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DESIGN EDUCATION | AFRIKA | 4TH INDUSTRIAL REVOLUTION

The new 3Rs in design education: A pedagogical suggestion

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Abstract

In this paper, we do three things. First we discuss the concept of the 3Rs in the anglophone world in the 20th century. Second, we briefly view 3Rs in the context of environmental concerns. Third, we elucidate the three Rs in design education and practice, a concept which we have originated without reference to preliminary models other than Reading, Writing and 'Rithmetic and Reuse, Repurpose and Recycle. We strive to remain a theoretical as we promote the consideration and inclusion of the full range of technologies in our teaching from the simplest to the more complex, plus the ancient to the most recent of materials, tools and processes for designers. Within each range we look to development of the broadest possible material and skills Repertoire for each designer. This means identifying useful materials and acquiring and transmitting as many skills as possible to enable our students to develop Resilience in their design practice and lives. As the innovators of the New 3Rs, we explore and discuss some solutions to teaching the New 3Rs in a digital age cluttered with the internet, the internet of things (IoT), robotics, virtual and augmented reality (VR/AR) and artificial intelligence (AI) as we mine the technologies of our respective cultures and disseminate them to students and the lay public.

Keywords: Design, education, educational paradigms, innovation, range, repertoire, resilience, technology, professional paradigms

Introduction

The twenty-first century has brought unprecedented access to information from all cultures at all times. It has also brought us amazing technologies to reproduce and disseminate our ideas. At the same time, COVID-19 has placed immediate stops on everything we can do and has forced us to rework our approaches to education. Design educators are challenged to redesign our own pedagogies and those of other academic disciplines by using our full array of technologies from simple blades to scissors to laser beams, from chalk and talk to virtual and augmented realities, from building clay pots to printing out crockery in 3D. Because of the interdisciplinary anomalies that place heavier emphasis on so-called 'high tech' in design and education, we in Kenya are also looking at the anomalies of access by ordinary people and the possibilities for the future that may, sadly, include the collapse of global cyber infrastructure, as well as global and local supply chains. We have noted with horror that we now face a generation of students who do not know that their grandparents grew up without shoes and

who do not know how to make footwear for themselves. Many of our students simply cannot pay for access to the all-important internet and cyber messaging services.

As a trio and as individuals we have witnessed or participated in many research undertakings that, because of 'theoretical' and 'scientific' 'rigour' have failed to answer the questions they were designed to answer (Moore, 2002, Shuftan, et al., 1993, Pittracher, et al., 2004). We have also advised many advanced degree candidates and colleagues in efforts to steer them away from developing slick theoretical and scientific research designs that do not work (Pido, 2001; Pido, et al., 2018, 2019). Having seen many theoretical frameworks come into and out of fashion and having seen work that cannot be distinguished from the work of the theoreticians and the people under study (Galaty, 1978)We do not try to integrate or contextualise our inquiries within any particular existing framework. This article is not based on a single, finite, bounded 'research' exercise but rather on bits and pieces of data gathered primarily through reading, experiment and participant observation over more than five decades. The authors' cumulative experience in research, teaching, professional practice and life over more than five decades has provided us with a pool of data to cherry-pick in making our points. If we must name our research design it is 'Bricolage,' a French word referring to the process of bringing apparently disparate things together to form a cohesive whole;

In 2019 we published an article entitled "Decolonizing 'Technology' in Kenyan Higher Education and Implications for Development" (Pido, et al., 2019) In that article we pointed to several kinds of technology and the idea sets that had accompanied them up until then. We noted that culture, esthetics and technologies are parts of a comprehensive whole that, sadly, has been divided into compartments that may no longer work. We lamented that, as academics and professionals, we were affected by compartmentalization of various kinds of technology and their classification along several axes such as primitive/modern, hi tech/low tech and male/female (Pido, 2021), which we identified as kinds of colonization that need to be modified or done away with;

In the end we introduced what we call our New 3R's, namely Range, Repertoire and Resilience; of course other design educators and professionals may think beyond our 3R's. The term Three Rs is based on the use of that term in our childhoods and also in the environmental movements. **Range** would be the complete cross and inter-cultural and intra-cultural array of materials and technologies drawn from all cultures and times and now accessible in our local communities and on the internet. **Repertoire** would be the skills acquired and/or adopted, learned and implemented by any particular person or group. **Resilience** is the ability to change or to pivot when circumstances dictate and to adjust to new situations. For designers, this should be the awareness of the range and the repertoire to maximise efficiency at all times and enable greater creativity and productivity, not to mention better recognition of all peoples and their technologies as equals (Pido, 2021). We were acutely aware, and still are, of the ranking of peoples, genders and occupations based on the technologies they use. We noted that the Euro-idea that Africans are inferior to Westerners was generated in connection with the need to justify the massive enslavement of Africans in the sixteenth to nineteenth centuries and women since time immemorial. Within the nineteenth and twentieth-century colonial oppression we grew up learning that Euro-based tools and processes outclassed anything the Africans had ever come up with and were 'modern'. We also learned that most of the technologies that women used to make everybody's life more pleasant were of little importance and should be shunned by males (Pido, 2021);

Here we elaborate on the concept of the New Three Rs explaining them in greater detail and recounting our personal stories that point to the importance of decolonization through the neutralization of perceived hierarchies of worth and importance (Pido, 2001, 2021; Pido, et al., 2018, 2019). Our present discussion is made all the more relevant if not urgent by the

recent blow that COVID-19 has dealt against our entire world. It has disrupted our lives and forced us to rearrange the ways we have lived and interacted with each other by forcing social distance, destroying employment systems and supply networks. To be realistic, and for the foreseeable future, all humans must now develop resilience and must reconsider many things that we have taken for granted such as the milk and sugar in our tea, the supply of breakfast foods in our supermarkets, as well as the supermarkets themselves. We can no longer pass around hard copies of documents, including money, for fear of infection. As we write, we are daily seeing reports on the international TV news (MSNBC, CNN, AlJazeera and others) of people in 'developed' countries struggling to adjust and perform tasks that are commonplace to us in Africa;

In academia, we have to revise our approaches to teaching because we may never again be able to stand up in front of a class. We authors, among our many colleagues, are now in the throes of relearning how to impart knowledge and even more so, understanding of the world our youngsters are now entering. We often remark on how, as highly educated people who occupy higher status than those who never learned to read, become instantly illiterate when handed a Chinese newspaper. In the range of orthographies, our repertoire is limited to the Latin alphabet with a little Greek and maybe some Arabic thrown in, but it does not include Chinese, Japanese, Korean, Sanskrit, Burmese, Ethiopian or Russian. Before European-style reading and writing came to Kenya, peoples of this country practised drawing as a form of technology and other methods of making images; but none of those drawing styles developed into Hieroglyphics, as in Egypt. The Egyptian hieroglyphs morphed into the Greek, Hebrew, Arabic and Latin alphabets. Today drawing and painting are among the technologies that designers use to transmit information to others. We can now do this not just by hand but can marshal many technological aids such as templates, machines and computer programs. In so doing, we are abandoning the observation of detail that came with drawing from sight. That many of our students wish to abandon all the technologies of pre-computer days presents a challenge to us educators. We now find ourselves busy adapting to new ways and leaving the more traditional style or the foundation of our range of communication technology;

Kenyans and foreigners alike are amazed to see children in our cities' peri-urban areas code-switching effortlessly between English, Swahili, Dholuo, Ekegusii, Kikuyu and Kikamba. They take their own resilience for granted while we 'privileged' adults stand in awe;

Most Kenyans know bread as a convenience food we buy at the kiosk, but we do not know how to make it ourselves. There are many movements afoot since the mid-twentieth century, to recover and retain the knowledge of the ways humans did things in earlier centuries. In the late twentieth century so many Kenyans were at pains to show themselves as 'modern,' or 'developed' or 'advanced' that many skills and knowledge about our surroundings had been lost. Families that moved their children to the cities to 'escape' their own cultures have generated a population that may not even speak their own languages much less understand the fine points of growing their own food. They may not recognise the plant that brings bees into a new hive or the one that sterilises the milk gourd AND breaks down cholesterol in the bloodstream (Pido, 2016);

Plastic and other 'high tech' materials that can only be produced in big factory settings have supplanted traditional pottery – along with the loss of the knowledge and skills needed to make that pottery. What will we do if and when there is no more plastic? Think of how we used to wrap perishables in banana leaves. Now we live where there are no banana leaves so, when the government rightly banned plastic bags, we were all caught with no good alternatives other than a newspaper – if we could afford it. The communities that used to grow milk gourds for the Maasai have stopped since glass and plastic containers arrived. These are but a few examples. As the global economies, and especially its supply chains, begin to crash

around us, we need to consider the three Rs and develop ourselves and the next generation of designers accordingly; and

We now turn to our own life experiences and observations, often through our students, of the cost of neglect of the range of technologies that we should have. Along with this, we consider the need to expand our technological repertoires and cultivate resilience by learning new ways, especially online teaching, without sacrificing our original repertoires. We can now make chapattis with an electric machine AND when there is no power, we can also roll them out by hand and roast them in a frying pan AND/OR buy them from the kiosk or the lady at the bus stage as needed (Pido, 2016). With chapattis, both our Range and Repertoire are enabling our Resilience.

The original 3Rs: Reading, writing and 'rithmetic

When we authors were very young, in the mid to late 1900s, we learned early on that the 3Rs were Reading, Writing and 'Rithmetic (Harlan 1907; Cedarmont, 2015). In the Anglophone world, education was about literacy, and numeracy was imparted in an atmosphere of extreme discipline, including corporal punishment (caning) to help us become 'good' people. Art, music, physical education, history, and science were often de-emphasised or omitted from curricula. By the time we reached secondary school, our cohorts were segregated into those who showed an aptitude for 'higher education,' those who just wanted to get on with their ordinary lives and those whose performance in the testable subjects was poor. These children were shunted into learning 'trades', a euphemism for manual skills for those who would become blue-collar workers. In East Africa, only a small minority of children ever saw the inside of classrooms and found out about the 3Rs. The rest remained illiterate, meaning, and unable to read and write in Western-style. The few who got to school were carefully selected for aptitude in literacy and numeracy and also for docility and obedience. A tiny percentage of them got as far as university education and became tools that colonial and local politicians freely exploited, thus reaping much benefit.

The environmental 3RS – reuse, repurpose, recycle

By the 1980s when humanity found ourselves wallowing in our own global garbage, the 3Rs took on a new set of meanings – Re-use, Repurpose, Recycle. There are many people alive today who do not remember the original 3Rs that held much broader meaning than the later set. All the same, the three of us managed to grow up and become an engineer, an anthropologist and a solid, start-to-finish design educator. We all now work as design educators and face the challenge of building a new generation of excellent designers. This is no small challenge when we consider the ever-intensifying global changes and pressures on our species, all other species and our planet itself.

By the late twentieth century, it had become clear that the resources we humans had inherited from our ancestors would be depleted if we continued to consume them as if we were. Our environment was deteriorating fast and required urgent attention in order to prevent serious trouble. Packaging, especially connected to the supermarket and its plastic wrappers and shopping bags, was one of the main sources of garbage/waste and environmental pollutants. The culture of disposable packages generated garbage that defied all efforts at waste management, but local peoples everywhere learned to repurpose such items as plastic cooking oil containers and cardboard boxes.

The quest to turn waste into something useful has been with us for some time and now seems to drive the more recent recycling efforts, at least in our respective classrooms. In East Africa we know that people cut broken gourds into plates and trays while we also make sandal straps from skins that are too worn-out to wear. Today's recycling is also driven by the quest to turn waste into useful and beautiful things. Junk Art, made from discarded objects and materials, appeared on the scene in the early 1900s (Junk Arts Cork, n.d.); though recycling was still uncommon, it seems, from our own childhood and youth perspectives, Junk Art was a precursor to recycling in East Africa. Opportunistic use of newly presented, abundant and functional materials also played a part. Whatever it was, we can safely say that recycling helped generate an artistic genre that thrives on metal and mechanical parts of vehicles and electronic gadgets, among other things. Recycling and repurposing have made inroads into African design, especially plastic and metal containers that are replacing gourds and clay pots. Often the plastic containers are a form of packaging in which cooking oil and other goods are imported to Kenya. Once empty, the containers find their way into second-hand markets and into people's homes. All three of us have witnessed the replacement of palms with plastic strapping and clay water pots with the infinitely lighter cooking oil containers for carrying water. We have former students who now make at least a part of their living from paper mache goods from recycled newspapers.

The new 3Rs: Range, repertoire and resilience, in design education

Building on the two earlier incarnations of the Three Rs, we authors, using design methodology (Wikipedia, n.d.), have ideated and created a model that we now can explain to other designers and other educators. We developed the concept of Range, Repertoire and resilience without reference to any theoretical framework or grounding in anyone else's research. We believe that this is one of the things that designers are supposed to do in spite of our embedment in an academia that over-values the so-called 'hard sciences and STEM subjects (Pido, et al., 2019). By **Range** we mean all the materials, tools and processes available to the designer in creating an outcome. Within the full range, especially of skills, each designer, craftsperson, or hobbyist can and does develop a personal **Repertoire**, a menu or playbill so to speak that they have mastered or dabbled with and can try to mobilise. **Resilience**, to us, means the ability to pivot, to adjust to changed circumstances with relative ease and speed in getting the job done.

That design education in East Africa often starts as art education in primary and secondary schools gives us a skills foundation that can be augmented and increased in detail and range as our students develop. In Kenya's primary and secondary schools, children learn drafting and crafting skills; the lessons are imparted in Art education, including life, still life and Instrumental Drawing. In addition, schoolchildren learn Craft and Sculpture, where they acquire skills of forming objects from different so-called art materials. It is important to note that 'school' portrays Art as a subject that stands timidly and alone yet it is bold and has connections with Biology, Physics, Chemistry and other school subjects (Ongachi, et al., 2013). It is also clear that the European views on artistic expression and communication seem to drive Art education in Kenya schools and beyond (Olweny Mark, 2020). The school's views of Art as a subject without connections to other school subjects and leaving Art as a European-style intellectual engagement tend to deprive Kenya of the full development and benefit of the 3Rs.

In some schools, with gendered settings, some children learn skills of construction and formation of objects in woodwork and metalwork classes while others learn handwork and sewing skills. None of these skill sets is even marginally considered significant criteria for admission to university education. Students also spend more time learning construction

methods and related skills instead of studying and gaining a clear understanding of the materials and tools in metalwork and woodwork. Lack of adequate materials and tools (Otati, 2013) undermines the development of the 3Rs and the overall pattern of undergraduate design education. Home science is the other subject where school children learn textile and clothing skills like crochet, knitting and needlework. However, for reasons connected to indigenous cultures and global misogyny, students mistake Home Science to be a subject for girls, never boys. Boys tend to think learning particular skills will make them feminine, or they feel they have to hide their interest in these skills for fear of social ostracism. Girls on the other hand show a proclivity to shy away from learning technical topics. Even when they have a cursory interest in participating in these design activities, the influence from society to conform to female expectations has often held them back.

Undergraduate design students and other creative people tend to be poor in mathematics. Their computational skills are usually very weak. But nearly all students are interested in learning digital technology especially things close to design; there is little doubt that this plays a significant role in the mastery of digital technology and the programs that design professionals use in their day-to-day work. From our experience sitting on admission committees, it is clear that only a few students joining undergraduate design programs offer Physics and Chemistry in secondary school. It is not fully clear why this happens; but many schools do not offer science because mounting science subjects are expensive and many parents cannot afford them. Besides, there is the odd feeling that design does not require science or art possibly because of the belief that a good computer is all a student needs to become a designer.

All the factors described above, coupled with limited physical resources at the university level make it difficult to teach undergraduate design using a wide range of technologies. Many Kenya universities are cash-strapped and unable to support their programs. This is the case because governments but do few good things about universities. Consequently, many of the universities lack studio spaces, libraries, as well as computers and other pieces of equipment for design education and training. Without a broad range of technologies it is difficult to see students develop and possess a wide skills Repertoire. Besides, some university administrators still think that technical and hands-on training is not intellectually fit for university education; a university registrar recently told one of the authors that he does not consider industry-based learning to be the equivalent of an academic term.

Resilience is not easy to build among students who believe that they have 'arrived' and that the technologies now available to them will always be there. Since the 1960s we have been observing people, in class and out, who believe that they have moved beyond a technological/skills level that can or must now be relegated to their past as they climb the socio-economic ladder. We have repeatedly observed people who find it difficult or impossible to carry water once they have an indoor tap in their homes. We work with people who have very sophisticated electric sewing machines but do not know how to operate a treadle machine.

Living in both rural and urban areas in Kenya, we know that when the electricity goes off, we have to adjust by changing our work focus or by resorting to tools and processes that do not require 'power'. We still blithely believe that milk comes in a packet or a tin and that chicken is something in a plastic tray with a cellophane wrapper. Comparing ourselves with urban dwellers in more 'developed' countries, we feel empowered by our awareness that there is another set of skills still lurking in our past and that we can mobilise those skills. Most of our students do not know that. Few if any have ever drawn an ellipse by hand. Even fewer can plot a pattern in a grid by hand. Rendering an image of a cat (example) means going to the internet

and searching for such an image. Freehand and observational drawing are becoming things of the past.

The Technological Perspective and 4I American philosopher John Dewey said, "If we teach today's students as we taught yesterday's, we rob them of tomorrow". As the fourth industrial revolution (4IR) becomes imminent, educators must re-think education and how to prepare the next generation to take advantage of the plethora of opportunities to overcome the challenges enabled by ever-increasing technological change (Marr, 2019). The role of design programmes could assume even greater meaning in readying students to be innovative active participants in the design profession by interrogating the capacity for their curricula to adequately prepare students for the Fourth industrial age (4IR).

Faculties of Design are uniquely placed to deconstruct design student learning outcomes. The future will place new demands on practitioners and digital literacy will be a requisite skill. Yet, design programmes on the African continent, have limited digital integration and are barely keeping abreast with emergent issues facing learners in the third industrial age. It is against this backdrop that we contend the time may be ripe for a new design thinking, an approach that finds utility in edifying students on a range of technologies and establishing a sufficient repertoire of skills to build resilience that can effectively navigate the fourth industrial revolution (4IR).

The Situation This section examines the implications of the current mode of design instruction on future productivity for a 4IR workplace. We consider strategies derived from psychomotor skills, the context of social interaction and visual-spatial learning styles, as well as home-grown approaches that are personalised, targeted and localised. Our position emphasises the importance of congruence between the range of design materials, tools and practices, the repertoire of skills of practising designers and their capacity to adapt to a new digital age. The overarching aim is to improve learning outcomes among Design students for future professional practice.

The pushback against the technology giants over data breaches affecting users was far too common. Design technology being used to track users, breach privacy, and the massive collection and monetisation of personal data, has done much damage to the design industry. Unfortunately, much of this is done with the active participation of designers who were just applying the 'best practices' of our field. The design work at these technology firms follows a 'human-centred process' that purports to 'improve the user experience'.

A large number of technology services we celebrate as disruptive have significant negative structural impacts. Africa depends on Western design technology without developing her own indigenous knowledge (Pido, 2018). This dependency status has enormous challenges since some of these western technologies are not congenial with the African environment (Abanyam, Lumun, 2013).

Let us look at two examples. Airbnb (Air Bed and Breakfast), is a technology platform that lets property owners rent out their spaces to travellers looking for a place to stay. Travellers can rent a space for multiple people to share, a shared space with private rooms, or the entire property for themselves. The Airbnb product helps make accessing accommodation easy, enjoyable, and safe. However, Airbnb also skews housing affordability in many cities. It facilitates mass tourism with many negative impacts on local communities. Many African countries have called for legislation to level the playing field and ensure that rules and regulations are equally valid for all market players.

Uber is based on a technology where those who drive and deliver can connect with riders, eaters, and restaurants. In cities where Uber is available on the continent, one can use the

Uber app to request a ride. The service is very popular. However, Uber considers its drivers 'partners' rather than employees to maximise flexibility and to avoid paying them employee benefits. On its face, their service appears to be socially beneficial to all stakeholders, but Uber drivers in Nairobi and other towns repeatedly went on strike (2019) because of what they described as low wages and poor working conditions. The result has been for Uber to drive away traditional taxi business operators, which has impacted drivers' subsistence.

We recognise the role of human-centred design especially when measured with the traditional metrics of ease-of-use, time-to-task, efficiency, productivity, reduced wait times, and even 'delight'. When designers make things more convenient for users, products easier to buy for customers, and customer service more frictionless, there is almost always a business behind the scenes, profiting from the user-data. When something is being bought, there is almost invariably a direct or an indirect component of extraction, exploitation or emissions to it. This is unavoidable in the system of industrial capitalism, for it is a system that is fundamentally unsustainable (Pasanen, 2019). Design activities in their traditionally role are subservient to business considerations.

Identification of range to establish repertoire and resilience

The fourth industrial revolution is emerging out of the third, and is considered to be more advanced and widespread than the previous revolutions because of the frenzy of its development and the disruptiveness of its technologies. Design can positively change the way modern people live, at the same time adversely affecting the sociocultural and environmental conditions in which they live. According to Professor Klaus Schwab, Founder and Executive Chairman of the World Economic Forum and author of The fourth industrial revolution, the new age is differentiated by the speed of technological breakthroughs, the pervasiveness of scope and the tremendous impact of new systems. If the first three industrial revolutions brought us the steam engine, electricity, and global communication, the fourth revolution merges the digital, physical and biological. This trajectory is destined to result in the concurrence between man and machine.

Some have described the convergence of these exponential technologies as providing a Singularity (Kurzweil, 2005), which may not change what we are doing, but will likely change us. This poses a unique challenge to Designers that building products, for a future in which the barriers between man and machine are eliminated, will be tantamount to redesigning the human condition.

Repertoire

The fourth industrial revolution often is described as the result of an integration and compounding effects of multiple "exponential technologies", such as artificial intelligence, biotechnologies, and nanomaterials. When these digital exponential technologies are combined, the combination multiplies the pace of change (Peters, 2017) and challenge some of our fundamental assumptions of what it means to be human, and the conditions of our relationship with the natural world. How should design education respond to this new human condition?

With the evolution of online instruction and expanding uses of artificial intelligence, new guidelines are needed to provide a theoretical basis for digital pedagogy. Some have called the old models of teaching Anthropocentric Humanism, and the new types of digital education

'Critical Posthumanism'. These approaches stress that digital education is more than a purely technical concern, as it changes the dynamics of space and creates new types of learning cultures that challenge our notions of what it means to be human (Bayne & Jandric, 2017).

These humanistic concerns are inseparable from Design education, and a new 4IR curriculum may be needed to reduce the divisions between the humanities and fields of science, technology, engineering and math (STEM) to create a more integrated "system" of education that can explore the newly emerging conceptions of self and identity within the 4IR, including discussions of autonomy vs social determinism.

Resilience

More than ever, higher education in the 4IR age must develop capacities not just for analysing but also for breaking down the Design problem into its constituent parts. It must, instead, emphasise the interconnections between each scientific problem across global scales, and interrelations between physical, chemical, biological and economic dimensions of a problem. The educational experience of all students should culminate in the integration of knowledge into some meaningful whole. This is the notion of trans-disciplinarity as described by Petrie (1992). He suggested that it transcended disciplinary boundaries, exhibiting the most potential to respond to new demands and imperatives. To achieve this experience, the curricula would require multidisciplinary thinking and integration across all areas of design and academia. This kind of thinking is critical to addressing environmentally sustainable actions at local, regional, and continental levels over short, medium, and intergenerational timescales. Design education would need to have the same "lateral rigor" across disciplines, as the "vertical rigour" within, the discipline.

In addition to this more inclusive approach, the rapid pace of change within the 4IR will require rapid expansion of existing initiatives in design placement for upskilling beyond their initial qualification and employers' immediate skills needs, because that is what the 4IR labour market will need and demand from graduates. Within design education, we will need to educate and re-educate students to help develop resilience in the use of today's most rapidly emerging technologies. To facilitate faculty in keeping their knowledge current, more active and creative forms of faculty development will be needed to maintain institutions within a fast-paced workplace of the future. At the same time we must be reminded of Shakespeare referring to the 'best-laid plans of mice and men' and take into account what will happen when all our cyber tools are shut down by failure of electrical grids, what our production will be when all the global water runs out. What will happen when a future pandemic takes out half of us instead of 1 in 500.

Summary and conclusions

We have tried to explain what we mean by Range, Repertoire and Resilience, first by describing the background of the term Three Rs and then by detailing our definitions and experiences that led us to come up with The New three Rs. We recognise that there are probably many other Rs and other letters but we would like to leave those to other scholars and maintain our simple if not simplistic motif here.

It is against this backdrop that this paper contends that the time is ripe for the advent of indigenised design approaches to learning. By this, we mean making all the materials, tools, ad processes we now have our own by modifying them to suit African needs, aesthetics and

priorities. Such an approach would find its concrete expression in the edification of learners on the range of possible technologies to establish the stock of twenty-first-century skills Designers need to build resilience and effectively navigate their future work-life. It almost certainly means the indigenisation of objects and concepts that originated outside of Africa but have been adopted and incorporated into African culture. As an example, we can point to a student who showed us a composite picture of several common objects of everyday life in Kenya – a chair, a backpack, a TV, a cell phone. He was lamenting that none of them is 'African'. We pointed out that these are familiar objects to nearly all Kenyans and are, therefore 'African'.

Thinking Afro-centrically and De-colonially, we must acknowledge that the very first industrial revolution happened when our remote ancestors in East and Southern Africa extended their cutting edge beyond their teeth, out of their mouths and into their hands by banging rocks together to create tools. At around the same time our ancestors learned how to make and control fire, yet another revolutionary innovation that astronomically increased our chances of survival as individuals and a species. We live where it happened so why are we still thinking Euro-centrically? As we face the so called fourth industrial revolution head on, design educators in Africa should be standing our cultural ground and insisting on recognition of the blatant fact that there were two industrial revolutions in Eastern and Southern Africa many millennia before the 1 to 4 that are recognised in our post-colonial world.

References

'The case for tropicality in interior design' 2018, Presentation to *Interior Design Association of Kenya DAK conference,* Radisson Hotel, Nairobi.

Abanyam, NL, IOSR 2013, *Journal of Humanities & Social Science* (IOSR-JHSS) vol. 8, Issue 4 (Mar – Apr, 2013), pp. 26-28 e-ISSN: 2279-0837, p-ISSN: 2279-0845. www.iosrjournals.org.

Amutabi, MN (ed.) 2019, 'A new kind of development in Africa', Center for Education Democracy, Research and Development (CEDRED) Nairobi.

Bayne, S & Jandric, P 2017, 'From Anthropocentric humanism to critical posthumanism in digital education', *Knowledge Cultures,* vol. 5, pp. 197-216.

Bryan, E 2017, *The fourth industrial revolution and higher education*, Penprase, BE Penprase.

Cedarmont Kids 2015, 'School days', https://www.youtube.com/watch?v=nGi5u5btQMw.

Design for All Institute 2021, 'Social ranking, sexism and embellishment needlework in education and the economy', *Design for All Institute*, vol. 16, no. 4, April, p. 31-60 ISSN 2582.

Design methods n.d., Wikipedia, https://en.wikipedia.org/wiki/Design_methods, viewed 12 January, 2021.

Freeman, LB 2016, 'Enzymes, ants, chapattis and weeds: figuring out how to 'manage' 'indigenous' 'knowledge'', *The First International Conference on Information and Knowledge Management* August 24-26, 2016, organized by the Technical University of Kenya and Moi University.

Galaty, J 1977, 'The symbolic dynamics of Maasai identity', doctoral thesis, McGill University.

Harlan, B n.d., 'School days', https://www.youtube.com/watch?v=nfUmCBmHc1o.

Khamala, M & Pido, O 2018a, 'An inclusive, dynamic 'science' paradigm: Capacity building in kenya from a design perspective', A presentation to the Kenya National Academy of

Sciences for the Scientific Revival Day of Africa Celebrations, June 28th 2018 at the Nairobi Safari Club.

Khamala, M & Pido, O 2018b, 'Indigenous knowledge and identity formation in East Africa: An inside outside perspective', presented at the *2nd International Conference on Knowledge Management*, Technical University of Kenya, Panafric Hotel, August 20-24, 2018 published in the conference proceedings.

Khamala, M & Pido, O 2019, 'Decolonizing 'technology' in Kenyan higher education', in *A new kind of development in Africa*, Maurice N Amutabi (ed.), Nairobi, Center for Democracy, Research and Development.

Khamala, M & Pido, O 2020a, 'The past present and future of social design in Kenyan higher education', in *Gender and sustainable development in Africa*, Elinami V Swai (eds), Nairobi, Center for Democracy.

Khamala, M & Pido, O 2020b, 'Indigenous and exotic design in Kenya: Identifying the possibilities and limitations', in *Discourses on Sustainable Development in Africa*. Maurice Amutabi (ed.), Nairobi, Center for Democracy, Research and Development.

Khamala, M & Pido, O 2021, 'Varieties of intelligence in Kenyan higher education,' *11th International Interdisciplinary Conference* on June 23 to 26, 2021 at Multimedia University of Kenya.

Kurzweil, R 2005, *The singularity is near,* Penguin, New York.

Mettienen, S (ed.) 2001, 'Considering indigenous design paradigms in teaching and practice, in art design, education exchange with Africa', Helsinki, University of Art and Design, www.arted.uiah.fi/adeea/.

Moore, M & Griffith, M 2002, *A behavior change approach to investigating factors influencing women's use of skilled care in Homa Bay District, Kenya,* the Change Project, Academy for Educational Development/ Manoff Group, Washington.

Olweny, MRO 2020, 'Architectural education in sub-Saharan Africa: An investigation into pedagogical positions and knowledge frameworks', doi: 10.1080/13602365.2020.1800794.

Ongachi, WM, Okwara, MO, James, A 2013, 'Challenges on implementation of art and design curriculum in secondary schools in Kenya', http://ir.jooust.ac.ke:8080/xmlui/handle/123456789/2664, viewed June 4 2021.

Otati, MN 2013, 'Factors affecting students' kenya certificate of secondary education performance in art and design, in secondary schools of Nairobi Coun*ty,* Kenya', http://ir-library.ku.ac.ke/handle/123456789/7025.

Pasanen, J 2019, 'Human centered design'*,* https://www.jussipasanen.com/human-centred-design-considered-harmful/

Peters, M 2017, 'Technological unemployment: Educating for the fourth industrial revolution', *Journal of Self-Governance and Management Economics*, vol. 5, no. 1, pp. 25-33.

Petrie, HG 1992, 'Interdisciplinary education: Are we faced with insurmountable opportunities?', *Review of Research in Education*, vol. 18, pp. 299-333, American Educational Research Association, Stable URL: http://www.jstor.org/stable/1167302.

Pido, D 1990, 'The role of handicraft industries in development in Maasailand', *Proceedings of a Conferenceon the Future of Maasai Pastoralism* in Kajiado District Brackenhurst, Limuru, Kenya, May 28-31, 1989, MK Van Klinken and J Ole Seitah (eds).

Pido, O 2020b, August 2020, 'An assessment of stakeholder engagements in design education in Kenya', in *Politics and sustainable development in Africa.* Maurice Amutabi and Linnet Hamasi (eds), Nairobi, Center for Democracy, Research and Development.

Pittracher, B, et al. 2004, *Tracking footprints*, in-house research report, SOS Kinderdorf International, Innsbruck Austria.

Schwab, K 2016, *The fourth industrial revolution: What it means and how to respond.* Global Agenda, World Economic Forum, Geneva.

Shuftan, C & Mbugua, J 1993 'Evaluation of SIDA water and sanitation projects in Rift Valley and eastern provinces', Swedish International Development Agency, Nairobi.

Visual Arts Cork., n.d., 'Junk art', http://www.visual-arts-cork.com/definitions/junk-art.htm, viewed 1 January 2021.