a comprehensive overview of the groups that are mainstreamed through such targets and indicators, we have coded the latest *SDG Indicator Framework* (United Nations, 2020) to identify the quantity and distribution of references to such groups. During an initial deductive coding (Elliott, 2018), we manually identified and tagged the different groups that are highlighted either in SDG targets or SDG indicators and clustered them in sub-codes (Saldaña, 2013). On the basis of the groups we identified, we further used computer-assisted analysis to inductively code all mentions of these groups throughout the document, applying multiple keyword searches. Further analysing our search results, we identified the development areas in which they are highlighted. We clustered these areas thematically, instead of mapping them by the respective goals, since, for example, mentions of poverty could be found in SDG1, SDG5, or SDG10, to name a few.

Our coding process resulted in a novel and original analysis of the different forms of inequality embedded in the SDGs, identifying the areas within which they are integrated. Concretely, the coding process resulted in a cross-table of (1) marginalized groups (Equality for Whom?) and (2) the respective development areas (Equality of What?), identifying the number of mentions for each group per area, as listed in Table 1.

Our data shows nine different marginalized groups that are being highlighted throughout the document, yet to very different degrees. Figure 1, where bubble-size represents the total number of mentions, and stroke-width illustrates the distribution of mentions per respective development area, visualizes the connections between the *Equality for Whom* and *Equality of What* axes. The case of gender equality presents a prime example showing how inequalities are mainstreamed through sector-specific targets. The high number of these gender-related targets (72) substantially expand the scope of SDG 5 (Gender Equality) by mainstreaming a gender-sensitive approach throughout the SDGs.

A closer look at the variety of sector-specific targets of this nature further reveals the scope of inequalities that are embedded in the SDGs, making the ambition to leave no-one behind somewhat more tangible. In addition to the vague mention of *All People* (28 times), we for example find numerous targets specifically highlighting children (28) throughout development areas such as education, safety, hunger or health. Moreover, 28 of the SDG targets and indicators explicitly refer to the somewhat vague group of *the poor and the vulnerable*, sometimes identified as those in extreme poverty or the bottom 40 per cent. As Figure 1 illustrates, these mentions are not limited to the targets on poverty reduction but likewise feature in areas such as education, justice or health.

Other marginalised groups that are referred to across the SDGs' 169 targets include persons with disabilities (18 mentions, including poverty, decent work and infrastructure), older people (10, including poverty, infrastructure and hunger), as well as rural population (7, poverty, education, infrastructure), indigenous people (4, poverty, education) or racial minorities (3, justice and political inclusion). In addition to the concrete targets and indicators, Target 17.18 calls for maximising the disaggregation of all data "by income, gender, age, race, ethnicity, migratory status, disability, geographic location and other characteristics" (United Nations, 2020). This general call for disaggregated data, which is prominently reinstated directly under the header of the SDG framework, aims to further mainstream these groups across the agenda.

In order to interpret these manifold references, we will view them through the lens of the intersectional interplay of inequalities, and their mutually reinforcing and reproductive nature (Crenshaw, 1989). Understanding how incoherent development policies across the SDGs risk contributing to reinforced intersectional inequalities will then allow us to draw parallels to the literature on digital inequalities, demonstrating the implications of *leave no-one behind* for digital development programming.

Table 1 . SDG mentions of marginalized groups per development area

		EQUALITY FOR WHOM										TOTAL
		(Groups highlighted within SDG targets and indicators)										
		Women	Children	Poor / Vulnerable	People with Disabilities	Older People	Migrants	Rural Population	Indegenous People	Racial/ Ethnic Minorities	"All People"	
EQUALITY OF WHAT (Development areas in which these groups are highlighted)	No Poverty	6	2	11	3	3		1	2		5	33
	Education	11	5	2	1			1	2		3	25
	Safety	11	6	3	1		4					25
	Justice / Political Inclusion	13	2	1	3					1	4	24
	Infrastructure / Transport	4	2	1	4	4		3			3	21
	Statistical Inclusion	2	2	2	2	2	2	2		2		16
	Health	9	2	1							3	15
	Decent Work	7			3		3				2	15
	Social Protection / Basic Services	3	2	3	1	1					2	12
	No Hunger	3	4	1		1					1	10
	Water / Sanitation	1	1	1							4	7
	Ownership of Land / Resources	5		1							1	7
	Technology	2									1	3
	Energy										2	2
	Housing										1	1
	TOTAL	72	28	28	18	10	8	7	4	3	28	

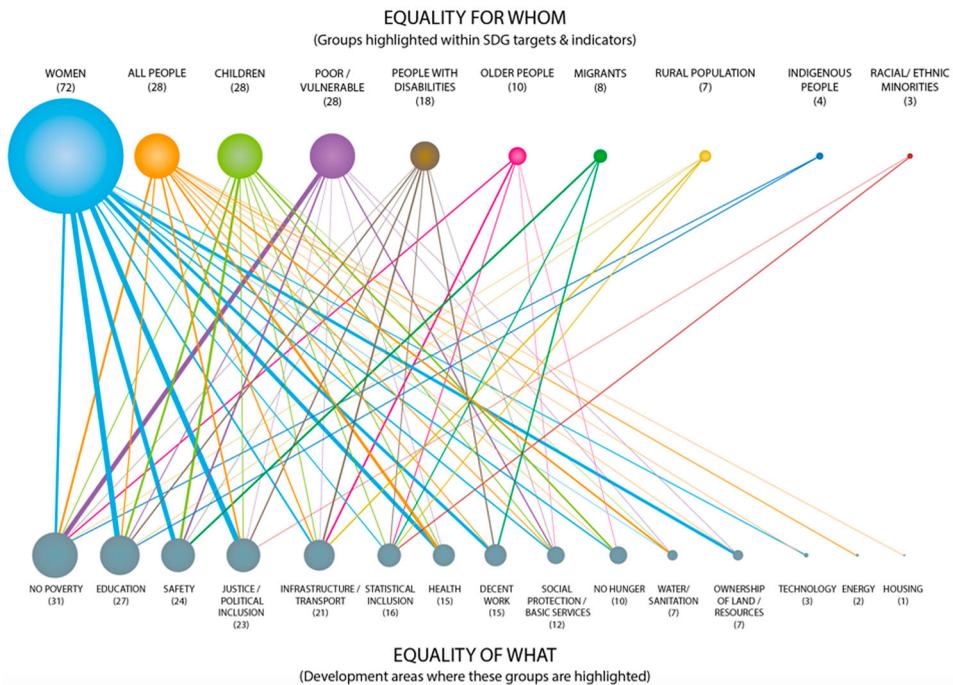


Figure 1 . Distribution of mentions of marginalized groups per development area

2.1.2 Intersectional inequalities in the network of goals & targets: a call for coherence

Conceptually, the broad range of goals that feature such references to marginalized groups resonates with the multidimensionality and intersectional nature of inequalities as such. As Kabeer (2016) summarises, inequalities can be conceptualised as horizontal, spatial, and vertical inequalities. Horizontal inequalities refer to identity-based disadvantages of groups, based on aspects such as race, gender or ethnicity (Arauco et al., 2014). Much like spatial inequalities, which describe marginalization based on geographic location (slums, rural areas, etc.), these inequalities are partly represented through the various marginalised groups that are highlighted throughout the SDGs (see the *Equality for Whom* axis in Figure 1), ranging from women and children to indigenous people and rural populations. Vertical inequalities refer to “inequality between those who are better off and worse off” (Wisor, 2016, p. 449) in terms of wealth, education, health and other social outcomes (MacNaughton, 2017; Unterhalter, 2012). These inequalities relate to the development goals within which the previously mentioned groups are highlighted (see the *Equality of What* axis in Figure 1).

The interplay between and overlap of these different dimensions of inequality result in “an intersecting, rather than an additive, model of inequality, where each fuses with, and exacerbates, the effects of the other” (Kabeer, 2016, p. 56). Based on the work of Crenshaw (1989), the notion of intersectionality can be utilized to shed light on the complexity of inequality, where a multitude of disadvantages reinforce and constitute one another. Such intersectional inequalities are at the core of the disadvantage of those most likely to be left behind (Arauco et al., 2014), for example a poorly educated, disabled woman in a rural environment, as each of these dimensions represent mutually reproducing mechanisms (Winker & Degele, 2011). Identifying such reproducing mechanisms is thus a crucial part of addressing inequalities (Freistein & Mahlert, 2016).

In order to understand the relevance and concrete implications of mainstreaming these intersectional inequalities throughout the SDGs, it is helpful to discuss it in conjunction with the notion of policy coherence. The example of gender equality, which features the highest number of such references across a broad variety of development sectors, provides an excellent example for doing so. In

comparison to SDG5, the respective MDG on gender equality was not only rather narrow in its scope, but it was also in no way mainstreamed across other goals (Stuart & Woodroffe, 2016). In the context of the SDGs, we find gender targets included across most of the agenda including the goals on justice, education, poverty, hunger, health, or work, to name a few. This new approach partly results from the SDGs' novel focus on policy coherence, which aims to ensure that advancements in one area of development do not undermine advancements in another.

Unintentional consequences and side-effects of well-intended development interventions have proven to be serious roadblocks in international development and have hampered the achievement of previous development agendas (Mackie et al., 2017). In evaluating the success of the MDGs - for example when examining what hampered progress towards MDG 7 on climate change (UNEP, 2012) - it was often shown that incoherent efforts in pursuit of other MDGs had negative side-effects. As we have seen, inequalities are a prime example of such negative side-effects of development efforts. Development efforts in pursuit of the MDGs often benefitted the so-called *low-hanging fruits*, while leaving the most marginalized even further behind (Bhatkal et al., 2015). Thus the MDGs have not only failed to reduce the gap between the most marginalized and those in somewhat better positions, but have, on the contrary, essentially increased those inequalities (Klasen & Fleurbaey, 2018).

Seeing that sustainable development can only be achieved through coherent policies that take such side-effects into account, the SDGs have in response been designed in an integrated manner. Target 17.14 calls, rather generally, for policy coherence for sustainable development (PCSD), meaning development policies that are in greatest possible coherence with efforts throughout the whole of the SDGs. More practically, however, the interdependencies between different development areas are mirrored in the network architecture of the SDGs. Instead of a *list* of goals, the SDGs represent a complex *system*, highlighting a broad range of interlinkages of goals, between which synergies must be sought and trade-offs minimized (Le Blanc, 2015).

Through making these interdependencies explicit, the SDGs seek to promote coherent development policies that take into account their spill-over effects on other development areas (Mackie et al., 2017). As our analysis illustrates, the case of inequalities represents a perfect example of this network architecture and, accordingly, marks an inherent call for policy coherence. For example, the cross-cutting integration of gender serves as a reminder that gender equality can only be achieved through coherent, gender-sensitive policies in multiple other areas. Incoherent policies in, for example, education or health could lead to side-effects that directly undermine this effort.

Considering the notion of policy coherence, we thus see the double-bind between inequalities and the SDGs as a whole. Not only does the achievement of the SDGs depend on addressing inequalities. Likewise, the fight against inequalities depends on coherent policies throughout the SDG framework. A tangible example of this complexity is the fact that, in Table 1, we find poverty both on the axis of equality of *what* and *for whom*. On the one hand, we must strive for more financial equality and lessen the poverty of those worst off. On the other hand, we must also ensure that those who *are* living in poverty receive particular attention within other development areas, as their poverty is likely to reinforce – and be reinforced by – other forms of inequality, too (Stuart & Woodroffe, 2016).

The sector-specific targets we mapped out show a number of potential examples of the need for inequality-sensitive development: Advancements in education that do not benefit women or ethnic minorities or financially poor individuals, for example, reproduce intersectional inequalities, as do advancements in infrastructure that neglect the need of older people or people with disabilities. In fact, each of the connections drawn in Figure 1 represents such potential reproducing mechanisms that must be addressed in order to maximise a goal's coherence with the quest to leave no-one behind. Yet, while the SDG framework highlights several of the intersectional interdependencies to take into account, the links we have identified remain illustrative at best and are, naturally, far from exhaustive. The challenge will be to mainstream the issue of inequalities beyond the examples we find in Figure 1, and to identify and mitigate the reproducing mechanisms they might entail. In the remainder of the paper, we will demonstrate that this presents a particular challenge in the digital context.

3. Digital inequalities and the reproductive nature of digital capital

In this section, we will outline the drivers of digital inequalities and their interplay with existing traditional inequalities, focusing in particular on Ragnedda's notion of digital capital. This will allow us to, in Section 4, demonstrate the parallels between the reproductive nature of digital inequalities and the SDGs' integrated approach to intersectional inequalities, which was analyzed in the previous section. By demonstrating how the literature on digital capital resonates with our analysis, we will make the case for mainstreaming the issue of digital inequalities throughout digitalized development programming.

Over the past decades, we have witnessed an ever-increasing digitalization of international development. Since the advent of the internet in the 1980s and 90s, when it was seen as a *solution in search of a problem*, it has been treated as an answer to the challenges of development, which represented a *problem in search of a solution* (Heeks, 2009). During the period that followed, the field of digital development – or ICT4D as it is more commonly called in academia – has been constantly evolving alongside the changing development paradigms that guided it (Walsham, 2017; Zheng et al., 2017). Moving from a hardware-centric focus on technology transfer throughout the 1990s and 2000s, when technology was seen as a “quick, off-the-shelf solution” (Heeks, 2008, p. 28) for achieving development, technology was eventually treated as a platform for development, rather than merely an end in itself (Marais, 2015).

In the context of the SDGs, ICT-driven *solutions* are implemented across virtually all sectors of development (Thapa & Sæbø, 2014), throughout the SDGs' social, environmental, economic or political dimensions. Such solutions range from mobile money, virtual education, and e-governance to smart agriculture, smart cities or smart disaster relief, to name just a few examples (Ericsson, 2015; NetHope, 2015). However, ICT4D research and practice has continuously shown that technology is by no means the silver bullet it was hailed to be by techno-optimists and -determinists, and its application in the context of development is, in fact, far from unproblematic.

Indeed, while a vast amount of literature points at the various potentials of utilizing ICTs for the benefit of certain development objectives (see ITU, 2016; 2017; Kleine, 2013), the use of ICTs is also associated with a plethora of negative side-effects (Tarafdar et al., 2015; Unwin, 2017a; 2017b). Seeing that these side-effects throughout the lifecycles of ICTs range from health implications and environmental pollution (Andreopoulou, 2016) to slave and child labor (Amnesty International, 2016), the use of ICTs in pursuit of the SDGs comes at the risk of undermining development objectives across all their dimensions (Rothe, 2020). This risk is particularly palpable for the underlying objective of reducing inequalities.

Despite their inclusive potential, digital technologies are inherently linked to the reproductive mechanisms driving the very inequalities that the SDGs seek to reduce. The assumption that technology increases inequalities (Unwin, 2017b) rests in a reading of technology as an *amplifier*. The amplification model (Agre, 2002) opposes the idea of technology as a transformative force that leads to societal change. Instead, it views technology as embedded in larger structures, within which it tends to have reinforcing effects, amplifying existing trends and forces (Toyama, 2011). Accordingly, technology tends to amplify existing inequalities (Hernandez & Roberts, 2018). To understand this relationship between technology and inequalities, it is crucial to draw from literature on the digital divide and digital inequalities. In the following sections we will outline the notion of the digital divide(s) and its relation to inequalities, before utilizing the concept of digital capital to demonstrate the mutually reinforcing nature of offline and online inequalities.

3.1 Inequalities and the digital divide(s)

Since the mid-90s, when the Internet became increasingly linked to development, researchers studied the so-called *digital divide*. In its early stages, the notion of the digital divide represented the oversimplified dichotomy between those with physical access to the internet and those

without (Katz & Aspden, 1997; Norris, 2001), following the techno-deterministic view that access determines societal change (Cammaerts & Van Audenhove, 2003; Yu et al., 2018). This binary conception, however, has gradually given way to more nuanced approaches (Ragnedda et al., 2020; Van Audenhove & Fourie, 2014) beyond the physical level. More recent research acknowledges that a physical connection to the internet does not equal digital inclusion, let alone societal change. Instead, literature now takes into account different layers of access, such as cognitive, political, cognitive, or institutional (Warschauer, 2003; Wilson, 2004), as well as socially constructed hurdles such as gender norms (Pokpas et al., 2019), and gradual differences in quality of access, motivation, types of use, or digital literacy (Livingstone & Helsper, 2007; Robinson, 2009; van Dijk, 2005).

Instead of a singular digital *divide*, we are thus seeing a spectrum of digital inequalities (Cinnamon, 2020; DiMaggio & Hargittai, 2001; Hargittai, 2003) shaping not only to which degree one can access digital technology, but also how and how well one can make use of the internet (Peter & Valkenburg, 2006). Researchers differentiate between a first level of the digital divide (several forms of access to digital technology) and a second level (proficient use of digital technology) (Friemel & Signer, 2010). In recent years, research has moreover focused on a third level of the digital divide (van Dijk, 2020), which refers to the degree to which a user can generate tangible positive outcomes from interacting with digital technology (Calderón Gómez, 2020; Loh & Chib, 2019). The generation of outcomes depends on a variety of resources and represents another level on which we see an array of inequalities (Van Deursen & Helsper, 2015). Even with similar levels of access, we see systematic differences between different groups regarding the actual outcomes that they can generate when using technologies (Helsper, 2021).

For this article, these three levels are highly relevant because inequalities in access, use, and tangible outcomes represent reproductive mechanisms that are rooted in existing offline inequalities, which they tend to reinforce. In short, one's position in society, defined by socio-economic, demographic, geographic, and a plethora of other factors, shapes one's position in regard to the digital divide(s), which in turn shapes the degree to which one can benefit from digital technology, for example by taking advantage of digitalized development efforts. If we want to understand how, through these reproductive mechanisms, digitalization of development may therefore contribute to increased inequalities, we have to scrutinize how they link to the intersectional inequalities and marginalized groups we identified in the SDG framework.

On the one hand, there is literature focusing in particular on the situation of several of these marginalized groups in relation to digital inequalities. Such literature would look at how factors like gender, age, disability, migration, education, economic background or geographic location affect one or more levels of the digital divide (See Friemel & Signer, 2010; Hernandez & Roberts, 2018; UN DESA, 2018a). Other approaches, on the other hand, focus less on individual groups but provide more general frameworks regarding the accessibility and usability of technology, and whom it might exclude (Roberts & Hernandez, 2019; Yu et al., 2018). For the purpose of this article, we will view the reproductive nature of digital inequalities through Ragnedda's (2018) lens of Bourdieusian digital capital, which is ideally suited to discuss how digitalization may interact with the existing inequalities of those whom the SDGs seek to safeguard the most.

3.2 Digital capital

Ragnedda (2018) presents an individual's set of accumulated digital competencies and (access to) technology as capital in the Bourdieusian sense, resonating with Bourdieu's *internalized ability and aptitude* (competencies) and *externalised resources* (technology) (Bourdieu, 1986). This notion is particularly helpful because the dynamics of Bourdieu's capital allow us to discuss the interaction between traditional inequalities and digital inequalities. Bourdieusian capital – material, cultural, social, or symbolic – can be accumulated by an individual and, most importantly, converted from one form to another. For example, economic capital can be converted into cultural capital, by

investing money in education (Ignatow & Robinson, 2017). The accumulation of one form of capital thus depends on the possession of another (Bourdieu, 1986), which shows that the unequal distribution of this capital drives the reproduction of existing inequalities.

Ragnedda (2018) argues that digital capital shares the characteristics of traditional capital, as it represents a set of abilities and resources that can be accumulated and converted. The accumulation of digital capital likewise requires an individual to possess different forms of traditional capital to convert. Using five forms of capital – economic, social, cultural, political, and personal – Ragnedda and Ruiu (2020) demonstrate in great depth how each of them affects a person’s digital capital across all three levels of the digital divide, as the following examples illustrate. Obviously, the degree to which a user will access, use and benefit from technology depends on cultural capital, for example in form of education, digital literacy and skills, language proficiencies, and more (Chohan & Hu, 2022; Rojas et al., 2004) Moreover, research shows that users with higher economic capital are not only more likely to afford access to the internet and to use it efficiently, but they also tend to generate greater benefits from its use (Van Deursen & Helsper, 2015). Ragnedda and Ruiu (2020) show similar trends for social capital (such as social acceptance for women to use the internet, or the existence of support systems for older people), political capital (such as the freedom to act in the digital realm), or personal capital (such as motivation, interest, or awareness).

These five forms of capital, or 5Cs, thus “place users at unequal departure points” (Ragnedda, 2018, p. 2373), as those with higher traditional capital are more likely to benefit from interaction with technology. This is particularly relevant considering the bidirectional nature of this conversion process (Ignatow & Robinson, 2017). The 5Cs (or lack thereof) interact with an individual’s digital capital, shaping not only the degree of access to technology (1st level of digital divide) and the quality of use (2nd level). In turn, the benefits gained from the use of technology (3rd level) mark the re-conversion of digital capital into traditional capital (Calderón Gómez, 2020), as these benefits take the form of increased 5Cs in the offline world. Therefore, like with traditional capital, bidirectional conversion of digital capital represents a potential reproductive mechanism preserving existing inequalities. As a “*bridge capital* between online and offline life chances” (Ragnedda, 2018, p. 2367, italics added), digital capital allows those with higher traditional capital to further increase their traditional capital more easily than others. Those who lack the 5Cs, and, therefore, lack digital capital to access and use technology effectively, will in turn miss out on opportunities to reconvert digital activities into offline capital.

Clearly, we need to approach the relationship between digital and social exclusion with the necessary nuance. As authors like Asmar et al. (2022) point out, this relation is all too often treated as a one-way street, “assuming too readily that low social and/ or economic capital automatically supposes low digital inclusion” (p. 2). The multitude of factors at play, however, also means that certain users who would traditionally be considered *rich* can be likely to be excluded due to, for example, poor social support systems when retired. Vice versa, we also see users who are *poor* in traditional understandings (for example financially or educationally), but whose strong social support systems allow them to do unexpectedly well in the digital realm (Asmar et al., 2020). This shows that the relationship between socio-demographics and digital inequalities is highly complex and not all 5 C’s are always equally relevant. Yet, the underlying dynamics of traditional capital as both *needed for* and *attainable through* digital interaction presents a crucial mechanism when viewing digital development programming in the context of the SDGs’ promise to leave no-one behind.

4. Leave no-one behind in digital development?

The concept of digital inequalities and, in particular, Ragnedda’s notion of digital capital are highly useful as they tangibly demonstrate the relation between traditional inequalities and the digital realm. As this section will show, the dynamics driving digital inequalities strongly resonate with the nature of the traditional inequalities that are at the core of the SDGs. In what follows, we

bring together the two previous sections, showing the parallels between digital capital and the complex challenge of combatting inequalities. On this basis, we will argue that the issue of digital inequalities must be mainstreamed in digital development programming if we want to ensure that the digitalization of development does not undermine the SDGs’ quest to leave no-one behind.

If we apply the lens of digital capital onto Table 1, we see an inherent link between digital capital and the inequalities which are embedded in the SDGs. While there are only a few SDG targets that refer to digital capital per se (such as ICT-related skills and access to digital technology), we see that the *Equality of What* axis resonates with the traditional capital needed to acquire digital capital. These vertical inequalities that the SDGs seek to reduce – for example inequalities of wealth, health, education, or justice – represent inequalities of Ragnedda’s 5Cs. Accordingly, the groups that are given particular attention in these areas, which we find in the *Equality for Whom* axis, are the groups potentially lacking this capital. Empirical research by Ragnedda et al. (2020) indeed shows likeliness of lower digital capital for a number of these groups. Concretely, they demonstrate that women, older people, rural populations, as well as those with lower income or lower education are likely to have less digital capital than their respective counterparts.

This research, however, is merely exemplary of the greater structural relationship between intersectional inequalities and digital development, and the lens of digital capital allows for a much broader reading of this interplay. Rather than merely concluding that these particular groups are at risk of being partially excluded from digital development efforts, we can see that, more generally, those who are *furthest behind* are commonly those at the highest risk of being even further excluded in a digital context. As we discussed earlier, leaving no-one behind requires particular focus on reproductive mechanisms that drive intersectional inequalities (Kabeer, 2016). Seeing that inequalities tend to be interlocked and reinforce each other, those who are subject to overlapping disadvantages are at the highest risk of not benefitting from development (Klasen & Fleurbaey, 2018).

In a digital context, this interplay of reinforcing mechanisms is intensified even further as they intersect with digital inequalities. The disadvantages of outcome, which are both result and driving force of the intersectional inequalities faced by members of multiple marginalized groups, mean relative disadvantages in terms of traditional capital. This suggests fewer opportunities to acquire digital capital, and, in turn, fewer opportunities to benefit from digital technology.

In the context of increasingly digitalized development programming, we may therefore see new loops of reproduced inequalities: Those with low capital may be denied the benefits of digital development efforts, while those with more capital may be able to profit from them. As we illustrate in Figure 2, this may reinforce the existing intersectional inequalities. Considering that precisely those groups that the SDGs aim to safeguard the most are less likely to benefit from digital

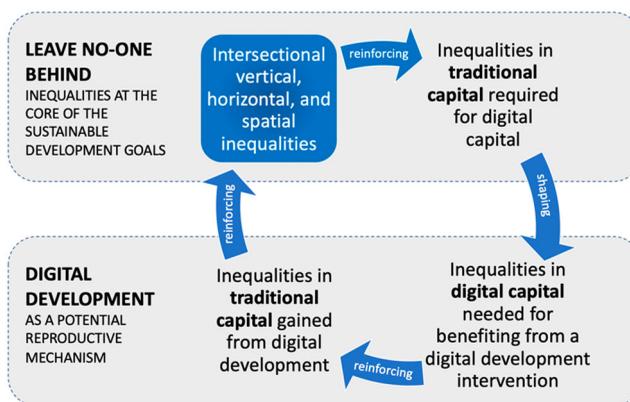


Figure 2 . Digital development as a potential mechanism reproducing inequalities

technology than others, we see that digitalization of development may increase the horizontal, vertical, and spatial inequalities that the SDGs seek to reduce.

Considering the manifold applications of digital technologies for development we outlined in Section 3, be it digital tools for political participation, online education, economic empowerment or the use of big data for development programming, to name just a few examples, there is thus a wide scope of development progress that is more likely to benefit *low-hanging fruits* than those worst off. If benefitting from digitalized development requires digital capital, it may be precisely those groups mainstreamed throughout the SDG framework – and in particular those who are subject to intersectional inequalities – who are least likely to benefit from them. We therefore see the need for policy coherence in order to ensure that digital development programming does not undermine the quest to leave no-one behind.

5. Conclusions

We have shown that reducing inequalities and leaving no-one behind are not only declared values but also instrumental building blocks for achieving the SDGs. Given their manifold negative downstream effects on virtually all areas of the SDGs, reducing inequalities presents a crucial prerequisite for sustainable development as a whole. As our analysis of the SDG framework has shown, the issue of inequalities is mainstreamed throughout the complex network of goals and targets. The integration of horizontal, spatial and vertical inequalities resonates with the intersectional and reproductive nature of inequalities and shows the need for coherent development programming that is aware of these interactions. History has shown that even well-intended development efforts risk reinforcing existing inequalities by delivering for those who are already relatively better off and failing those furthest behind.

In order to avoid repeating the mistakes of the past, development programming in pursuit of any of the SDGs therefore needs to take into account the potentially reproductive effects on existing inequalities. As we have demonstrated, this challenge is also particularly relevant for digital development programming. Surely, digital technology can be successfully utilized in pursuit of the SDGs, and their inclusive potential can be employed in projects aiming at reducing certain inequalities. Yet, the use of digital technologies is associated with a wide range of negative side-effects, not least their inherently problematic implications for inequalities. The bi-directional conversion process at the core of digital capital correlates with the reproductive nature of intersectional inequalities at the core of the SDGs.

Across the three levels of the digital divide (access to, proficient use of, and benefits from technologies) inequalities of digital capital define who can generate positive outcomes from interacting with digital technologies. Embedded in larger structures, the inequalities of digital capital are both a result and a further generator of existing offline inequalities, as their accumulation requires the possession of traditional forms of capital, such as economic, cultural, social, political or personal capital (5Cs).

The marginalized groups that the SDGs seek to safeguard – such as women, older people, children, or racial and ethnic minorities – are likely to face a range of inequalities of outcome which result in relative shortage of those 5Cs. This, in turn, means that they are less likely to acquire the digital capital needed to benefit from digital technologies. In particular those who are subject to multiple vertical, horizontal, and spatial inequalities experience intersectional dynamics of mutually reinforcing disadvantages which likely lead to particularly low traditional and, therefore, low digital capital. Here, the digital context adds yet another reproductive layer, further manifesting the socio-economic situation of those furthest behind. Digitalized development efforts therefore risk excluding precisely those groups who deserve the greatest attention in pursuing the SDGs, as they are the least likely to benefit from digital technology.

Clearly, this is in no way an argument *against* digital development. However, we have demonstrated the need for identifying and minimizing the potential reproductive effects of digital

development programming. This represents a dual challenge, targeting both sides of the loop illustrated in [Figure 2](#). On the one hand, it will require decreasing the inequalities of digital capital for marginalized groups, either directly (by enhancing access to digital technologies or digital skills) or indirectly (by enhancing the traditional capital that is required). Lessening these digital and traditional inequalities, which we find in the upper half of [Figure 2](#), will increase opportunities to benefit from digitalized development efforts for those worst off. Clearly, addressing this side of the reproductive loop is already a central part of development programming at large, given that the various inequalities related to the 5Cs are represented in a broad range of goals and targets, as are certain aspects of digital capital, such as access and education.

On the other hand, however, attention must equally be paid to the other side of the loop. Seeing that existing traditional inequalities and the resulting digital inequalities put those furthest behind at risk of not benefitting from digital technologies, we must focus on the lower half of [Figure 2](#). Here, it will be crucial to maximise inclusiveness by minimizing the digital capital that is needed in order to benefit from digital development efforts. If we want to ensure that digital development does not undermine the quest to leave no-one behind, the issue of inequalities must be mainstreamed throughout any digital development programming, informing policy and practice. Research on digital inequalities should therefore not be treated as a separate field. Much rather, it should inform programming throughout the vast landscape of digital development, in order to identify the forms of capital needed to benefit from concrete digital development interventions and groups who might be excluded. This is especially relevant for those interventions that follow a *digital by default* or *digital first* approach and which make digital capital an inherent prerequisite.

To avoid delivering for the low-hanging fruits instead of those most marginalized and, as a result, increasing the very inequalities the SDGs seek to reduce, we must therefore mainstream the following question into designing digital development interventions: What digital and traditional capital is required in order to benefit from it, and who is therefore likely to be left out? This capital-based approach can allow for identifying ways to program digital development in a way that requires the least capital, providing low-tech or no-tech alternatives, and paying particular attention to the likely bias of outcomes, in particular when working with data for development. Only such an explicitly inequality-sensitive approach will allow for harvesting the potential digital technologies without excluding those most marginalized from the progress, ensuring that no-one is left behind in digital development.

5.1 Discussion: digital inequalities in a post-2030 agenda

The SDGs are set to guide development programming until 2030 and, as of now, there is no indication of what will follow them. Seeing that the UN prided itself with a lengthy and inclusive consultation process leading up to the SDGs, we can expect a similar process to begin in the coming years, discussing a potential follow-up agenda. Authors like Coscieme et al. (2021), already call for such potential post-2030 development agenda to integrate a more streamlined and explicit approach to policy coherence. In this context, we believe that this article highlights issues that will be crucial to take into consideration when designing new goals and targets.

Seeing the increasing digitalization of development throughout the last decade, we can only assume that, by 2030, development efforts will be more digital than ever. Not only are we seeing an increased importance of data and digital technologies for driving and tracking progress towards the SDGs, but the Covid-19 pandemic is further accelerating digital transformation processes, with more and more aspects of daily life shifting into the digital realm. This means a growing need for international development to respond to the challenges that arise in the digital context (Yoo & Song, 2021). Likewise, recent trends in technological innovation, such as the growing relevance of virtual reality and the move towards the so-called *metaverse* (Mozumder et al., 2022.), show that development goals in 2030 must be designed with an increased focus on their relation to digital technologies.

If we agree that inequalities should remain at the core of a post-2030 agenda, our research demonstrates that their interaction with the digital realm must therefore be made much more explicit. Instead of treating digital inclusion as a narrow objective in and of itself, a new agenda should treat this issue as a central building block towards tackling inequalities as a whole. The kind of analysis that we have undertaken in order to unearth the link between the mantra of leaving no-one behind and digital inequalities should, in fact, not be necessary. Instead, this link should be made explicit in a new agenda. On the one hand, a post-2030 set of goals should integrate digital capital as a prominent goal in order to decrease inequalities of opportunities in the digital context. On the other hand, it should mainstream the issue of digital inequalities more explicitly throughout the network of targets, in order to emphasize the vulnerable position of marginalised groups in a digital context.

Such an integration could promote more coherent development programming by stressing the risk of reproducing intersectional inequalities in digital development. Therefore, this approach would respond to the ambiguous relationship between development and digital technologies: Integrating a *more* explicit approach towards digital inequalities would highlight the need to consider a *less* digital approach toward achieving particular goals and to integrate low- and no-tech alternatives where vulnerable groups are likely to be excluded and left behind.

ORCID

Franz-Ferdinand Rothe  <http://orcid.org/0000-0002-8072-592X>

Leo Van Audenhove  <http://orcid.org/0000-0002-1093-9041>

Jan Loisen  <http://orcid.org/0000-0002-4712-0750>

Bibliography

- Agre, P. E. (2002). Real-time politics: The internet and the political process. *The Information Society*, 18(5), 311–331. doi:10.1080/01972240290075174
- Amnesty International. (2016). *This is what we die for: Human rights abuses in the Democratic Republic of the Congo power the global trade in cobalt*. Amnesty International.
- Andreopoulou, Z. (2016). Green ICTs for climate change mitigation and energy sustainability: EU challenge. *Quality - Access to Success*, 1(17), 492–496.
- Arauco, V. P., Gazdar, H., Hevia-Pacheco, P., Kabeer, N., Lenhardt, A., Masood, Q., ... Mariotti, C. (2014). *Strengthening social justice to address intersecting inequalities post-2015*. Overseas Development Institute.
- Asmar, A., Marien, I., & Van Audenhove, L. (2022). No one-size-fits-all! Eight profiles of digital inequalities for customized inclusion strategies. *New Media & Society*, 24(2), 279–310. doi:10.1177/14614448211063182
- Asmar, A., Van Audenhove, L., & Mariën, I. (2020). Social support for digital inclusion: Towards a typology of social support patterns. *Social Inclusion*, 8(2), 138–150. doi:10.17645/si.v8i2.2627
- Baek, J., & Gweisah, G. (2013). Does income inequality harm the environment?: Empirical evidence from the United States. *Energy Policy*, 62, 1434–1437. doi:10.1016/j.enpol.2013.07.097
- Bhatkal, T., Samman, E., & Stuart, E. (2015). *Leave no one behind: The real bottom billion*. Overseas Development Institute.
- Bourdieu, P. (1986). The forms of capital. In J. Richardson (Ed.), *Handbook of Theory and Research for the Sociology of Education* (pp. 241–258). Greenwood.
- Calderón Gómez, D. (2020). The third digital divide and Bourdieu: Bidirectional conversion of economic, cultural, and social capital to (and from) digital capital among young people in Madrid. *New Media & Society*, 23(9), 2534–2553. doi:10.1177/1461444820933252
- Cammaerts, B., & Van Audenhove, L. (2003). Dominant digital divide discourses. In B. Cammaerts (Ed.), *Beyond the digital divide: Reducing exclusion, fostering inclusion* (pp. 7–14). VUB Press.
- Chancel, L., Hough, A., & Voituriez, T. (2018). Reducing inequalities within countries: Assessing the potential of the Sustainable Development Goals. *Global Policy*, 9(1), 5–16. doi:10.1111/1758-5899.12511
- Chohan, S. R., & Hu, G. (2022). Strengthening digital inclusion through e-government: Cohesive ICT training programs to intensify digital competency. *Information Technology for Development*, 28(1), 16–38. doi:10.1080/02681102.2020.1841713
- Cinnamon, J. (2020). Data inequalities and why they matter for development. *Information Technology for Development*, 26(2), 214–233. doi:10.1080/02681102.2019.1650244

- Coscieme, L., Mortensen, L. F., & Donohue, I. (2021). Enhance environmental policy coherence to meet the Sustainable Development Goals. *Journal of Cleaner Production*, 296, 126502. doi:10.1016/j.jclepro.2021.126502
- Crenshaw, K. (1989). Demarginalizing the intersection of race and sex: A black feminist critique of antidiscrimination doctrine, feminist theory and antiracist politics. *University of Chicago Legal Forum*, 1(8), 139–176.
- DiMaggio, P., & Hargittai, E. (2001). *From the “digital divide” to “digital inequality”: Studying internet use as penetration increases*. Center for Arts and Cultural Policy Studies.
- Elliott, V. (2018). Thinking about the coding process in qualitative data analysis. *Qualitative Report*, 23(11), 2850–2861.
- Ericsson. (2015). *ICT & SDG - How information and communications technologies can achieve the Sustainable Development Goals*. Ericsson.
- Freistein, K., & Mahler, B. (2016). The potential for tackling inequality in the Sustainable Development Goals. *Third World Quarterly*, 37(12), 2139–2155. doi:10.1080/01436597.2016.1166945
- Friemel, T. N., & Signer, S. (2010). Web 2.0 literacy: Four aspects of the second-level digital divide. *Studies in Communication Sciences*, 10(2), 143–166.
- Gabizon, S. (2016). Women’s movements’ engagement in the SDGs: Lessons learned from the Women’s Major Group. *Gender & Development*, 24(1), 99–110. doi:10.1080/13552074.2016.1145962
- Hargittai, E. (2003). The digital divide and what to do about it. In D. Jones (Ed.), *New Economy Handbook (Vol. 2003)* (pp. 821–839). Academic Press.
- Heeks, R. (2008). ICT4D 2.0: The next phase of applying ICT for international development. *Computer*, 41(6), 26–33. doi:10.1109/MC.2008.192
- Heeks, R. (2009). *The ICT4D 2.0 manifesto where next for ICTs and international development?* Institute for Development Policy and Management.
- Helsper, E. (2021). *The digital disconnect: The social causes and consequences of digital inequalities*. Sage Publications.
- Hepp, P., Somerville, C., & Borisch, B. (2019). Accelerating the United Nation’s 2030 global agenda: Why prioritization of the gender goal is essential. *Global Policy*, 10(4), 677–685. doi:10.1111/1758-5899.12721
- Hernandez, K., & Roberts, T. (2018). *Leaving no one behind in a digital world*. Institute of Development Studies.
- Ignatow, G., & Robinson, L. (2017). Pierre Bourdieu: Theorizing the digital. *Information, Communication & Society*, 20(7), 950–966. doi:10.1080/1369118X.2017.1301519
- ITU. (2016). *Advancing sustainable development through information and communication technologies: WSIS action lines enabling SDGs*. ITU.
- ITU. (2017). *Fast forward progress. Leveraging tech to achieve the global goals*. ITU.
- Jolly, R. (2017). Broadening the development agenda for the SDG world. In P. van Bergeijk, & R. van der Hoeven (Eds.), *Sustainable Development Goals and Income Inequality* (pp. 20–31). Edward Elgar Publishing.
- Kabeer, N. (2016). ‘Leaving no one behind’: The challenge of intersecting inequalities. In UNESCO, ISSC, & IDS (Eds.), *Challenging Inequalities: Pathways to a Just World, World Social Science Report (2016)* (pp. 55–58). UNESCO.
- Katz, J., & Aspden, P. (1997). Motives, hurdles, and dropouts. *Communications of the ACM*, 40(4), 97–102. doi:10.1145/248448.248464
- Klasen, S., & Fleurbaey, M. (2018). *Leaving no one behind: Some conceptual and empirical issues*. United Nations.
- Kleine, D. (2013). *Technologies of choice? ICTs, development, and the capabilities approach*. MIT Press.
- Kuhn, H. (2020). Reducing inequality within and among countries: Realizing SDG 10—A developmental perspective. In M. Kaltenborn, M. Krajewski, & H. Kuhn (Eds.), *Sustainable Development Goals and human rights* (pp. 137–153). Springer Nature.
- Le Blanc, D. (2015). Towards integration at last? The sustainable development goals as a network of targets. *Sustainable Development*, 23(3), 176–187. doi:10.1002/sd.1582
- Livingstone, S., & Helsper, E. (2007). Gradations in digital inclusion: Children, young people and the digital divide. *New Media & Society*, 9(4), 671–696. doi:10.1177/1461444807080335
- Loh, Y. A.-C., & Chib, A. (2019). Tackling social inequality in development: Beyond access to appropriation of ICTs for employability. *Information Technology for Development*, 25(3), 532–551. doi:10.1080/02681102.2018.1520190
- Mackie, J., Ronceray, M., & Spierings, E. (2017). *Policy coherence and the 2030 Agenda: Building on the PCD experience*. ECDPM.
- MacNaughton, G. (2017). Vertical inequalities: Are the SDGs and human rights up to the challenges? *The International Journal of Human Rights*, 21(8), 1050–1072. doi:10.1080/13642987.2017.1348697
- Marais, M. A. (2015). ICT4D and sustainability. In R. Mansell, & P. H. Ang (Eds.), *The international encyclopedia of digital communication and society* (pp. 429–437). Wiley.
- Mozumder, A. I., Sheeraz, M. M., Athar, A., Aich, S., & Kim, H.-C. (2022). Overview: Technology roadmap of the future trend of metaverse based on IoT, Blockchain, AI technique, and medical domain metaverse activity. *Conference proceedings*. International Conference on Advanced Communications Technology (ICACT).
- NetHope. (2015). *SDG ICT Playbook—From Innovation to Impact*. NetHope.
- Norris, P. (2001). *Digital divide: Civic engagement, information poverty, and the internet worldwide*. Cambridge University Press.
- Pandey, U., Kumar, C., Ayanore, M., & Shalaby, H. (2020). *SDG10 – Reduce inequality within and among countries*. Emerald Publishing.

- Peter, J., & Valkenburg, P. M. (2006). Adolescents' internet use: Testing the "disappearing digital divide" versus the "emerging digital differentiation" approach. *Poetics*, 34(4–5), 293–305. doi:10.1016/j.poetic.2006.05.005
- Pokpas, C., Craffert, L., Van Audenhove, L., & Marien, I. (2019). Women and ICT in South Africa: Mental models on gender and ICT in marginalised communities. In P. Cunningham, & M. Cunningham (Eds.), *2019 IST-Africa Week Conference, IST-Africa 2019* (pp. 1–8). IEEE Xplore Digital Library.
- Ragnedda, M. (2018). Conceptualizing digital capital. *Telematics and Informatics*, 35(8), 2366–2375. doi:10.1016/j.tele.2018.10.006
- Ragnedda, M., & Ruiu, M. L. (2020). *Digital capital: A Bourdieusian perspective on the digital divide*. Emerald Publishing.
- Ragnedda, M., Ruiu, M. L., & Addeo, F. (2020). Measuring digital capital: An empirical investigation. *New Media & Society*, 22(5), 793–816. doi:10.1177/1461444819869604
- Roberts, T., & Hernandez, K. (2019). Digital access is not binary: The 5'A's of technology access in the Philippines. *The Electronic Journal of Information Systems in Developing Countries*, 85(4), e12084. doi:10.1002/isd2.12084
- Robinson, L. (2009). A taste for the necessary: A Bourdieuan approach to digital inequality. *Information, Communication & Society*, 12(4), 488–507. doi:10.1080/13691180902857678
- Rojas, V., Roychowdhury, D., Okur, O., Straubhaar, J., & Estrada-Ortiz, Y. (2004). Beyond access: Cultural capital and the roots of the digital divide. In E. Bucy, & J. Newhagen (Eds.), *Media Access: Social and psychological dimensions of new technology use* (pp. 107–130). Erlbaum.
- Rothe, F.-F. (2020). Rethinking positive and negative impacts of 'ICT for development' through the holistic lens of the Sustainable Development Goals. *Information Technology for Development*, 26(4), 653–669. doi:10.1080/02681102.2020.1756728
- Sachs, J. D. (2015). *The age of sustainable development*. Columbia University Press.
- Saldaña, J. (2013). *The coding manual for qualitative researchers*. Sage Publications.
- Stiglitz, J. E. (2012). *The price of inequality: How today's divided society endangers our future*. WW Norton & Company.
- Stuart, E., & Samman, E. (2017). *Defining 'leave no one behind'*. Overseas Development Institute.
- Stuart, E., & Woodroffe, J. (2016). Leaving no-one behind: Can the Sustainable Development Goals succeed where the Millennium Development Goals lacked? *Gender & Development*, 24(1), 69–81. doi:10.1080/13552074.2016.1142206
- Tarafdar, M., Gupta, A., & Turel, O. (2015). Editorial: Dark side of information technology use. *Information Systems Journal*, 25(3), 161–170. doi:10.1111/isj.12070
- Taukobong, H. F. G., Kincaid, M. M., Levy, J. K., Bloom, S. S., Platt, J. L., Henry, S. K., & Darmstadt, G. L. (2016). Does addressing gender inequalities and empowering women and girls improve health and development programme outcomes? *Health Policy and Planning*, 31(10), 1492–1514. doi:10.1093/heapol/czw074
- Thapa, D., & Sæbø, Ø. (2014). Exploring the link between ICT and development in the context of developing countries: A literature review. *The Electronic Journal of Information Systems in Developing Countries*, 64(1), 1–15. doi:10.1002/j.1681-4835.2014.tb00454.x
- Toyama, K. (2011). Technology as amplifier in international development. *Proceedings of the 2011 IConference*, 75–82. doi:10.1145/1940761.1940772
- UN DESA. (2018a). *United Nations E-Governance Survey 2018*. UN Department of Economic and Social Affairs.
- UN DESA. (2018b). *World economic and social survey 2018: Frontier technologies for sustainable development*. UN Department of Economic and Social Affairs.
- UNEP. (2012). *Global environmental outlook 5*. United Nations Environment Programme.
- United Nations. (2015). *Transforming our world: The 2030 agenda for sustainable development (A/RES/70/1)*. United Nations.
- United Nations. (2020). *Global indicator framework for the Sustainable Development Goals and targets of the 2030 Agenda for Sustainable Development (A/RES/71/313)*. United Nations.
- Unterhalter, E. (2012). Poverty, education, gender and the Millennium Development Goals: Reflections on boundaries and intersectionality. *Theory and Research in Education*, 10(3), 253–274. doi:10.1177/1477878512459394
- Unwin, T. (2017a). ICTs, sustainability and development: Critical elements. In A. R. Sharafat, & H. L. William (Eds.), *ICT-centric economic growth, innovation and job creation* (pp. 37–65). ITU.
- Unwin, T. (2017b). *Reclaiming Information and Communication Technologies for Development*. Oxford University Press.
- Van Audenhove, L., & Fourie, L. (2014). From digital divide to digital inclusion. In C. Tapscott, S. Slembrouck, L. Pokpas, E. Ridge, & S. Ridge (Eds.), *Dynamics of building a better society. Reflections on ten years of development cooperation and capacity building* (pp. 145–162). University of the Western Cape.
- van Bergeijk, P., & van der Hoeven, R. (2017). *Sustainable Development Goals and income inequality*. Edward Elgar Publishing.
- Vandemoortele, J. (2017). From MDGs to SDGs: Critical reflections on global targets and their measurement. In P. van Bergeijk, & R. van der Hoeven (Eds.), *Sustainable Development Goals and income inequality* (pp. 32–50). Edward Elgar Publishing.
- van der Hoeven, R. (2017). Can the SDGs stem rising income inequality in the world? In P. van Bergeijk, & R. van der Hoeven (Eds.), *Sustainable Development Goals and income inequality* (pp. 192–218). Edward Elgar Publishing.

- Van Deursen, A. J., & Helsper, E. J. (2015). The third-level digital divide: Who benefits most from being online? In L. Robinson, S. R. Cotton, & J. Schulz (Eds.), *Communication and Information Technologies Annual* (pp. 29–52). Emerald Group Publishing Limited.
- van Dijk, J. (2005). *The deepening divide: Inequality in the information society*. Sage Publications.
- van Dijk, J. (2020). *The digital divide*. Polity Press.
- Walsham, G. (2017). ICT4D research: Reflections on history and future agenda. *Information Technology for Development*, 23(1), 18–41. doi:10.1080/02681102.2016.1246406
- Warschauer, M. (2003). *Technology and social inclusion: Rethinking the digital divide*. MIT Press.
- Wilkinson, R., & Pickett, K. (2010). *The spirit level*. Penguin.
- Wilson, E. J. (2004). *The information revolution and developing countries*. MIT Press.
- Winker, G., & Degele, N. (2011). Intersectionality as multi-level analysis: Dealing with social inequality. *European Journal of Women's Studies*, 18(1), 51–66. doi:10.1177/1350506810386084
- Winkler, I. T., & Satterthwaite, M. L. (2017). Leaving no one behind? Persistent inequalities in the SDGs. *The International Journal of Human Rights*, 21(8), 1073–1097. doi:10.1080/13642987.2017.1348702
- Wisor, S. (2016). Multidimensional horizontal and global inequality. *Journal of Human Development and Capabilities*, 17(3), 447–452. doi:10.1080/19452829.2016.1203031
- Yoo, S., & Song, Y. (2021). Role of digital technology in achieving the Sustainable Development Goals: Focus on the efforts of the international community. *Journal of International Development Cooperation*, 16(2), 31–57. doi:10.34225/jidc.2021.16.2.31
- Yu, B., Ndumu, A., Mon, L. M., & Fan, Z. (2018). E-inclusion or digital divide: An integrated model of digital inequality. *Journal of Documentation*, 74(3), 552–574. doi:10.1108/JD-10-2017-0148
- Zheng, Y., Hatakka, M., Sahay, S., & Andersson, A. (2017). Conceptualizing development in information and communication technology for development (ICT4D). *Information Technology for Development*, 24(1), 1–14. doi:10.1080/02681102.2017.1396020