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The myth of being modern: Digital machines and the loss of discovery

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Abstract

'Digitization' is a logical operation that deconstructs information and transforms it into digits, rendering it a logical construct. Digital operations are fast, infinitely replicable, objective, and absolute. But digitization is not without costs: the result of operationalizing information is that it becomes abstract—disconnected from its referent, and subject to processes that alter its representation without detection. Visions of modernity that draw on the potential for digital technology to invariably raise standards of living fail to consider the intrinsic properties of the digital that tend toward replicability, speed, and scalability, which favor globalization. This article argues how, through reductive processes, the discrete, mathematical nature of the digital provides a framework for rationality and order that is fundamentally incompatible with multiple modernities. Moreover, the history of digital machines is intricately linked to education and epistemology across North America and South Africa. The mechanization of learning illustrates the promise, power, and potential consequence of digital operations; by limiting our horizons, the Modern and now the Digital, limits our ability to think, thereby concealing the destruction of society, nature, and us as a species.

KEYWORDS

Africa, computers, digital, machine, modernity, teaching

INTRODUCTION: THE DIGITAL

At the time of writing, the term 'digital' has achieved widespread usage across many contexts and disciplines. Its usage is so broad and varied, that it may be productive to begin with a brief elucidation of how it has been framed and applied in the current work.

Something is digital (note the small letter 'd') if it involves whole numbers (digits). This is an elementary statement of fact, but it is an important one. When you hear that something is digital, you should recognize that all this implies is that somewhere along the line, a human has devised a method of taking something that existed in the world (a photograph, a song, a handful of coins) and translated it into something that can be represented as numbers. We will revisit this topic in greater depth later, but for now accept the basic equivalence that digital means numerical.

If something is numerically based, that further implies it can be operated on mathematically. It can be computed. This is why our most recognizable digital machines are commonly referred to as 'computers'. This association is neither necessary nor inevitable, but it provides a convenient segue to address the larger and hazier connotations that have become associated with the term.

For the sake of expediency, let us refer to these other uses as 'Digital' with the Big letter 'D'. Big-D Digital is more of a cultural phenomenon than a technological or mathematical one. 'The Digital' is the zeitgeist of the early 21st century, when (at least in industrialized settings) so much of our lives are enmeshed with devices and media and networks that provide a compelling interactive layer on top of what might otherwise appear to be mundane aspects of daily life.

Those devices, media, and networks that power the Digital's glossy public face do utilize little-d digital logic in their underpinnings, but the implications of this are often too subtle to warrant much attention in sociological inquiry. Unfortunately, this lack of scrutiny leaves open the possibility that widespread adoption of the Digital may be responsible for unwittingly perpetuating existing power relations and ultimately failing to empower the people for whom it is expected to have the greatest positive impact. This failure, as explained by Latour, is part of a Modern constitution that constrains the worldview of science to laboratory methods and allows the West to position itself above nature, which is something distinct and separate to be scrutinized and examined. As Latour points out, this severance enables the modern world to essentially discuss the intricate inner workings of global markets, engines, satellites, and guidance systems without acknowledging these are also the very 'arrangements that can kill us all' (Latour, 1993, p. 2). This type of reasoning illustrates the propensity to break analytical continuity (examined later) that is a key aspect of the Modern constitution, and one which is well accommodated by digital technology and expressed in the Digital.

These dynamics will be exposed through an examination of historical efforts to empower children through the use of 'learning machines' (digital and otherwise) and extended to a broader inquiry into the impacts of deploying Digital technologies in developing contexts.

Essentially, what follows is an argument for a reconceptualization of 'the digital', its history, and its ongoing impacts globally.

When Nicholas Negroponte, founding director of the MIT Media Lab, published 'Being Digital' in 1995 the focus was primarily on the birth of a Digital age, and the effects thereof on modern day-to-day life. The book discusses core principles of digital technology but not digital as a concept. Following the birth of the iPhone in 2007 (Isaacson, 2011) and the subsequent rapid adoption of the 'smart phone' and access to the internet in the global south (Global System for Mobile Communications Association, 2022a), conversations have been focused on the Digital (big D), now synonymous with the modern information age and transformation.

My argument in this article proposes that prescriptive digital processes, and the Digital by extension, sever ties between the social and nature, thereby narrowing perspectives of science and hindering curiosity and exploration. Latour goes through a painstaking effort to formulate a 'Modern Constitution' (Latour, 1993, p. 32) that reveals the way in which the purification of Modernism claims to separate and break the continuity between society and nature. This lines up surprisingly well with how the digital works and what its tendencies are. In this modern age, 'Being Digital' might well be more precisely described as the myth of being Modern.

The 'digital', as I refer to it in this article, is not adequately historicized. While scholars such as Sherry Turkle and George Dyson go to great lengths to unpack the history of technology and its effects on modern life, their focus tends to be on the Digital and its applications (Dyson, 2012a, 2012b, 2020; Turkle, 1997, 2005, 2011). As such, aspects of digital as a concept are not critiqued when a society adopts the latest and greatest Digital infrastructure. Visions of modernity (such as Weberian modernization theory) that draw upon the promises of technology to invariably raise living standards rarely reflect how it might also change things for the worse.

This research considers a history of the d/Digital across continents and institutions in North America and Africa in an effort to explore the often unexamined effects of digital logic on the formation of knowledge, belief systems, and epistemology. This impacts human communication and is pervasive throughout the customs of many different contemporary societies, in the way commercial and social interactions are facilitated. Yet, when considered from the perspective of future generations, perhaps the most significant impact will arise from those digital machines that are used to either teach, learn, or construct world views—devices that could be considered 'teaching machines' (Benjamin, 1988; Skinner, 1960b).

> Historians of education take technologies for granted, except for tests and textbooks; historians of psychology overlook the production of apparatus, except for tests; and, except for the training of engineers, historians of technology ignore education.
> (Petrina, 2004, p. 306)

Seymour Papert, a South African-born mathematician, computer scientist, and educator, sought to create one such machine that he believed would democratize access to education. He called this the 'Proteus of machines' (Papert, 1980, p. 3). We call this 'the laptop', the portable computer. Papert is considered to be the father of educational computing. He is one of the pioneers of Artificial Intelligence (AI) and co-founded the Massachusetts Institute of Technology's (MIT) Artificial Intelligence Laboratory (AI Lab). Seymour Papert was born in South Africa in 1928, moved to the United Kingdom in 1954, and settled in North America in 1963 (Stager, 2016). His life's work and ambition was to democratize access to education and was grounded in his personal experiences as a young revolutionary socialist during apartheid (Levine, 1989; Weber, 1997). Ultimately, Papert's work would manifest itself as the digital machine known as the laptop computer. But that was not the point: he sought to make a machine that could be flexible, portable, and used by all for exploration, discovery, and learning about the mathematical world. What he failed to recognize was that this is not possible when the substrate of the machine is digital. To him, the mobile computer was to be a 'transitional object' that could be personalized by all beyond the elite spaces of North America (Papert, 1980, p. 183). In actuality, the modern digital computer has come to be something else entirely.

Nevertheless, there is still considerable interest in incorporating digital computers into the educational process. This is Digital thinking, the type of thinking that assumes more computers, more mobile devices, means better classrooms (Kwet, 2019, p. 225). This is in line with conventional thinking about infrastructure, a prevailing belief that incorporating more will improve things. Applied to the specific case of education, more learning infrastructure should improve our literacy, increase inclusion, and bridge the divide between the 'haves' and the 'have-nots', populations that can be mapped roughly onto the West and the South (Compaine, 2001; Rafalow, 2020): 'As the primary way most people access the internet in sub-Saharan Africa, mobile is driving digital inclusion. This delivers significant economic benefits, reduces poverty and transforms lives by providing people with access to a range of life-enhancing services' (Global System for Mobile Communications Association, 2022b, p. 27).

Anand et al.'s volume *The Promise of Infrastructure* interrogates the failures of infrastructural systems to distribute power, resources, wealth, and opportunity: 'Infrastructures have been technologies that modern states use … to demonstrate development, progress, and modernity, giving these categories their aesthetics, form, and substance' (Anand et al., 2018, p. 5). These are the promises bundled in with infrastructure offered by wealthy, industrialized nations as a form of assistance for 'international development' of less wealthy nations. Infrastructure is a key component of traditional concepts of modernisation, theorized by Max Weber (Weberian modernisation theory), which views the formation of a world society as a result, almost entirely, of functional subsystems. That is to say, 'functionally integrated systems—most importantly, the global economy, but also global systems of scientific research, communication, education etc.' (Allen & Mendieta, 2019, p. 283).

Essentially, traditional concepts 'presuppose a universal set of developmental or social-evolutionary structures leading to a single, unified modernity' (Allen & Mendieta, 2019, p. 283). The deployment of technological infrastructures from the West and ideals of globalization makes it easy to conflate modernity with 'colonialism, Eurocentrism, Western cultural imperialism, and neocolonialism' (Allen & Mendieta, 2019, p. 283). However, while Western systems and infrastructure may be exported, transplanted, and integrated into foreign cultural contexts, the outcomes vary greatly from one cultural context to the next.

When endeavors fail to deliver on 'promises' of modernity, it becomes clear that the 'functionalist perspectives' of modernity, or 'globalized infrastructure' as it were, do not take into account that:

> Different cultures assimilate and adapt these processes emanating from Western culture in their own ways…other civilisations respond to the pressures from the West to modernise their societies as challenges to which they seek answers that draw upon their own cultural resources.
>
> (Jürgen Habermas, cited in Allen, 2016, p. 70)

As an alternative to the functionalist concept of 'globalized infrastructure' (classic modernity), Shmuel Eisenstadt proposed 'multiple modernities':

> One of the most important implications of the term 'multiple modernities' is that modernity and Westernization are not identical … Western patterns of modernity are not the only 'authentic' modernities, though they enjoy historical precedence and continue to be a basic reference point for others.
>
> (Eisenstadt, 2000, p. 2, 2002)

Eisenstadt's work is vital in understanding globalization in a world that attempts to recognize 'cultural identities and the reaffirmation of primordial ties' (Allen & Mendieta, 2019, p. 283). Multiple modernities as a concept 'departs from schools treating modernization and Westernization as closely related processes' (Sachsenmaier et al., 2002, p. 42).

In Jürgen Habermas' *Essay on Faith and Knowledge: Postmetaphysical Thinking and the Secular Self-Interpretation of Modernity* (Habermas, n.d.), Habermas defined (for himself) 'Modernity' as that which 'represents something like the shared arena in which different civilizations encounter one another as they modify this infrastructure in more or less culture-specific ways'.

When the infrastructure is digital, it cannot be modified in culturally specific ways, because the medium itself is incapable of transformation. It can only hold literal bits of information. At best, a Digital service may be used as a medium for storing or transmitting simulacra of culturally-specific material (textual stories, photographs of artwork, recordings of music), but the original production of this material occurs outside of the digital framework. Once produced, it can be encoded, sampled, or recorded to comply with the digital's requirements. The transformation is of the cultural material itself, not the digital infrastructure.

The idea that multiple modernities might exist in the Digital is therefore a myth. In reality, digital technologies promote trust by imitating analogue processes in the real world that allow for the transmission of truth. However, by imitating analogue processes the digital is capable of transmitting (and generating) falsehoods as truths. Digital information need not be grounded in fact at all for it is a mathematical construct, and the more it is processed, the farther it departs from the truth. For digital information to serve its actual purpose (more on this later), it needs only to replicate quickly and inexpensively.

MASTERS OF THE MODERN—MECHANIZING EPISTEMOLOGIES

The promise of the Digital age comes down to the fact that computers are very good at executing algorithms and mechanizing life. This produces an almost inescapable path toward the mechanization of learning and the development of devices as teaching aids to promote algorithmic thinking. By diminishing local values and traditions in favor of the Digital, teaching machines continue a trend toward centralized and globalized media, decreasing the possibility that multiple modernities might ever exist. Systems that use digital circuitry can be applied to the mechanization of education, not just in the classroom, but in any situation where there is a desire for a single, correct or 'optimal' answer. Consequently, educational materials become biassed toward providing shortcuts to knowledge—the 'correct' answers—rather than providing opportunities for exploration and discovery (Johnstone, 2003, p. 10; Papert, 1972, p. 353). 'Children learn by doing and by thinking about what they do' (1972, 2003). Exploration is the natural driver of learning, and the real world is always shaped by local geographic and cultural conditions. When information about the real world is reduced, possibilities for exploration are diminished (more on this later).

The development of teaching machines was deliberate and culminated in ambitious efforts to deploy Western technologies, epistemologies, and values across the global South, specifically Africa. Projects such as One Laptop Per Child (OLPC), born in the United States at MIT, 'referenced African children as its imagined beneficiaries' (Ames, 2019, p. 161).

The history of teaching machines is deeply rooted in mechanization and industrialization. In the 1920s, Sidney Pressey said:

> There must be an 'industrial revolution' in education, in which educational science and the ingenuity of educational technology combine to modernize the grossly inefficient and clumsy procedures of conventional education….
>
> There will be many labor-saving schemes and devices, and even machines – not at all for the mechanizing of education, but for the freeing of teacher and pupil from educational drudgery and incompetence.
>
> (Pressey et al., 1944, p. 640)

Pressey was a professor of psychology and is said to have invented the first teaching machine, the Automatic Teacher (Petrina, 2004). Edward Thorndike, a Columbia University Teachers College psychologist, inspired Pressey's desire to mechanize teaching content.

> If, by a miracle of mechanical ingenuity, a book could be so arranged that only to him who had done what was directed on page one would page two become visible, and so on, much that now requires personal instruction could be managed by print.
>
> (Thorndike, 1912, p. 165)

Later, in the 1950s, Burrhus Frederic (B. F.) Skinner developed similar teaching machines. During World War II, Skinner was a psychologist and Harvard University graduate who trained pigeons (Project Pigeon) to guide missiles to their targets (Figure 1) (Skinner, 1960a; Watters, 2021, p. 24). A project funded by the United States National Defense Research Committee (NDRC) to pursue 'Project Pigeon' as a 'Homing Device' for missiles (Watters, 2021, p. 24). His work was focused primarily on behavioral conditioning. Skinner invented the Operant Conditioning Chamber, now known as the Skinner Box. This device was used to study the change in animal behavior based on responses to reward/punishment, such as the peck of a pigeon (Capshew, 1993, p. 842; Skinner, 1965, p. 429). This work followed prototypes developed by none other than Edward Thorndike to test what he called 'The Law of Effect' (Skinner, 1965, p. 428). Skinner's Project Pigeon, which used similar techniques to the conditioning chamber, produced successful results.

Skinner would later draw parallels between his pigeons and humans. Skinner would apply his findings, his theories in conditioning, and the automation of teaching he had developed to teaching human children (Figure 2).

> Experiments on pigeons may not throw much light on the 'nature' of man, but they are extraordinarily helpful in enabling us to analyse man's environment more effectively. What is common to pigeon and man is a world in which certain contingencies of reinforcement prevail. The schedule of reinforcement which makes a pigeon a pathological gambler is to be found at race track and roulette table, where it has a comparable effect.
>
> (Skinner, 1965, p. 439)

Skinner's teaching machine had three advantages over Pressey's 'Automatic Teacher'. First, it allowed for each student to move at their own pace. Second, it was designed to present new/unknown content to the learner, whereas Pressey's machine, he argued, only tested a student on prior knowledge. Third, the student could write down open-ended answers instead of simply picking the correct answer from multiple choice.

It was not until the 1960s that teaching machines would finally take off, but it would take a major paradigm shift in educational thinking. In the mid-20th century, Science, Technology, Engineering, and Mathematics (what are referred to now as STEM) became the primary focus of the US federal government, putting the algorithm and computation at the forefront of federal policy (Urban, 2010). This was attributed to 'national defense', or more accurately, 'fear of the other'.

> On a morning in October 1957, Americans were awakened by the beeping of a satellite. It was a Russian satellite, Sputnik. Why was it not American? Was something wrong with American education? Evidently so, and money was quickly voted to improve American schools, Now we are being awakened by the beepings of Japanese cars, Japanese radios, phonographs, and television sets, and Japanese wristwatch alarms, and again questions are being asked about American education, especially in science and mathematics.
>
> (Skinner, 1984, p. 947)

In 1957 when the USSR launched Sputnik, the reaction in the West was nothing short of complete panic and utter shame. Politicians attributed this to a failed education system, and within a year the 'National Defense Education Act' (1958) was formed, which pushed unmatched amounts of funding into the development of STEM-related endeavors (Rudolph, 2002) for experiments in education. The NDEA was the brainchild of Vannevar Bush, then the director of the Office of Scientific Research and Development (OSRD) that was created to oversee the NDRC, which he had also founded. The NDEA was to be the 'mechanism for implementing

FIGURE 1 Bird in working position, facing target. Courtesy of the B.F. Skinner Foundation. A Pigeon in an experimental harness responding to visual stimuli in a viewfinder by pecking.

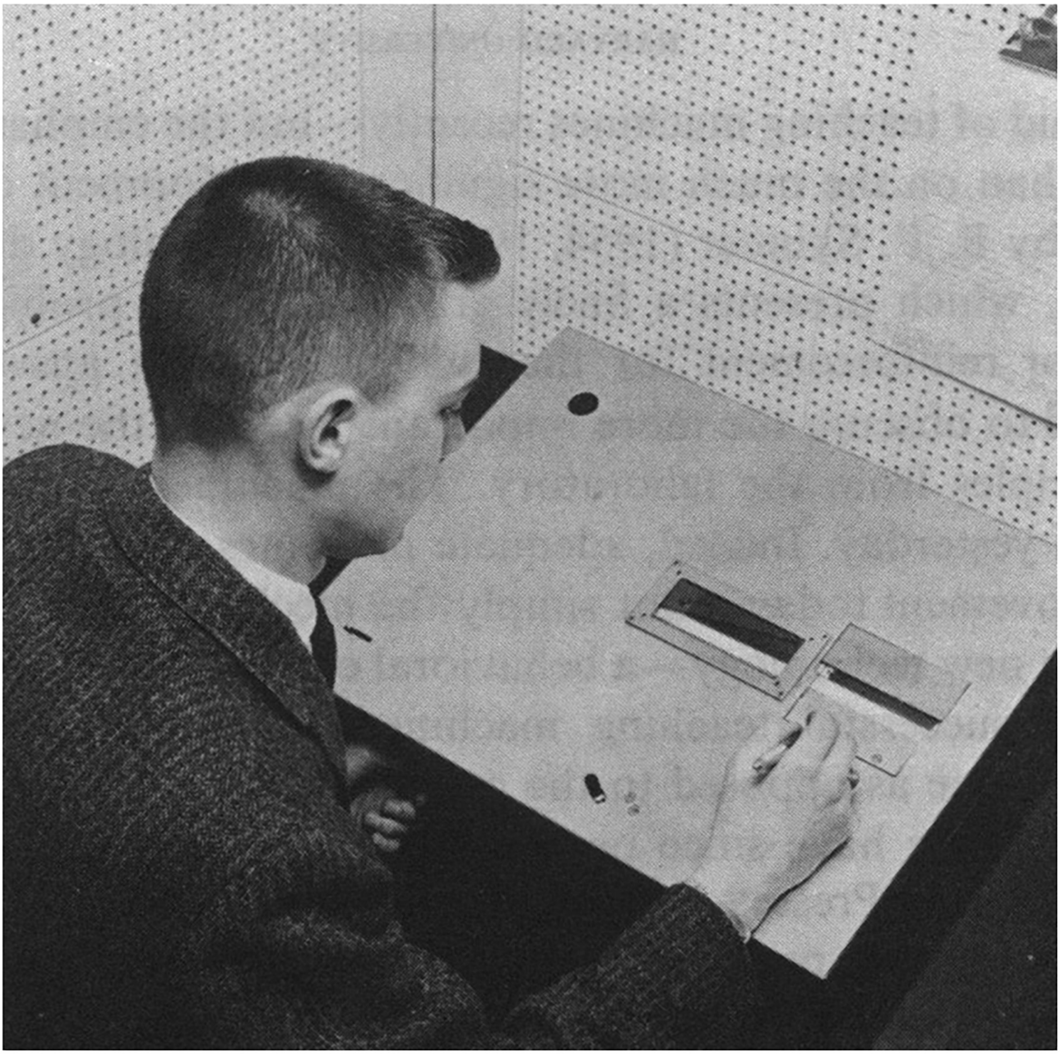

FIGURE 2 Student working on a Skinner teaching machine (Holland, 1960). Courtesy of John Wiley and Sons. A student responds to questions presented in the viewfinder of a Skinner teaching machine by writing answers on paper tape.

the recommendations' (Bush & Holt, 1945, p. VI) put forth in a report written for the President of the United States titled 'Science, The Endless Frontier'. This report was written by Bush and colleagues in which they advocate: 'Scientific progress is one essential **key to our security as a nation, to our better health, to more jobs, to a higher standard of living, and to our cultural progress**' (Bush & Holt, 1945, p. VI) (emphasis added).

National Defense Education Act

> The Congress hereby finds and declares that the security of the Nation requires the fullest development of the mental resources and technical skills of its young men and women… The defense of this Nation depends upon the **mastery of modern techniques** developed from complex scientific principles.
>
> (National Defense Education Act, 1958, p. 1581) (emphasis added)

In the Spring of 1962, the Central Intelligence Agency (CIA) produced the now declassified 6th volume of their 'SECRET/NOFORN (Not For Foreign Nationals)' documents on 'Studies in Intelligence'. The document includes an article titled 'Comes the Teaching Machine—Auto-instruction for intelligence training' in which the author makes reference to Dr. B. F. Skinner, and provides examples of how 'programmed instruction' can be applied to both overt and covert intelligence operations (Fulcher, 1962, p. A5). The author, Fulcher, predicts that 'technical advances in programming hardware promise that we soon may have devices to reproduce programs quickly and inexpensively in small easily handled packages'. This was a premonition that would later be realized in the form of laptops and mobile phones.

Programmed Instruction and Teaching Machines were to benefit from NDEA funding and many companies—among them IBM and the Grolier Min-Max machine—manufactured and marketed 'Teaching Machines', sometimes door-to-door. However, by the end of the 1960s the 'Teaching Machines' movement had all but vanished. The movement ultimately failed to deliver on promises such as enabling students to learn 'twice as much in the same time and with the same effort' (Skinner, 1984, p. 947).

> I liked the Roanoke experiment because it confirmed something I had said a few years earlier to the effect that with teaching machines and programmed instruction, one could teach what is now taught in American schools in half the time with half the effort.
>
> (Skinner, 1984, p. 948)

Ludy Benjamin summarizes the 'rise and fall' of teaching machines during the 1960s. Noting the many concerns over the introduction of machines that claim to replace teachers, and also mechanize the teaching process itself, Benjamin lists the following authors and articles that raised these concerns at the time (Benjamin, 1988, p. 709):

- 'Can People Be Taught Like Pigeons? (Boehm, 1960)'
- 'Can Machines Replace Teachers? (Luce, 1960)'
- 'Teaching Machines–Blessing or Curse? (K. Gilmore, 1961)'
- 'Will Robots Teach Your Children? (Bell, 1961)'
- 'Do Teaching Machines Really Teach? (Margolis, 1963)'
- 'Which Is It? New World of Teaching Machines or Brave New Teaching Machines? (Morello, 1965)'

Teaching machines then took on a new form in the 1970s. 'Computer-Assisted Instruction' or 'Computer-Aided Instruction' (CAI) was an outgrowth of the Teaching Machine Project at the IBM Research Center in the late 1950s (Benjamin, 1988, p. 710). CAI would transition into what we now know as educational software, e-learning, and adaptive learning. In the past, IBM had worked with both Skinner (Frederic, 1958) and Pressey (IBM Punch-Card Self-Teaching Device) to develop teaching machines. In 1960 IBM created a digital teaching machine, the '650 Teaching Machine'. Digital computers would hereafter take precedence over analogue teaching machines.

It was at this time that Seymour Papert, in collaboration with Cynthia Solomon and Wally Feurzeig, had invented the first computer, and later robotics, programming language for children, and called it Logo (Figure 3) (Papert, 1980; Stager, 1999). Unlike previous teaching machines whose designers sought to programme the child, Papert's vision would have the child programme the computer, the machine, with an emphasis on discovery learning (Papert, 1980, p. 5). In essence, Papert advocated that learning leads to neural connections that enable people to understand how their world works. The process of discovery creates these connections according to the individual's own experience with the world, and later serve as shortcuts for

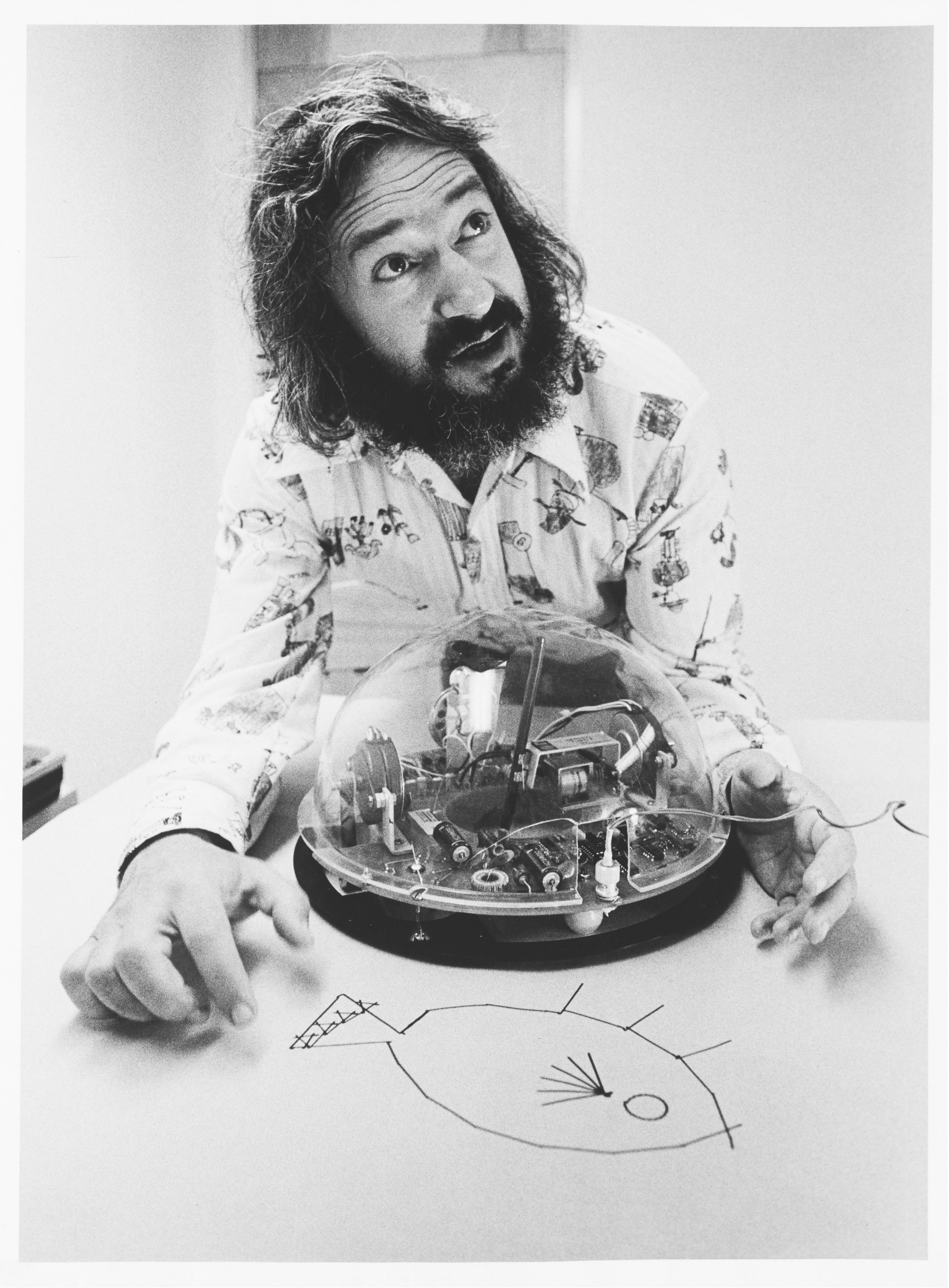

FIGURE 3 Seymour Papert with the LOGO Turtle (Pogany, 1973). Courtesy MIT Museum. Portrait of Seymour Papert with an early prototype of the robotic Turtle used to physically draw Logo vector graphics with a pen.

navigating this world. However, I argue, when those shortcuts are received from elsewhere, delivered as opposed to learnt, they are in effect preparing the learner for navigating another world entirely.

Seymour Papert built upon Piaget's theory of constructivism, developing the idea of ‘constructionism’, whereby ‘building knowledge structures’ is combined with the construction of a ‘public [social] entity’ in order to form mental models of a child's world (Papert & Harel, 1991, p. 2):

> In many schools today, the phrase ‘computer-aided instruction’ means making the computer teach the child. One might say the computer is being used to program the child. In my vision, the child programs the computer and, in doing so, both acquires a sense of **mastery over a piece of the most modern and powerful technology** and establishes an intimate contact with some of the deepest ideas from science, from mathematics, and from the art of intellectual model building.
>
> (Papert, 1980, p. 5) (emphasis added)

However, his ambition was not without those all-important words, ‘Mastery’ and ‘Modern’. The mastery over the modern resonated with the National Defense Act two decades prior. The promise was to give young people ‘mastery over a piece of the most modern and powerful technology’. Fast forward to 1982 and Seymour Papert had just published *Mind Storms*, his manifesto on educational computers. In 1982 *Time Magazine* published the ‘Person of the Year’, which was, in fact, a machine; it was the digital computer. In this edition, there are articles that interview the likes of Bill Gates, Steve Jobs, Alan Kaye, Marvin Minsky, and Seymour Papert. In this manner, the machine became the master of modernity, and manifest through the day-to-day digitization of epistemologies.

THE DEVELOPERS PROMISE OF PROGRESS – FROM PRECISION TO POWER

In the early 2000s, developments in educational computing culminated in the greatest promise of all, the One Laptop Per Child project. The promise was to put a laptop in the hands of every child on the planet for $100. It would deliver ‘powerful technology’ to all youth, including the developing world and the global South. The news coverage was nothing short of monumental. OLPC faced major hurdles and did not deliver on its promise. Its failures have been documented (Ames, 2019); some argue it was worth it for the lessons learned (Hacker, 2014; Kane, 2012).

The allure of OLPC was compelling because it promised the Digital would bring opportunity and potential growth to poor children and their communities. What machines based on digital technology actually offer is an affordable means to manipulate information with unprecedented speed, precision, and consistency. When provided with the right hardware and enough energy, the scalability of digital applications is effectively limitless. At a high level, digitization allows for systems that are replicable, fast, and scalable. These qualities are often seen as assisting rapid change, or what the modern world considers progress, and which could rightly be called globalization. The Western world provides the template for an advanced Digital society, and it becomes the objective of developing nations to play catch-up and replicate the advancements of the West. This raises an important question: are contexts in the global South developing or being developed? (Ziai, 2013).

If the machines and algorithms of the West are deployed in another context, can they produce a different outcome? The nature of digital computers is, in fact, deterministic, so the odds of this are effectively zero. It is therefore reasonable to question whether the deployment of these technologies might ever lead to new permutations of established cultural systems. Perhaps they will lead to colonization of culture instead?

In my broader research I argue that all digital technologies have one thing in common that is vital to their operation: precision. This is what allows it to be deterministic—generating the same predictable output over and over again. The digital space is, at its core, built to be precise and persistent when transferred and stored. The key to this persistence and precision is the simplistic binary nature of modern digital systems, which use binary digits known as 'bits': zero and one, true and false, on and off. Whereas information in the real world contains ambiguity and spectra of possibilities, digitizing this information requires it to be ultimately reducible to a zero or one. Doing so greatly increases the speed of data transmission and reduces the probability of errors significantly. However, as I emphasize, it also eliminates the richness and variability of this information.

My description of Digital technology takes as its point of departure that digital systems are much older than the form of electronic technology we associate them with today. Instead, the digital is neither a tangible thing nor is it simply technology. Rather it is a concept that has been in existence for thousands of years, and is not specific to any one Western discipline or site of knowledge production. For example, digital computing dates back to the Mesopotamian Sumerian abacus, which emerged around 2500 BCE (Garfinkel & Grunspan, 2018, p. 22). And before that, humans used a digital numeral system known as decimal (base-10) to count with their fingers, otherwise known as digits: 'digit—any numeral below 10, any of the ten Arabic figures; finger, toe—Latin. digitus finger, toe' (Onions, 1996, p. 267).

Modern digital computers use a two-value digital numeral system known as binary (base-2). Whether mechanical, electrical, or a logical thought process, the application of a base-2 system uses binary digits (bits), which are created by negating and filtering the textural information of the world. A binary digital system filters analogue signals of the natural world into either 0 or 1. This is achieved by removing all noise between 0 and 1 from a signal and distilling information to 0 or 1. In effect, a digital system achieves its efficiency by rounding numbers up to one or down to zero. Unlike an analogue signal (full spectral content with infinite values between 0 and 1), the digital is less likely to misinterpret or lose information since it only watches for two values. An analogy to a digital signal would be sending a message using Morse code with a torch. The intensity or brightness of the light source does not matter, its 'digits' are encoded in the simple distinction between the light source being on or off.

Within a binary system, reductive algorithms recognize only the information that it has been programmed to recognize, while everything else is filtered out. This greatly reduces errors in the transference of information, enabling faster forms of data transfer, such as fiber optics. The same applies to digital storage. When done correctly, digital storage can retain information indefinitely and replicate it infinitely while maintaining verbatim copies.

With a fast, precise and replicable medium, scalability becomes effortless, which lends itself to mechanization. And just as mechanization of manufacturing is associated with globalization, so too is the mechanization of information. Digital technology is now ubiquitous; it is on our desktops, in our pockets and homes, and we wear it on our bodies. With ubiquity comes immense power to formulate and instantly deliver algorithmically optimized information to a global population. However, all of this can only be achieved through a reductive process wherein information is cut up and repackaged in order to fit the template specified by the digital system. By design, such information is bounded and limited according to the intentions or whims of the programmers who implemented the tools for processing it. And no matter how much digital information (data) is added to a system, these fundamental constraints cannot be overcome. Data structures created to serve Western economic needs will always serve Western economic needs. Even when deployed in the global South, the data generated by these tools usually finds its way back into the West, because the economic models of digital software development demand it.

THE PRICE OF SHORTCUTS—ALL DIGITAL LINES LEAD TO THE WEST, AND A LOSS OF DISCOVERY

If the OLPC project is considered in the context of the global South, the price of that promise might be read as a loss of discovery, which in turn might lead to a loss of autonomy. The algorithms embedded in these digital systems to be utilized by the South, are born of the West's own culturally-specific heuristics for learning and discovery. In effect, this allows corporations and Western entities to colonize digitally without colonizing physically at a speed and scale never seen before. This is a colonization of thought and of how a person learns to think. If you remove the need for exploration, you remove the possibility for discovery, and with it the chance for multiple modernities to exist.

Papert's original vision for educational computers (his version of a teaching machine) was in itself an attempt to counter the wholesale transfer of the technological to Africa that so often operates under the guise of development (Anand et al., 2018). He saw the computer as the ‘Proteus of machines’, a machine for all: ‘Its essence is its universality, its power to simulate. Because it can take on a thousand forms and can serve a thousand functions, it can appeal to a thousand tastes’ (Papert, 1980, p. viii). While Papert's vision may be applicable to the computer as a machine, the digital not only simulates but also dissimulates and the universality of the Digital is one of uniformity, not only of adaptation. As Western software developers seek more users, more data, and more power, this is achieved through the reduction of perspectives rich in textural information, resulting in a flattening of the world and a diminishment of reality, which is increasingly shared across geographic space among users of interconnected digital devices. This, in turn, results in uniformity of experience.

Since 2000, media—from news to video and music—have been delivered extensively through digital machines. These media predominate digital distribution channels specifically because they can be digitized easily. This by itself is a bias of the transmission mode, and new forms of expression that cannot be digitized easily will not spread widely or persistently when competing for attention against broadband currents of digital media. The sheer volume of operable digital information—data that has been pre-processed for efficient consumption—provides a competitive advantage over localized, legacy (analogue) media. ‘Digitization’ is not simply the process of taking and putting information online. It is a logical operation that deconstructs information and transforms it into digits, rendering it a mathematical or logical construct. This is achieved through algorithmic interpolation, where the gaps are filled algorithmically during recall of the information. This technique is applied to all processes of digital content creation—typing, drawing, music, and visual production.

To help illustrate, this paper provides an analogy of loss that occurs in the conversion from analogue to digital signals. Line drawings can illustrate the reductive nature of digital information. Artist Paul Klee (1879–1940) said, a line ‘goes out for a walk, so to speak, aimlessly for the sake of the walk’ (Klee, 2012, p. 193). Many people focus on the dynamics of this statement with respect to movement of the hand, but have not taken the time to understand the analogue qualities of such a statement. When comparing digital and analogue lines, the analogue would seem to be made of an infinite number of steps. In fact, there are no discrete steps at all. On closer inspection, the infinite number of points in the analogue is actually a solid curve (Figure 4). Spatially, physically, when an analogue line is being drawn it must travel through every conceivable point to reach its destination. The analogue path contains infinite possibilities (Figure 5).

In contrast, the digital line is a subset of points in space. Predefined steps, that jump from one point to the next, each point mutually exclusive from the other, and discrete. These steps create a shortcut from origin to destination, while algorithms interpolate between these points providing the illusion of continuity and wholeness (Figure 6). Unlike the analogue, a Digital line cannot be infinite in its resolution, and so it goes to work and does what it does best, it

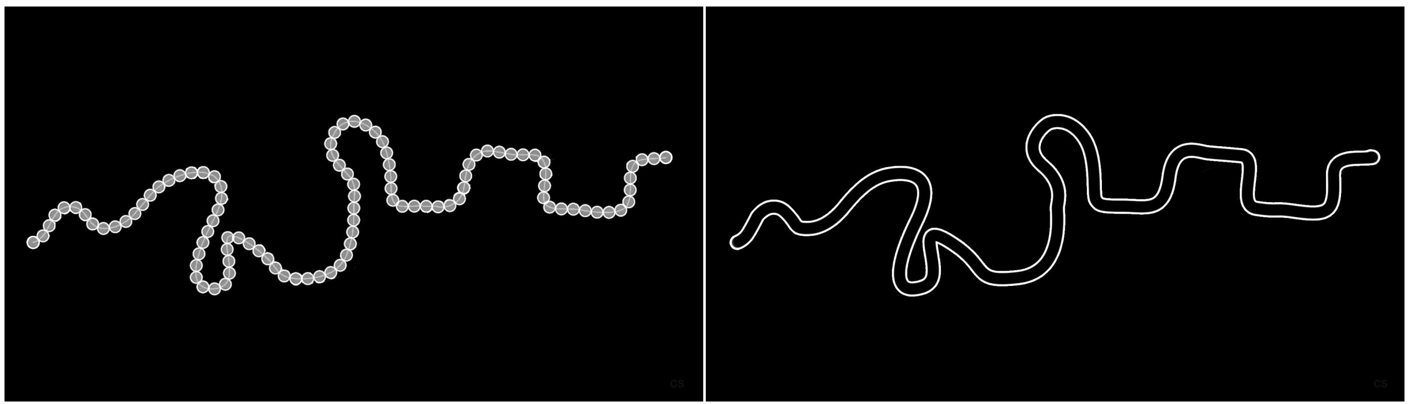

FIGURE 4 Nothing in the analogue signal is excluded; its continuity permits an infinite resolution between two points. We think of analogue lines as a series of "dots" (left) but in reality the dots do not exist (right). Carson Smuts 2023.

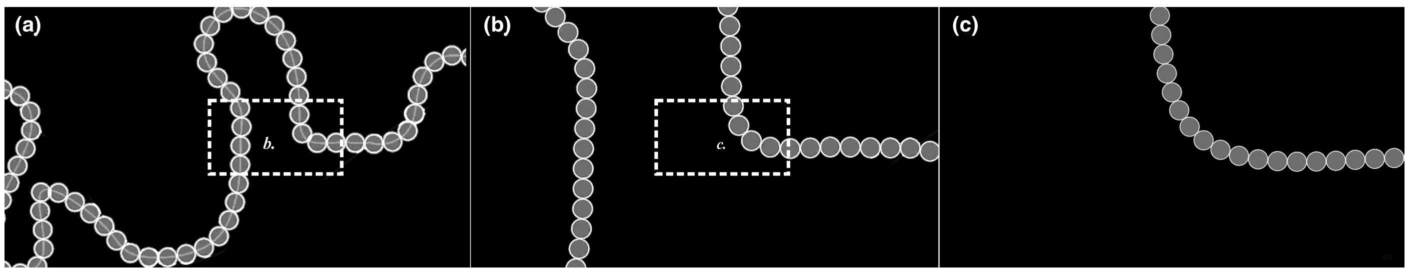

FIGURE 5 When examining analogue lines at any zoom factor (×2 or ×10) what we find is that the resolution adapts; you simply discover more potential steps the further you explore. The analogue is limitless. Carson Smuts 2023.

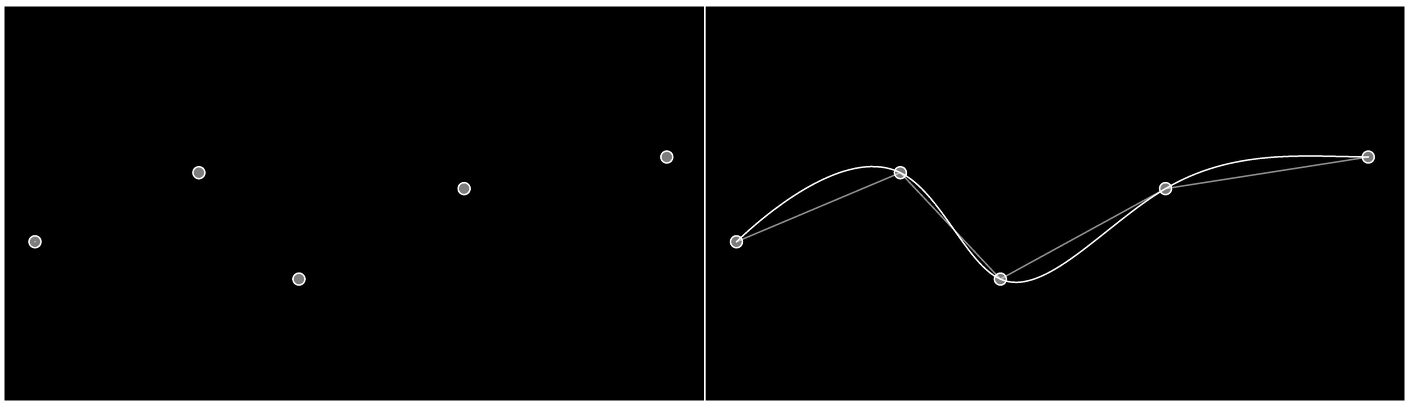

FIGURE 6 The digital line is a series of discrete, disconnected points with missing information in between. Predefined algorithms are then used to fill in the blanks and create various versions of a line, such as bezier or polyline, that appear continuous and complete at the chosen zoom factor. Carson Smuts 2023.

abstracts information down to a subset (discrete steps). In doing so, it skips all the information between and creates a shortcut. The algorithm then comes in and interpolates, providing the illusion of continuity and wholeness.

When extrapolated, this digital process results in a subset of reality disconnected from its origin point. This can be applied to all digital processes. In other words, in the analogue reality, there are no shortcuts between points. A body must traverse all intermediate points in space, whereas in the digital, the journey—the message—is truncated. This truncation (shortcut) negates textural information about the world, thus performing a fundamental function of digital systems: the filtration of noise. It is the very reason why the digital is so fast, precise, and scalable. It is also the heavy price paid for the advantages of the Digital.

The advantages the Digital enjoys are the same advantages enjoyed by the Modern or what Latour calls the 'Modern Constitution'. Though Latour does not discuss the analogue explicitly, his thesis makes an argument for the continuous analogue network, or 'networks of the nonmodern' as he calls it. What Latour describes as the 'skein' bears a striking resemblance to that of the analogue network of signals. Just as I have outlined why being Digitally connected has nothing to do with parity or continuity, Latour argues Modern continuity is a myth. The skein, what he considers to be 'nonmodern', is a network made up of knots through which all paths must travel, 'object-discourse-nature-society' (Figure 7). Latour argues that the skein has always been; it is everything across time and space, and it has no bounds and no gaps. It therefore cannot be compartmentalized, as the Modern constitution would require. Essentially, he argues that the Modern, like the Digital, is not something that humans can 'be', because even pretending at modernity requires so much erasure of reality.

Latour describes the 'Great Divide', the removal of the parts of the skein in-between convenient classification, as a 'clever trick' (Latour, 1993, p. 9) employed by the Moderns to sever nature from society, and itself (the West) from the other.

> 'We Westerners are absolutely different from others!'—such is the moderns' victory cry, or protracted lament. The Great Divide between Us—Occidentals—and Them—everyone else, from the China seas to the Yucatan, from the Inuit to the Tasmanian aborigines—has not ceased to obsess us. Whatever they do, Westerners bring history along with them in the hulls of their caravels and their gunboats, in the cylinders of their telescopes and the pistons of their immunizing syringes. They bear this white man's burden sometimes as an exalting challenge, sometimes as a tragedy, but always as a destiny. They do not claim merely that they differ from others as the Sioux differ from the Algonquins, or the Baoules from the Lapps, but that they differ radically, absolutely, to the extent that Westerners can be lined up on one side and all the cultures on the other, since the latter all have in common the fact that they are precisely cultures among others. In Westerners' eyes the West, and the West alone, is not a culture, not merely a culture.
>
> (Latour, 1993, p. 97)

Everything could be explained by the Moderns 'but only by leaving out what was in the middle'. The Modernist claimed that the in-between is 'nothing, nothing at all'… 'merely residue' (Latour, 1993, p. 47), and the Digital has taken this up. However, there is a fundamental difference: today's digital nonhuman actors automate the incision and removal of the in-between. The Digital does not claim anything of the in-between, it exists simply without this 'residue'.

As with the analogy of the line, when digital technology is given input, it bypasses the in-between through the algorithm to deliver output. In contrast to the analogue process, you bypass a lot of 'stuff'. The irony of digital technology is that it removes information to retain information indefinitely, leveraging loss to prevent loss. The data retained are immutable and,

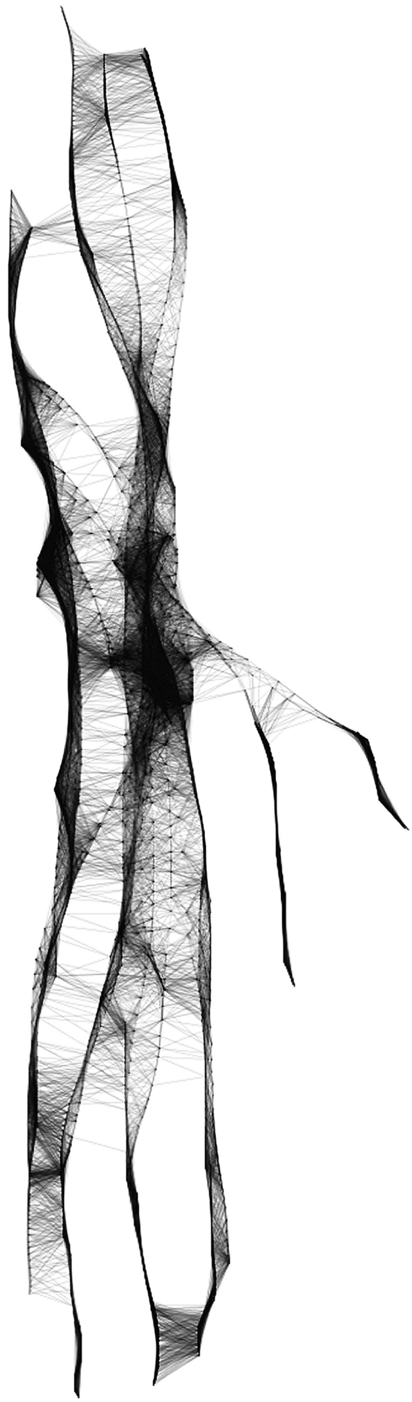

FIGURE 7 The Skein–Carson Smuts 2012. A conceptual interpretation of what a Skein might look like. A web of thousands of lines all interconnected which in turn creates larger lines that also begin to intertwine and weave together. No line is exclusive, everything is connected to create one large network of threads. Focal points, where lines meet in the web, create knots.

in effect, never fades or deteriorates, whether it is useful or not: ‘a book can go out of print. Digital books never go out of print’ (Negroponte, 1995, p. 12).

This appeals to society's aversion to loss, but the permanence of the output, that which gets saved and never fades, results in Digital content appearing whole and complete; it asserts itself as verbatim, the truth, and accurate. Consequently, the developing nation does not question the shortcuts delivered by the Digital developer. The risk of digital systems is that they perpetuate this persistent content selectively. This results in a curated dataset, a subset. The only answers digital technology can provide are already known (contained in the data set). Therefore, whenever a question is asked of a digital system, the conclusion is a prescribed answer. All roads eventually direct all users to the same location in a system with persistent bounds.

Any solution that does not exist within a dataset cannot be answered, and therefore if the dataset is to have any utility, it becomes the purview of the user to ask a different question. Over time, all users narrow their ask down to the same question, and the answer is the same for everyone. Even if the global South had access to all Western technology, its questions could not be answered. A Western data set cannot have the solution for Africa, so Africa is forced to ask a different question or to change its behavior until it gets an answer, which is the same answer offered in the West. That is what technology does; it shapes human behavior to conform to its expectations. It is the antithesis of a Multiple-Modernity. It is the Mono-Modernity.

The curation of answers is the very premise of AI (Machine Learning), where sophisticated scoring gives rise to a ‘confidence score’; a number between 0 and 1 that indicates how probable a machine learning model is to provide an answer (output) that satisfies the query of an end user. In other words, my argument is that a machine model will attempt to achieve the highest possible confidence, with the least effort and without discretion, to provide satisfactory answers. The result is a dance between machine and user where the machine model has prescribed answers to questions that a user must ultimately come to ask.

CONCLUSION: MYTH OF BEING MODERN—WHY DIGITAL IS NOT ‘DIFFERENT’?

So what is the point of all this? Why not think Digital? The answer is in the small-d digital. Everything that the digital is good at serves to increase efficiency and predictability. That might not sound like a bad thing (and it is not if you are principally concerned with economic development), but these advantages come with a cost in cultural evolution. The Digital lacks variability and serendipity. Its reductionism and determinism are at odds with imagination. Imagination is what allows you to look up at the clouds (yes, real clouds) and see something entirely different from what the person next to you might see. This is evidence of our explicit histories, and our individualism—as opposed to a central, filtered, and bounded digital collectivism.

Like Seymour Papert, Steve Jobs saw the computer as an instrument to explore new possibilities, albeit in a commercial context. Jobs maintained that ‘you have to think differently to buy an Apple computer… people who buy them do think different’. He is known to have said that if Pablo Picasso or Albert Einstein had ‘ever used a computer, it would have been a Mac’ (Steve Jobs, 1997).

And that is the point… as outlined in this paper, technology, and especially digital technology used in products such as Apple, does not allow for divergence, its very purpose is convergence. The pioneers of the past, the ‘crazy ones, the misfits, the rebels, the troublemakers, the round pegs in a square hole’ (Apples 1997 TV Commercial, ‘Here's to the Crazy Ones’) (Lam, 2001, p. 243), would have never seen the world differently if they had used a digital computer. What is more, Apple's 1997 ‘Think Different’ slogan implied that Digital involves thinking at all. But as illustrated previously, since shortcuts are provided by the digital, people do not have to develop their own, they implicitly trust the Digital to learn and think for them.

Consequently, Big-D Digital corporations, and their mobile computers, are now in our pockets and are used to learn about the world, though a digital world that captures only a subset of life. This is where the myth of Being Modern arises. The same 'purification' that digital affords the Digital, the Modern embraced to create 'two entirely distinct ontological zones: that of human beings on the one hand; that of nonhumans on the other' (Latour, 1993, p. 10); the West on one side and their digital savior, AI, on the other. It is only through abstraction that Digital's discrete nature provides the illusion of rationality, separation, and order, that is, modernity. As I argue in my broader thesis, the thinking about the Digital's promise of scalability and infrastructure delivery is wrong. Modernity, and Multiple Modernities, are a myth in a digital context, inasmuch as they are not realizable through digital logic, which is an abstraction. The Digital cannot carry culturally specific truths because a person's localized, specific discovery of truths is no longer required. The shortcuts provided by the digital are uniform across the globe, formulated by a single culture or, in the words of Haraway, 'one language (guess whose?) [that] must be enforced as a standard for all' (Haraway, 1988, p. 580). The language of the Digital is the language of its creators and, ultimately, that of its consumers. It is a language derived from and steeped in binarity. It is the nature of the digital to reduce experience to clear and predictable binaries, and in so doing it obviates the potential for the other to be Modern, and multiple modernities to exist.

To be Modern today is to be Digital. What Latour refers to as the 'Modern Partition' and the 'Great Divide' is perpetrated by the technological binarity of the Digital. The durability of the digital, and the 'proliferation of nonhumans', creates a 'topology that makes it possible to go almost everywhere, yet without occupying anything except narrow lines of force and a continuous hybridization between socialised objects and societies' (Latour, 1993, p. 144); the digital instrument is the Modern scalpel that slices the skein with unmatched precision. And so, algorithmic minds, the artificially intelligent machines, have quietly taken their place in society as the…:

> Inert bodies, incapable of will and bias but capable of showing, signing, writing, and scribbling on laboratory instruments before trustworthy witnesses. These nonhumans, lacking souls but endowed with meaning, are even more reliable than ordinary mortals, to whom will is attributed but who lack the capacity to indicate phenomena in a reliable way.
>
> (Latour, 1993, p. 23)

To 'Think Digital' is not to think at all, but instead to act only as a witness to the nonhuman. Furthermore, to be Digital, to be Modern, is a luxurious myth afforded to those who shield themselves with nonhuman accomplices. These individuals need not (and choose not to) care about the consequences of action on a far-off land. As Latour says 'the Great Divide between Us and Them', that solves 'the insoluble problem of relativism', is realized through the 'other Great Divide between humans and nonhumans' (Latour, 1993, p. 97).

> The powers of the North and the West have been able to save their peoples and some of their countrysides by destroying the rest of the world and reducing its peoples to abject poverty. Hence a double tragedy: the former socialist societies think they can solve both their problems by imitating the West; the West thinks it has escaped both problems and believes it has lessons for others even as it leaves the Earth and its people to die. The West thinks it is the sole possessor of the clever trick that will allow it to keep on winning indefinitely, whereas it has perhaps already lost everything.
>
> (Latour, 1993, p. 9)

Recognition of skein—the seamless analogue world—is vital if we are to be anything other than Western. If we embrace the Digital, if we are Modern, the loss suffered is beyond asymmetry—this or that, them or us. Instead, we lose everything that lies outside of the digital domain of the West. The severance of the skein obfuscates all. Because we are digital, 'because we are modern, our fabric is no longer seamless. Analytic continuity has become impossible' (Latour, 1993, p. 8), and the dangers are real, though we may not see them beyond a dataset.

The fact that we can still ask 'What do you think that cloud looks like?' tells us that we are still capable of questioning… of thinking… fortunately for us, for now, 'you cannot think about thinking without thinking about thinking about something' (Papert, cited in Negroponte, 1995, p. 234).

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

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