4IR in South Africa and some of its educational implications

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Abstract

This article focuses on the attempts to construct the fourth industrial revolution (4IR) in South Africa, and some of its educational implications. Using Foucault's (1972) notion of *enunciative modalities*, and drawing empirically on statements made by the World Economic Forum, the South African government, and some South African universities, the article shows that it is people in governments, the economy, and academia who are positioned as the authorities of delimitation who define what the 4IR is, and who bring it into visibility. The article then shows that, inevitability, STEM matter, instrumentalism, and benevolence are the coordinates around which the 4IR is being articulated. In discussing these coordinates, some of the educational implications of such articulations are explored. These include the technicist way in which education is viewed, the lack of adequate recognition of the inequalities in the educational system, and the problems with customised curricula that 4IR assumes, and which erode the possibilities of developing deep learning.

Keywords: 4IR, South African education, STEM, skill sets, instrumentalism

Introduction

The fourth industrial revolution (4IR) is an important emerging sociological phenomenon that has the potential to reconfigure societies and people throughout the world in ways that have not been experienced before. It is being described as constituted by artificial intelligence (AI), quantum or big data, the Internet of Things, robotics, and bringing in interfaces between physical and cyber systems, inter alia (Gleason, 2018). Such physical and cyber system interfaces would surpass what was experienced in the digital age or the third industrial revolution (3IR). As Schwab pointed out:

> The possibilities of billions of people connected by mobile devices, with unprecedented processing power, storage capacity, and access to knowledge, are unlimited. And these possibilities will be multiplied by emerging technology breakthroughs in fields such as artificial intelligence, robotics, the Internet of Things,

autonomous vehicles, 3-D printing, nanotechnology, biotechnology, materials science, energy storage, and quantum computing. (2016, p. 1)

This article focuses on the 4IR in South Africa currently. It also looks at some of the educational implications. It looks at who articulates, and from where the 4IR is articulated, and some of the implications—particularly educational implications—that arise from such articulations. This article is, however, exploratory. Part of the reason why the article is exploratory is because the construction of the 4IR is underway and, although some of its points of emphasis are already discernible, not all of it is fully consolidated or in place.

In this article, Foucault's (1972) notion of *enunciative modalities* is used to show what the 4IR *surface of emergence* and the *authorities of delimitation* are, and the *sites* in which it sees itself being enunciated and applied. It is through such mechanisms that the *dispositive* (Foucault, 1980) of the 4IR is constructed. These notions are explained later in this article and are used to indicate that the 4IR currently revolves around four coordinates. These are inevitability, STEM matter, instrumentalism, and benevolence.

The coordinates are also discussed with respect to the educational implications of such a construction. The teaching and learning assumptions implied in the 4IR are discussed in relation to Bloom's taxonomy and the skill sets for the 4IR, as identified by the World Economic Forum (WEF, 2019). The contradictions and inconsistencies that seem to be at work in these point to the serious educational problems and challenges that may be facing us in the 4IR. In this regard, three points are made:

- The instrumentalism assumed in the skills sets for 4IR are behaviourist and technicist.
- The benevolence projected by 4IR ignores the educational levels of performance in South African schools and the inequalities that exist within the system.
- The customised curricula of 4IR reduces the possibilities of developing deep learning.

One of the points made in the argument in this article, and which is discussed later but needs to be clarified at the outset, is that a sense of inevitability of the 4IR is one of the coordinates in the construction of the 4IR. Given that various and varying online interactions have increased during the pandemic the inevitability of 4IR may be said to be confirmed. It is not just inevitable anymore. It is already happening.

Although, this inevitability may be viewed as confirmed, it is important to note that going online does not equal the 4IR. At this point, it is also important to indicate that assuming that what has been done in the 3IR and the infusion of digitalising and technology in education—which include blended learning, e-learning, and on-line learning—are not quite the same as what would be expected in the 4IR. The 4IR may be unique and distinct, and to assume that it will be continuous with what exists may be mistaken. The 4IR will bring cyber-physical systems into play that will entail an interface between human and machines in ways that we have not even imagined. It is therefore important to note that 4IR will be new and will require new approaches.

Online interactions are an important part of the 4IR—but the 4IR is more than going online. Being online is more continuous with the 3IR given that going online digitalises interactions and predates the pandemic. The pandemic may have increased its presence globally but going online existed before the pandemic. Given this, it could be said that the pandemic may have consolidated the digital age and brought it closer into the 4IR.

This point about 3IR and 4IR is picked up later in the article in the discussion of viewing constructions of the 4IR as dispersed and not necessarily continuous with a single point of origin and with a sort of implied historical determinism. In this regard, it is shown later that it is important to view the 4IR specifically and as distinct.

Foucault and enunciative modalities

Foucault's work is extensive and complex. There is no pretence in this article that the use and coverage of Foucault in this article is comprehensive or goes into the detail and depth a Foucauldian perspective offers. I do not provide a full and comprehensive *archaeology* (Foucault, 1972) or *genealogy* (Foucault, 1980) as Foucault does. Nor do I use a discursive analysis. Instead, my use of Foucault in this article is purposive and selective. I only focus briefly on Foucault's (1972) account of the formation of *objects of discourse* and discuss what he refers to as enunciative modalities.

In the *Archaeology of Knowledge*, Foucault (1972) indicated that objects of discourse do not emerge from single points but in systems of dispersion. Objects of discourse do not have a single point of origin and they are not necessarily linked to "traditions" or "oeuvres" (Foucault, 1972, p. 38). Foucault pointed out that objects of discourse are constituted in systems of dispersion and have multiple points of origin. In these systems of dispersion, a regularity of discursive formations is established, and Foucault described such discursive formations as:

> Whenever one can describe, between a number of statements, such a system of dispersion, whenever between objects, types of statement, concepts, or thematic choices, one can define a regularity (an order, correlations, positions and functionings, transformations), we will say for the sake of convenience, that we are dealing with *a discursive formation.* (1972, p. 38)

The discursive formation is also part of what Foucault (1980) regarded as the dispositive. A dispositive is an assemblage of the power and governance mechanisms that function as strategic components of societal arrangement. It is a

> heterogeneous ensemble consisting of discourses, institutions, architectural forms, regulatory decisions, laws, administrative measures, scientific statements, philosophical, moral, and philanthropic propositions—in short, the said as much as the unsaid. Such are the elements of the apparatus [dispositive]. The apparatus itself is a system of relations that can be established between these elements. (Foucault, 1980, p. 194)

Therefore, the construction of discursive objects in discursive formations happen in "a system of dispersion" (Foucault, 1972, p. 38). This suggests that objects of discourse are not necessarily historically continuous or linked to, as Foucault (1972, p. 38) indicated, "oeuvres" or single points of origin. It is for this reason that I indicated earlier that it is important to view the construction of the 4IR specifically, and not automatically assume that it is merely a sequential development of the 3IR into the 4IR in a linear and somewhat historically continuous manner. Recognising how the 4IR is articulated and constructed needs to be viewed specifically. Later, though, I also indicate that, currently, the construction of the 4IR is projected as continuous with the 3IR and, in so doing, suggests that the 4IR is inevitable.

It is also important to note that for Foucault, discursive formations are part of a dispositive. This means that they are not just discourses, words, or statements but imply "architectural forms, regulatory decisions, laws, administrative measures" (1980, p. 194). As such, they are material and not only discursive. This is the reason why this article does not engage in a discursive analysis but, instead, shows the people who are constructed as authorities who enunciate the 4IR and the sites from which they are enabled and allowed to do so. Thus, while the argument in this article is that 4IR in South Africa is largely enunciation, this does not mean that it is without a material base that allows such ideological enunciations to be possible.

Foucault (1972, pp. 50–55) pointed out that when a discursive formation is established, enunciative modalities are put also into place. Such enunciative modalities include "who is speaking" (p. 50) and the "sites" (p. 51) from which they speak or where they view it should be applied; and they position subjects in specific ways for its enactment (Foucault, 1972). Those who articulate, enunciate, or speak the discourse tend to be what Foucault described as "authorities of delimitation" (1972, p. 52). In being authorities, they prescribe and proscribe what it includes and excludes. In the process, "grids of specification" (Foucault, 1972, p. 53) are also established, and such grids of specification indicate how objects in the discursive formation are classified, how they are distinguished from each other, and how they are ordered.

As can be seen from the above, enunciative modalities are mechanisms that are used to establish a dispositive (Foucault, 1980) and, whilst they put into place authorities of delimitation, enable, and position them to enunciate in particular sites and apparatuses, they are more ideological and discursive rather than actually being in place materially. In this regard, Foucault's notion of enunciative modalities is similar to the *ideological state apparatuses* (ISAs) that was elaborated by Althusser (1971).

The reason why Foucault's notion of enunciative modalities was chosen in this article instead of Althusser's ISAs is two-fold. First, as part of Marxist thinking, Althusser's notion of ISAs runs the risk of (economic) reductionism because, for Althusser (1971), state apparatuses were in the first and final instance determined by the economic base. Such an approach tends to view ISAs in general terms and does not always specifically address how and by whom such ISAs get to do what they do.

This leads to the second reason why Foucault's notion of enunciative modalities was chosen. Enunciative modalities allow one to look specifically at how the 4IR ideology is framed, who enunciates it, from where they enunciate it, and the networks in which they intersect. This is linked to Foucault's (1972, p.18) idea that discursive formations are dispersed, do not come from only one point, and are more "capillarized." Nonetheless, the enunciative modalities and the authorities of delimitation that articulate them are not reflective of what pertains materially. They are statements, articulations, and, as such, largely ideological—albeit being enunciated in particular sites that are material.

The following uses the notion of enunciative modalities, and focuses specifically on who speaks and from which sites they speak to construct the 4IR.

Enunciating the 4IR

The "surface of emergence" (Foucault, 1972, p. 51) of the 4IR discourse, that is, when it was first spoken about, can be traced to Klaus Schwab's address to the World Economic Forum in 2015. The address was subsequently published in early 2016. Schwab indicated the growing development of the Fourth Industrial Revolution, and said:

> We stand on the brink of a technological revolution that will fundamentally alter the way we live, work, and relate to one another. In its scale, scope, and complexity, the transformation will be unlike anything humankind has experienced before. We do not yet know just how it will unfold, but one thing is clear: the response to it must be integrated and comprehensive, involving all stakeholders of the global polity, from the public and private sectors to academia and civil society. (2016, para. 1)

Schwab further indicated:

> There are three reasons why today's transformations represent not merely a prolongation of the Third Industrial Revolution but rather the arrival of a Fourth and distinct one: velocity, scope, and systems impact. The speed of current breakthroughs has no historical precedent. When compared with previous industrial revolutions, the Fourth is evolving at an exponential rather than a linear pace. Moreover, it is disrupting almost every industry in every country. And the breadth and depth of these changes herald the transformation of entire systems of production, management, and governance. (2016, para. 3)

The above statements by Schwab indicate that the 4IR is all encompassing in its breadth and depth; it covers the private and public sectors. It involves academia and civil society. It affects production, management and governance. For Schwab, then, the 4IR is coming from and affecting various sites in society and does not have a single point of origin. In Foucauldian terms, this means that the 4IR surface of emergence, whilst first articulated by Schwab in the WEF, has its construction in systems of dispersion. This also suggests that although one can discern a regularity in and about 4IR, it is not a single thing, but is comprised of different dimensions, operates in different ways, and in different sites. Thus,

while one can see the 4IR as a discursive formation with a discursive regularity, it is not one thing and does not emerge from one site.

When Cyril Ramaphosa, the current President of South Africa, established the Presidential Commission on the Fourth Industrial Revolution in April 2019, the terms of reference of the Commission similarly indicated a dispersed reach and emergence of the 4IR. The following indicates this:

> The 4IR manifests itself through technological innovations its impact cuts across all levels of society hence the need for a broader perspective and approach. (Republic of South Africa, 2019, p. 5)

Later in the same document, the following was indicated:

> Viewed collectively, the Commission will comprise representatives of a cross section of stakeholders including government, business, labour and civil society, including youth, women, people living with disability, academia and research institutions, and other non-governmental organisations. (Republic of South Africa, 2019, p. 8)

Later, in February 2020, in his State of the Nation address, Ramaphosa said:

> The Presidential Commission on the Fourth Industrial Revolution has made far-reaching recommendations that impact on nearly every aspect of the economy and in many areas of our lives. (Republic of South Africa, 2020, p. 26)

The surface of emergence of the 4IR, then, as well as its reach, is dispersed and widespread. It is not with a single point of origin, nor are its anticipated applications in one site—they are dispersed over multiple sites, cutting across all societies of the global polity.

The above also indicates who enunciates or speaks about 4IR. Two things arise from the above in this regard. First, people who are in government and the economy are positioned as the authorities of delimitation. Second, the 4IR discourse is enunciated concurrently on global and local levels. This not only indicates further degrees of dispersion in the surface of emergence and enunciation of the 4IR discourse, but it also indicates that from its inception, the 4IR discourse is global and local in its reach.

The 4IRSA Partnership (the partners at time of writing are Telkom, Wits University, University of Johannesburg, University of Fort Hare, DTPS, Deloitte, Huawei, Vodacom) is another instance that indicates this broad reach of the 4IR in its surface of emergence and in its intended sites of application:

> 4IRSA is a platform to bring together key stakeholders, decision makers, and pioneers to define the principles, visions, and outcomes of industry 4.0 and its future effects on South Africa and to engage in constructive discussions, explore best practices, and propose solutions to address the challenges. (n.d. last para.)

As the above indicates, the authorities of delimitation are those who are in the economy and government, and academia. The 4IRSA is a local instance of a simultaneous global development. As also indicated above, academia is also a site from which the 4IR is enunciated. Not only are members of academia positioned and expected to contribute to the development of the 4IR, but they are also constituted as authorities of delimitation of the 4IR. It is not coincidental, then, that the chair of the Presidential Commission on the Fourth Industrial Revolution in South Africa is the Vice-Chancellor of the University of Johannesburg, and an academic.

International economic organisations like the WEF, and governments like the South African government, mention members of academia directly in their enunciations about 4IR, as indicated in the quotations cited above. Academia, then, is viewed both as a site for the development and application of the 4IR, as well as the authorities of delimitation that contribute to defining 4IR. In so doing, they also construct the relations between objects of discourse and grids of specification. This is captured most clearly in the following:

> Universities in Africa, as with their counterparts globally, are required to contribute to the advancement and development of their societies. This needs to be underpinned by teaching and learning strategies that create well educated, socially conscious citizens who are equipped with skills for their era, in this case the fourth industrial revolution (4IR)

> The 4IR is creating overarching conditions that have important implications for our universities: what we teach, what we research and our contribution to the economy, employment, and society. This requires a deliberate leveraging and repositioning of our universities to optimise our role in reconstructing South Africa's future and the associated development and employment landscape. (Kupe, 2019, paras 1&2)

In the quotations above, Kupe, as Vice Chancellor of University of Pretoria, not only (re)positioned academia as a site of application and authorities of delimitation of the 4IR, but also indicated that the developments about the 4IR in academic institutions is happening both locally and globally. Kupe (2019) also suggested grids of specification above, by pointing to the implications of the 4IR for our universities, which include teaching, research, and employment.

The following discusses these developments about the 4IR in academia in relation to some courses that are being put into place, the conferences that are increasingly beginning to focus on the 4IR, and publications that are being produced. These indicate how academia contributes to the construction of the 4IR, and also indicates how grids of specification are put into place to define and proscribe what the 4IR includes.

The International Council for Educating Teachers (ICET) held a conference in July 2019 on the theme, "Reconceptualising Teacher Education for the 4th Industrial Revolution and Knowledge Democracy: Teaching Beyond the 3Rs" (ICET, 2019). Although this conference was held in South Africa, the delegates at the conference were from many countries and their

presence at the conference indicated that the 4IR was a development that was affecting academics around the world. Despite the variations in presentations and positions adopted, the theme of the conference is what is most significant. It clearly placed 4IR centrally on the agenda not only for education but for teacher education, in particular.

At this ICET conference, many presenters spoke about how the 4IR afforded new possibilities for teaching and learning, not only in universities but in schools too. For example, Penn and Ramnarain (2019) pointed out that virtual learning could benefit the learning of science. Armah and Westhuisen (2019) argued that, in Ghana, although students complained about not having access to data, devices, and connectivity, they would want more virtual learning environments to be used in the teaching and learning of their courses, which they viewed as beneficial to their learning.

Also at the ICET conference, were presentations including a response to the keynote address that attempted to view the 4IR discourse in more critical ways (Carrim, 2019). Some also pointed to the enormous inequalities and lack of infrastructure in schools and generally in South African society, which suggested that issues such as the lack of access to electricity meant that devices such as computers would not allow for the development of the 4IR as suggested and could easily lead to exacerbating existing inequalities in society between the rich and poor (ICET, 2019).

At the South African Education Research Association conference held in October 2019, a panel discussion was put into place and focused on "Critical Educational Responses to the "Fourth Industrial Revolution: Meanings, Appropriations, and Critiques" (Osman et al., 2019, p. 6). This discussion picked up on the impetus started at the ICET conference and indicated, not only the growing focus within academia on the 4IR, but also the speed at which this is happening. In a space of three months two big conferences on 4IR and education occurred in South Africa: one with global participants, and one with mainly local, South African participants. Together, both of these conferences pointed to the amount of work that is already being done in universities to promote and develop the enunciation of the 4IR.

In addition, Tawana Kupe, the vice-chancellor of University of Pretoria, indicated that:

> The University of Pretoria (UP) is cognisant of this and is proactively positioning itself as a 4IR leader in several sought-after fields. One of these is engineering and we launched a hub called Engineering 4.0 in August 2018. Engineering 4.0 focuses on smart cities and transport for economic development in a disruptive 4IR society, with the associated development of civil engineering skills and technology and data sciences, which are also offered to all our other faculties. (2019, para. 9)

> The most sought-after 4IR skills with high employment prospects are in science, technology, engineering, arts, and mathematics. Qualifications such as data science and geoinformatics are increasingly in demand as new technologies and digital platforms are making it possible to generate huge amounts of data and are changing the ways that knowledge is produced, accessed, and used. (2019, para. 6)

As can be seen from these quotations from Kupe (2019), courses offered by universities are now also beginning to actively develop competences in the 4IR related areas such as data science, geoinformatics—and an emphasis is placed on science, technology, engineering, and mathematics (STEM). What should also be noted is that courses like data science and geoinformatics are new to university curricula and, although some form of these courses may have existed before, they are not quite the same as what is now contained in and expected from these courses.

Thus, it can be said that the enunciative modalities of the 4IR currently constitute people in the economy, government, and academia as authorities of delimitation, and the economy, government, and academia are the sites of enunciation and also its points of development and application. In addition, platforms like 4IRSA bring wider society into the enunciative modality, also as a point for its development and application. In addition, academic conferences and publications that focus on 4IR contribute to the enunciation of 4IR and indications of introducing curricula that include subjects like data sciences not only relate directly to 4IR but also begin to provide grids of specification.

In the following section, the coordinates that seem to arise from these enunciations are discussed and their educational implications are also addressed.

4IR and some of its coordinates

Since the fourth industrial revolution (4IR) was signalled and framed as such when Klaus Schwab of the World Economic Forum (WEF) enunciated it in 2016, it has spread across the globe to the extent that the "4IR-speak" is now in popular conversations. This is not coincidental given the focus placed on the 4IR by people within the economy, government, and academia who have contributed to bringing into the public. In this section, I look at what some of the coordinates in the 4IR enunciations are. I focus on four such coordinates: inevitability, STEM matter, instrumentalism, and benevolence. These coordinates arise because they appear repeatedly in government, economic, and academic enunciations of the 4IR.

Inevitability

4IR, as it stands, tends to project the 4IR as if it is inevitable. 4IR is here, it is happening, it will increase exponentially, and it is inevitable. This was alluded to at the beginning of this article as well. It was indicated that the increasing presence of online interactions during the pandemic can be viewed as bringing the 3IR closer into the 4IR, given that an online presence is one of the key features of the 4IR.

However, what is generally done to indicate the inevitability of the 4IR is the tracing of industrial revolutions of the past and to indicate that technology is growing from where it began to where it is going. As Schwab put it: "When compared with previous industrial revolutions, the Fourth Industrial revolution is evolving at an exponential rather than a linear pace" (2016, p. 1).

The 1st, 2nd, and 3rd industrial revolutions are described in various ways to show that the 1st was steam engine led, the 2nd was electricity based, and the 3rd is digitally based. The 4IR follows these previous industrial revolutions bringing in big data, AI, and robots, inter alia.

> What is the phenomenon we are now experiencing? The first industrial revolution emerged in the 1780s with steam power, making humans more productive. Then in the 1870s the second industrial revolution emerged with the development of mass production and electrical energy. The third industrial revolution emerged with the development of IT and electronics, which enabled more efficient production. We are now in a new phase where the fusion of several technologies is not only automating production, but also knowledge. (Gleason, 2018, p. 2)

For some like Xing et al. (2018), the new and critical resource of the 4IR is data. Others like Gleason (2018) viewed such resources of the 4IR as *cyber-physical systems*. Such differences aside, the inevitability of the 4IR is still assumed. It is as if there is no human intervention that is creating such conditions. It is as if there is no agency among people and the 4IR will happen, nonetheless. Such assumptions of the inevitability of the 4IR, thus, remove human agency in the development of the 4IR and accords the 4IR with a power—as if it is a force on its own. In the process, in whose interests 4IR is constructed to serve, where and how 4IR is being made into what it is, and which forces are being configured to propel it get ignored. 4IR is, instead, projected as if it is force on its own with an historical determinism that cannot be stopped.

It is in relation to this that Foucault's (1972) point about discursive formations not necessarily emerging from single points of origin and with historical continuity in deterministic ways become important. As discussed earlier, Foucault's (1972) view that discursive formations are dispersed helps to show, as indicated above too, that discursive formations come from various sites (the WEF, government, and academia), and on different levels (local and global), and get to be enunciated by particular people in specific spaces who, in fact, bring the discursive formation into existence and visibility. They do not happen inevitably, nor do they happen in historically deterministic ways, but are actively constructed by people in specific spaces and who enunciate it, define, and bring it into visibility.

This claim about the inevitability of the 4IR has been responded to in a debate about whether the 4IR is a "revolution" or merely a continuation of the 3IR. Moll (2021), who used Rifkin's (2016) argument on this point, indicated that the features that are enunciated as characterising 4IR, such as the Internet of Things, AI, big data, 3D printing, and machine learning exist within 3IR and were indicated by Castells' (1999, 2000, 2004, as cited in Moll, 2021) seminal work on information communications technologies and network societies, and are present in 3IR. On this basis, then, for Moll (2021), 4IR is a myth.

Neither Rifkin (2016) nor Moll (2021) noted the absence of agency in the enunciation of 4IR as inevitable. They did not look at who articulate 4IR (apart from Schwab) and the sites from which they enunciate the 4IR. They also did not engage with the dispersed nature of the enunciation and construction of the 4IR and its historical specificity but instead, lapsed into

historical continuity and regarded the 1IR as a revolution—and not the 4IR; for 4IR to be seen as a revolution, it needed to meet the characteristics of the 1IR (Moll, 2021). 4IR was also viewed as more continuous with 3IR. As indicated in the introduction of this article, it is questionable whether the 4IR can simply be read as being the same as 3IR because the ways in which the 4IR may develop could indeed be exponentially different than the 3IR, and we have not yet even imagined what those possibilities may entail. It may be, therefore, premature to dismiss the 4IR as a myth.

STEM matter

The 4IR also consistently foregrounds STEM learning areas. On the one hand, this is understandable due to the emphasis on robots, data, and the use of sophisticated computer-based approaches. This was indicated in the quotation from Kupe discussed earlier, in which he indicated that: "The most sought-after 4IR skills with high employment prospects are in science, technology, engineering, arts and mathematics" (2019, para. 6). This not only privileges STEM but also does not indicate what would happen to other areas such as the humanities and liberal arts. This allows the historical marginalisation of non-STEM related areas to be perpetuated, and does not consider that education does much more than only teach STEM subjects.

At the same time, the emphasis on STEM also reinforces and consolidates a distinctly positivist paradigm that assumes that only scientific approaches are valid and worthwhile for the 4IR future. Theoretical perspectives that have, historically, significantly critiqued the positivist and scientific paradigm are, almost conveniently, ignored. There is no recognition of paradigms such as interpretivism, critical theory, postmodernism, critical realism, and postcolonialism, to name a few (see Usher, 1996, for example). This positivist and behaviourist emphasis in enunciations of the 4IR was also noted by Rifkin (2016) and Moll (2021) who viewed this as *technocratic*.

However, at moments the arts are mentioned—as the quotation from Kupe (2019) above also indicates. Law and philosophy of ethics are also mentioned at other moments (see University of the Witwatersrand, 2019, for example). Arts, here, however, need to be seen as those arts that can be produced digitally and with AIs. With regard to the latter, the legal and moral implications of the 4IR with all its attendant features such as AI, robotics, and autonomous cars are viewed as raising serious legal questions and moral implications about machines taking over what humans would otherwise have done—to the point where AIs are also seen as outperforming what human can do. Consider the following:

> From the first to third industrial revolutions, machines outperformed humans in terms of mechanical tasks. This led to a shift in the duties associated with human labour, from mechanical tasks to cognitive tasks in the service industry. 4IR technologies, with the advent of AI, are poised to outperform humans in cognitive tasks. (Xing et al., 2018, p. 176)

For Elon Musk, this was precisely what potentially poses the most serious threat to humanity given that he too, noted that AI could outperform humans in cognitive tasks. As Musk put it, "AI is a fundamental risk to the existence of human civilisation" (2017, para. 5).

Thus, areas such as law and moral philosophy are positioned into handmaiden roles in relation to the booming developments with STEM subjects. They are not viewed as significant in themselves but, rather, as how they can further inform the development of the 4IR in ways that would not block its progress. Law will help clear the legislative framework to allow for the 4IR, and moral philosophy would aid in showing that the 4IR is ethically defensible—irrespective of the potential risk it could pose to humanity.

Instrumentalism

The emphasis on STEM, however, is also linked to the assumption of instrumentalism. The 4IR assumes that education should lead to actual practice, where practice is usually assumed to be the new demands that would arise in the wake of the 4IR. Constant upgrading, through lifelong learning in order to become highly skilled to function in the 4IR global economy are consistently emphasised (see Marr, 2019). From an economic perspective, such instrumentalism that is aimed at meeting and fulfilling the demands of the 4IR global economy is probably anticipated. For Marr this entailed:

> During the 4th industrial revolution, college qualifications will become shorter and more focused, and colleges will provide more life-long education with modular post-grad qualifications throughout the working lives of individuals. (2019, para. 10)

However, from an educational point of view this is seriously myopic and problematic. This is the case because not all of education is meant to lead to practice or action in a one-to-one correspondence way. Education also attempts to develop deep learning and engagement with knowledge, which do not necessarily lead directly to any action or practice—a point made by Moll (2021) as well. Such deep learning and engagement with knowledge develop among people a deeper appreciation of knowledge. Deep, disciplinary knowledge that education develops, and the learning of such deep disciplinary based knowledge, does not occur by proliferating short courses and offering a "bits and pieces" curriculum, as Marr (2019, p. 2) seemed to assume.

The 4IR assumes that high-level skills and knowledge will be required in the 4IR economy, and that schools and teacher education need to reconfigure themselves to ensure that such high knowledge and skills will be developed through education. In this regard, the infusion of technology into teaching and learning is taken as given. In addition, new knowledge areas such as data science and coding are also proposed. "This year, we will be introducing coding and robotics in Grades R to 3 in 200 schools, with a plan to implement it fully by 2022" (Republic of South Africa, 2020, p. 15).

The question, however, is where is education now—and, would such changes in education in fact be viable, is important to look at, too. Using South African education as a lens, where

South Africans sit at the bottom 5% in international literacy and numeracy tests, and where almost 80% of learners in Grade 4 cannot read for comprehension (see Fleisch, 2018, for example), it is questionable whether the high skills and high knowledge of the 4IR are achievable. What seems to be more the case is that developed country contexts that have adequate baseline numeracy and literacy (including computer literacy) levels may be able to develop such high skills and knowledge but in developing country contexts, where these do not exist, it will be more difficult to develop.

Some have indicated that the 4IR will require and lead people to develop the higher order of learning in terms of Bloom's taxonomy (see, for example, Gleason, 2018 and Xing et al., 2018). Bloom's taxonomy (1956) outlined the kind of learning that operates on different levels and includes comprehension (remembering), understanding, applying, analysing, evaluating, and creating. The argument is that the 4IR will require the higher orders of learning: analysis, evaluation, and creation.

Consequently, the 4IR will develop higher order thinking skills among humans. If about 80% of Grade 4 learners in South African cannot read for comprehension (Fleisch, 2018), then for them to attain higher order thinking skills is going to be rather difficult. Gleason (2018) also noted that higher education institutions across the globe have not been particularly good at ensuring higher order thinking skills either. If higher education has not been good at developing higher order thinking skills, then it is likely to be more the case with schools.

Added to this is the WEF's skill sets for the future 4IR, which indicates that what will be crucial are:

> Complex problem solving, critical thinking, creativity, people's management, coordinating with others, emotional intelligence, judgement and decision making, service orientation, negotiation and cognitive flexibility. (2019, p. 1)

In this regard, it will suffice to point to three of these skills to indicate the difficulties associated with them. Given the persistence of inequality and polarisation increasing globally, intolerance rather than negotiation dominate. Intolerance and polarisation also do not enable emotional intelligence to develop because, rather than identifying with and relating to how the other feels, the other is pushed further away and bordered with surrounding walls. It is also not clear what exactly is meant by cognitive flexibility. Are people expected to simply switch on and switch off their cognitions at will? Can this be done? Can people actually change their cognitive structures? What does cognitive flexibility actually mean?

Exposure to computer technology in schools in the Global South is also lacking. In South Africa, the majority of schools do not have computers, internet access, or adequate infrastructure. Although wealthier schools in South Africa do have such access, this is not the case for the many. Computer literacy is also, as a result, not quite as developed in most South African schools as one would hope. However, this points to the persistence of inequality both

within South Africa and globally. This reality was made more visible during the pandemic (see Fataar & Badroodien, 2020).

Benevolence

The 4IR is also projected as benevolent. It is will free people from dangerous jobs, it will make people's lives easier, it will do away with jobs people do not want to do and, overall, it will free people to pursue higher levels of being and to evolve (see Xing et al., 2018). The 4IR, thus, is a good thing and will be good for people.

But, in this regard, it is not indicated who these people would be. Would everybody globally be able to grow and develop in these ways? Would this be the case for only a few and, if so, who might they be? Such framing of the 4IR as a benevolent force also does not sufficiently address the impact the 4IR would have on deskilling, reskilling, and rendering some people and jobs obsolete. To this, Xing et al. (2019, p. 175) simply stated: "Future professionals will have to shift to new areas and types of work."

The benevolence projected does not adequately deal with the high levels of industrial unrest that are likely to result from people being rendered unemployed due to changes in the economy. This is the case despite clear indications from the WEF (see Schwab, 2016) that such economic instability and social unrest are likely with the advent of the 4IR. Can one then simply assume that the 4IR is something one needs to adapt to quickly and adopt fast (Xing et al., 2018)? It seems that we need to be more critical in our engagement with the 4IR than to adapt to it and adopt it because the consequences could be dire on a global scale.

Given the points made earlier, if such inequalities increase, and if economic and social instability increase, it seems that it will be the poor in developing country contexts who will be hardest hit. Gleason (2018) also noted that women, especially in developing country contexts, would be equally hit hard. South Africans on the African continent are also included in this group that will probably be affected. The point, though, is that it cannot simply be assumed that 4IR will reduce such inequalities on its own.

These inequalities impact schools in direct ways. Poor schools in developing country contexts do not have the resources and facilities available to them to enable the kind of learning the 4IR will require. Given the lack of basic facilities, they also lack basic skills to be able to manage with the demands of the current economy. Dealing with the level of polarisation in schools and societies needs to also be addressed, and to assume that technology will erode such polarisations is a problematic assumption to make. The inequalities and polarisations that persist globally raise the question about whether the conditions materially exist for the 4IR in education.

The 4IR also raises inconsistencies and contradictions. On the one hand, educationally, the 4IR promotes individualised, customised, and learner active, and learner-centred approaches. Getting learners to work autonomously needs to be understood as being in competition with robots that can work autonomously in the 4IR. On the other hand, given the WEF's skill sets,

learners are also expected to work collaboratively, coordinating with others. How these are to be balanced with each other is unclear and contradict each other in practice.

Finally, what the 4IR will require for teacher education is unclear. Deep thinking, which is seen to be linked to higher order thinking skills, is not what is acquired in pieces and the short courses, bits curriculum (Marr, 2019) that is suggested does not develop such deep thinking. Existing teacher education programmes have noted that deep thinking and deep knowledge happens after a considerable amount of time, and cumulatively develops through a structured immersion in discipline-based knowledge. The 4IR emphasises deep thinking and knowledge yet it suggests bits-and-pieces and customised forms of curriculum. If not viewed critically, such 4IR curricula will not only erode disciplinary knowledge bases and thereby reduce possibilities for deep thinking to develop, but they will also potentially take away the disciplinary bases of teachers' knowledge.

The instrumentalism assumed by 4IR education indicates changes in the curriculum that put into place new subject areas like coding and robotics, and suggest an increase in short course offerings that are customised, and which raise questions about the extent to which deep learning will be possible. In addition, with the emphasis on STEM subjects, humanities and liberal arts subjects get to be marginalised. The benevolence that is projected in 4IR ignores the increasing polarisation and inequalities in schools and society and, in South Africa, does not acknowledge the level of educational performance and lack of facilities and basic resources in schools. The contradictions in the WEF skill set such as those about deep learning and higher order thinking skills and promoting a bits-and-pieces curriculum point to further educational implications of the 4IR.

Conclusion

In conclusion, it needs to be stated that this article is not anti-4IR or anti-technology. Technology is a tool in the hands of humans, and how we use it will determine its outcome. This article used Foucault's (1972) notion of enunciative modalities. It did so to show how people in government, the economy, and academia are positioned as authorities of delimitation of the 4IR discourse, and the sites from which they speak. It has also shown that the 4IR may be viewed as a discursive regularity, but it is not a single thing, and operates in various sites and is simultaneously global and local.

The article also argued that inevitability, STEM matter, instrumentalism, and benevolence may be viewed as some of the coordinates around which the current 4IR may be said to revolve. In relation to inevitability, it was noted that such enunciations of 4IR as inevitable remove human agency from the picture and project 4IR as a force on its own.

The instrumentalism in 4IR enunciations, it was indicated, imply a behaviourist and technocratic approach to education that ignores the criticisms of this approach to education, which have historically shown that such approaches to education do not recognise the complexity of teaching and learning and that human beings in education are not like machines.

The benevolence that is claimed by 4IR enunciations were also been shown to seriously ignore the social instability that may come into play with the 4IR and also does not treat seriously enough the ways such developments could exacerbate inequalities and polarisations in the global political economy and in specific country contexts.

This article also indicated that by privileging STEM related subjects and areas, other subjects and fields of knowledge either get to be positioned in handmaiden sort of ways or get marginalised. The skill sets that are viewed as crucial for 4IR were also been shown to be contradictory in themselves and fail to recognise current educational levels of competencies and realities, especially in South African schools. The bits-and-pieces and short course assumptions of 4IR in education were also been argued to not recognise the deep learning that education attempts to develop in students and, instead, reinforces the instrumentalist approach to education in 4IR enunciations.

This article aimed to show and highlight the need to engage with the 4IR critically and what it would mean in relation to where we are and what will be required of us educationally to ensure that it is we, as human beings, who direct the ways the 4IR will unfold, rather than technology directing the way we need to think and be.

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