LEARNING ENVIRONMENTS IN HIGHER EDUCATION: THEIR ADAPTABILITY TO THE 4TH INDUSTRIAL REVOLUTION AND THE "SOCIAL TRANSFORMATION" DISCOURSE

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ABSTRACT

The South African higher-education sector is currently undergoing a significant phase in its transition. The phase is marked by a sense of uncertainty felt across institutions and entities that make up the sector. This uncertainty, to a large extent, is brought about by the socio-political realities the transition entails. Compounding this situation is the advent of the 4th Industrial Revolution (Hadden), a phenomenon to which the higher-education sector needs a heightened degree of adaptability. The learning environments provided by the higher-education sector are therefore crucial in terms of advancing the cause of positive social change as a realisable educational objective. Against this backdrop, this conceptual article examines the issue of *social change* as a moral imperative. The purpose is therefore to contribute to the 4IR discourse currently evolving in the context of South African higher education and its social change agenda, with cognitive capitalism as a theoretical lens. Significant scholarly work has been done on the issue of technological advancement and its implications for the social practice of education. However, a concerted effort has not been undertaken to examine the 4IR as an inevitable educational experience with potential to be both materialistically transformative and morally enslaving. The article concludes that, as 4IR unfolds into a magnificent event and starts to control every aspect of human life in general, and education in particular, the moral and ethical affirmations that support the experience of education may run into troubled waters.

Keywords: learning environments, higher education, 4th Industrial Revolution, cognitive capitalism

INTRODUCTION

The 4th Industrial Revolution has come of age as a transformational reference point in the

evolution of our scientific and technical consciousness. It has, in its wake, refreshed and reformed the singularity of educational thought and practice as a tributary of such consciousness. Higher education is one of the sectors on which the 4IR has a significant impact. In this context, this article views the idea of *learning environments* in higher education against the backdrop of such environments' adaptability to the notion of the 4IR. The authors' intention is also to investigate the positioning of "social transformation" as an implicit objective of educational thought and practice envisaged in the context of the 4IR; and hence carried out in such environments. The authors look specifically at HE professional practice as distinct from such practices at the level of school education in the context of the 4IR. This is because the urgency with which the HE sector has to respond to the demands of the 4IR is felt across institutions (Bryan 2018). An acknowledgment that "a deep consideration of the human condition" and "an abiding respect for freedom and human rights" should characterize such a response is also significant (Bryan 2018, 219). In this sense, this conceptual article aims to explore the implications of having sustainable learning environments in higher education, especially aligned with the social transformation discourse that the idea of the 4IR tacitly subsumes.

This article is conceptualised in the form of a theoretical piece that engages the reader in a discussion of the idea of the 4IR, and its implications for higher education. The discussion is anchored in the recent literature, and in the professional experiences of the authors, as higher-education practitioners.

THE 4IR AND HIGHER EDUCATION

Klaus Schwab, the founder and executive chairman of the World Economic Forum, is credited with the authorship of the term "The Fourth Industrial Revolution" (Michael 2017). Klaus Schwab conceptualised a set of "cyber-physical systems" as that which defines the 4IR. This cyber-physical interface of multiple systems is further complemented by what Schwab called "the single planetary technical system". The planetary system thus facilitates real-time interaction between individuals, irrespective of the physical distance between such individuals. The interconnected nature of the world, industrialised for the "fourth time", thus offers higher education a new facet in terms of its affordances and agency to undertake the cause of social transformation on a giant scale. Such institutions' positioning in a world that is polarised − some embrace the new era of the 4IR, while some do not − offers yet another interesting context (Konstantin and Vladimir 2017). Institutional positioning in the face of advancing technologies also has historical importance. Such advances in the past have left indelible marks of societal transformation far beyond mere increases in technical efficiency (Thomas and Nicholas 2018).

The idea of "4IR" is closely related to "Industry 4.0", a revolutionary thought that evolved in Germany, underscoring the use of digital technologies in the manufacturing industry (Thomas and Nicholas 2018). These two notions differ slightly in meaning, in that Industry 4.0 is often considered subsumed within the notion of the 4IR, with its emphasis on digital technologies, institutional transformation, and the optimization of productivity (Pfeiffer 2017). The 4IR can also be said to have a distinct emphasis on valorization, exchange and distribution of economic, political and social entities. The 4IR also has a bearing on the changes in markets and employment trends significantly influencing higher-education institutions' positioning (Pfeiffer 2017, 18). A radical shift in human-identity formations, supported by a shift in the ways humans experience the world, is therefore a fundamental issue concerning the impact of the 4IR as a socially transformative phenomenon. The transformative nature of the 4IR often leads to a certain degree of scepticism that new technologies have the potential to instruct and prescribe norms; whereas such technologies should ideally be endorsing values of liberty and sovereignty (Pfeiffer 2017, 21).

The 4IR, in this way, places the education community in a precarious position, because of the inherent uncertainties in value positions that the initiators of this technological revolution assume. In spite of these uncertainties, the related discourse emphasises the transformative power of technology; while acknowledging the fact that its potential is purposely framed to be situated within a neo-liberal or capitalist ideology (James 2018). It is worth noting that capitalism, as a political and economic ideology, is inherently devoid of any interest in equality or well-being as a social virtue; apart from a concerted effort to accumulate capital by the creation of surplus value (James 2018, 342).

Each of the three previous industrial revolutions contributed to significant changes in the modalities of economics of nations, cultural attributes of societies, and the creation of wealth (Nguyen, Le Quang, and Nguyen 2017). Most of Africa, however, is still "stuck in the second industrial revolution, with governments still prioritizing industrial programmes and skills that will be disrupted" (Games 2019, 18). While this apparent reluctance to embrace 4IR and its potential benefits is somewhat disturbing, the prevailing notion that the 4IR is an ideologically legitimized political position is problematic. The 4IR is a natural succession of the three previous industrial revolutions, however, this does not constitute its moral and ethical legitimacy. The implicit ways in which the 4IR aligns with capitalism, and the way it articulates with class struggle, are often concealed in formulations of this nature (James 2018). The ways in which the 4IR epitomises unscrupulous intellectual and moral extortion of citizens, are thus often obscured by its (4IR's) undeniable technical merits trumpeted on an epic scale. Such merits, as noted earlier, are often phenomenal and unprecedented in their magnitude. For

instance, 4IR-related technologies can design anything with the help of a computer, having the designed object printed by a 3D printer. Such objects can be as large as an entire building, or as small as groups of atoms, the construction of either being achieved with an unimaginable level of precision (Bryan 2018). The point here is that, while 4IR embodies a magnificent period of technological advancement to which higher education institutions are expected to respond accordingly, there remain issues of social transformation with which the ideological foundations of 4IR seem to be in direct conflict (Bahji 2018). The critical research question that this article tries to answer is therefore:

- How can *social change* be positioned and realised as a moral imperative in the current higher-education learning environments in South Africa, in the context of the 4IR?

The authors also float certain questions on what constitutes social change; and in what manner HE institutions can bring about such social change. Which particular aspect of social change do these institutional agents of change have the potential for? Exploring these questions helps us approach the main issue of positioning social change in a structured way.

This article now examines *cognitive capitalism* in explicating various social transformational aspects of the 4IR; and the agentive ways in which HE institutions can advance the social transformation discourse. An attempt is also made here to highlight how *cognitive capitalism* theorises issues mentioned above by offering a set of tentative explanatory propositions.

COGNITIVE CAPITALISM AS A THEORETICAL FRAME

Yann Moulier-Boutang's (2011) notion of "cognitive capitalism" offers a convenient theoretical frame for this context. Associated with this notion is the Marxian idea of "general intellect" (a combination of "technological expertise" and "social intellect"). These three ideas make up a formidable conceptual foundation onto which the notion of the 4IR can be affixed. Cognitive capitalism is, however, best conceived against the backdrop of its predecessors, i.e., "mercantile capitalism" (characterised by mechanisms of merchant trade and accumulation of wealth) and "industrial capitalism" (characterised by the accumulation of physical capital and mass-production facilities). Cognitive capitalism is based on "immaterial capital" and the omnipresence of the "knowledge economy" (Boutang 2011, 52). Both "immaterial capital" and "knowledge economy" are thus significant facets of the 4IR.

Cognitive capitalism manifests subtly in the production of knowledge by the use of knowledge (Boutang 2011, 55) This is facilitated by the coordination of mental activities

engaged in by individuals who are physically apart from, and, perhaps, unfamiliar with one another. “Knowledge” and “creativity” form the two critical “immaterial investment” aspects that cognitive capitalism focuses on, for the generation of profit. The method of production is essentially configured on multiple “platforms” provided by the mental powers of multiple individuals, executed by networks of computers. Another aspect is that cognitive capitalism is not merely confined to drawing from living labour (humans) as opposed to dead labour (machines). As Marx pointed out, in the context of industrial capitalism dominated by machines, societies governed by cognitive capitalism will have “living labour” (the human brain), characterising the nature of society in general (Boutang 2011, 55). Cognitive capitalism produces essentially immaterial goods that have a high degree of specificity of nature in terms of their use, depreciation, and expropriation by those who exploit such goods. Such goods, therefore, are transacted within society in particular ways, much to the advantage of the cognitive capitalists.

A form of production that uses digital networks in cognitive capitalism has certain advantages. First, solutions can be generated without any preconceived notion about the nature of such solutions. Second, the cognitive division of labour facilitates ease of finding solutions to problems. The 4IR thus has inherent characteristics that lend themselves to cognitive capitalist ideology. The cognitive capital that defines the digital revolution therefore is the key aspect of the 4IR.

Let us now look at cognitive capitalism from a different angle. Cognitive capitalism is essentially based on the idea of amassing immaterial capital, rapid decentralization of sources of knowledge, and an associated formation of a *knowledge economy* (Boutang 2011). The economy of states becomes *virtualised* and is increasingly constituted by the *immaterial* (the abstract opposite of *material*, or loosely described as *intangible assets*). Boutang (2011), in this context, considers *science* and *knowledge* the two critical entities in which capitalist exploitation manifests implicitly. The appropriation of knowledge, as opposed to the acquisition of it, coupled with the utilization of technology, is central to this process. Productivity enhancement in the knowledge economy is defined by “economies of learning” rather than by the scaling up of the production line, as in the conventional notion of incremental growth in productivity. The idea of division of labour has thus come to be defined in terms of cognitive criteria of this nature (Boutang 2011, 52). This has, in turn, given rise to a new categorization of goods and services as: the physical *hardware*, the logical *software* and the cerebral *wetware* (Boutang 2011, 52). The cerebral wetware thus becomes a significant tool in cognitive capitalism: appropriation of *knowledge* and *creativity* constitutes the accumulation of immaterial wealth. Knowledge also becomes the single most significant source of value that

warrants valorization, which characterises capitalism, in general.

As a social and political ideal, capitalism essentially involves the relationship between profit and the wage. Cognitive capitalism therefore defines the reconstituted nature of that relationship manifesting as capital – labour relation and the newly defined entities on which generation of capital has come to depend, such as the power of cognition (Carlo 2005). The cognitive aspect of labour thus has the potential to become resistant to the brutal nature of production and accumulation of capital (Carlo 2005, 3). The institutions controlling the "intellectual powers of production" constituted by cognitive labour, can also determine the "social purpose of production" (Carlo 2005, 3). Covert mechanisms to convert the labour force into objective technical entities unworthy of any subjective qualities, can thus lead to the creation of muted and despondent societies. This insidious characteristic of cognitive capitalism is best experienced by the ulterior maximization of profit through the preference of *living knowledge* over *dead knowledge*, in which *the creative power of the living labour* comes in handy (Carlo 2005, 7). Accordingly, it is appropriate to stress that "it is the labour and not the capital which is cognitive in cognitive capitalism" (Carlo 2005, 8). This is despite that accumulation of capital still remains the result of exploitation of the cognitive product of labour; and the resultant conversion of knowledge into consumable commodity. These aspects lead us to the conclusion that cognitive capitalism is a natural impediment; and hence an immoral constraint on the growth of knowledge economies. Such knowledge economies owe their legitimacy to open access to and free exchange of raw knowledge. Let us now view the 4IR from yet another "critical angle".

COGNITIVE CAPITALISM AND THE MARXIAN UNDERTONES

There is significant literature that lauds positive technical influences glorifying the stature of the 4IR as a phenomenon worth living in (Shahram 2017). However, certain other theoretical positions help us place the 4IR in the broader context of ethics, morality, and social justice which are fundamental to modern democratic societies. Marxism, as an analytical framework, is one such stance (Shahram 2017, 105). A Marxian framework gives us a clear picture of the social context in which goods and services are produced and consumed; and the manner in which that process is related to the foregrounding of technological advancements. The social context here is occupied by two significant players: (a) those who are performing the labour and are hence called the *direct producers*; and (b) those who are making decisions about the products, hence called *appropriators.* As opposed to other theories dealing with profitability and efficiency, Marxian theory seeks answers to the question of who produces the surplus, who makes decisions about the surplus, and why such decisions are taken. The monopoly profits of

billions of dollars that Facebook and Google make are classic cases of this scenario. While these companies are primarily based in rich European countries, their exorbitant profit is attributed to "unpaid labour extractions" practised on unsuspecting consumers spread across the world (Shahram 2017, 106). This profit-generation process involves the creation of a network of users, the associated traffic, and the subsequent monetizing of that traffic. This is practised by the selling of the commodity known as "promotion services" which are built into the interface. For instance, in the case of media advertisements, the audience is the commodity that is sold to advertisers. Since the audience's attention is produced, sold, purchased, and consumed, it attracts a price.

The phenomenal growth of these organisations embodies a systematic, cognitive capitalistic exploitation of cognitive labour. A counterargument here would be that certain countries with historically communist dispensations, such as China, also practise capitalistic exploitations of this nature, in the context of their phenomenal 4IR-related technological advancement. This may be construed as a departure from anti-capitalist and Marxist doctrines that such regimes preach and practise for the protection of their workers' rights. However, China's version of Marxism has effectively merged certain proven "merits" of capitalism with the conventional Marxist ideology that originated in Russia (Gafurov 2019). As a result, China has allowed private production of goods, and achieved significant economic growth, demonstrating to the world the compatibility of capitalist ideologies with conventional notions of communist governance of production (Gafurov 2019, 17). This phenomenon was manifested in the recent effort by China to snatch the opportunity to mass produce and export protective masks, used as protection against the Covid-19 infection, with clear short-term monitory gains in mind. This apparent emphasis on opportunistic exploitation of a wretched situation to create wealth is, interestingly, what has been called "building socialism the Chinese way" (Gafurov 2019, 18). Within Marx's propositions, however, we understand that "surplus value exploitation", perpetuated by capitalism, restricts the benefits of digital technology brought about by the 4IR within a set of elite capitalist countries. Instances of this phenomenon can be seen in the cases of Google, YouTube, Facebook, inter alia, all situated in First World countries. Such companies are some of the incredibly popular social media firms thriving on the digital technological advancements of the 4IR (Christian 2011). Exploitation of surplus value, in these cases, is not necessarily carried out by their own programmers or technicians, but by users, who produce the content as a result of the user-interface technology.

The corporations mentioned above do not pay the users for the content such users produce. Instead, the users are given platforms on which they produce content. Subsequently, large groups of such users are handed over to advertisers as a tradable commodity. An interesting

aspect here is that, while the means of production is in the hands of such users, its ownership is placed elsewhere. Through the use of the worldwide computer network, the economic value of such massive labour is focussed on the privileged few who happen to be in the First World countries (Christian 2011). This has been achieved because the capitalists have managed to maximise the production of surplus value; and hence, achieve the maximised exploitation of immaterial labour power, leading to permanent capital accumulation (Christian 2011, 79). Immaterial labour, in this case, is constituted by immaterial products of "knowledge, information, communication, a relationship, or an emotional response" (Christian 2011, 80). It is important to note that this kind of labour is characterised by the capitalists' use of tools such as the "mind" and "creativity" for the production of value, where the soul becomes the "subject of domination" practised by the "commercial appropriation of general intellect" (Christian 2011, 88). This appropriation is facilitated by the ever-expanding web of the Internet, which is an instrumental aftermath of capitalism itself. Computer networks, the most defining feature of the 4IR, in this way have facilitated the evolution of global network capitalism. It has legitimised the accumulation of "economic, political and cultural capital" through the extensive use of the Internet (Christian 2011, 96). Through the appropriation of the general intellect, practised in this manner, all categories of paid and unpaid knowledge workers become victims of unscrupulous exploitation as an unintended consequence of the 4IR.

An interesting irony is that, while the means of production are vested in the masses, the masses are being systematically deprived of the ownership of their products, placing the accumulated economic value of their labour in the hands of a privileged few. An interesting question here, as to why then the victims of capitalism or the exploited segment of the workforce remain impervious to their own predicament, and hence reluctant to engage in agentive ways to transform lives, is also pertinent. Boutang (2011) has a definitive answer to this question. Boutang contends that capitalism, by its very nature, controls the physical labour power (as opposed to the intellectual labour power); while the "mobilization of affects" of workers is limited solely to facilitate the movement of the physical body of such workers (Boutang 2011, 78). In other words, the capitalists unscrupulously nullify any chance of intellectual awakenings among the labour force, while tactically augmenting the workers' physical maneuverability, and hence their productivity. In relation to capitalists' purposeful effort to keep the labour force away from being educated into higher consciousness and increased awareness of their own predicament, Boutang tells us how the colonial British power of the 17th century banned the Irish Roman Catholics from becoming literate. When the Roman Catholics eventually learned to read and write, Britain, until 1851, banned them from attending universities. While colonialism, as a political expansionist project, is far more complex than

capitalism as an ideology, both seem to have used education, or the lack of it, as a device for oppression and exploitation.

Boutang further notes that cognitive capitalism, as an ideology in which information technology and hence the notion of the 4IR can be configured, is the direct consequence of the unexpected educational upliftment of the workforce that led to the "working class rebellion" in the 19th Century (Boutang 2011, 79). The widespread resistance further led to the workforce gaining increased access to universities. However, this also led to the instruments of cognitive capitalism evolving into a subtle machinery capable of exploiting more of the cognitive labour as opposed to the physical labour, as happened in the era of the industrial capitalism. The point here is that the exploited workforce remaining largely subservient to the machinations of the cognitive capitalists is simply owing to the mechanisms that ensure "employees' loyalty" through the "capturing of the cooperation of brains" (Boutang 2011, 79).

SOCIAL TRANSFORMATION THROUGH THE 4IR IN THE HIGHER-EDUCATION CONTEXT

The 4IR has brought about significant socio-economic development across nations (Nguyen, Le Quang, and Nguyen 2017). At the same time, it has the potential to widen the rich-poor divide (Nguyen et al. 2017, 31). The 4IR also has implications on socially and racially sensitive issues, such as gender income parity, or equal pay, no matter the gender of the employee. Social transformation, therefore, as an idea underpinning higher education, has been a critical point in the related discourse (Bryan 2018). The 4IR has brought about an unprecedented level of access and success for students in higher education across the world (Bryan 2018, 213). The higher-education environment has thus changed significantly, with access to information becoming free and instant. The focus has shifted to extensive collaborative learning pedagogies facilitated by the Internet. In terms of content, the spotlight is on interdisciplinary areas of learning, and associated interdisciplinary curricula, resulting from inter-institutional collaboration across nations and their institutions. This has led to increased collaboration among students in the globalised higher-education context. The values of national identity, tolerance, and co-existence have thus been promoted as a by-product of the 4IR (Bryan 2018, 218). As a related aspect of this trend in global cooperative learning, Bryan (2018) also cautions us on the potential economic imbalances created by the 4IR. The ideals of human rights and equitable access to economic resources are hence critical points that an interconnected, globalised, higher-education system should take into consideration in the context of the 4IR. A comprehensive plan of action for higher-education institutions is thus necessary. Graduates in the 4IR should be able to advance "material culture", with concomitant emphasis on ethical and

sustainable use of technologies (Bryan 2018, 220). Social change, as a moral obligation entrusted to the higher-education professional practice, envisioned in the context of technological advancements, is inherently vested in those graduates.

In spite of a primary-education system that has consistently fallen short of expectations, a higher-education system that is one of the best on the African continent raises hopes for a social transformation agenda that can be carried by the system as a vehicle (More and Soumaya 2019). However, the transformation of the system itself, in terms of access for previously disadvantaged racial groups, remains an unrealised dream (More and Soumaya 2019, 249). While the South African government has prioritised transformation as a social exigency, a labour force dominated by unskilled labour threatens any rapid and tangible transformation (More and Soumaya 2019, 250). Social transformation, in this sense, constitutes the empowerment of the workforce that will otherwise be replaced by algorithms capable of executing non-routine cognitive tasks (Michael 2017). The 4IR thus brings about the additional dimension of inequality, i.e., the inequality between those with technologically empowering learning experiences in higher education, and those without. The digital revolution, by itself, is therefore incapable of bringing about social transformation; rather, a concerted political and social will has to be in place. Such a will would have to define in clear terms the role higher education should play in the context of potential technological unemployment exacerbated by social injustices. This is especially relevant in a cognitive capitalistic world, in which human resources that cannot be readily commodified face exclusion, much to the advantage of the "historically privileged", and to the disadvantage of the "historically underprivileged". The technological advancement discourse of the 4IR thus becomes yet another instrument of oppression of the capitalist world, crafted for the subjugation of the masses for purely utilitarian purposes. Let us now look more closely at the impact of the 4IR on higher education.

Technological unemployment inherent in the advent of the 4IR and potential job losses still remain the gravest concern for most countries (Shuo-Yan 2018). Significant differences in expected core knowledge, capabilities, and skills of the workforce, will be the hallmark of the transition into the new era. Our universities and training institutions are fundamentally designed to cater for job opportunities that already exist (Shuo-Yan 2018, 118). As employment space is gradually filled by artificial intelligence (AI) and smart technology, the conventional higher-education learning environments need to be drastically reoriented to embrace 21st Century learning objectives. Significant restructuring of current pedagogical practices must be undertaken to live up to the expectations of potential employers brought about by the 4IR (Shuo-Yan 2018, 118). This is because the conventional workforce will be found having skills that robots do not have, so that the human-capital-based workforce is not rendered redundant

altogether (Delaila, Mohd, and Mohd 2017). A clear and comprehensive picture of what is in store for education, in general, as the 4IR gets into full swing, remains rather speculative (Butler 2018). This is despite widespread acknowledgement that universities will be the primary centres of attention, as technological advancement becomes an inseparable aspect of daily life as far as people's lives are concerned. An increased focus is now seen on higher-education curricula that ensures production of graduates well suited to take up the challenges posed by the 4IR. An interesting aspect here is that the concept of qualitatively improved citizenry has much to do with an awareness of how the world functions in the context of the 4IR (Butler 2018). While literacy and numeracy continue to be significant attributes of such citizenry, new literacies of usage of and exposure to technology define the other version of citizenry. Students of scientific and technical disciplines need exposure to "political and social natures of the world" just as students in humanities and social sciences need basic literacies of artificial intelligence and robotics (Butler 2018, 1). Ethical and moral considerations that are not natural constituents of artificial intelligence will have to be integrated into the higher-education teaching and learning mechanisms, while catering for novel curricular innovations in the 4IR. As complex learning outcomes are thus formulated, and technological sophistications of learning environments advanced, ethical and moral considerations of a pedagogy that guarantees universal social justice assume relevance.

"Social dislocations" inevitable in the 4IR are to be seriously considered in the higher-education curricula that look forward to re-establishing social stability and democratic order (Bryan 2018, 221). Certain paradoxical trends brought about by the 4IR can be seen in the simultaneous advancement in democratic values on one side, and the centralization of wealth and political power perpetuated on the other (Bryan 2018, 221). Higher-education curricula must take such trends into consideration, so as to expose students to the potential political conflicts of "the convergence of physical, digital and biological worlds" that characterise the 4IR. The paradox, once again, will be that, while the citizenry becomes increasingly critical of governmental actions as an after-effect of reinforced democratic values, the governments will, on their part, exercise increased control over the citizens, as a result of having access to advanced technologies that facilitate such controls. Both these implications are worth considering in the context of a "digital pedagogy" that should encompass societal needs for a set of ethically and morally justified educational experiences offered by higher education (Bryan 2018, 222). Digital education, as a novel idea embraced by the higher-education sector, is to be seen beyond its mere technical nature. Just as in the case of online educational experiences, the concepts of shared humanity and social interactions are being redefined. Certain "humanistic concerns" of this nature are thus indispensable, while such educational

experiences are transformed to a higher level of sophistication (Bryan 2018, 222). When the social reality of a cybernetic organism is imminent, and the distinctions between nature-culture, private-public, and human-nonhuman, become blurred, a separation between the *humanities* and the *sciences*, as distinct areas of academic enterprise, becomes meaningless. The 4IR has thus brought about the need for a broader conception of what distinct and outdated areas of academic activity should collectively mean for a 21st century student, who is likely to coexist with a cybernetic citizen executing equally competent functionalities. The notion of cyber physical systems (CPS) that underpin the 4IR is a direct amalgamation of systems that have come to collectively define our world. Educational curricula driven by such a systemic confluence must be reflective of the associated experiences through which students go.

A RESPONSE TO 4IR INFORMED BY THE *SOCIAL CHANGE* AGENDA: THE EDUCATIONAL AND POLITICAL PREPAREDNESS IN SOUTH AFRICA

This article has so far dealt with the critical issue of 4IR and the logic of viewing its implications through the lens of cognitive capitalism and the notion of *surplus value exploitation.* The idea of *public education* being unethically used towards the generation of wealth as a covert capitalist project has also been discussed. These ideas help us take an informed and critical position with regard to the unquestionable material benefits that 4IR is bringing for the benefit of the people. These benefits and affordances are the implicit derivatives of work and learning environments that are "reimagined, enriched or facilitated by the technology they (the people) work alongside" (Butler 2018, 1). The 4IR has the potential to solve problems as varied and complex as disparities in educational affordances, environmental pollution and sustainable use of natural resources, diminishing food security, and mitigation of the effect of climate change (Hadden 2019). On the higher-education front, the 4IR has been used in the development of the first artificial-intelligence-teaching assistant, "Jill Watson", used to help students enhance their understanding of engineering concepts at a South African university. This particular digital innovation was successful with 97 per cent accuracy (Pillay, Maharaj, and Van Eeden 2018).

While the 4IR is thus poised to elevate the lives of people across the world to a very high degree of digital sophistication and convenience, on its flip side, there are vested capitalistic interests that maneuver the revolution as a whole to the advantage of such interest groups, as the article has argued. The educational and political preparedness of South Africa is, therefore, to be defined by such an awareness.

The higher-education institutions in SA are currently under pressure, owing primarily to the overwhelming number of students such institutions cater for, despite a severe infrastructure and human-resources-related shortage (Carr-Hill 2020). Previously disadvantaged universities,

in particular, also have their own resource-related problems. In the midst of these difficulties, the question of South African universities' preparedness to be "4IR-relevant" is significant. The call for academic staff to take on agentive roles to drive the agenda of transformation in this context, is also critical (Davidson 2019). University graduate attributes across universities around the world have been redefined; and conventional modes of instruction have given way to digitally sophisticated instructional techniques. The idea of measurement of educational attainment has been reconstituted to be aligned with a set of 21st Century competencies to help the new generation of students "rebuild the world molecule by molecule" (Michael 2017, 30). The pertinent issue then, is the extent to which South African universities have struck a balance between the social transformation imperative that has come to be integrated with the universities' basic functionalities, and an overwhelming need to be aligned with the demands of and relevance to the 4IR discourse.

It is also important for South Africa to tread its course towards the bliss of a digital future with caution, because of the potential technological unemployment the country may face as an essential fallout of such a transformation. Added to this, is the risk of concentrating value in the possession of the privileged few, with the end result of those who were the non-beneficiaries of the previous IRs being relegated further to positions of disadvantage (Harry 2018). Having said that, the 4IR promises to give immense opportunities to develop a culture of entrepreneurship (Africa being the fastest-growing continent for entrepreneurship) at the grass-roots level of Africa's economy (2018, 2). Harry (2018) further points out that approximately 90 000 entrepreneurs from Africa have established themselves in the US who, had they ventured into similar enterprises in Africa, could have contributed immensely to the continent's development. This is one indication that Africa has no shortage of successful entrepreneurs. This is exactly the "essential skill" that can help us ward off the possibility of technological unemployment that the 4IR may bring about. Now is also the golden opportunity for the continent and its economies to offer its young generation a bright future (Peck 2018). Such a future will be characterised by occupations rendered redundant by advancing technologies, and a simultaneous emergence of new trades and professions (such as *data scientist*) created by the very same technologies (Wyckoff and Nola 2016).

HE's agentiveness in facilitating people's affordances of improved quality of life, resulting from the material gains of the 4IR, is critical, as students graduate into these trades and professions. Quality of life, as a basic affordance of the masses, characterised by its ethical soundness, thus becomes one of the defining aspects of the social transformation enterprise that HE should be part of (Gray 2016). However, the transformation agenda that HE should pursue is, to some extent, determined by the national priorities and national contexts (Hadden 2019).

This is particularly true in the case of African countries, most of which are emerging economies, characterised by relatively less governmental efficiency. The greater number of African countries have manufacturing infrastructure that is still developing, with the associated uncertainties in policymaking (Hadden 2019, 19). Advanced economies, on the other hand, have adopted tried and tested policy frameworks requiring very little realignment of their governmental functionalities to reap the benefits of the 4IR. The "4.0 institutions" and "4.0 governance", when considered in the contexts of emerging economies of Africa, and their educational and training infrastructure, are characterised by muddled policy frameworks. Such frameworks inadvertently "ensure failure" of those economies' responses to the 4IR (Hadden 2019, 22). Africa's predicament of being "stuck in the second industrial revolution, with governments still prioritising industrial programmes and skills that will be disrupted by current trends" is to be seen in this context (Games 2019, 19).

A concerted effort is therefore needed to reinstate the 4IR imaginaries, as envisioned at the level of the aspirations of the average citizen, into the very foundations of the social, and hence educational, transformation discourses that underpin Africa's 4IR-related preparedness. HE is the platform on which 4IR imaginaries are grounded. Social change should then become central to such reconfigured discourses, groomed to become the lived realities of ordinary citizens, offering agency. HE, as an entity that nurtures a country's affordances in social change-related thought, and having such thought inculcated in its youth, in this sense is uniquely positioned to drive the agenda of social change. HE's role thus becomes one that helps social change evolve into an integral lived experience in the educational life of every student, while providing a fertile ground for complex scientific and technical knowledge to foreground the impact of 4IR. HE thus occupies the critical position of being able to manoeuvre the 4IR-related preparedness into alignment with social transformation as an HE objective. Positioning of positive social change as a moral imperative in the broader objectives of HE is also necessitated by the potential and possibilities of 4IR becoming a tool and a reason for social injustices inadvertently to be perpetuated. Cognitive capitalist ideology's infiltrations into the domain of 4IR should remain as a caveat for HE institutions in this context. This is because 4IR' material affordances may become valorised within cognitive capitalism as its ideological framework.

The importance of policy frameworks underpinning the functionalities of HE institutions cannot be overemphasised (Stirling and McGloin 2015). Positioning of social change and its realisation as a moral imperative in the HE context, with the advent of the 4IR, is therefore inherently associated with how such frameworks are formulated and understood. The underlying conflict between those who consider such frameworks socially just, and those who

consider them (the frameworks) manifestations of utilitarian discourses, makes the realisation a complex process (Stirling and McGloin 2015, 9). The neoliberal appearance that universities across the world have increasingly adopted, purportedly to address social change, has in reality failed to support such appearances with concrete policy formulations (Stirling and McGloin 2015, 15). Clearly articulated policy frameworks envisioning the optimised exploitation of 4IR, and its agentive potential for social change, is therefore central to HE's efforts to bring 4IR closer to the people.

Our educational and political preparedness to take on the challenges associated with the advent of the 4IR is the critical issue here. The degree to which our higher-education institutions drive the agenda of social change from a platform provided by the digital revolution, is therefore to be cautiously reconsidered. A major reconceptualization in terms of educational outcomes aligned with the demands of the 4IR, and a political will to adopt social transformation as fundamental to educational practice, are therefore to be the immediate concerns.

CONCLUDING REMARKS

This article has viewed the prospects of the construct "*social change"* in the context of learning environments in higher education, with special reference to the South African higher-education system. A quarter of a century of a politically decolonised period has produced a fair amount of confusion with regard to what constitutes the idea of higher education in the South African context. Decolonization, in the political sense, still remains to be filtered down to the simple practicalities and mundane aspirations of the downtrodden. Social change, as a noble cause, is therefore fundamental to any educational enterprise contemplated for higher education in South Africa. The primacy of social change in the higher-education discourse resonates well with the emancipatory pedagogies that colonial South Africa once longed for.

Social change, as a cultural, political, and educational aim, receives an unprecedented level of relevance in the context of the 4IR. This is because previous industrial revolutions have all manifested implicitly in colonial instruments of oppression and subjugation covertly designed and manufactured in the west. Such instruments had the hallmark of cleverly articulated intellectual, cultural, and economic domination that remain crystallised in the intellectual legacies of Africa, which the continent is unable to part with. Scholars have battled to theorise such legacies effectively, while the present generation struggles to understand its intricacies. This article, as a contribution to this conversation, offers some theoretical propositions based on *capitalism*, and specifically, *cognitive capitalism,* to better understand the implications of the 4IR on the agenda of social change that the post-colonial South African

higher-education system embodies.

Cognitive capitalism theorises that capitalist ideologies will always have their ultimate aim of accumulation of capital at the expense of values and ethics that societies cherish. When cognitive functions of individuals become the labour that is converted to capital, such functions are naturally subject to covert manipulations by vested interests. Therefore, how can social change, as an attribute of higher education, be visualised and practised, when the 4IR is seen through the lens of cognitive capitalism? The answer is that the 4IR, as the most significant technological phenomenon of this century, can be used as a platform for realising the ideals of positive social change. Such a platform should become the exclusive domain of interest for higher-education institutions in South Africa. Cognitive capitalism provides us with a set of principles that should safeguard us in this pursuit. Cognitive capitalism also provides us with a set of ideological pointers. Such pointers can help us strike a balance between embracing the material affordances of the 4IR on the one hand, and the sustainable empowerment of the historically sidelined population on the other hand. Higher-education institutions have to place themselves tactically in between these two realties; and should take the cause of positive social change as an act of moral indebtedness.

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