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Female School Leaders and the Fourth Industrial Revolution in South Africa

Virginia Naidoo[a], Onoriode Collins Potokri[b*], [a,b]University of Johannesburg, South Africa, *Corresponding author, Email: [a]virginia@clps.co.za, [b*]cpotokri@uj.ac.za, [b*]cnuvie@gmail.com

The study explored the leadership skills female leaders in South African schools require to be adequately prepared for the fourth industrial revolution (4IR) era. It was conducted with female education specialists, principals, deputy principals and heads of department at primary and secondary schools. Both private and public schools were selected. A generic qualitative approach was used with individual interviews to collect data. Data analysis was conducted using a thematic inductive approach. Themes were generated from clusters of information relating to the research questions. The findings include the skills required for females to effectively lead schools for the 4IR era to become better 4IR-aligned leaders. The study revealed that female leaders recognize the need to adjust their leadership skills to the rapidly changing technological environment in schools. The study further revealed that support for development is lacking in public schools while private schools offer more mentoring and coaching of leaders to become 4IR-aligned. It is thus clear that leadership support/development, especially in public schools, requires effective administration and communication to ensure that schools receive the level of support that is drafted and structured at national government level.

Key words: *fourth industrial revolution, women leadership, qualitative research, professional development*

Introduction and background

The 4IR has heralded a whirlwind of technology, that has significantly obscured lines between the digital and physical worlds (Schwab, 2016). These rapid technological changes require a fundamental shift in the "how" and "what" of doing things (Hoque, 2019). The South African President, Cyril Ramphosa, in his 2018 State of the Nation Address (SONA), announced the

inclusion of the 4IR in his economic policy. The education sector, however, is not equipped to produce sufficient degree holders in Science, Technology, Engineering and Mathematics (STEM) fields for the 4IR workforce demands (Sutherland, 2020). While many researchers comment on male leadership styles and models for the 21st century, there is limited focus on females in leadership roles in South African schools (Mestry & Schmidt, 2012; Adler & Osland, 2016) despite their contributions to the transformation of education (Potokri & Perumal, 2019).

The study explores the leadership skills required to adequately prepare female leaders in South African schools for the fourth industrial revolution. Literature in education management suggest that leadership include teachers in managerial positions in schools, at districts and departments of education that are mainly tasked with the provision of leadership directions and supports. Within the context of this study, females leading schools include principals, deputy principals, and HODs. The study thus investigates the leadership skills and supports that are essential for female leaders in schools to be effective in the 4IR era.

A preliminary literature review on female leadership and skills for the 4IR era reveals that the resource pool is very thin. Our quest is therefore, to add to the current knowledge base by providing a contrast and comparison of existing data is a driving force for this study. In view of this, the study seeks to answer two questions namely: (1) What leadership skills do female school leaders require to be prepared or ready for the 4IR era? (2) What type of support(s) do female school leaders need to help prepare them as 4IR equipped school leaders?

Theoretical Framework

This study is underpinned by Schwab's (2016) 4IR-Intelligence model as constructed by Oosthuizen (2016). Oosthuizen (2016), who proposes a model of digital leadership for which he coined the term "4IR-Intelligence". Using Schwab's (2016) argument of adapting to the 4IR environment by applying four types of intelligence, Oosthuizen (2016:7) explains the four types of intelligence required for effective implementation of digital skills. These are: (1) "Contextual" intelligence – describes the mind and how one understands, processes and applies knowledge, (2) "Emotional" intelligence – is about the heart and processing thoughts and feelings and the manner in which we relate to others, (3) "Inspired" intelligence – deals with the soul and our ability to share with and trust others, and (4) "Physical" intelligence – is associated with the body and how we maintain healthy lifestyles and wellbeing.

Oosthuizen (2016) used this framework in a quantitative study to assess the readiness of South African managers to deal with the onslaught of the 4IR technologies. His results when comparing male and female managers showed a statistically significant difference in emotional and contextual intelligence, and an insignificant difference in inspired and physical intelligence. However, the overall average scores for all variables shows no notable disparities

in the impressions of men and women with reference to 4IR intelligences (Oosthuizen (2016:19).

Annis and Nesbitt (2017) offer their version on gender differences from a neuroscience perspective, vehemently emphasizing that while "EQUAL DOES NOT MEAN THE SAME!" (p.36), women rate higher as "intuitive" and men as "factual" (p.37). Their argument summarises that women are, innately and by design, more perceptive, understanding and take personal interest in people, rather than looking at the factual context alone. This leads to the assumption that women may have strong emotional and contextual intelligence skills which can support their leadership in schools as they prepare learners for the 4IR workforce. Devnew and Storberg-Walker (2018) add that understanding the differences between men and women helps improve programmes for developing female leaders.

Literature Review:

Leadership for the 4IR

As technology advances, there is continued pressure on female school leaders to change and adjust to the current 4IR demands. Richardson, Flora and Batton (2013:145) succinctly express that digital technology continues to put pressure on the education system to change, to adapt, to improve, to streamline, to become more effective and to become more efficient. At the core of this shift is the school leader. If the school leader does not understand the trends in educational technology, then the leader is ill-prepared to harness the power of modern digital technologies. This is a powerful statement that triggers an assessment of leadership models currently being adopted in schools, followed by the pursuit of leadership skills for the 4IR-aligned leader.

Bush and Glover (2014) offer an informative review of some contemporary leadership theories used locally and internationally. In essence, these theories have value of its own, but do not fully encapsulate the requirements of the 4IR leader. In their writing, these scholars seem to emphasis on instructional leadership and other types of leadership styles. Accordingly, instructional leadership, also referred to as "learner-centred leadership" (Bush & Glover, 2014), emphasises the link between leadership and learning and is strongly supported as a leadership style for 21st century leaders (Hallinger & Heck, 2010). Transformational leadership, like instructional leadership, focuses on influencing the school outcomes and relies on high levels of commitment from teachers and learners (Bush & Glover, 2014). Transformational leadership can have a profound impact in the South African context when "transformational language" (Bush & Glover, 2014:7) is increasingly being used by government structures to underpin a non-racist environment, which inevitably must be fostered at schools by their leaders. Distributed leadership expands its focus from leaders leading to a shared approach that is of an interconnected and participatory style (Lumby, 2013).

Interestingly, studies have shown that women possess the qualities of both transformational and distributed leadership styles, acting as role models and gaining trust and support of their followers, and working collaboratively with others (Wright, 2011; Krinzman, 2015). Distributed leadership, however, is criticised by Lumby (2013), who claims that there is no suitable path to assess its degree of success in an evolving digital era. Each model focuses on various aspects of leadership which include personality traits and characteristics of leaders, managerial styles, power and authority and situation-based activities (Bush & Glover, 2014; Khan, Nawaz & Khan, 2016). The emphasis on specific aspects of leadership leads to the assumption that most contemporary models of leadership are inadequate to address the leadership approach for the 4IR (Bush & Glover, 2014).

In the conventional school context, these models of leadership have achieved the desired result, but leadership in a 4IR era calls for a drastically transformational approach that addresses the highly volatile and changing world of technological advancements (Richardson, Flora & Batton, 2013; Sheninger, 2014). Although transformational leadership is favoured in contemporary circles, the highly disruptive nature of the 4IR technologies calls for school leaders to engage in unconventional, innovative approaches that will lead and prepare learners for the 4IR workforce (Butler-Adam, 2018).

To solidify the argument for a shift in leadership strategies, a report by Tomorrow Project emphasises that leadership must evolve as a new generation of technologies unfold (Blackboard, 2018), a point further supported by Shute and Becker (2010). Shute and Becker (2010) contend that new innovative options for communication and expressiveness are emerging and therefore up-to-date proficiencies and capabilities are essential for leaders to gear learners to adapt to the demands of the 4IR workforce actively and effectively. School leaders must constantly search for new technologies and information in a quest to master new trends and practices (Yusof, Yaakob & Ibrahim, 2019).

Features of Leadership for the 4IR

Leadership in our volatile, uncertain, changing, and ambiguous (VUCA) climate undoubtedly invokes innovation and creativity, and an introduction of doing things in a manner that brings success and transformation within an institution (Gfrerer, Rademacher & Dobler, 2019). The literature reveals that defining digital leadership is complex.

Digital leadership is explained by Domeny (2017:vi) as “a new construction of leadership that connects leaders with technology”. Sheninger (2014: xxi) gives a more detailed description, defining it as “establishing direction, influencing others, and initiating sustainable change through the access of information, and establishing relationships in order to anticipate changes pivotal to school success in the future”. He elaborates further stating that digital leadership involves a mixture of behaviours, thinking and skill set that is used to revolutionise teaching

and learning with the aid of technology (Sheninger, 2014), a view supported by Zhong (2016). Zhong describes digital leadership as using a variety of technologies that strengthen teaching and learning practices, as well as administrative aspects of the school programme. Having offered a fair description of digital leadership, the researchers aim is to delve into the leadership skills and practices that are essential for leading schools in the 4IR era.

Leadership Skills for the 4IR Leader

In this research, review centres on two interesting and compelling theories of 4IR leadership skills and practices that have been put forward by female scholars and leaders in education and offers an argument to support researchers' research on women leading schools for the 4IR, as well as a model by Groscurth (2019). There is a degree of similarity among these ideas as well as independent, unique practices that are emphasized by each.

Demski (2012) refers to her presentation on digital leadership as the "The Seven Habits of Highly Effective Tech-Leading Principals", the practices and skills which are summarized in the mind map below:

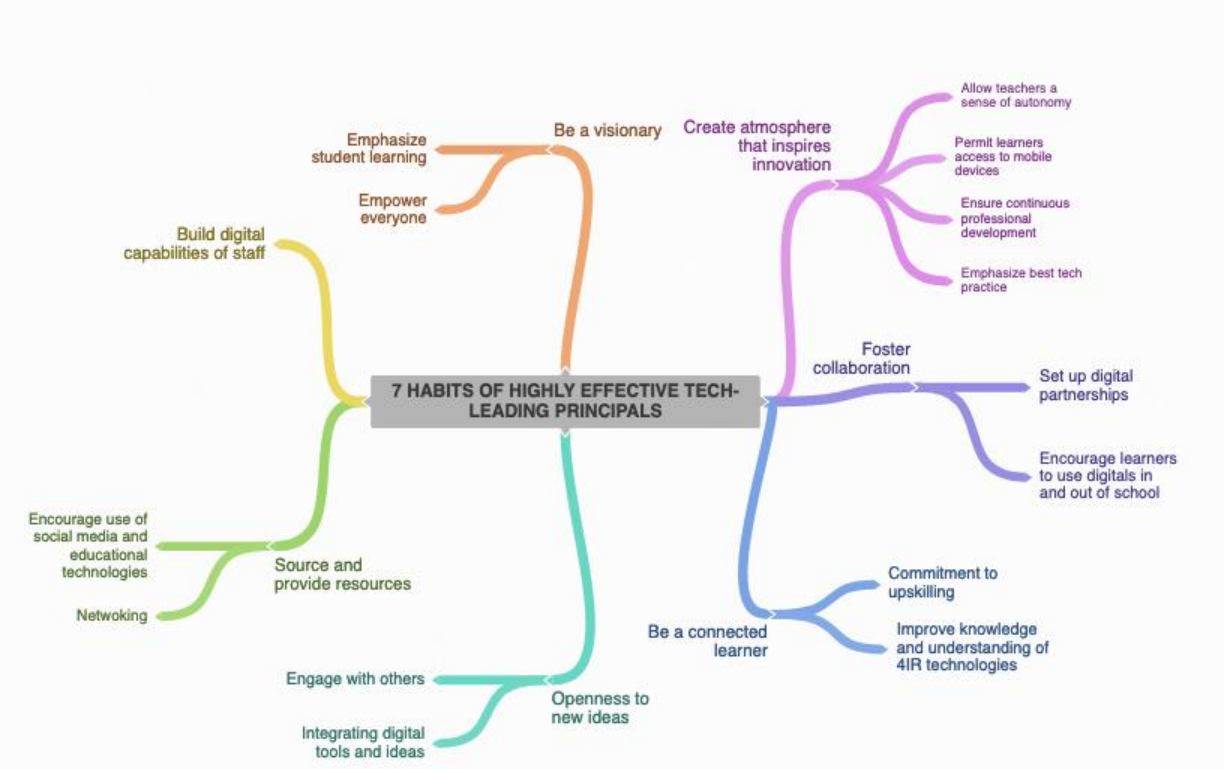

Figure 6: Mind map outlining the "7 Habits of Highly Effective Tech-leading Principals" (Demski, 2012)

These seven skills include collaborating with others in building a climate that stimulates innovation, connect a learner who is always open to new ideas, building digital capacities of self and staff by sourcing and providing trending resources, and ultimately being a visionary

who emphasizes student learning and empowering others (Demski, 2012). Demski (2012) reiterates that education reform in a school is a result of strong leadership and when it comes to technology, it is critical that leaders adopt and promote the use of technology themselves. She adds, "we have to model how to appropriately use these [digital] tools, how to have a positive digital footprint." (Demski, 2012:55).

Ahlquist (2014) maintains that 4IR leadership skills can be integrated and used in innovative ways to address gaps in the implementation of technological resources and tools and the world continually changes and advances. Groscurth (2019) refers to the 4IR leader as a "future-ready leader" (p.1) and classified 4IR skills into five as shown in below table.

4IR SKILL	DESCRIPTION	SIGNIFICANCE/BENEFIT
Presence	The art of being aware, attentive, mindful, and focused	Allows for more creativity, intellectual thinking, and practical insight
Agility	Acting with speed, dexterity, and swiftness	Fosters sharp reactions to change and 4IR disruptions
Development	The ability to prepare self and others for the future workforce	Leads to success of organizations
Discernment	"capacity to distinguish, decide, discriminate between alternatives" (p.146)	Helps bring focus to critical aspects of the organization, and subsequently leads to improvement and development
Collaboration	Working together to attain shared goals, values and beliefs	Promotes ownership and buy-in from all stakeholders

Groscurth (2019) contends that a 4IR leader exhibits an attentive, focused presence that allows for creativity and innovation; acts with speed and proficiency as an agile leader; leads the institution to success by constantly developing and building for the future workforce; shows the ability to distinguish and decide from a wide range of alternatives; and lastly, always collaborates with a team promoting ownership from all stakeholders. Groscurth's (2019) model resonates closely with Ahlquist (2014) regarding collaboration, presence, and decision-making, and with Demski (2012) in respect of development, amongst other aspects.

At this point, researchers revert to the argument that some inherent qualities of women position them as effective leaders for the 4IR. Firstly, women are more people oriented (Diekman, Clark, Johnston, Brown & Steinberg, 2011; Su, Rounds & Armstrong, 2009) and thus open to ideas, teamwork and collaboration. Secondly, women tend to be better at making decisions under stressful situations and engage in a harmonious manner with others, as proven by studies carried out by neuroscientists Preston, Buchanan, Stansfield and Bechara in 2007, and the constantly changing 4IR landscape which is a stressful environment. Key (2015) expresses her

view that women have an advantage in leadership because they are agile, having the ability to predict and manage change with proficiency and adeptness, adding that the high emotional intelligence (EI) of women positions them as cooperative, collaborative and sensitive leaders.

Further empirical studies carried out globally reveal a mixture of supporting and contradicting evidence of the effect of digital leadership skills and capabilities of school leaders in improving and promoting learner readiness and success for the 4IR workforce. For example, Zhong's (2016) mixed method study of schools in Mississippi, USA, to determine the impact of digital leadership on communication and collaboration showed that there was significant improvement due to the use of a combination of digital platforms. This highlights and corroborates the skills of integrating and encouraging the use of digital tools and social media as offered by Demski (2012). In South Africa, Domeny's (2017) study of the effect of principals' digital leadership on teachers' implementation of digital technologies showed little significant impact, emphasizing that school leaders need to develop digital skills such as being connected (Demski, 2012) and making sound digital usage decisions (Ahlquist, 2014).

Given this background on the required 4IR skill set for school leaders, with an emphasis on females, begs the question on what support and developmental strategies can be offered to empower female school leaders for the 4IR in South Africa.

Supporting and Developing Women School Leaders

Kelly (2019) maintains that in order for leaders to grow and adjust to this VUCA world, a paradigm shift, which undoubtedly creates a conducive developmental condition, is essential. Three key mindset shifts are posited by Kelly (2019).

Firstly, leaders must move from "decision-making to sensemaking" (p.124), meaning that one moves from the simply making decisions based on facts alone, to becoming aware of the situational context and considering a holistic approach. A second mindset shift is referred to as moving "from charismatic authority to swarm intelligence (p.129). Here Kelly (2019) argues that a single leader's influence, impact and personality are not as important as what the entire team brings to the front. Thirdly, a shift "from analogue to digital mindset" (p.134) is needed to move leaders in the 4IR era. Recognizing technological solutions as an enabling condition instead of an avenue to control and assert power moves a leader towards future readiness.

Larson, Miller and Ribble (2010) add that there are five considerations that will enhance and enable digital leadership. Firstly, school leaders must own the *vision* to keep technology moving and advancing within the institution, an idea supported by Couros (2015), who adds that having a shared vision promotes innovation and creativity. Secondly, understanding the *learning culture of the digital age* by assessing how new technologies promote learning creates

a conducive environment for development. Thirdly, school leaders must be able to predict the long-term effects of digital technologies in order to sustain *systemic improvement.* Next, establishing standards for *excellent professional practice* will set the stage for future success. Lastly, promoting *digital citizenship* at all levels of school leadership will enable a supportive developmental environment.

Moving away from traditional methods of leadership towards enhancing digital skills requires a change with the individual first before the organization can have significant impact with its support (Ahlquist, 2014; Demski, 2012; Groscurth, 2019). In light of these considerations, a proposal to support and develop female school leaders is to establish personal learning networks (PLNs) that reinforce connected learning and allows women to take ownership of and responsibility for their professional development.

Methodology

Approach and design

Qualitative research approach was used for this study. It made it possible for the researchers to conduct an in-depth study that seeks to answer questions that are substantiated by theory and practice (McMillan & Schumacher, 2014) and it involves the study of people's real-life experiences, it illustrates participants' views and perceptions, it accounts for these experiences within a specific context, it uses experiences to establish new meaning (Yin, 2016). From the many designs in qualitative approach, the researchers selected and used the generic design, because it helped to answer the study's research question that was about the experiences and practices of females leading schools for the 4IR era in South Africa. Merriam (1998: 11) defines "generic qualitative design as a design that "seeks to discover and understand a phenomenon, or process, or the perspectives and worldviews of the people involved", The focus of this study is to gain insight into the skills that females need to equip them as 4IR-aligned leaders, without necessarily being steered by a specific set of assumptions as laid out by other qualitative designs (Percy, Kostere & Kostere, 2015).

Sample and sampling

Six participants namely Joy, Val, Chloe, Kristy, Stacy, and Yolanda (all pseudonyms) shared their experience with researchers in the data collection stage of the study. Purposive sampling was used to select participants. Potokri (2011:111) explains that "purposive sampling" is used to "increase the utility of information obtained from participants who are faced with the research problem the researcher(s) wants answers to". The researchers selected participants of age 30-60 years from different levels of leadership within the education industry who are able to offer information-rich data. They include two principals from private schools, a deputy principal from a public secondary school, two heads of department, one from public and private

school respectively, as well as an employee in a senior position at the Department of Basic Education, all from Johannesburg, Gauteng. Both private and public schools were selected to draw comparison inferences between the public and private education sectors just in case the need arises at the data analysis stage of the study. The participants were contacted individually via telephone and email.

Data collection and analysis

Interviews were the method of data collection. These interviews were made up of questions related to our knowledge of the study's phenomenon and based on constructs revealed in the reviewed literature. Semi-structured questions in interview protocol were used. Creswell (2007) describes the interview protocol as a form with set of open-ended questions, with spaces between each question for participants to record their responses. The interview protocol as used consist of questions that was sent to the participants prior to the verbal interview so that they could be familiar with the contents. Because of the global COVID-19 pandemic and all related restrictions, individual interviews were held via Zoom for a duration of approximately 40-45 minutes.

The data collected was thereafter transcribed and analysed. Percy, Kostere and Kostere's (2015) step-by-step guide to use for inductive analysis, as follows was used. Step 1: After transcribing the data from the recordings, researchers copied and pasted the answers of each participant to each question to form a comprehensive unit of information, which was read repeatedly to familiarise themselves with all the data, highlighting meaningful words and phrases. This was done with each of the interview questions. Note(s) of overlapping answers and ideas was also made. Step 2: Researchers then determined if the words, phrases, and sentences highlighted were related to the research questions and headings of the reviewed literature. Unrelated words/phrases were ignored. Step 3: At this point, coding of data commenced. Using colours and the interview questions as a guide for clustering data, the information was clustered according to codes. The researchers made use of direct quotes from interviewees to substantiate interpretations and findings. Step 4: Lastly, they (researchers) took these clusters for use alongside appropriate headings of reviewed literature as themes. The researchers presented a summary of their analysis under each heading.

Ethics

Ethical clearance for this study was received from the Faculty of Education Ethics Committee of the University of Johannesburg. Before the ethical clearance, a prescribed form was submitted to the Department of Basic Education, South Africa for the use of participants at public schools. Permissions were also obtained from private institutions. Participants were contacted to seek their permission and willingness to participate in the study. With their consent, all participants voluntarily participated in their individual capacities. The researchers

also adhered to the principle of confidentiality and anonymity by using pseudonyms in place of their real names and representing and differentiating school with alphabets.

Findings and Discussion

Findings in this study are basically the responses or answers to the research question: What leadership skills do female school leaders require to be prepared or ready for the 4IR era?

Leadership skills that female school leaders require to be prepared or ready for the 4IR era were examined and established through data obtained, analysed, and shown in table 1 and 2 below. The tables show the emerged theme – 4IR leadership skills and emerging 4IR technologies and its impact on education. With the knowledge of interview protocol form (see section 4.3), researchers used the table to show statements or responses of participants and their respective deduced meanings – our interpretation and followed it with discussion that is anchored on the reviewed literature and the theoretical framework where applicable.

Table 1: 4IR Leadership Skills

Statements made by participants	**Deduced Meaning**
"I think with the complex problem-solving flexibility", "thinking, communication, critical collaboration, you know coordinating and working with others in teams and as individuals…" "I think virtual networking is important…" "You have to be innovative, ask questions, navigate the unknown and also think and problem solve…" "I think they need to train us also to be more independent thinkers and not kind of show us how to be independent thinkers, but more teach us the skills needed to be independent thinkers…" "I think we're being put in a box by school. Like we said memorising and repeating or parroting a lot of our information and it doesn't really play to everyone's strength."	Participants identified 4IR skills but recognized the needs for leaders to be better equipped. There is a focus on teaching learners to memorise and rote learn for exams rather than developing the essential 4IR skills. This again points to the need for a review of curriculum and assessment policies by the department of education.
"I'm a strategic servant. I love putting plans together and strategically move people around to ensure that they're in a space where they really flourish". "…basically, there are four leadership styles, Supporting, Coaching, Directing and Delegating,	Current leadership styles are similar to contemporary models, including supporting, coaching, democratic, strategic leadership styles.

and I think within each of us as leaders we have all of them…" "…I've always maintained that I am a democratic leader."	
"I think besides being a strategic thinker I'm a very optimistic person. So, for me there's always a plan, there's always a way of fixing things". "I believe that you know to be involved in strategic decision making is important to promote quality education at all times." "…one of my skills is that I am balanced. I do feel that that is a skill because a lot of people do not know how to do that…"	Leaders display a many of the 4IR leadership skills, highlighted in the literature, but tend to steer towards the conventional skills.
"…with the Fourth Industrial Revolution I feel like I can see where we are supposed to be but it's now getting the ship to go into that direction." "I think Networking, you know the Fourth Industrial Revolution is opened up such a broad range of networks"	Leaders in well-resourced schools using the internet are more progressive in their leadership skills, being visionary, having a presence that forges change and innovation.
"I am empathetic, and I am compassionate…" "I'm approachable…" "I would like to think I listen well and encourage…"	Female leaders are people-orientated, rather than machine-orientated.

The table above shows perhaps reveals that leadership style and skills of the participants, as well as the 4IR skills are necessary for effective leadership.

The participants shared their current leadership styles as being strategic-servant, supporting, coaching, delegating, directing, distributive and democratic. While these styles are of significant value in the conventional educational environment, the literature points to the fact that leadership skill rather than style is what makes for effective leadership in the 4IR (Richardson, Flora & Batton, 2013). Hence, the need for the differentiation between "style" and "skills" in leadership is considered important.

Gaffney (2016) explains that anyone who leads has a leadership style, for example, it can be strict or laidback, formal or informal. Leadership skills, on the other hand, are related to an individual's inherent potential and capabilities to lead, for example, being driven, engaging others or communicating well (Gaffney, 2016). In reference to the 4IR skills, participants mentioned skills such as complex problem solving, creativity, critical thinking, communication, collaboration, service orientation, decision-making and emotional

intelligence, all of which are linked to evidence obtained in reviewed literature, and which Deloitte (2018) refer to as "soft skills". Val (one of the participants) made mention of computer, technical or digital skills, which is regarded as a key 4IR skill (Grand-Clement, 2017). Yolanda emphasised that "She does think all these skills will fall into place and everyone will be on board – it's got to be done in stages." These feelings indicate once again how overwhelming the change heralded by the 4IR technologies can be, and what Mucharraz (2016) confirms as taking place in this VUCA world.

Most of the participants placed a strong emphasis on the quality of emotional intelligence in their leadership journey. Yolanda alluded to solving conflict in a fair and amicable manner, something that Goscurth (2019) labels as discernment. Being compassionate and empathetic were also common leadership skills. Effective communication and collaboration ranked high on the list of skills among the participants, both of which are supported by the literature. Stacy substantiates her effective communication skills by sharing that "if she has a situation at school, either between learners or two staff members, she like to sit them down and listen to both sides of the story before she makes a decision based on what she is hearing." Kirsty was very emphatic about her level of emotional intelligence, which involves effective communication, stating that "if there was a conflict to sort out, she could probably do it confidently." The continuous reference to qualities of compassion, empathy and fairness confirms the literature that women are more concerned with working with people than things (Diekman, Clark, Johnston, Brown & Steinberg, 2011; Su, Rounds & Armstrong, 2009).

When asked how these skills make them more effective leaders in the 4IR or digital era, Kirsty, Joy, and Val shared the common view that being an effective communicator is beneficial in the 4IR era, while Chloe expressed that being strategic and planning well helps her "to completely envision what the future will bring". From this statement, one recognises that Chloe is a visionary who is able to see where she wants to take the school and move in that direction, a key 4IR skill, as highlighted in the literature (see Demski, 2012).

The data collected with regards to the leadership skills that the participants would like to add to their skill set to further equip them as 4IR leaders revealed that there is a serious need for skills development. Becoming more "tech-savvy", as Yolanda puts it, is a very necessary step for her in skills development. She gathered that networking is a skill that is needed. Stacy stated that "keeping abreast with the trends, what is happening and not just being an ostrich" will help leaders in imparting knowledge to learners. These skills have been highlighted in the reviewed literature as essential 4IR leadership skills (Demski, 2012; Groscurth, 2019). What appears to be lacking in most participants are skills of building and developing digital capabilities, and integrating 4IR technologies in leading schools, as purported by Demski (2012).

Table 2: Emerging 4IR Technologies and its Impact on Education

STATEMENTS MADE BY PARTICIPANTS	THE MEANING WE ASCRIBED TO IT
"it [4IR] represents the fundamental change in the way we live…" "…you know we looking at skills for a changing world and our world is changing all the time…"	The 4IR is bringing about rapid change. South Africa is not ready for this change. People are afraid of change and reluctant or unwilling to change
"I do not think we are nearly as prepared as maybe what some of the first world countries are up to…".	
"So you know, the teachers are not ready for it." "And you know, older teachers, it's always the old school methods."	
"It sparks creativity, and it forces the learner to see things from a different perspective." "4IR has the potential to connect billions of people to digital networks" "It is awakening minds. It is making them curious, it is making them creative." "I do think that like even though this fourth industrial revolution is making life simpler for everybody it also makes everybody very lazy…"	There are positive implications for schools, like exposure to global innovations, simpler ways of doing things, but participants are sceptical, feeling that technology makes one lazy.
"so not having young blood, sometimes I would say, it's not the best." "how do you keep abreast of all these things, and one needs to be, keep abreast of things so that one can function effectively in this fast-changing world…" "it seems that there's a lack of support from the Department…" "You've got the parents on the other hand who just can't afford it." "I think it is a mindset change, using anything new will call for, you know an open mind."	There are negative implications for schools which have major limiting effects, including lack of funds and resources, lack of training, inability to cope with information overload. Older teachers are not open to change.
"it's a fusion of technological advances consisting of artificial intelligence, robotics,	Participants are familiar with the 4IR technologies, but are either not fully

advanced materials, 3D printing, block chain, IG and other technologies to succeed in preparing the country's learners forward the world of the fourth industrial revolution." "it actually describes the Age of Technology and it looks at the Age of Intelligence and how all these different technologies, if you think of The Internet of Things, the Quantum Computing, if you think of Augmented Reality or Artificial Intelligence, how do all these things you know come together into this wide, wide range of technologies." "I mean industrial revolution and we are busy in it now and people haven't… where we are at teaching at School D - there is nothing…" "They [DBE] will have to include subjects like coding, data analysis and robotics, at least at school level."	equipped to use them, or do not have these technologies available at their schools, specifically public schools. There is a definite need for a curriculum adjustment to include subjects aligned to the 4IR.

In the interviews, participants were assertive that school leaders in the 4IR era must be aware and embrace emerging technologies and its impact on education, the industry they find themselves. Accordingly, only with such awareness that they can develop the required skills which of course align them with the 4IR. Participants believe that such knowledge rather awareness will bring about rapid change for which South Africa may not be ready and this change can be overwhelming for some, an idea well-substantiated by the literature (see Oke & Fernandes, 2020). Despite the importance of their believe, almost all the participants seem to be fearful of the changes associated with the 4IR. This fear and reluctance to change resonated largely in the discussion.

Participants agreed that the impact of 4IR technologies on education was both positive and negative and explained the benefits and challenges for schools, teachers and learners. The challenge of teachers adapting to the changes is concerning especially with older staff. The ability to adjust and adapt to change is an issue underlined in the theoretical foundation of this study and hence it is pertinent that change brought about by the emerging 4IR technologies is handled effectively (Cummings, Bridgeman & Brown, 2016). Other challenges include the lack of resources, support from government level, lack of funds. Val believes that teachers lack the necessary skills to use the emerging technologies. All of these challenges are also revealed in the literature review (see for example, Kayembe & Nel, 2019).

In addition, Stacy believes that teachers feel they will lose control of the lessons if artificial intelligence (AI), an essential part of 4IR takes over. Chloe mentions that in her school she finds that her staff are not able to set boundaries when it comes to making use of technologies and will often address matters very late into the night due to constant access to information. Joy shared that although the DBE had uploaded lots of materials for teachers and learners, only 30% of them [13 million learners] were able to access the information, highlighting the challenge of access to the internet. The literature review, however, indicates that South Africans' access to the internet has increased significantly over the past four years, with almost 70% enjoying the internet and making use of social media platforms. To better understand the discrepancy, one would probably need to further investigate the socioeconomic status of various communities, something that is not part of this study.

The benefits of the 4IR are however, just as important as the challenges mentioned above. Both Joy and Chloe agree that the 4IR technologies and skills will allow learners and educators to think out of the box, thereby stimulating creative thinking and the opportunity to access new skills and opportunities. Joy mentions further that, with the onset of the COVID-19, various 4IR technologies allowed networking with Ministries of Education in Norway, Sweden and Singapore, to collaborate on ways to handle the COVID pandemic in schools. Yolanda reluctantly shared that the 4IR would prepare and equip learners for jobs that require innovative thinking.

Participants were no doubt aware and familiar with the 4IR technologies, naming AI, 3D printing, the internet of things, coding and robotics, all of which form part of the literature review. The internet plays the biggest role in these technologies, as Chloe expressed when she described that learner at her school were able to enjoy uninterrupted e-learning during the COVID-19 because they had access to the internet. Yolanda's argument is that government need to introduce new subjects like coding and robotics to begin the transition to more 4IR-aligned education. Kirsty shared about the "White Paper on e-Education: Transforming education through information and communication technologies", drafted in 2004 by the then Minister of Education, Naledi Pandor, where provision was made for the implementation of e-learning by 2013. Kirsty's response to this was "Well, I still don't know when this will happen and it's now 2020!". The challenges of lack of funding, identifying teachers for upskilling and developing 4IR skills in learners are highlighted by Kayembe and Nel (2019), as well as the slow pace at which national government implement policies.

Conclusion

The study sought to explore the leadership skills required to adequately prepare female leaders in South African schools for the fourth industrial revolution. With the rapidly changing technological landscape and emerging 4IR technologies, a visionary approach to leadership is essential.

The study exposed the stark reality that female leaders, especially older ones in public schools, are apprehensive and hesitant to move out of their comfort zones and embrace the 4IR leadership skills necessary to impress success in this VUCA world. Hence, there is a need to embrace the core ideas of change mentality. Based on this, implementing emotional intelligence in day-to-day operational functions as highlighted by participants becomes a key skill to deliver results and promote progress, together with the ability to inspire others to aspire to the vision and mission of the school.

Female school leaders are overwhelmed by the 4IR emerging technologies and admit that a mindset or paradigm shift is necessary to lead in the 4IR era. Leaders of private schools and younger leaders are better-equipped and enthusiastic about using 4IR technologies in their roles. The most effective 4IR skills identified by female leaders are emotional intelligence, effective communication, and collaboration.

Support for development is lacking in public schools whereas leaders in private schools receive a higher level of support from mentors and coaches. Very few leaders use PLNs, which is an effective tool to improve 4IR leadership skills through connection and collaboration with fellow school leaders. Those who made use of PLNs, used more conventional technologies and admitted that a more structured programme would be beneficial to them. It is thus clear that leadership support or development, especially in public schools, requires effective administration and communication to ensure that schools receive the level of support that is drafted and structured at national government level. Therefore, to recommend training in setting up and developing a PLN makes sense given the outcome of participants experiences.

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