Digital Education and Community Outreach for Sustainable Development in Africa

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Abstract

While the primary and secondary effects of the COVID-19 pandemic especially have spurred a new "push" by the United Nations into the four priority development areas of governance, social protection, green economies, and digitalization to achieve (or get back on track) *Agenda* 2030s Sustainable Development Goals (SDGs), how to most broadly upscale the reach, impact, and empowerment of digitalization efforts to the widest demographics possible is both highly challenging and now represents a significant new research construct. However, very little to no formal work has been done to date on the research construct of *ICT-scaling* specifically. In this chapter, the authors evaluate the reach of the scant available research for upscaling digitalized ICT educational training. Two key findings are a proposed "phasing" of ICT-scaling and the use of an index to measure the reach of educational animations for the support of the SDGs. Much more work is necessary in this area. Without effective and massively upscaled ICT educational messaging able to reliably secure people's buy-in to SDG solutions offered by international development efforts, achieving the SDGs themselves (if not simply a future for life on the planet) moves out of reach.

Keywords

COVID-19 · Sustainable Development Goals (SDGs) · Scientific Animations Without Borders (SAWBO) · United Nations (UN) · Digital divide

Introduction

Over the next decade, increasing risks of further ecosystem degradation, natural disasters, and new pandemics from worsening climate change will hinder progress toward the Sustainable Development Goals (SDGs). Already, COVID-19 has reversed or stalled efforts in many areas (United Nations 2020: 2). For Africa specifically, COVID-19 has exacerbated already existing problems in healthcare, education, water, and sanitation systems (Ekwebelem et al. 2021), with funds intended for SDGs likely (or already) redirected toward COVID-19 mitigation (Ekwebelem et al. 2021). Odey et al. (2021) argue that even the three SDGs that Africa has made significant progress on – SDG 5 (gender equality), SDG 13 (climate action), and SDG 15 (life on land) – might well be eroded due to the pandemic's secondary effects. A major consequence of this is the need to dramatically increase accessibility to digital information at dramatically reduced upscaling costs (Bello-Bravo et al. 2022); mass-upscaling educational messaging using information and communication technologies (ICTs) is one significant route for aligning work with the United Nations' push for digitalization generally.

The several lags, stalling, and reversals of progress toward SDG targets require redoubled effort by both national and international organizations to ensure that those targets and developmental goals are back on track. Naidoo and Fisher (2020) have argued for focusing on inward-local goals, especially when there was less connection with a slow economy. The UN report on the *Impact of COVID-19 on the SDGs* United Nations (2020) recommends a remediation pathway that focuses on four areas: "Governance (building a new social contract), Social protection (uprooting inequalities), Green economy (rebalancing nature, climate, economy), and Digital disruption and innovation (for speed and scale)" (United Nations 2020: 10). Leal Filho et al. (2021) offer a more thoroughgoing recommendation: to weave together African experiences, epistemology, and ontology toward increasing SDG buy-in around needs and sustainability generally. They highlight the significant link between lived experiences, indigenous knowledge systems, and recognition of Africans' realities as they relate to the SDGs as a primary component for eliciting change-adoption for sustainability. Much previous research by the authors of this chapter supports such a digitalization proposal (Rodríguez-Domenech et al. 2019; Bello-Bravo et al. 2021c), specifically by developing mass-scaling approaches for educational ICTs (Bello-Bravo et al. 2022).

One of the priority lines for *Agenda 2030* in Africa is innovation (SDG 9) and a reduction of the digital divide. Universities are often drivers of change in their regions of operation through research, teaching, engagement, and enterprise activities (Mbah and Johnson 2021). However, as will be seen in the literature review, research specifically around the research-construct of *ICT-scaling*, i.e., mass-scaling approaches using information and communication technologies (ICTs), is scarce at best. Accordingly, in this chapter, the authors describe an educational/knowledge sharing support system, Scientific Animation Without Borders (SAWBO), that utilizes strategies for mass ICT-scaling as part of a commitment to addressing SDG goals specifically.

More generally, this involves the process of translating basic research insights and innovation knowledge into real-world solutions for problems faced by the most vulnerable people (especially in Africa, which has many of the most vulnerable societies). SAWBO's prioritization to meet the needs of the world's poorer (and its concomitant recognition that the environment can sustain and provide an only limited, not boundless, range of technological solutions) specifically draw on Sustainable Development's founding document, the Brundtland Report (Brundtland et al. 1987). As such, SAWBO's approach to ICT-scaling to support the SDGs generates accessible, informative, and often life-saving and life-changing knowledge usable in academic (research) and nonacademic environments as nonformal and informal ICT education.

Scientific Animations Without Borders (SAWBO)

Established in 2011, Scientific Animations Without Borders (SAWBO) is a US university-based systems approach for mass-scaling the movement of basic research

insights "off the shelf" and through solution/innovation design and distribution to reach vulnerable populations who can then choose from available innovations the ones that best suit their local situations and problems (Bello-Bravo et al. 2021a). An overarching goal in these efforts is to upscale the reach, impact, and empowerment (Johnson et al. 2018) of the information, knowledge, or innovation embodied in the video's content.

In every case, SAWBO does not originate the scientifically grounded best-practices depicted in its videos (c.f., a Fall Armyworm pest mitigation protocol, Bello-Bravo et al. 2018a; or a postharvest storage improvement method using jerrycans to support food security, Mocumbe 2016). Rather, original research insights and innovation-solutions are embodied in an appealing, actionable, and locally translated animated video format accessible to, and providing demonstrable learning gains for, local populations regardless of age, gender, educational and technological literacy, socioeconomic status, or geographic locale (especially in marginalized and isolated areas) (Bello-Bravo et al. 2018b). Once produced, all content is made freely available, in multiple language variants, through an online digital library usable by any entity, from individual change activists (SAWBO 2021) to international coalitions of sustainable development partnerships in the furtherance of their educational projects and goals.

Over its decade of operation, topics commissioned for videos by large-scale and individual global and domestic partners have typically been those vital to educational support for SDG goals (including needs and priorities in food, agriculture, health, and peace-building) (Bello-Bravo et al. 2021c). During COVID-19, SAWBO was involved in Feed the Future's SAWBO *RAPID* (Responsive Adaptive Participatory Information Dissemination) project, which mass-scaled delivery of animations addressing critical food security topics and knowledge for mitigating COVID-19's secondary impacts (including disruption to trade, supply chains, and markets) in USAID Zones of Influence in Bangladesh, Ghana, Kenya, and Nigeria. Main activities included translating existing video content into local recipient-languages as necessary, supporting digital dissemination through existing or new pathways (e.g., national television stations, WhatsApp and other social media networks, government websites, and personal sharing), and measuring the reach, impact, and empowerment of disseminated videos.

COVID-19 in Africa and SDGs

Lockdowns and shutdowns due to the COVID-19 pandemic led to the closure of borders, while lockdowns affected economies and industries, impeding the flow of information, people, and trade across nations (Bloom 2020). Due to globalization, in the pre-COVID-19 world, some economies were thriving and moving out of poverty; in many countries, that progress has now been been thwarted, with impacts to supply and demand chains through increased demand for goods and costs of production (Iwuoha and Jude-Iwuoha 2020).

SDG 4, which stresses quality education (Roorda et al. 2012), has been affected by COVID-19 through closures of schools, universities, and colleges. In cases where schools or universities stayed open, students were often disadvantaged because institutions (or students) lacked the resources, training, or infrastructures for online learning (Iwuoha and Jude-Iwuoha 2020).

> Despite these constraints, however, education – minimally: the delivery of knowledge and skills that can offset these challenges and afford all people the opportunity and ability to secure dignified and satisfying lives for themselves, their families, and their communities – remains an indispensable need. It is not if or when we can tangibly move towards the actualization of education for sustainable development, but how and now. To effectively bridge the divide between the aspirations of the SDGs and their actualization on the ground represents one of the most pressing and obvious moral imperatives of our age. (United Nations 2020: 6).

Nevertheless, education – as "the delivery of knowledge and skills that can offset these challenges and afford all people the opportunity and ability to secure dignified and satisfying lives for themselves, their families, and their communities" (United Nations 2020: 6) – remains essential, such that the effects of COVID-19 on the capacity to educate are therefore especially harmful. Progress toward achieving access to education in Africa has been a constant effort since 2000 with significant achievements by 2015. Working through education to enable the SDGs moves toward resolving the short- and long-term effects of COVID-19, while remaining committed to bridging the gaps between digital technology and local innovation.

In Africa, as elsewhere, education affects agriculture. Agriculture remains essential to Africa, making up ~25% of the continent's GDP, with 70% of the population participating in smallholder farming for their livelihood (Fernando 2020). The pandemic critically affected processes that inform agriculture, agribusiness, and agricultural extension. Farmers could not access markets or extension services due to government restrictions, including lockdowns, curfews, restricted travel, and the closing of public gathering spaces.

To cope with COVID-19 regulations, preexisting (and emergent) social network groups and platforms for information sharing gained momentum, including WhatsApp, Facebook, Twitter, Zoom, and Telegram (Ross 2017). Social networks where members know each other and participate in information sharing illustrate a digitalization of agriculture information. This further affects how people can create an understanding of networks at the community, national, regional, and international levels (Ross 2017). An essential pathway for the communication of information among groups is provided by social networks. Knowledge about an innovation affects how readily people adopt it; innovation diffusion is more complex than information transmission. To embrace a new technology, an individual must think that its advantages outweigh those of the existing ones (Ross 2017).

To mitigate the havoc to agriculture in Africa caused by COVID-19, numerous recommendations to improve the online marketing of agricultural produce to reduce the risk of spreading COVID-19 and diversify the marketing of agricultural products have been proposed (Prosper et al., 2021). Also, the African Development Bank has

directed ten million dollars to respond to COVID-19 to increase technology in agriculture and healthcare. Within agriculture, the Bank established measures to facilitate access to farm inputs, the market, and the availability of soft loans and grants to farmers to modernize and improve agriculture (Fernando 2020). The Bank also strategized to increase the inclusion of youth and women in agriculture (Fernando 2020). International assistance has been implemented as well (Alden and Dunst 2022). Nonetheless, Jafri et al. (2021) warns of an urgent need to rethink how people and societies produce, process, market, and consume their food to create more sustainable and resilient food systems that protect livelihoods in the face of vulnerabilities and crises, which may impact people's ability to have access to healthier diets (Jafri et al. 2021).

COVID-19 and SDG Achievement in Africa

Although all countries in the world are affected by COVID-19, countries in the low-income range face increased risks. Because those living in vulnerable conditions have less or no access to health services, food, and basic services, this means that even in a post-COVID-19 world, the pandemic will still affect the attainment of SDG goals (United Nations 2020).

By 2020, highly impacted SDGs in Africa included: the well-being of humanity (SDG 3), decent work and economic growth (SDG 8), food security (SDG 2), and poverty (SDG 1). While some of the SDGs related to environmental indicators did not decline (United Nations 2020), the pandemic slowed progress with even more significant uncertainties for the future, especially around green growth, social protection, green economy, and digitalization.

The UN has developed SDG PUSH strategies to assist countries toward the SDG targets, while recognizing that full attainment of this effort's goals are unlikely (See Abidoye et al. 2021). The "SDG Push" strategy focuses on green growth, social protection, a green economy, and digitalization. These strategies aim to offset SDG setbacks due to the pandemic. Abidoye et al. (2021) write,

> With an 'SDG Push', by 2030 countries categorized as low and medium human development could make significant gains relative to the high human development group of countries for poverty, primary education, maternal and child mortality, and access to improved water sources. However, low and medium human development countries do not perform as well on the targets of reduction of malnourishment in people and children secondary education and improved sanitation groups (9).

Addressing the Digital Divide and Community Outreach for Sustainable Development in Africa

Noguchi et al. (2018) have illustrated how sustainable development is possible when (1) accepting that informal learning processes are lifelong events, (2) associating learning with actual contextual challenges, and (3) focusing on the reality of local

community and vulnerable target audiences. As such, inclusive education reaffirms sustainable development. However, understanding community development and proposing a plan of action can face obstacles from existing power structures and differentials between stakeholders. Improvement efforts at the "center" can have (deliberate or accidental) negative impacts of the "periphery" (Bunyi 2008). Accordingly, it is essential to recognize the ways that modern social structures (both within countries and between the Global North and South) can fail to include marginalized communities and people, especially rural and indigenous peoples.

As such, some means of delivering education in the sense noted above to all people despite these prevailing tendencies is necessary, especially as rural and indigenous knowledge is stigmatized as backward (Nemutandani et al. 2016). A reflection of this is a refusal to use locally most comfortably spoken languages for communicating public-interest information. Sometimes this refusal is deliberate and explicit but it also arises simply from poor planning, a lack of resources, or inconvenience; it is therefore remediable.

Again, finding common ground and common parlance with vulnerable populations to address their concerns is essential. An approach like SAWBO's, which translates its content into the locally most comfortably spoken languages and is designed to be accessible to people regardless of educational and technological literacy or geographic isolation, already contains "remedies" to the above challenges. However, linguistic translation of videos is not simply a logical and practical communication strategy (Nonaka and Takeuchi 1997).

All cultures practice some form of language ideology whereby certain languages, deemed "official," are not just treated and used as mainstream but are positioned as valid (in contrast to invalid other languages) (Bourdieu 1991). Simply in terms of pragmatics, this creates a situation of unidirectional communications that may not even reach an intended audience, by design or not, but also no channel for indigenous, marginalized, or rural people to express their concerns in daily life. When trying to solve problems, it is critical to be able to hear from those receiving the "help," to affirm that the effort is actually helping. Moreover, when "outsiders" address people in a language more comfortably spoken by locals, especially when it the language is one not otherwise deemed "official," this signals an intercultural respect that better fosters the uptake of the information communicated (Bello-Bravo et al. 2021a). This is the sense behind McLuhan's famous statement that the medium is the message (McLuhan 1964). In education, how one communicates is often more important than what one communicates (MacLean 1962). Accordingly, translating a SAWBO animation into a local language can have a greater impact than creating a new animation from scratch (Rodríguez-Domenech et al. 2019).

SAWBO Addresses the Digital Divide by Informal Education for ESD

While the SAWBO approach and platform have been described previously at greater length than here (Rodríguez-Domenech et al. 2019), this chapter focuses attention specifically on education and learning.

In its most basic sense, learning involves eliciting knowledge adoption or uptake in learners. However, this is not cognitive only; Hollingworth (1932) long ago emphasized that the sign or evidence of learning is a change of behavior. Freire (1970) heavily criticized a banking model or vision of education, where educators simply "deposit" information in the minds of students. For adult education particularly, Knowles (1990), Vygotsky and Cole (2018) in general, emphasized the constructivist mandate to make apparent the connection between any information imparted and the lived-realities of the learners; that is, under those circumstances, knowledge adoption and behavior change would be more likely to follow because learners have a reason to "construct" the knowledge in a way relevant to them.

This especially matters for informal learning, where learners generally already come to the opportunity with a reason to construct the knowledge in a way relevant to them, i.e., precisely the motivation that led them to pursue the opportunity in the first place. For informal education, irrelevance (as a failure to connect to the lived realities of an interested learner) is the kiss of death.

SAWBO's mobile ESD is designed to maximize this potential for connection and makes available knowledge and skills for future community application – more specifically, to support emergent communities of practice around sustainable community change (Lutomia et al. 2021). Referring specifically to women in agriculture, Johnson et al. (2018) distinguish between reaching, impacting, and empowering innovation recipients; SAWBO educational materials and activities propose the development of organic, sustainable activities for empowering marginal audiences (Rodríguez-Domenech et al. 2019).

SAWBO core areas are defined with a broadly inclusive vision of adding new topics that are both scientific and inclusive of knowledge from indigenous knowledge experts. The program's core areas are agriculture, health, women empowerment, and peace and justice. The ongoing creation of educational materials grows with the needs and the funding (Rodríguez-Domenech et al. 2019).

Global development must engage communities in sustainable development issues using curricula accessible to communities in developing nations. Some common approaches could be applied to populations, communities, and countries, but these approaches need to be defined and negotiated with a challenge for generalizations. A cost-effective strategy could focus on a standard canon for finding simple solutions to global problems – for instance, storing seeds in a jerrycan container to prevent postharvest food loss to address food security. An initial strategy to teach a technique can follow other steps such as translations into local languages and finding partners for deployment pathways (Rodríguez-Domenech et al. 2019).

ICT-Scaling to Support the SDGs

This chapter extends previous work by Rodríguez-Domenech et al. (2019), where the authors showcased how SAWBO's *mobile Education for Sustainable Development (ESD)* approach supports *Agenda 2030*'s 17 SDGs. Mobile ESD, in its most

prevalent application, empowers individual change agents and organizations (at all scales from local-grassroots to global coalitions) by affording them access to a freely available library of small-sized digital educational animations (either already in locally most comfortably spoken languages or translatable into those languages) from which they can select scientifically based solutions to problems they have locally identified. Those mobile ESD videos are then viewable, sharable, available for teaching presentations (especially extension teaching in poorer or resource-straitened agricultural areas) and redistributable on the currently most widespread digital access device (mobile phones) (Bello-Bravo et al. 2021b). More importantly for this chapter, the format of these animated educational videos affect a *decreasing* unit cost for more broadly mass-distributing the videos (i.e., ICT-scaling) in support of any educational project, including support for the SDGs.

The advent of the literally World Wide Web (in conjunction with the earlier promise of computer-mediated learning) initially inspired very large claims around a promise in digital ICT mass education that has met with serious obstacles (Aker and Mbiti 2010; Hafkin 2003), especially in terms of unequal access by women, the poor, and isolated or rural areas away from centers – access inequalities that persist across all types of ICTs (i.e., personal computers, laptops, other digital devices, and mobile phones) (Ma 2017; Dixon et al. 2014; Kimbrough et al. 2013; Hafkin 2000, 2003; Bello-Bravo et al. 2021b). Nevertheless, ICTs and consequent digitalization constructs (like information literacy and digital literacy) are now reflexively assumed and included as part of messaging generally and educational messaging specifically (Reddy et al. 2020; Byfield et al. 2015; Bunker 2010), despite the obstacles and access barriers (Ameen and Gorman 2009; Tata and McNamara 2018).

This results in an almost paradoxical situation where educational ICTs (and the need to scale them) are indisputably ubiquitous and seemingly indispensable but hardly researched. Indeed, animated educational videos, both locally translated and otherwise (Groeneveld 2022; Smith et al. 2012; Ben-Zeev et al. 2021; Bohonos et al. 2022; Lutomia et al. 2022; Welch et al. 2009; Bello-Bravo et al. 2021a), have been successfully delivered on ICTs (Mindu et al. 2020; Owolabi 2020; Reeves et al. 2020; Bello-Bravo et al. 2020) and accessed through Apps and digital repositories online (Bello-Bravo et al. 2021c; Rodríguez-Domenech et al. 2019; Kumar 2022). Nonetheless, a review by Sartas et al. (2020) found no comprehensive frameworks for research-for-development ICT-scaling practices.

Even a non-delimited literature search for "ICT-scaling" yields only ten results, which is intriguing given the massive upscaling of digital (online) education spurred by COVID-19 and the many reviews of problems associated with that abrupt movement of education from predominantly offline to obligatorily online (for K-12 and higher education alike) (Pokhrel and Chhetri 2021; Carrillo and Flores 2020; Mielgo-Conde et al. 2021; Parveen et al. 2022; Wen et al. 2021). Nearly a decade ago, Foster and Heeks (2013) explored ICT-scaling as "successful diffusion" (296) in the specific case of one of the most popular mobile banking ICTs (on cell phones) in Kenya. Their aim to support "bottom-of-the-pyramid" ICT-scaling aligns well with the sustainability criterion to prioritize empowering and meeting the needs

of the world's poor, consistent with SAWBO's approach (Rodríguez-Domenech et al. 2019; Bello-Bravo and Lutomia 2022). While other research has previously acknowledged the importance, value, and necessity of ICT-scaling (Fisac Garcia et al. 2013; Reddy and Kumar 2014), this emphasis is not operationalized as a research construct for ICT-scaling (Medendorp et al. 2022; Bello-Bravo et al. 2022; Payumo et al. 2021). Recently, Goyal et al. (2022) cited the comparatively much smaller costs of ICT-scaling compared to the sector scaled to medicine and health; this echoes the more widely applicable call for dramatically increased access to ICT-scaled information at decreased costs for such scaling (Bello-Bravo et al. 2022). As stressed in this chapter, Lopez and Nastasi (2014) acknowledged the utility of ICT-scaling as a research construct.

Again, while this paucity of other research echoes the finding by Sartas et al. (2020) of no comprehensive frameworks for research-for-development ICT-scaling practices, Bello-Bravo et al. (2022) offers quantitative evidence for ICT-scaling's decreased unit costs, and Medendorp et al. (2022) discloses the "Big Data" possibilities for regional ICT-scaling. As such, while ICT-scaling is an emergent research-construct within international development, it has always been present in potential or as a development within SAWBO's approach (Bello-Bravo et al. 2020), especially as a support for the 17 SDGs (Rodríguez-Domenech et al. 2019).

SAWBO's adaptation of Sachs et al.'s (2017) SDGs and Dashboards Report approach (used for collaborating with countries to help select priorities for achieving the 17 SDGs) generated the "SAWBO Index of SDGs" (SIS), as the percentage (from 0% to 100%) of SDG target content "hits" expressed, captured, or represented in 71 analyzed videos) (Table 1). This provides a quantitative measure of the reach of ICT-scaled educational messaging. Table 2 then summarizes the total and average number of content "hits" and the average SIS by SDG for all 71 videos. In total, the 71 videos were relevant to at least one of the 17 SDG targets 2472 times, averaging 34.82 hits per video across all 17 SDGs and a SIS of 20.60. Video(s) having the highest SIS (28.4) and number of hits (48) over 16 of 17 SDGs (SDG 14 had no hits) were the series of eight on "Survival Gardening." Second-highest were 13 videos on food security (addressing postharvest lost prevention, a safer non-synthetic pesticide, and improved shea processing) and 5 on health (disease prevention) with a SIS ranging from 20.7 to 26.6 and averaging 35–45 hits on 14 of 17 SDGs. Lowest was SDG 14 (Oceans, Life Below Water), with zero hits.

For the sake of greater specificity from a single example, Tables 3 and 4 present the data analysis for a single (randomly selected) video, "Biocontrol of Legume Pod Borer (*Maruca vitrata*)" (SAWBO 2022). Table 3 then exhibits the coding for a total four (of ten) SDG 4 targets ("Ensure Inclusive and Equitable Quality Education and Promote Lifelong Learning Opportunities for All"). Table 4 summarizes the video's SIS across the 169 targets for all 17 SDGs (average SIS = 19.5). Three SDGs (SDG 6, SDG 7, and SDG 14) have SIS = 0. The other 14 range from 62.5 (SDG 9) to 10.0 (SDG 10).

Video access history by country was also tabulated against the Human Development Index (HDI) categories (low, medium, high, and very high) (see Table 5). Overall, the 71 videos were accessed or downloaded at least once in 53 (of 188)

Table 1 SAWBO index of SDGs (SIS) by video

	SAWBO index of SDGs (SIS)																		
Video title	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Hits	Avg.
Biocontrol of Legume Pod Borer (*Maruca vitrata*)	14	25	17	40	11	0	0	25	63	10	20	36	40	0	17	17	11	33	19.5
Cooking with Soy!	14	38	17	40	11	0	0	25	63	10	20	36	40	0	17	17	16	35	20.7
How to Remove the Poison from Cassava Flour	14	38	17	30	11	13	0	25	63	10	20	36	40	0	17	17	16	35	20.7
Natural Insecticide from Neem Seeds	29	63	17	30	11	0	0	25	63	10	20	36	40	0	17	17	26	39	23.1
Natural Insecticide from Neem Seeds	29	63	17	40	22	0	17	25	63	10	20	36	40	0	17	17	26	42	24.9
Postharvest Loss: Bag Stacking	14	63	17	40	11	0	17	25	63	10	20	36	40	0	17	17	26	40	23.7
Postharvest Loss: Bag Transportation	14	63	17	40	11	0	17	25	63	10	20	36	40	0	17	17	26	40	23.7
Postharvest Loss: Bulk Transportation	14	63	17	40	11	0	17	25	63	10	20	36	40	0	17	17	26	40	23.7
Postharvest Loss: Hermetic Sealing with Locally Available Containers	29	63	17	50	22	0	17	25	63	10	20	36	40	0	17	17	16	41	24.3
Postharvest Loss: How to Build a Solar Grain Dryer	29	63	17	50	22	0	17	33	63	20	20	36	40	0	17	17	26	45	26.6
Postharvest Loss: How to Use a Solar Grain Dryer	29	63	17	50	22	0	17	33	63	20	20	36	40	0	17	17	26	45	26.6
Postharvest Loss: Jerrycan Bean Storage	29	0	17	40	22	0	17	33	63	20	20	36	40	0	17	17	5	35	20.7
Postharvest Loss: Salt Testing for Grain Moisture Levels 2D	29	63	17	40	11	0	17	33	63	20	20	36	40	0	17	17	21	42	24.9
Postharvest Loss: Salt Testing for Grain Moisture Levels 3D	29	63	17	40	11	0	17	33	63	20	20	36	40	0	17	17	21	42	24.9
Postharvest Loss: Storage	29	63	17	40	11	0	17	17	13	10	20	36	40	0	17	17	16	34	20.1
Prevention of Postharvest Loss: Agricultural Value Chain	29	63	17	40	22	0	17	33	38	10	20	27	40	0	17	17	32	41	24.3
Prevention of Postharvest Loss: Agricultural Value Chain CTA	29	63	17	40	22	0	17	33	38	10	20	27	40	0	17	17	32	41	24.3

(continued)

Table 1 (continued)

	SAWBO index of SDGs (SIS)																		
Video title	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Hits	Avg.
Prevention of Postharvest Loss: Supply and Demand	43	63	17	40	22	0	17	33	38	10	20	27	40	0	17	17	32	42	24.9
Prevention of Postharvest Loss: Supply and Demand CTA	43	63	17	40	22	0	17	33	38	10	20	27	40	0	17	17	32	42	24.9
Row Planting of Teff	29	75	17	40	11	0	0	33	25	10	10	27	20	0	17	17	16	34	20.1
Solar Treating of Cowpea Seeds	29	63	17	30	11	0	0	8	63	10	20	36	40	0	17	17	26	37	21.9
Survival Gardening: Drip Irrigation	29	88	17	40	11	50	17	25	63	20	20	36	40	0	17	17	26	48	28.4
Survival Gardening: Drip Irrigation HHI	29	88	17	40	11	50	17	25	63	20	20	36	40	0	17	17	26	48	28.4
Survival Gardening: How to Create Compost (2D)	29	88	17	40	11	50	17	25	63	20	20	36	40	0	17	17	26	48	28.4
Survival Gardening: How to Create Compost (2D) HHI	29	88	17	40	11	50	17	25	63	20	20	36	40	0	17	17	26	48	28.4
Survival Gardening: How to Create Compost (3D)	29	88	17	40	11	50	17	25	63	20	20	36	40	0	17	17	26	48	28.4
Survival Gardening: How to Create Compost (3D) HHI	29	88	17	40	11	50	17	25	63	20	20	36	40	0	17	17	26	48	28.4
Survival Gardening: Raised Planting Beds	29	88	17	40	11	50	17	25	63	20	20	36	40	0	17	17	26	48	28.4
Survival Gardening: Raised Planting Beds HHI	29	88	17	40	11	50	17	25	63	20	20	36	40	0	17	17	26	48	28.4
Tef (Teff) Transplanting Technology	29	75	17	40	11	0	0	33	25	10	10	27	20	0	17	17	16	34	20.1
Financial Scams	43	0	0	40	22	0	0	50	50	10	40	36	0	0	0	25	26	36	21.3
Resettlement Guide for People Affected by Dam Development	43	0	0	40	22	13	0	42	50	20	30	36	0	0	0	25	26	36	21.3
Charcoal Water Filtration	43	25	25	30	11	88	0	8	50	20	30	9	40	0	0	17	16	37	21.9
Cholera Prevention	29	25	42	30	11	88	0	8	50	20	30	9	40	0	0	17	16	38	22.5
Colorectal Cancer Prevention	29	25	42	30	11	88	0	8	50	20	30	9	40	0	0	17	16	38	22.5
Colorectal Cancer Prevention UIC	29	25	42	30	11	88	0	8	50	20	30	9	40	0	0	17	16	38	22.5

Correcting Clubfoot: The Ponseti Method	29	25	42	30	11	88	0	8	50	20	30	9	40	0	0	17	16	38	22.5
Dengue Prevention	29	25	42	30	11	88	0	8	50	20	30	9	40	0	0	17	16	38	22.5
Dengue Prevention: Variant for Tonga	29	25	42	30	11	88	0	8	50	20	30	9	40	0	0	17	16	38	22.5
Developmental Dysplasia of the Hip (DDH)	29	25	33	30	11	0	0	8	50	20	10	9	0	0	0	17	16	26	15.4
Ebola Prevention	29	25	50	30	11	0	0	8	25	10	10	9	20	0	0	17	21	27	16.0
Ebola Prevention: Variant for Liberia	29	25	50	30	11	0	0	17	25	10	20	9	20	0	0	17	21	29	17.2
Healthy Eating	29	0	50	30	11	0	0	8	25	10	10	9	20	0	17	17	16	26	15.4
Hip Dysplasia	29	0	33	30	11	0	0	8	13	10	10	9	0	0	0	17	16	20	11.8
How to Prevent the Spread of Ebola	29	0	50	30	11	0	0	8	25	10	10	9	40	0	0	17	16	25	14.8
How to Use a Metered Dose Inhaler (Hyper-Reality Version)	29	0	50	30	11	0	0	8	25	10	10	9	20	0	0	17	16	24	14.2
How to Use a Metered Dose Inhaler (Low-Poly Version)	29	0	50	30	11	0	0	8	25	10	10	9	20	0	0	17	16	24	14.2
How to Use a Metered Dose Inhaler with a Spacer	29	0	50	30	11	0	0	8	25	10	10	9	20	0	0	17	16	24	14.2
How to Wash Your Hands	14	0	50	30	11	38	0	8	25	10	10	9	20	0	0	17	16	26	15.4
Identifying the Symptoms of Ebola	29	0	50	30	11	0	0	8	25	10	10	9	20	0	0	17	16	24	14.2
Lung Cancer Screening	29	0	50	30	11	0	0	8	25	10	10	9	20	0	0	17	16	24	14.2
Malaria Prevention	29	0	50	30	11	0	0	8	25	10	10	9	40	0	0	17	16	25	14.8
Malaria Prevention: Bed Nets	29	0	50	30	11	0	0	8	25	10	10	9	40	0	0	17	16	25	14.8
Oral Rehydration Solution	29	0	50	30	11	0	0	8	25	10	10	9	40	0	0	17	16	25	14.8
Preventing Sickness	29	0	50	30	11	0	0	8	25	10	10	9	40	0	0	17	16	25	14.8
Prevention of Chagas Disease	29	0	50	30	11	0	0	8	25	10	10	9	40	0	0	17	16	25	14.8
Prevention of West Nile Virus	29	0	50	30	11	0	0	8	25	10	10	9	40	0	0	17	16	25	14.8
Prevention of Yellow Fever	29	0	50	30	11	0	0	8	25	10	10	9	40	0	0	17	16	25	14.8
Sickle Cell Disease	29	0	50	30	11	0	0	8	25	10	10	9	40	0	0	17	16	25	14.8
The Zika Virus	29	0	50	30	11	0	0	8	25	10	10	9	40	0	0	17	16	25	14.8

(continued)

Table 1 (continued)

	SAWBO index of SDGs (SIS)																		
Video title	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Hits	Avg.
Tuberculosis Prevention	29	0	50	30	11	0	0	8	25	10	10	9	40	0	0	17	16	25	14.8
Tuberculosis: Variant for Swaziland	29	0	50	30	11	0	0	8	25	10	10	9	40	0	0	17	16	25	14.8
What to Do If Someone Shows Symptoms of Ebola	29	0	50	30	11	0	0	8	25	10	10	9	40	0	0	17	16	25	14.8
Improved Method of Shea Butter Processing	43	63	0	50	44	50	0	33	38	10	20	18	20	0	0	17	16	39	23.1
Microfinance 1: Starting a Savings Group	57	0	0	50	44	0	0	42	50	10	20	27	20	0	0	33	16	36	21.3
Microfinance 2: Election of a Management Committee	57	0	0	50	44	0	0	42	50	10	20	27	20	0	0	33	16	36	21.3
Microfinance 3: Fines for Missing a Meeting and Missing a Payment	57	0	0	50	44	0	0	42	50	10	20	27	20	0	0	33	16	36	21.3
Microfinance 4: Example of a Meeting	57	0	0	50	44	0	0	42	50	10	20	27	20	0	0	33	16	36	21.3
Microfinance 5: Taking a Loan	57	0	0	50	44	0	0	42	50	10	20	27	20	0	0	33	16	36	21.3
Microfinance 6: How to Hold a Meeting	57	0	0	50	44	0	0	42	50	10	20	27	20	0	0	33	16	36	21.3
Quality Shea Nuts – Best Practices for Production	43	63	0	50	33	50	0	33	38	10	20	18	20	0	0	17	16	38	22.5

Table 2 Summary of SDG targets for 71 videos

SDG	Total hits	Average hits per SDG	Average SIS
1	154	2.17	30.99
2	186	2.62	32.75
3	233	3.28	27.35
4	261	3.68	36.76
5	105	1.48	16.43
6	94	1.32	16.55
7	23	0.32	5.40
8	179	2.52	21.01
9	247	3.48	43.49
10	93	1.31	13.10
11	127	1.79	17.89
12	175	2.46	22.41
13	115	1.62	32.39
14	0	0.00	0.00
15	62	0.87	7.28
16	156	2.20	18.31
17	262	3.69	19.42
All	2472	34.82	20.6

HDI-measured countries in one or more of 421 language variants for the videos. The majority (44%) of the access countries are classified as low-HDI settings. Table 6 tallies the number of different animations and language variants accessed by continent and country. Countries with 40+ animations accessed include the USA, India, and Congo; countries with more than 20 animations include China, Spain, and Ethiopia; more than 10 animations include Brazil, Ghana, Nigeria, Benin, Kenya, Mongolia, and Taiwan. Overall, at least 19 countries accessed videos in more than one language variant (see Table 7). The country with the largest number of language variations accessed was Liberia (1 video in 16 language variants).

Overcoming Challenges to ICT-Scaling

As already noted, while the importance and new problems of ICT-scaling (especially as forced by mass-digitalization due to COVID-19) is widely readily acknowledged and documented (Bello-Bravo et al. 2022; Medendorp et al. 2022; Reddy and Kumar 2014; Fisac Garcia et al. 2013; Wen et al. 2021; Parveen et al. 2022; Mielgo-Conde et al. 2021), research specifically to operationalize ICT-scaling itself as a research construct is surprisingly scant (Sartas et al. 2020). Moreover, although it is impossible to discuss here the abundance of studies on the new problems, challenges, missteps, difficulties, and missed opportunities occasioned by the abrupt, usually very ad hoc, online digitalization of primarily offline education in response to COVID-19, virtually all such studies are diagnostic of research problems implicated

Table 3 SDG Goal 4's assessment in SAWBO's animations "Biocontrol of Legume Pod Borer (*Maruca vitrata*)"

SDG 4 targets[a]	Indicators	Relevant (0 = no, 1 = yes)
4.1 By 2030, ensure that all quality primary and secondary education	4.1.1 Proportion of children and young people: (a) in grades 2/3	0
4.2 By 2030, ensure that all girls and boys have access to quality early childhood development, care and preprimary education so that they are ready for primary education	4.2.1 Proportion of children under 5 years of age who are developmentally on track in health, learning, and psychosocial well-being by sex	0
	4.2.2 Participation rate in organized learning (1 year before the official primary entry age) by sex	0
4.3 By 2030, ensure equal access for all women and men to affordable and quality technical, vocational, and tertiary education, including university	4.3.1 Participation rate of youth and adults in formal and nonformal education and training in the previous 12 months, by sex	0
4.4 By 2030, substantially increase the number of youth and adults who have relevant skills	4.4.1 Proportion of youth and adults with information and communications technology (ICT) skills, by type of skill	**1**
4.5 By 2030, eliminate gender disparities in education and ensure equal access to all levels of education and vocational training for the vulnerable	4.5.1 Parity indices for all education indicators on this list that can be disaggregated	0
4.6 By 2030, ensure that all youth and a substantial proportion of adults, both men and women, achieve literacy and numeracy	4.6.1 Proportion of population in a given age group achieving at least a fixed level of proficiency in functional (a) literacy and (b) numeracy skills by sex	**1**
4.7 By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and nonviolence, global citizenship, and appreciation of cultural diversity and culture's contribution to sustainable development	4.7.1 Extent to which (i) global citizenship education and (ii) education for sustainable development, including gender equality and human rights, are mainstreamed at all levels in (1) national education policies, (2) curricula, (3) teacher education, and (4) student assessment	**1**
4.a Build and upgrade education facilities that are child, disability and gender sensitive and provide safe, non-violent, inclusive and effective learning environments for all	4.a.1 Proportion of schools with access to (a) electricity; (b) the Internet for pedagogical purposes; (c) computers for pedagogical purposes; (d) adapted infrastructure and materials for students with disabilities; (e) basic drinking water; (f) single-sex basic sanitation facilities; and (g) basic handwashing facilities (as per the WASH indicator definitions)	0

(continued)

Table 3 (continued)

SDG 4 targets[a]	Indicators	Relevant (0 = no, 1 = yes)
4.b By 2020, substantially expand the number of scholarships available to developing countries globally	4.b.1 Volume of official development assistance flows for scholarships by sector and type of study	0
4.c By 2030, substantially increase the supply of qualified teachers, including through international cooperation for teacher training in developing countries	4.c.1 Proportion of teachers in (a) preprimary; (b) primary; (c) lower secondary; and (d) upper secondary education who have received at least the minimum organized teacher training	**1**
	Total	4

Source: Own elaboration by Source: United Nations. https://unstats.un.org/sdgs/indicators/indicators-list/

[a]SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

Table 4 Overview of assessment's SDGs in SAWBO's animations "Biocontrol of Legume Pod Borer (*Maruca vitrata*)"

SDG	*Count of targets*	*Total targets*	SIS (%)
SDG 1	1	7	14.3
SDG 2	2	8	25.0
SDG 3	2	12	16.7
SDG 4	4	10	40.0
SDG 5	1	9	11.1
SDG 6	0	8	0.0
SDG 7	0	6	0.0
SDG 8	3	12	25.0
SDG 9	5	8	62.5
SDG 10	1	10	10.0
SDG 11	2	10	20.0
SDG 12	4	11	36.4
SDG 13	2	5	40.0
SDG 14	0	10	0.0
SDG 15	2	12	16.7
SDG 16	2	12	16.7
SDG 17	2	19	10.5
Total	33	169	19.5

Source: Own elaboration from United Nations (2022c)

in ICT-scaling. Accordingly, although the reasons for this shortfall are many, we engage the work that does exist in further detail below.

Foster and Heeks (2013) describe ICT scaling as a "successful diffusion that ensures sizeable impact and earnings from information and communication technology (ICT) innovations in emerging markets" (296). This is certainly an adequate definition for the purpose of their research, which seeks to effectively understand ICT-scaling to "bottom-of-the-pyramid" markets and stakeholders, specifically

Table 5 SIS by SDG

Goal	Avg. indicators per video	SIS (all videos)
SDG 1: End Poverty	2	30.6
SDG 2: Zero Hunger	3	33.2
SDG 3: Good Health and Well-Being	3	25.2
SDG 4: Quality Education	4	36.8
SDG 5: Gender Equality	1	16.4
SDG 6: Clean Water and Sanitation	1	12.0
SDG 7: Affordable and Clean Energy	0	5.4
SDG 8: Decent Work and Economic Growth	3	21.0
SDG 9: Industry, Innovation, and Infrastructure	3	43.5
SDG 10: Reduced Inequalities	1	13.1
SDG 11: Sustainable Cities and Communities	2	17.9
SDG 12: Responsible Consumption and Production	2	22.4
SDG 13: Climate Action	2	32.4
SDG 14: Oceans (Life Below Water)	0	0.0
SDG 15: Life on Land	1	7.3
SDG 16: Peace, Justice, and Strong Institutions	2	18.3
SDG 17: Partnerships for the Goals	4	19.4
	Overall	20.9

Table 6 Videos accessed per HDI-countries

Human development (HD) classification	# of HDI-countries by classification	# of HDI-countries Accessed by classification	# of videos accessed
All	188	53	421
Low HD	41	18 (44%)	139
Medium HD	41	11 (27%)	90
High HD	52	10 (19%)	97
Very High HD	54	10 (19%)	79
Not HDI-classified[a]	N/A	2 (0%)	16

Source: Authors
[a]Taiwan and Tibet

around the use of a mobile banking App in Kenya (MPESA, which has been very popular). That they allude to "diffusion" links this framing of ICT-scaling to Roger's (Rogers 2003) diffusion of innovations framework. Consequently, "scaling" includes the idea that recipients of the innovation will adopt its use. At a minimum, this aims for more than simply making the innovation widely available (its "reach") (Johnson et al. 2018). For digital information online, this is critical, because metrics to assess how widely viewed some information is (its "reach" or its "virality") (Han et al. 2020) will not capture whether that information had any effect on those who viewed it (its "impact") (Bello-Bravo et al. 2021d; Johnson et al. 2018). As such, the critical and correct goal in Foster and Heeks (2013) to achieve an impact (in mobile

Table 7 SAWBO's contributions by country

Continent	Country	Total animations (n = 421)	# of language variants
Africa	Congo	42	3
	Ethiopia	21	4
	Ghana	16	13
	Nigeria	15	5
	Benin	14	5
	Kenya	12	1
	Sierra Leone	8	5
	Niger	6	4
	Senegal	5	2
	Malawi	4	1
	South Africa	4	1
	Burkina Faso	3	5
	Madagascar	3	2
	São Tomé and Principe	2	1
	Burundi	1	1
	Central African Republic	1	1
	Guinea	1	1
	Liberia	1	16
	Mozambique	1	2
	Rwanda	1	1
	Swaziland	1	1
	Uganda	1	1
	Egypt	1	1
	Tonga	1	1
	Subtotal:	163 (39%)	
Asia	India	43	6
	China	28	2
	Taiwan	15	4
	Mongolia	13	1
	Haiti	8	2
	Indonesia	4	1
	Pakistan	4	1
	Iran	3	2
	Afghanistan	2	1
	Japan	2	1
	Jordan	2	1
	Philippines	2	1
	Thailand	2	1
	Nepal	1	1
	Saudi Arabia	1	1
	Tibet	1	1
	Vietnam	1	1
	Subtotal:	132 (31%)	

(continued)

Table 7 (continued)

Continent	Country	Total animations (n = 421)	# of language variants
Europe	Spain	23	2
	Italy	2	1
	France	1	1
	The Netherlands	1	1
	Norway	1	1
	Russia	1	1
	Subtotal:	29 (7%)	
N. America	The USA	64 (15%)	2
S. America	Brazil	18	1
	Latin America	10	1
	Chile	1	1
	Mexico	1	1
	Uruguay	1	1
	Subtotal:	33(8%)	

Source: Authors

banking-App users) is an indispensable emphasis for reaching a goal or target. Similarly, SAWBO's SIS (as a metric that can only measure reach) is already embedded within a broader ICT-scaling approach that strives for impact and empowerment of end users with respect to the SDGs, where empowerment is "an expansion in people's ability to make strategic life choices, in a context where this ability was previously denied to them" (Kabeer 1999: 437). Similarly, that they describe a multiphase, iterative approach to ICT-scaling and that such efforts must "recognise the multi-locational, continuous, and emergent nature of innovation, and develop processes to monitor and address those innovations" (296) echoes similar emphases in SAWBO's ICT-scaling for supporting the SDGs (Rodríguez-Domenech et al. 2019).

SDG 9, SDG 4, and SDG 1: Innovation for Ending Poverty

The average SIS for the 71 animated videos is 20.6, with contributions to all of the SDGs except SDG 14 ("Oceans"). While the SIS for some SDGs is low, this is partly because those SDG goals focus on building new policies at the national or international level, while SAWBO's content more often aims at innovation (SDG 9), educational resources (SDG 4), and sustainable partnerships (SDG 17). The SIS are 40+ for SDG 9 (Innovation, 43.49), and 30+ for SDG 4 (Quality Education, 36.76), SDG 2 (Zero Hunger, 32.75), SDG 13 (Climate Action, 32.39), and SDG 1 (End Poverty, 30.99).

The several contributions of the videos above reflect the "keystone problem" facing the majority of humanity: *poverty*, now further exacerbated by COVID-19 and worsening climate change (Eichsteller et al. 2022). Self-evidently, in areas still

predominated by agriculture, environmental impacts on food security (SDG 2: "Zero Hunger") from events like COVID-19 (SDG 3: "Good Health and Well-Being") and worsening climate change (SDG 13: "Climate Action") heavily impact people's ability to provide for themselves, their families, and their communities (Iwuoha and Jude-Iwuoha 2020).

For climate change in particular, innovations (SDG 9: "Industry, Innovation, and Infrastructure") purport a reliable way to address people's resistance or failure to change behavior to mitigate climate change (Farrell 2019). Consequently, communicating these innovations (SDG 4: "Quality Education") for climate change mitigation in an appealing, actionable, and convenient way for people (SDG 9) becomes essential (Bello-Bravo et al. 2021c).

The 30+ SIS for SDG 4, SDG 9, and SDG 13 suggest that the emphases on these issues are moving in the right direction. However, with regard to impacts from SDG 9 ("Industry, Innovation, and Infrastructure"), these cannot be approached as gender-neutral; see discussion in section "SDG 5 ("Gender Equality") and SDG 10 ("End Inequalities"). This recommendation dovetails with those in section "SDG 5 ("Gender Equality") and SDG 10 ("End Inequalities")" as well.

SDG 2 and SDG 3: Ending Poverty and Promoting Well-Being

The underlying goal of ending poverty must annul the condition that poverty imposes on people, namely, *an inability or unsustainable degree of difficulty in meeting the human essentials required for living a good life* (Diener and Oishi 2000). Since not suffering from physical or cognitive maladies (or their stigmatization) is often part of such a good life, the emphasis on well-being in SDG 3 points to *social well-being* as a critically important element for the SDGs as well (Bakar et al. 2015).

However, the relationship between material and economic well-being (SDG 2) and social well-being (SDG 3) can be ambiguous and fraught. Consistent with other research, Kumar et al. (2020) found that "relative to possessions, experiences elicit greater in-the-moment happiness" (1). Relatedly, DeLeire and Kalil (2010) specifically found that material consumption and acquisition did not associate with happiness, while "leisure consumption" did when it afforded affords "social goods and social connectedness" (163).

These findings for experiences, social goods, and social connectedness underscore the *social* (not the *economic*) pillar of sustainability for securing a good life for people (Bello-Bravo and Lutomia 2022). This is an essential point, given the tendency to overemphasize the economic pillar of sustainability to the detriment of the social and the environmental pillars (Luetz and Walid 2019; Bello-Bravo and Lutomia 2022; Sánchez-Flores et al. 2020; Holmgren et al. 2020). As such, while SDG 3 primarily emphasizes physical well-being, the need for social well-being (at a minimum, as mental health, life satisfaction, and happiness generally) must be a part of it.

The idea that sustainability can only indefinitely strive to alleviate miserable human conditions (rather than enable happiness and a good life for people) seems inconsistent with the goals of the SDGs generally. While the 25+ SIS indices for

SDG 2 and SDG 3 show considerable emphasis, success will ultimately require a shift of SDG efforts away from the habit of using money as a proxy for happiness and as the apparently simplest and most convenient means for solving all problems. Such efforts will require a pivot toward affording people access to the more genuine root of social well-being: experiential and socially connected interactions. Ultimately, this requires a committed stance against the conditions that impose poverty on people in the first place, including "business as usual" (Zundel 2017; Daré et al. 2014; Bello-Bravo and Lutomia 2022; Lutomia et al. 2020), a reluctance to stop imposing and demanding culturally incoherent changes of behavior and identity on peoples locally (Desai 2017; Bello-Bravo 2020a), and a better recognition of the legitimacy of local and indigenous cultural practices (Madela 2020; Lutomia 2019; Bello-Bravo 2019).

SDG 5 ("Gender Equality") and SDG 10 ("End Inequalities")

An essential part of that effort must be not to neglect a critical reorientation toward the inclusion of women, marginalized people, and even a recognition of nonhuman species in sustainability efforts (Bello-Bravo and Lutomia 2022; Bello-Bravo 2020b; Kimmerer 2013). Indeed, broad trends now emphasize and celebrate a particular *power* within women and girls for achieving success for sustainability efforts and the survival of the human species generally; this power occurs both in terms of leadership and on-the-ground activities (Bannò et al. 2021; Desai 2017).

However, from this chapter's findings, the SIS for SDG 5 ("Gender Equality") and SDG 10 ("Reduce Inequalities") for the 71 videos are 16.43 and 13.10, respectively – both of which are below the average overall (20.6) and rank 13th and 14th among all 17 SDGs, above only SDG 15 (7.28, "Life on Land"), SDG 7 (5.40, "Affordable and Clean Energy"), and SDG 14 (0.00, "Oceans: Life Below Water"). For SDG 5 ("Gender Equality"), 6 videos on microfinance and 1 on shea processing (a traditionally women's agricultural sector) had a SIS of 44; a second shea processing video had a SIS of 33. Further, 8 videos on postharvest loss prevention, 1 on financial scams, 1 on a safer non-synthetic pesticide, and a resettlement guide for people affected by dam development had a SIS of 22; the remaining 52 videos had a SIS of 11 for SDG 5. For SDG 10 ("Reduce Inequalities"), 7 videos related to health, 8 on survival gardening, 5 on postharvest loss prevention, 1 on charcoal filtration, and the resettlement guide for people affected by dam development had a SIS of 20; the remaining 49 videos had a SIS of 10.

Two key observations (one technical and the other historical) arise from this generally below-average or very low SIS for the SDGs explicitly focused on (gender) inequalities. With regard to the technical, it seems above all that effort (especially in SDGs 1–3 to end poverty, hunger, and assure good health and well-being for all) are treated as gender-neutral. Without meaning to be tendentious, to take simply the summary presentations of facts and goals for SDG 1, while children in poverty are specifically cited (1 in 5, globally), no specific fact about women is noted (United Nations 2022a). In the Goal Targets, there are references to "all people

everywhere" and "men and women" together (as well as the "poor and the vulnerable") (United Nations 2022b), but no specific reference to women alone (c.f., Agarwal 2018: as well). This may reflect an assumption that addressing SDGs 1–3 does not need to disambiguate or take account of differences of gender in such efforts. However, differences arising from gender are well-documented. For instance,

> It is often expected that projects that lead to improvements in women's agricultural production, income, or nutritional status [SDG 1-3] will begin to reduce underlying inequities between men and women [SDG 5, SDG 10]. A growing body of evidence suggests that this does not happen automatically (Johnson et al. 2018: 5).

While this warns that addressing SDGs 1–3 can fail to address SDG 5 and SDG 10, it is also the case that specifically centering women can yield more sustainable outcomes; for children's well-being, for example, "the improvements in child health and nutrition brought about by a USD$10 increase in women's income would require a $110 increase in men's income" (Ashby et al. 2009: 2). Consequently, the shortfalls around gender noted by Agarwal (2018) (and which arguably also echo the low ranking of SDG 5 and SDG 10 in the findings) in all likelihood mask missed opportunities for better sustainability efforts:

> Moreover, other goals which bear on food security as essential providers of nutrition, such as SDG 15 as it relates to forests and SDG 14 as it relates to fish resources, make no mention of gender equality, nor does SDG 13 (Climate Action) recognize the vulnerabilities of women farmers. A bold interpretation of SDG 5 and establishing synergies with other SDGs could provide ways forward. This includes not only SDGs which recognize the importance of gender equality, such as SDGs 1, 2, and 13 on poverty, hunger, and climate change, respectively, but also SDGs 14 and 15, whose silence on gender could prove detrimental not just to attaining food security, but also to further their stated objectives of resource conservation (26).

More deeply, at the root of this situation is the false assumption that technologies (and all technical solutions are a form of technology) are gender-neutral (Williams 2014). All technology operates culturally differently by gender, although those differences may not hinder the intended affordances, use, and outcomes of that technology for men and women. That is, because the technology generally "works" for both men and women, this creates a false impression that technology is gender-neutral and can be approached as such.

However, Tata and McNamara (2016) observed how women can sometimes prefer face-to-face instruction over computer-mediated instruction. Moreover, because SAWBO videos are often distributed and shared (redistributed) on mobile phones, they provide a model example demonstrating the error of assuming gender-neutrality in a technology. Mobile phones have indeed become the primary access device for digital (and online) information globally, for all people (Bello-Bravo et al. 2021b), especially in Africa where access to personal computers, laptops, tablets, and high-speed (cable) Internet can be limited, unavailable, or prohibitively

expensive. Nevertheless, women generally face a "digital divide" of decreased access to digital information not just for the technical reasons (lack of infrastructure, lack of stable electricity, and exorbitant cost) faced by people generally (Chang et al. 2004). Women's typically lower income makes the price-point for digital participation generally higher than for men (Huyer et al. 2005), while decreased access to education (especially in rural settings) lowers the chances of encountering digital education in schooling (if any) (Lotriet and Twinomurinzi 2021). At times, cultural prohibitions preclude women's use of mobile phones outright (Qushua 2020).

Beyond these immediate problems of cultural access to digital technologies, both in Africa and elsewhere around the world women also encounter problems around the use and refusal to use mobile phones compared to men, particularly due to safety issues as well as health and interest issues not faced by men (Hafkin 2003; Huyer et al. 2005). This "digital divide" can be bridged (Bello-Bravo et al. 2018b), but "this does not happen automatically" (Johnson et al. 2018: 5) without explicit attention to overcoming it. While no one imagines that the SDGs operate in total isolation of one another, to approach SDGs 1–3 especially without explicit attention to overcoming gender inequality puts its solutions at risk of reproducing the inequalities SDG 5 and SDG 10 intend to ameliorate.

This issue may explain the below-average SIS indices for SDG 5 and SDG 10 in this chapter in contrast to the higher SIS 27+ for SDGs 1–3. As a recommendation, it may not be an exaggeration to suggest that sustainability efforts overall could be improved by moving SDG 5 to the top of the SDGs overall. Insofar as women globally are generally poorer than men, shifting this priority to focus on women would meet the *Brundtland Report*'s (1987) imperative to give "overriding priority" (p. 41) to meeting the needs of the world's poorer. In fact, that Johnson et al. (2018) can note how solutions for SDGs 1–3 do not automatically redress inequality is itself a suggestion that some sustainability efforts may contribute to the reproduction of existing inequalities. As such, the below-average SIS for SDG 5 and SDG 10 not only suggests a possible movement in the wrong direction but also warns that any attempted course correction must again involve a change of stance or worldview (Daré et al. 2014; Bello-Bravo and Lutomia 2022; Agarwal 2018) around *how* to redress inequalities.

Recommendations and Conclusion

This chapter analyzed the limited research on the research-construct ICT-scaling (for support of the SDGs). This included multiphase strategies that "recognise the multi-locational, continuous, and emergent nature of innovation, and develop processes to monitor and address those innovations" (Foster and Heeks 2013: 296) and the content of 71 Scientific Animations Without Borders animated educational videos as they relate to the 169 SDG targets. The latter illustrates where in the discourse around SDG efforts the emphases and gaps related to SDG targets fell, including the SDGs that matched the highest average SIS for the videos – namely, in rank order, SDG 9 ("Industry, Innovation, and Infrastructure"), SDG 4 ("Quality Education"),

SDG 2 ("Zero Hunger"), SDG 13 ("Climate Action"), and SDG 1 ("End Poverty") – and the lowest, namely, in reverse rank order, SDG 14 ("Oceans: Life Below Water"), SDG 7 ("Affordable and Clean Energy"), SDG 15 ("Life on Land"), SDG 10 ("End Inequalities"), and SDG 5 ("Gender Equality"). While education and innovation for addressing the poverty, food insecurity, and health and well-being challenges are apposite, the lesser emphasis on gender equality (and reducing inequalities generally) raises concerns, especially as progress meeting SDGs 1–4 may not "automatically" alleviate inequalities.

Recommendations include a need to recalibrate or re-center gender, in particular (SDG 5), to better ensure that progress and recovery from the losses incurred by COVID-19 do indeed meet SDG 5's and SDG 10's targets. Additionally, a reorientation toward thinking in terms of social well-being as an aspect of the second pillar of sustainability rather than the economic pillar primarily (especially in its current neoliberal, globalizing framework) is needed. Efforts should be made to treat solving the problems of poverty, hunger, physical and mental well-being, and education not in gender-neutral terms but as inflected through the culturality of male and female differences. While this is inconvenient and certainly adds complexity to efforts to meet the SDGs in general, it is necessary if sustainability would genuinely be implemented, not only for ourselves and the world in which everyone lives but also for all of the other nonhuman species who live with us. However, most of all this points to a great need to much more specifically research ICT-scaling itself, not only to research how to maximize the extent of that scaling but also how to overcome the many troubling symptoms that arise when attempting ICT-scaling (even at small scales). For meeting the future of the SDGs in general, this especially means dramatically increasing digital accessibility, which the United Nation's sectoral "push" on digitalization presupposes.

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