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Preparing the future workforce in African universities of technology: A case of new media art as a mutating discipline in the 4IR

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Abstract

The industrial revolution, a steady process of change that started in the eighteenth century, has been characterised as presenting different phases. The fourth phase (4IR), which signals an unprecedented convergence of physical, digital and biological spheres into technological forces, is transforming jobs faster than employees can adapt, and setting the base for a different kind of skill. Hence, everyone, including arts and design educators, are asking similar questions about its potential challenges and opportunities in their fields, particularly in the African universities of technology that place emphasis on career-directed courses. One of the questions revolves around the issue of how 4IR will affect the visual arts ecosystem in general and specific to types of skills required, production processes, theory, epistemological curiosity, intellectual tools, authorship, commodification, representation, distribution, among others. Furthermore, it is thought provoking to realise, through literature search that not much is written about the potential challenges and opportunities in the context of visual arts at universities of technology in Africa. Against this backdrop, this paper explores the changing landscape of the supply and demand of skills and how arts and design education can respond to this inevitable change. Using new media art as a case study, the exploratory case study employed post-phenomenology to interrogate the mediating effects of the technological revolution in shaping the new media art discipline. This was achieved through a content analysis of secondary data. In response to these mediating effects, the study proposed a framework that could help create access to new skills sets that would equip students to face the new markets and opportunities.

Keywords: Arts and design education, African university of technology, fourth industrial revolution (4IR), new media art, post-phenomenology

Introduction

Higher education has gone through different phases (elite, mass, and post-massification) as a result of its connection with the socio-economic structures, and its constant role creating prepared minds that contribute to scientific, technological, economic and social development. With the advent of the fourth industrial revolution (4IR), higher education is facing a world where technology is creating different opportunities and challenges for formal education systems, and post-work is defining the present period (Xing & Marwala, 2017). Even though the 4IR is similar to the first three revolutions, in that it is characterised by advances in technology, 4IR differs from the first three in two major ways. First, 4IR not only advances technology it also augments technology with web connectivity, which allows automated visualisation and decision making. The second difference is that the technologies in the 4IR are capable of cognitive processes similar to humans (Masinde & Roux, 2020). As a result, institutions are constantly reimagining their central role by introducing technology-centred curricula that focus on developing new mindsets needed for current and future jobs.

Against this backdrop, this paper investigates, from a post-phenomenological viewpoint, the mediating role of technology in visual arts and design education at the African universities of technology, with a primary focus on the universities of technology in South Africa. The study begins by examining the role of African universities of technology as career-oriented institutions. The study delves deeper into the subject matter by exploring the impacts of 4IR on visual arts and design disciplines, and with a specific focus on new media art, highlights the mutating nature of disciplines in visual arts and design in response to technological developments. Based on these understandings, the study then proposes a framework of skillsets needed to face new markets and opportunities in the 4IR.

Methodology

This study uses new media art as a case study to explore how arts and design education can respond to the changing landscape of the supply and demand of skills amidst the 4IR. Post-phenomenology theory was employed to understand the mediating effects of the technological revolution in shaping the visual arts and design disciplines in general and the new media art discipline in specific, and to develop a framework that respond to the effects. These effects were viewed from the four dimensions of post-phenomenology: 1) the existential nature of technological systems; 2) the epistemological dimension, which promotes experiential knowledge; 3) the practical dimension, which emphasises the importance of interaction; and lastly; 4) the ethical dimension that emphasis the two-sidedness of technological mediation. The desktop study takes the form of an exploratory case study using content analysis of secondary data such as analysis of policies and reports, institutional websites, qualifications (CEMS), published empirical studies, among others.

African universities of technology as career-directed institutions

According to Thathiah (2005), the focus on the concept of universities of technology should not only be limited to an institutional type but also the concepts of a University or of Technology. His argument questions the "lack of clarity [that] extends beyond the question of what a University of Technology is or, for that matter, what technology is, to the question of what the human condition is" (Thathiah, 2005, p. 187). In South Africa, there are views that universities of technology are or should be distinguished as career-directed institutions because of their historical association in comparison to their counterparts (traditional universities) (Du Pré, 2010). However, in relation to curriculum development in disciplines of arts and design, Thathiah (2013) expresses concerns that universities of technology do not possess the skills and knowledge base to take on challenges. More recently, Garraway and Winberg (2019) also add to the argument that there are fundamental contradictions between current practices and the desirable vision in terms of the future identity of the University of Technology, especially when it comes to training for Industry 4.0 (Garraway & Winberg, 2019).

The establishment of universities of technology from Technikons in 2004 to this date (and future reference on 4IR) still presents challenges of conceptualisation and the meaning of such higher institutions in terms of identity, role/positioning, curriculum development, among others. One of these challenges can be related to the nature and variances between universities. Lategan (2005) argues that irrespective of the three types of university, namely classical universities, comprehensive universities and universities of technology, they all have three similar core mandates of teaching and learning, research and service. Thathiah (2013) suggests that the development of modules in the Theory of Technology could be a starting point to interrogate, differentiate, and question the essence of universities of technology. Programmes at universities of technology should focus on the application of scientific principles in practice, and only use basic scientific principles in those cases where such knowledge is deemed to be essential to the successful application of the scientific principle concerned (Du Pré, 2010, pp. 10-11). This speaks to one of the five pillars of the University of technology, "Excellence in teaching and learning" under the heading career-oriented programmes, where programmes are generally acknowledged and guided by industry and respond to the needs of industry, business and society (Van Staden, 2010).

Above the issue of the nature of the University of Technology, the question of what African universities of technology look like in comparison to universities of technology also adds another dimension to the challenges. This can be seen in the vision and mission statement of the universities of technology in South Africa. What is also nebulous in this context is that out of the six universities of technology in South Africa, three have included the word Africa or African in their institutional visions. For example, the vision of the Vaal University of Technology (VUT) states that "An African University that leads in quality teaching and learning, informed by research and driven by innovation and technology" (VUT, n.d.). While Central University of Technology's (CUT) Vision is to be "a leading African University of Technology, shaping the future through innovation" (CUT, n.d.). Lastly, Walter Sisulu University of Technology (WSU) "An impactful, technology-infused African University" (WSU, n.d.). In this view, what makes an African university of technology an African university of technology? Should it be defined by its vision, students/staffing demographics, geographical, language, Intellectual independence, curriculum, research niche areas, architecture, technology and community upliftment? The meaning of the word Africa or African is complex, and it is always contested on many levels, especially when it comes to knowledge politics. As highlighted by Horsthemke (2009), the answer to 'what is the essence of Africa, western culture, the African culture and who or what is African? might be seen to turn on three aspects: ethnic and racial identity, orientation/commitment, and geographic location and identity. For the purpose of this paper, African universities of technology are referred to as higher education institutions in Africa with a fundamental goal to provide African solutions to African problems through the development and application of technology and research.

Industrial revolutions and their impacts on visual arts and design disciplines

Through the ages, the development of technology has always presented challenges and opportunities for the creative art industry, in general and specific to the use of tools from prehistoric use of stones to computer technology. Adopting Don Ihde's framework of concepts and perspective on post-phenomenology,[1] we intend to highlight general impacts on visual arts and design disciplines in relation to disruptions that have incurred in the case of first three industrial revolutions and possible predictions on the fourth industrial revolution. According to Rosenberger and Verbeek (2015, p. 1) one of the questions a post-phenomenologist study engages with includes how do technologies inform our politics, ethics, and our understandings of the basic features of our everyday experience? And secondly "As 'empirical philosophy', post-phenomenology does not base itself on the philosophical tradition and on conceptual analysis only, but also on the study of actual technological practices and artifacts" (Rosenberger & Verbeek, 2015, p. 30). In this view post-phenomenology studies can be characterised by four elements and for the purpose of this study, the focus is primarily on the fourth element that emphasises "conceptual analysis of the implications of technologies for one or more specific dimensions of human-world relations – which can be epistemological, political, aesthetic, ethical, metaphysical, among others" (Rosenberger & Verbeek, 2015, p. 31).

Taking into consideration Ihde's framework, the impact of industrial revolutions on visual arts and design disciplines can be seen in many ways at different levels from types of skills required, production

[1] https://sts.au.dk/fileadmin/sts/publications/working_papers/Ihde_-_Postphenomenology_Again.pdf

processes, theory, epistemological curiosity, intellectual tools, authorship, commodification, representation/aesthetics to distribution. Generally, the bone of contention in this is mainly centred (and still will be) on the establishment of new order versus the survival of the established disciplines. To put this in context, first we need to have a basic understanding of philosophy of art, secondly the technological historical development in relation to the industrial revolution 1.0, 2.0, 3.0, and 4.0. Philosophy of art engages the meaning and the interpretation of "the purpose of art, the nature of beauty, the effects of art on individuals and society and how the various arts are to be classified" (Harrison-Barbet 1990, pp. 286). There are generally three theories of art that offer a different understanding of the purpose of art, i.e. imitation (images of physical things), expression (human feeling) and form (aesthetic value) (Harrison-Barbet, 1990, p. 286). There are merits in each of the three theoretical perspectives in which help us to understand the visual arts ecosystem or visual culture/studies.

The impact of the development of technology during industrial revolution 1.0 in visual arts can be related to the photographic process. One of the early challenges faced by the medium of photography was gaining acceptance as a legitimate art form. It was also seen as serving the purpose to reference material for the artists for their paintings. However, in the later years when photography gained the reputation as an art form and this led Paul Delaroche to declare that "from today painting is dead". In order for the artist to remain relevant, concepts such as art for art's sake were introduced. According to Honour and Fleming (1999, p. 675), such concepts "develops when artists feel a hopeless contradiction between their aims and the aims of the society to which they belong". Muybridge's photographic study commenced in 1872 to complete 1885 also played an important role to bring to realisation the moving picture.

Industrial revolution 3.0 also affected the production, representation and distribution of artistic images in many ways. According to Marley (2000) "most of the early artistic images were produced by scientist or mathematicians, who had access to computer technology which was not commercially available" (Marley 2000, p. 19). Most methods of production also demanded collaboration and merging of techniques and skills. As a result, this also improved the aesthetic values, for example Lister, et al. (2009, pp. 140) identify the spectacular effects of verisimilitude, photorealism and hyperrealism as other elements that affected cinema as a result of computer technology. In animation, while the genre enjoys growing, traditional hand-drawn techniques were discontinued or downsized in favour of 3D computer animation by animation production studios (Beck, 2004, p. 336).

Labarre (2016) wrote about 18 new predicted design jobs (UX designers) by designers from big tech companies such as Google, Microsoft, Autodesk, among others. These jobs include augmented reality designer, avatar programmer, chief creative officer, chief drone experience designer, conductor, cybernetic director, director of concierge services, embodied interactions designer, fusionist, human organ designer, intelligent system designer, interventionist, machine learning designer, programme director, real-time 3D designer, sim designer, nanotech designer. In Ferrari's view, these predictions and connections, such as software revolution, will speed up the changes in design processes as well (Labarre, 2017, p. 2631)

The changing landscape in the fourth industrial revolution: A case study on New Media Art

Several disciplines in visual arts and design have always been associated with socio-technological forces in the different phases of the industrial revolution. One of these disciplines is new media art, which is a merge of new media and technology within the field of contemporary art. The defining feature that differentiates it from conventional visual art is the emphasis on medium. The discipline is entirely tied to technological development, and its beginning can be traced back to the invention of moving images during the first two phases of the industrial revolution, from the late nineteenth century to the early twentieth century. The third industrial revolution that took place in the second half of the twentieth century progressively integrated technology into all fields of human activity, including visual arts and design. This relationship between art and technology ushered in a new dimension of new media art; where, rather than just an art piece, new media art acts as a platform for communication and interaction. The predominance of electronics and information technologies during this phase brought about the various forms of new media art such as digital art, computer graphics, video games, computer animation, and sound art. However, the 4IR, which is characterised by the fusion of technologies (Schwab, 2016), is creating the space for new forms of new media art, which include virtual art, internet art, interactive art technologies, computer robotics and cyborg art.

It is inevitable that technology forces will shape the future, and therefore, important to understand the extent to which these forces will impact our way of life and future jobs so as to stay relevant and prepared. In Kevin Kelly's book, "The inevitable", he proposed twelve overlapping technological forces that will shape the intangible digital realm of the 4IR; which are Becoming, Cornifying, Flowing, Screening, Accessing, Sharing, Filtering, Remixing, Interacting, Tracking, Questioning and Beginning (Kelly, 2016). According to Kelly (2016) as cited in Ferrari (2017), "*in the intangible digital realm, nothing is static or fixed. Everything is becoming".* From the post-phenomenology school of thought, the mediating effects of technology as a driving force in the process of *becoming* can be viewed from four dimensions (existential, epistemology, practical and ethical); 1) The process of becoming aligns with the existential nature of technological systems, which is chiefly maintenance (continual upgrades); 2) the epistemological dimension promotes experiential knowledge while; 3) the practical dimension emphasises the importance of interaction in the process of *becoming*, which according to Olalere (2018), improves applicative knowledge. Lastly, the fourth dimension (ethical) raises awareness about the two-sidedness of technological mediation, in which technology can both support and deplete efforts and good intentions.

Hence, from the post-phenomenology perspective, the '*new*' in new media art can be seen as an indicator of that process of *becoming*, which is driven by technology and multidisciplinary interactions. In this case, technology is not replacing the discipline-specific skills. It is acting as the medium in the process, where new techniques, interactions, innovations, jobs and skillsets emerge. Technological mediation is shifting the focus from a culture of the object (art object) to a culture oriented toward systems (Bessette, 2018), which Burnham (1968) called *systems art*. According to Burnham (1968), systems art focuses on the process of developing a relationship between art and technology within the larger culture (disciplines or fields). Multidisciplinary collaboration is key in this process and the driving force is technology; thus, expanding the new media art from just creating works of art to the creation of *lifestyle* (Bessette, 2018), which is dynamic and as a result '*becoming*'.

Besides technology acting as a medium, Smith and Leymarie (2017) opines that technology also acts as a creator/co-creator, and authors support their claim with relevant literature that bears ample witness of the emergence of technology as creator or co-creator. Some examples are 1) the algorithmic studio assistant that embellishes computer-mediated graphic or sculptural works of art (Rees, 1997; Lambert, Latham & Leymarie, 2013); 2) autonomous painting robot that creates striking abstract works (Doepner & Jurman, 2016); 3) AI systems that predict the author of existing works of graphic art (Johnson, et al., 2008); and 4) anthropomorphic robot that creates imaginative portraits of their human subjects (Figure 2) (Berio, Calinon & Leymarie, 2016). With this unprecedented development of technologies, 4IR presents a gradual release of the labour force from physical activity and mental efforts in favour of more striking creativity (Prisecaru, 2016). Thus, disciplines, such as new media art, that is not locked to the idea of form-giving (art object) has a bright future (Ferrari, 2017).

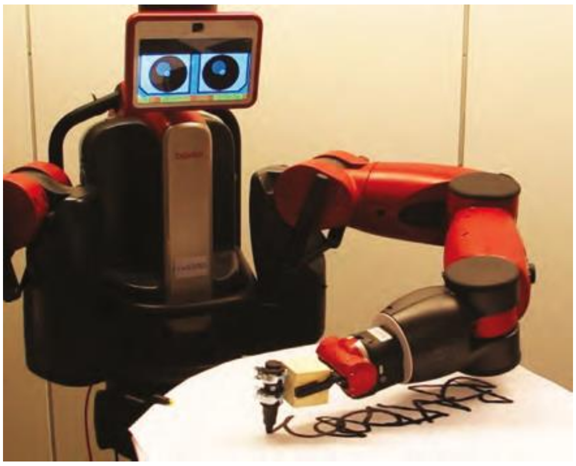

Figure 2: Baxter writing its name as a graffiti tag (Berio, Calinon & Leymarie, 2016)

Interestingly, the recently released technical report by the Department of Home Affairs listed only new media art (digital artist and multimedia designer) under the critical skills list in South Africa, with other specialisations within the visual arts and design excluded (Department of Home Affairs, 2021). This evidently shows that new media art is one of the jobs of the future. Unfortunately, most of the universities of technology in South Africa do not offer new media art (or multimedia) as a stand-alone programme. A few of the universities of technology only offer new media art (or multimedia) as a module within a programme. Although, some traditional and comprehensive universities, as well as private higher education institutions, have already recognised the potential in this domain in South Africa. Therefore, UoTs should stand up to the challenge and re-invent their programmes to prepare a workforce for this scarce skill in South Africa.

Framework of skillsets needed to face new markets and opportunities in 4IR

The changes and developments in 4IR indeed will affect the visual arts ecosystem in many ways and specific to the types of skills required from African universities of technology. In order to conceptualise a framework of skillsets needed to face new markets and opportunities in 4IR, it is important to find ways to adapt to those new technologies. According to Schwab & Samans (2016, p. 31), "technological trends such as the 4IR will create many new cross-functional roles for which employees will need both technical and social and analytical skills. Most existing education systems at all levels provide highly siloed training and that is hindering progress on today's talent and labour market issues". In South African universities of technology, most of the courses offered under CESM's art and culture are still focused on siloed training. Therefore, we argue that in order to adapt to the technological drivers of change in 4IR, a multidisciplinary approach in developing skills sets for future jobs in new media art is one way to address this challenge of siloed training.

As illustrated in Figure 3, the multidisciplinary approach requires an integration of technological skills as a driving force rather than a replacement of discipline-specific skills. We believe that discipline-specific skills will still play pivotal roles in future jobs but will require technological skills to function effectively in the changing landscape. Such skills that will cater for technological advancement, namely artificial intelligence (AI), augmented reality (AR), virtual reality (VR), programming or coding, internet of things (IoT), three-dimensional (3D CAD) modelling and simulation, and additive manufacturing (3D printing). Even though the relevance of the technological skills will vary across different specialisations, the dynamic nature of the technological applications will require keeping up-to-date with the technological development in order to stay aware of what is obtainable. The multidisciplinary approach also requires exposure to both management and entrepreneurial skills to drive multi and transdisciplinary collaborations and interactions. The management skills include the ability to plan or organise with set guidelines, good communication skills (interpersonal skills), great decision-making and problem-solving skills. The entrepreneurial skills include strategic and critical thinking ability, financial skills, analytical and organisational skills.

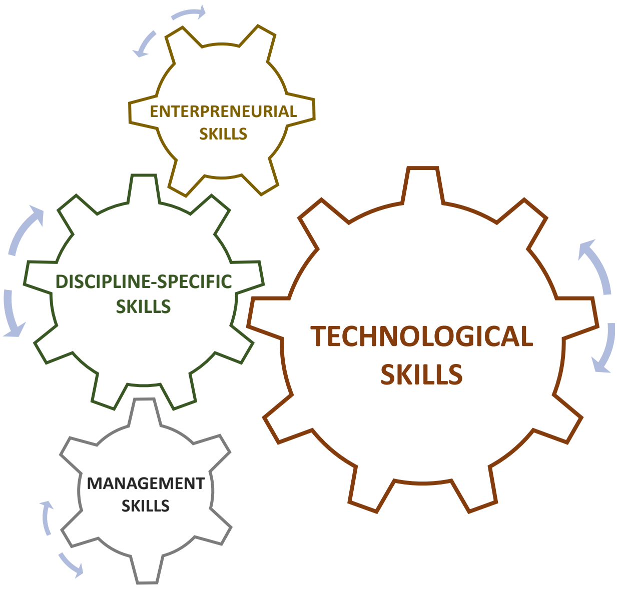

Figure 3: Multidisciplinary approach in developing skills sets for future jobs

The fusion of technologies is creating the space for new forms of new media art such as virtual art, internet art, interactive art technologies, computer robotics and cyborg art, which demand a multidisciplinary approach that drives disciplines and ensures interaction with other disciplines. Schwab & Samans (2016, pp. 31–33) suggest that across all industries, a higher level of technology literacy will be at the core of the 4IR. Above technological skills, the demand for a wide range of skills or skill set combinations for different industries will also become a basic requirement for most industries. So now, in the case of an undergraduate programme, for example, three years diploma with 360 credit or bachelor's degree (first degree) with 360 credit, how can the mediating effects of technology and the concept of *becoming* assist to identify the skill sets needed to face the new markets and opportunities in 4IR at the African University of Technology.

The illustrative diagram (Figure 4) suggests possible skills required to meet the continual changing landscape. According to Schwab & Samans (2016, p. 20), there are three categories of skill sets that cut across all the industries, namely, abilities (cognitive skills, physical skills), Basic skills (content skills and process skills), and cross-functional skills (social skills, resource management, system skills, complex problem-solving skills and technical skills). As shown in Figure 4, New Media Art provides a bridge to linking the changing landscape of future jobs. To function effectively as a New Media Artist in this changing landscape, one requires the core skills or in other words, discipline-specific skills (such as creativity, design thinking, basic skills, artistic and aesthetic skills). In addition to the core skills, the technical skills are needed to engage effectively with the emerging 4IR technologies. The technical skills include programming and coding, 3D CAD modelling and simulation, data science and visualisation, critical and analytical thinking, digital literacy and ethics. However, to drive an effective multidisciplinary interaction and aid the technological drivers of change, some soft skills (such as complex problem solving, system thinking, cross-functional skills, among others) are needed. In Europe, this multidisciplinary interaction is already happening. An example is organ designer, which is a collaboration between bioengineering and design to develop prototypes of human organs through 3D printing (Amsen, 2019). There are, however, limitations at the African University of Technology and the developing countries. Three years of education might not be enough to prepare students to be industry-ready; hence, the training should start from a basic education level.

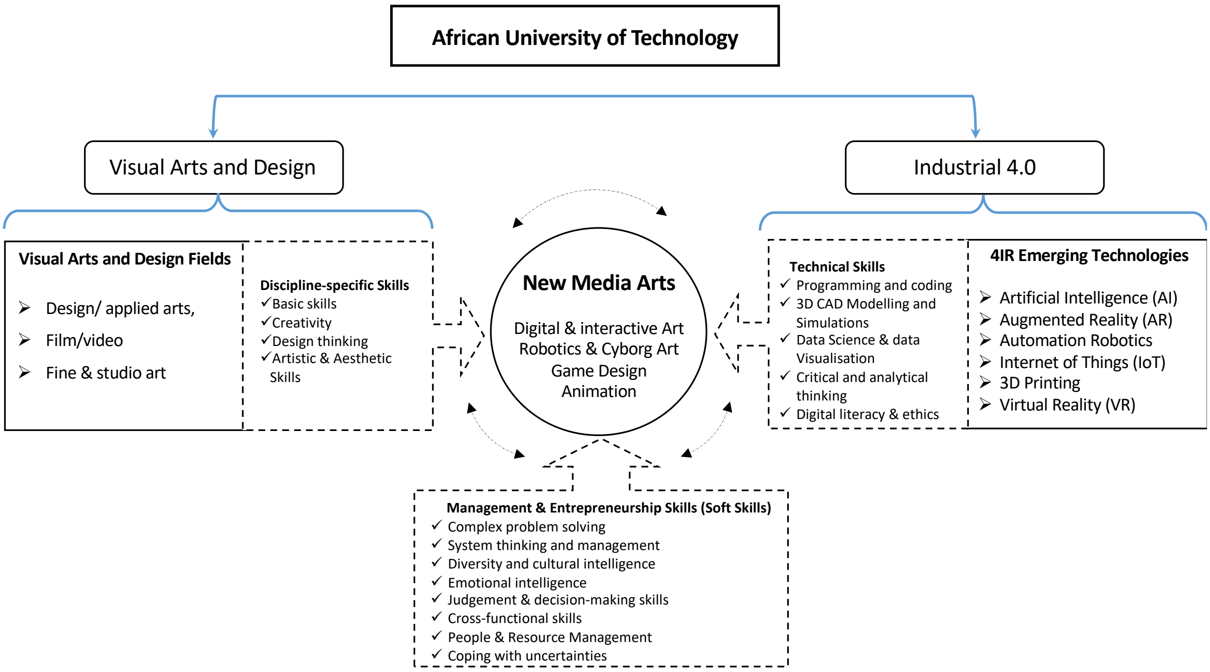

Figure 4: Framework of skillsets needed to face new markets and opportunities in 4IR

Conclusion and recommendation

It is evident that in South Africa, African universities of technology are regarded as career-directed institutions with historical ties with Technikons in which are primarily industry oriented. This type of institution has its own challenges and opportunities to contribute to the socio-economic and technological developments, especially the historically disadvantaged universities of technology. These challenges and opportunities also affect the underrated and so-called expensive visual arts and design departments and their programmes to achieve its potentiality in socio-economic and technological developments. The impact of all three industrial revolutions (IR 1.0; IR 2.0 and IR 3.0) on visual arts and design disciplines can be seen in the tension between at least the established disciplines and the emerging new disciplines, automated and hand-crafted, analogue and digital, among others. During IR 3.0 we also experienced the convergence of these established disciplines and the emerging new disciplines into one through computer technology. IR 4.0 is at its initial stages or is imminent to disrupt future jobs, skills, and industries at a higher pace compared to IR 3.0, through automation, internet of things, among others. Even though the relevance of the technological skills will vary across different specialisations, the dynamic nature of the technological applications will require keeping up to date with the technological development in order to stay aware of what is obtainable. The multidisciplinary approach also requires exposure to both management and entrepreneurial skills to drive multi and transdisciplinary collaborations and interactions. At the South African universities of technology most of the courses offered under CESM’s art and culture are still focused on siloed training. Therefore, we argued that in order to adapt to the technological drivers of change in 4IR, a multidisciplinary approach in developing skills sets for future jobs in new media art is one way to address this challenge of siloed training.

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