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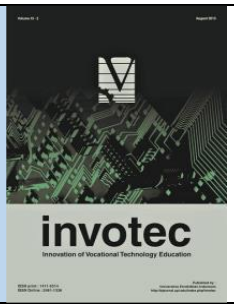

Readiness of Public TVET for the Fourth Industrial Revolution: The Case of South Africa

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ABSTRACT

This study aimed at determining the readiness of South African Public Technical and Vocational Education and Training (TVET) Colleges to operate in the 4IR. An assessment of the indicators deemed to prove readiness by the researchers of this study basing on literature was conducted through virtually interviewing public TVET College Principals, Deputy Principals Academic, Human Resources Managers and ICT Managers. A purposive sample of 26 from a population of 50 public TVET colleges proportionally representing the 9 provinces of South Africa was identified. The interviews were video recorded and later transcribed. From the findings it was concluded that most of the public TVETs realised the importance of readiness for 4IR as they got a push from Covid-19 and started or intensified preparing but were not completely ready due to lack of or inadequate teaching and learning technologies, training for teaching staff on the use of available technology; poor connectivity; lack of computing equipment; lack of ICT infrastructure; lack of ICT Strategies; and above all lack of policy directive. The findings could be used by the South African government to inform policy formulation and supporting higher education and training as a response to demands of 4IR to promote readiness by public TVETs to operate in the era characterised by intense technological changes.

1. Introduction

The concept of 4IR has various discourses, interpretations, and conceptualizations. Several researchers have asserted that it is mostly associated with technology (Johal et al., 2018; Xing & Marwala, 2020). Whilst the concept has no standard agreed definition, from the education perspective, Ndung'u (2018) and the World Economic Forum (2018) defined it as the integration of human and technology intelligent systems that are fusing the physical, digital, and biological worlds with unprecedented consequences across different education disciplines, and pose significant challenges on how people learn, teach, and work. This era calls for people who adjust to find ways of coping with the new dictates.

In this era, there has been a growing usage of new technologies that include artificial intelligence, cloud computing, robotics, 3D printing and advanced wireless technologies (Moloi & Marwala, 2020). The technological changes have reshaped the workshop continually over the years and radically transformed the structure of organisations and employment models (Makgato, 2019). According to Oke and Fernandes (2020), 4IR will introduce a sharp decline in demand for many jobs, such as those that require manual skills and physical abilities, due to automation with the digitalization of operations process. Consequently, the TVET has to respond accordingly by ensuring that it gets ready to train the potential industrial labour force and prepare them to fit into the industrial demands of the fourth industrial revolution.

Makgato (2019) conducted a study in South Africa to gauge the extent of readiness of some TVET colleges for 4IR at 3 TVET colleges in one province and data was collected from students and lecturers. The study recommended further studies on the same issue on more TVET colleges across the nine provinces. It is against this background that this study sought to establish the readiness of the public TVET colleges in South Africa for the 4IR. This time around by widening the scope from the 3 TVET colleges in one province to 26 public TVET colleges distributed across the 9 provinces of South Africa. Unlike in the Makgato (2019) study, the current study collected data from college Principals, Deputy Principals Academic, Human Resources Managers and ICT Managers instead of students and lecturers.

Therefore, the aim of this study was to gauge the readiness of public TVET colleges for the 4IR. The objectives of the study were to: establish teaching and learning technologies at the disposal of lecturers and their competency levels in using these technologies; establish positions taken by TVET colleges with regards to procurement of technologies, skills plans, ICT strategies, and identification of key personnel to drive their ICT strategies; and determine the extent to which students have sufficient technological infrastructure to enable them to participate meaningfully in teaching and learning, particularly as institutions ramp-up the use of technology to meet the demands of the 4th industrial revolution. To achieve the aim of this study an assessment of indicators embedded in the above objectives and deemed critical to prove readiness for 4IR by researchers of this study was conducted through interviews.

2. Literature Review

This section briefly discusses 4IR and TVET colleges and also readiness for 4IR in TVETs.

2.1 4IR and TVET colleges

TVET colleges in South Africa provide education and training for expertise for industry, commerce and public sector organisations particularly in engineering and business studies programmes on National Qualifications Framework (NQF) levels 2 to 4. Loynes (2016) posited that TVET colleges are South Africa's basic source for the training and development of artisans as well as the answer to achieving the Human Resources strategy objectives. Education delivery within the

TVET space is affected by the influence of the 4IR characteristics, as the need for education is connected to mobile device applications and varied digital platforms (Nundkumar & Subban, 2018). Therefore, teaching and learning programmes need to be flexible and supported by the relevant technology where access is increased.

Given the rapid changes, and new technologies coming to the fore, it is apparent that a new set of skills would be required to equip those that are involved in teaching and learning in the 4IR era and it is critical to embrace the fact that teaching within the current digital space cannot be business as usual (Vermaak, 2020). This realisation has ushered in rapidly changing educational trends in the last decade with a movement towards web-based instruction and blended learning which replaced face-to-face instruction.

Nundkumar and Subban (2018) acknowledge the merits of web-based and blended learning but raised the fundamental realities such as ICT infrastructure, connectivity, capability of teaching staff to implement emerging technologies, material development, credible online assessment systems and adapting to the new training requirements that have to be considered. For TVET colleges to be prepared for the 4IR effectively, there is need to meet the requirements of the fundamental realities raised above and churn out graduands that are agile and flexible to the rapid changes in technology (Minister of Higher Education and Training Budget Vote Speech, 2017).

2.2 Readiness of TVET College for 4IR

Literature has some studies conducted in relation to the education sector and 4IR from different dimensions. Against the background that a lot is known about business operations undergoing rapid changes as a result of disruptive effects of technological innovations while little is known regarding the acceptability and consequences of the 4IR in the education sector, Oke and Fernandes (2020) conducted a study in South Africa using the Unified Theory of Acceptance and Use of Technology (UTAUT). The study explored and explained the readiness of the education sector in adapting and embracing the 4IR and its disruptive capabilities, particularly in facilitating teaching and learning. It was motivated by the lack of existing empirical studies in this area, and particularly about Africa. Face-to-face semi-structured interviews were adopted in the study to explore the views of professors and PhD holders working in the education sector. Their findings showed that the education sector, especially in Africa, was unprepared for 4IR, although there were indications for opportunities to harness the potential of the much-anticipated 4IR.

Another study by Makgato (2019) was influenced by the global and national literature in current trends on the forces that determine new jobs and skills for the fourth industrial revolution. This was a case study to gauge the extent of readiness in some TVET colleges for the fourth industrial revolution. The indicators used to gauge the readiness were vocational pedagogic and didactic practices; workshop material and equipment for practical training; work integrated learning, and integration of theory and practice in vocational subjects. The case covered three TVET colleges from one province in South Africa. Data was collected through questionnaires, interviews and

observations from students and lecturers, who were selected purposefully. From their findings it was concluded that those three TVET colleges were not ready for 4IR because they were found wanting in terms of offering practical activities, outdated curriculum and poor funding. The study also recommended further studies on the same issue on more TVET colleges across the nine provinces.

Makgato (2019) study had a small case size which was far from representing TVET colleges in South Africa. Oke and Fernandes (2020) study focused on readiness for the education sector in general while Makgato (2019) focused on three specific TVET colleges from one province. The current study sought to conduct a similar study using a different list of indicators, a larger sample of TVET colleges representing all the nine provinces of South Africa and collecting data from the management of academics, human resources and ICT in the 26 public TVET Colleges. This current study also employed virtual semi-structured interviews to collect data since the data was collected during the Covid-19 lockdown period.

Determining readiness of TVET colleges for the 4IR is a broad issue which could involve assessing various indicators. The researchers of this study opined to assess indicators such as teaching and learning technologies available, availability of ICT infrastructure, connectivity, competency of teaching staff, procurement of new technologies, training of staff members on the newly procured technologies, challenges associated with institutionalising technology, policy direction from authorities on matters relating to 4IR, guidance from industry partners and relevant associations on inclusion of technology in the curriculum, awareness of emerging technologies, formulation of 4IR strategy, identification of training needs and formulation of skills plans, identification of key personnel to drive the 4IR, students access to technology, and additional support required by TVETs. If 100% was scored for each of the listed indicators, few or no challenges experienced when institutionalising technology and no additional support required, then according to this research, the TVETs would be ready for the 4IR and vice-versa.

3. Methodological approach

This study was a single case study and a qualitative design. It was a case of 26 public TVET colleges from the nine provinces of South Africa. The term case study has a number of definitions, but this study adopted the one by Heale and Twycross (2018) which describes it as an intensive, systematic investigation of a single individual, group, community or some other unit in which the researcher examines in-depth data relating to several variables. This study adopted the definition as it points to an intensive systematic investigation of a community of 26 public TVET colleges drawn from a population of 50 public TVET colleges in South Africa. According to Zainal (2007) this approach enables researchers to closely examine the data within a specific context, explore and investigate contemporary real-life phenomenon through detailed contextual analysis of a limited number of events or conditions, and their relationships.

3.1 Sampling and data collection

Ishak and Abu Bakar (2014) posited that qualitative researchers focus less on a sample's representativeness or on detailed techniques for drawing a probability sample but argue that instead their focus is on how the small sample or small collection of cases, illuminates the phenomenon being studied. Therefore, the main purpose of sampling in qualitative research is to collect specific cases, events, or actions that can intensify the researchers' understanding about the phenomenon under study. This study employed purposive sampling. According to Crouch and McKenzie (2006) and De Vos et al. (2002), saturation is described as increasing a sample until a comprehensive understanding is gained and no new additional substantive data is produced. Consequently, determination of the sample size for this study was based on saturation and proportionality in the nine provinces which saw a sample of 26 out of 50 public TVET Colleges being purposively sampled.

Data for this study was collected through semi-structured virtual interviews and an interview guide with 16 questions based on the deemed 4IR readiness indicators was employed. From each of the 26 public TVET colleges interview participants were the College Principals, Deputy Principals Academic, Human Resources Managers and ICT Managers and this amounted to 104 participants. Each and every participating college had its own interview session scheduled and the 4 participants attended the virtual interview session for their college together and would respond to questions that had to do with their areas of responsibility in the college. The interviews were recorded upon participants' consent and later transcribed. This study employed the codes and coding technique to analyse the data (Atkinson, 2002). The process involved generating codes that were used for analysing the case study data and then coding the data thereby allowing for quick identification of the sections relating to the research questions and any potential themes (Atkinson, 2002).

4. Presentation of Results

4.1 Technologies at the disposal of public TVET colleges

The question sought to determine technologies available for teaching and learning activities at each Public TVET College that was to be interviewed. Respondents were asked to indicate technologies at their disposal in the TVET Colleges for teaching and learning.

Table 1. Technologies at the disposal of public TVET College

Teaching and learning technology deployed	Technologies available for teaching and learning activities		
	N	**% Contribution of the identified Technology**	**% of TVET Colleges using identified Technology**
Computers/Laptops/Tablets	26	15	100
Data projectors	12	7	46
Smart/Interactive Boards	5	3	19
Printers	2	1	8
Regular whiteboards	2	1	8
Visualizers	3	2	12
Apple Graphic Computers	1	1	4
Proxy Server	1	1	4
EduBoards/EduTouch	1	1	4
eBeam Edge	1	1	4
Flat TV screens	1	1	4
Cell phones	1	1	4
Routers	9	5	35
Automotive workshop robots	1	1	4
Welding robots	1	1	4
Video players and recorders	1	1	4
Disability assistive devices	1	1	4
Wi-Fi/mobile data/internet connection	19	11	73
Office 365 packages	6	4	23
Moodle LMS	11	6	42
Kupula/GSE FOR ME LMS	1	1	4
College-developed LMS	1	1	4
Blackboard LMS	1	1	4
Call Campus LMS	1	1	4
Student Hub LMS	3	2	12
Bright Space Core LMS	1	1	4
VastraTech LMS	1	1	4
Coltech System	2	1	8
MyPedia	1	1	4
Microsoft Teams	7	4	27
Zoom	3	2	12
Zoom Text for visually impaired	1	1	4
G-Suite Learning Centre	1	1	4
Google classroom	2	1	8
Financial Accounting Software	6	4	23
AS Tutor	3	2	12
Ask Archie	4	2	15
Facebook	1	1	4
YouTube	2	1	8
Google Play Store App	1	1	4
WhatsApp	3	1	12
Website	8	5	31
Dragon Education Software/webinar	1	1	4
E-Library/E-Books	2	1	8
Virtual Reality	1	1	4
ITS Lecturer/Student Enabler	1	1	4
Student Profiler	1	1	4
Netserver system for demo in labs	1	1	4
MIS	3	2	12
Other	2	1	8
Total mentions of technologies by respondents	**171**	**100**	
Total Responses	**26**		

Table 1 illustrates that Public TVET colleges deployed fifty different types of technologies to facilitate teaching and learning. These included Computers/Laptops/Tablets some of which were connected to the internet. Other hard technology infrastructure in use included routers, data projectors, and smart or interactive boards. The Public TVET Colleges websites and the Moodle LMS systems were the most used platforms to host and deliver teaching and learning. The MS Office 365 package, MS Teams, and Zoom emerged as essential tools to deliver teaching and learning. Some colleges had installed the robotic infrastructure in their labs, and some were deploying Virtual Reality technology.

The existence of a variety of technologies is an encouraging sign that TVETs have realised the need for employing technology in teaching and learning to brace for the 4IR dictates. This shows a shift from the old classroom blackboard tradition which is being overtaken by the rapid technological changes. The listed technologies were distributed differently amongst the participating TVET colleges.

4.2 Competency of staff members in using the existing technology

After having identified the various technologies in different TVET colleges that were part of the study, researchers also wanted to establish the competence levels of the teaching staff that were using the technologies at their disposal.

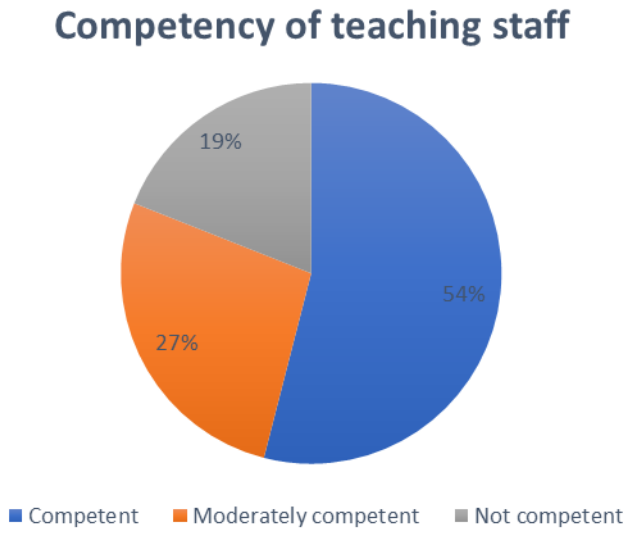

Figure 1. Competency of staff members in using the existing technology

Figure 1 illustrates that 54% of interview participants had competent teaching staff and 27% moderately competent in using the existing technologies for teaching. However, 19% indicated that their staff was not competent. Competency was attributed to training, making ICT skills a pre-requisite for employment, and the Public TVET College self-developing the LMS system which allowed them to develop in-house skills training videos that could be circulated amongst relevant

staff members. Incompetence was attributed to lack of training and technology mismatches as a result of teaching technology at their disposal not consistent with the online teaching requirements.

To show preparedness for 4IR it is critical for the teaching staff to be competent in using the technology at their disposal. If the staff is not competent, the technology would be just white elephants in the colleges, and they continue to use the old classroom method of teaching.

4.3 Procurement of new technologies and training

Researchers sought to determine whether the institution had procured any new technology/ies to keep abreast with the changing landscape due to the fourth industrial revolution. In this regard, participants were requested to indicate any new technology that would have been acquired/ added in order to keep abreast with technological advances.

Table 2. Procurement of new technologies to keep abreast with technological advances

Procurement of new technologies	**Technologies available for teaching and learning activities**	
	N	**% of TVET using identified Technology**
Valstratek LMS	2	5
Moodle	8	19
Student Hub LMS	3	7
MS Teams	3	7
Zoom	2	5
Office 365 LMS	1	2
3-D Printers	1	2
YouTube	1	2
Computers/Laptops	7	17
Visualizers	3	7
Speakers	1	2
Laser cutters	1	2
Google classroom	1	2
Interactive screens	2	5
Overhead projectors	1	2
Document cameras	1	2
Robotic welding arms	1	2
Pastel Financial Management	1	2
MyPedia	1	2
Technology infrastructure for conference facilities	1	2
Total mentions of technologies by respondents	**42**	**100**

Table 2 illustrates that the Public TVET Colleges recently added twenty different teaching technologies with the Moodle LMS remaining attractive as it was added by most colleges. 4IR demands the use of technology in delivery of teaching and learning. The use of LMS has become the way to go. At least some colleges realised the need for these and procured these technologies to become prepared to operate in the technological era.

A follow up question was asked to establish whether the teaching staff was trained to use the newly acquired technologies. Responses showed that 65% of participants had provided training on the newly acquired technology to the relevant employees, that training was provided by suppliers for all the newly acquired technology and that it was generally provided on an ongoing basis. 35% of the participants indicated there was no training provided at all because there had not been any technology procured and that they were still identifying staff that might require training. Training is crucial for the relevant staff to be able to employ the available technologies. It was encouraging to note that those that had recently procured new technologies had their staff trained. This equips and empowers staff for preparedness to operate in the 4IR.

4.4 Challenges associated with institutionalizing technology

The question sought to determine challenges associated with institutionalizing technologies within the Public TVET Colleges.

Table 3. Challenges associated with institutionalizing technology

Challenges	**Challenges associated with technologies**	
	N	**%**
Rural/Poor/Funding	13	15
Negative Attitude	19	21
Aging Workforce	5	6
Security/Vandalism	1	1
Gadgets and data for students	5	6
ICT Infrastructural challenges	12	13
Lack of staff and students training	12	13
Electricity unavailability/load shedding	3	3
Lack of ICT Strategic Plan	1	1
Connectivity	13	15
Lecturers without teaching training	4	4
Support from Service Providers Training/ Skills Mismatches	1	1
Total mentions of challenges mentioned by respondents	**89**	**100**

Table 3 illustrates that challenges around the negative attitude towards using technology, connectivity, lack of funding, lack of training for staff and students, and ICT infrastructural challenges were flagged as significant issues. Participants acknowledged that both students and academic staff had connectivity on campus; but students could not however keep on participating meaningfully and access the institutions learning management systems offsite as many of them were struggling with data. The cited challenges are a hinderance towards TVETs preparedness to operate in the 4IR. These need to be addressed to allow the colleges to forge ahead with preparing for the 4IR.

4.5 Policy direction from authorities and guidance from industry partners and associations

Researchers sought to determine whether the institutions had received any policy direction from authorities on the fourth industrial revolution. Respondents from all the 26 public TVET colleges indicated they had not received any policy direction on how to move towards the fourth industrial revolution. However, instead of a clear policy directive, the Department of Higher Education, Science, and Technology drafted a number of documents encouraging colleges to participate in external bodies on 4IR skills and technologies which are instrumental in Public TVET staff capacity building. Lack of policy direction is a huge barrier in stalling the preparedness of TVETs to operate in the 4IR. Some colleges might take a long time to realise the rapid technological changes in their space depending on their location, whether in the urban location or rural. Also, the type of leadership in some colleges might not be technological savvy hence they would resist change and hinder preparedness towards operating in the 4IR. In this regard a policy directive becomes very necessary.

4.6 Awareness of emerging technologies and formulation of ICT strategies

Participants were also asked to indicate if their interactions with the industry partners and related associations made them aware of any new emerging technologies which might be necessary to prepare students for the world of work, where the expectation is that technology will be dominating. Figure 2 shows that 92% of the participants indicated they were aware of the emerging technologies in one area or the other while 8% indicated that they were unaware of any emerging technologies in their own space. Those that were aware of emerging technologies had committees in place to track these technologies and the idea behind tracking these technologies on an ongoing basis resulted from the realisation that technologies change rapidly. Some colleges indicated they became aware of Bright Space; CISCO Webex; simulation technologies; augmented and virtual reality; artificial intelligence which could be used in engineering; 3D; and robotic infrastructure from industry partners for education purposes. Those that did not have a functioning LMS had been made aware of IQ Hospitality, the Host, Auto Cad, Typing Tutor, interactive screens in the classrooms and the Google classroom.

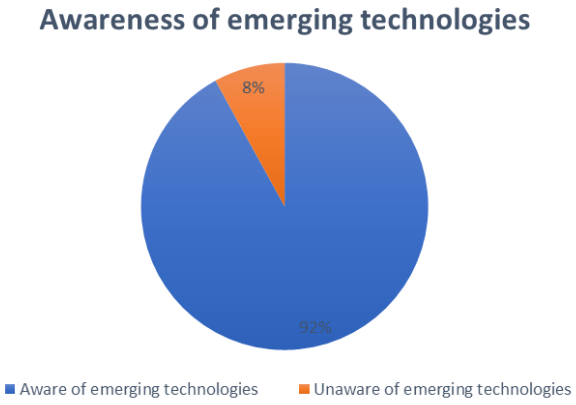

Figure 2. Awareness of emerging technologies

Being aware of new teaching and learning technologies on the market engages the TVETs in considering which ones to procure for advancing their preparedness to operate in the 4IR. It was also encouraging that 92% of the participants were aware of new technologies and this would push them to do something about procurements. Being ignorant of new technologies would be the worst scenario because it is not a pushing factor into action.

A follow up question was asked to establish the formulation of ICT strategies as a result of their awareness of emerging technologies. Responses showed that 50% of the Public TVET colleges had formulated the ICT Strategies to guide them in procurement of 4IR technologies to promote teaching and learning and they kept updating the strategies to incorporate new technological advances. The other 50% had not formulated ICT Strategies but had put steering committees in place to develop the strategies. This question sought to establish whether participants had determined the direction of their college in terms of ICT procurement to embrace the technological advances in teaching and learning in the 4IR. Lack of a strategy is tantamount to lack of vision and those colleges that did not have strategies would have challenges in keeping abreast with the rapid technological changes in the 4IR. Those with the strategies in place would be better placed in working towards preparedness for the 4IR.

Another follow up question was for participants to indicate whether they had identified key personnel to drive the formulated ICT strategies, training needs and formulated skills plans to respond to the changing landscape due to the 4IR. 54% of the participants indicated their institutions had identified key personnel, and 46% indicated they had not identified key personnel that would drive the ICT strategies as they flagged the lack of ICT strategy as their main ‘derailer’. Having key personnel in place to drive the ICT strategy is critical in embracing the technologies by staff in the colleges as these would be responsible for the employment of the available technologies, organising training and championing the technologies in their colleges. All this contributing towards 4IR preparedness.

Responses also showed that 85% of the participants indicated they had identified the relevant staff training needs as part of their response strategy and also to equip them so that they are ready to operate in a technology-driven environment. These also indicated that they had training committees in place that looked after the training needs. However, 15% indicated they had not identified the training needs and attributed this to the lack of training committees and lack of emerging technologies identification committees that could assist in scanning the environment for the emerging technologies. The risk here was that even if technology were to be procured, it would find relevant staff members not yet ready to leverage it.

On the question of skills plans, responses showed that 35% of the participants had not formulated any skills plans to document and respond to their staff members technological needs. The concern here is that these staff members might not be in a position to interact with technology and hence fail to impart necessary skills to their students to enable them to successfully participate in the technology-driven economy. However, it was encouraging that 65% of the participants had put

together skills plans to document and respond to their staff members' technological needs. These had committees that tracked the emerging technologies and then feed this back to the relevant structures that dealt with training and skills. The 4IR demands certain skills that were not in existence before. Therefore, putting in place skills plans advances preparedness to operate in the 4IR era.

4.7 Access to technology by students

Participants were asked to indicate the extent to which their students were able to meaningfully participate in teaching and learning with all the new technologies in place. To this question all the 26 TVET colleges indicated a moderate extent. The explanation was that within the campus environment, students could participate meaningfully as there was WiFi connectivity. However, the moment the students left the campuses, other challenges such as lack of data in their homes emerged. This situation slightly improved when some of the educational sites were zero-rated at the time of data collection due to the Covid-19 pandemic hard lockdown. Some participants also raised concerns that even though they issued computing gadgets to students, these were always at risk of getting lost/stolen as most of the students used public transport. Failure by students to participate meaningfully as a result of lack of or inadequate ICT infrastructure stalls TVETs preparedness for the 4IR. This is very critical because the students should be equipped with the necessary skills to fit into industry when they join the world of work which is dominated by technology.

4.8 Additional support required

Participating TVET colleges were asked to indicate additional support they required to be ready to teach in the 4IR era and deliver the cohort of students ready to enter the world of work powered by technology.

Table 4. Additional support required to deliver the cohort of students ready for the 4IR

Additional support required	**Additional support required**	
	N	**% Contribution of the identified assistance**
Staff training	22	30
Computers/Laptops/Tablets	12	16
Data/Wi-Fi/Internet connection	13	18
Funding	8	11
Sufficiently ICT trained staff	8	11
Change Management	4	5
Technical advice	5	7
Mobile data for employees	2	3
Total count the assistance was identified	**74**	**100**

Table 4 illustrates that respondents identified eight essential needs that reflected additional support required. Results indicated that Public TVET Colleges mostly required training of teaching staff, sufficiently trained staff in ICT, funding, computing equipment, technical advice and

connectivity. The additional support required indicates what is lacking in TVETs to meaningfully prepare for the 4IR. Some of the needs indicated are too basic and critical such that their absence from the colleges is a sign that a lot still needs to be done towards preparing for 4IR.

5. Discussion

This study aimed at determining the readiness of South African public TVET Colleges to operate in the era dominated by machines. Preparedness of the TVETs for 4IR was gauged by assessing the indicators deemed critical to prove preparedness for the successful operation in the fourth industrial revolution by researchers of this study. This study increased the sample size from the three TVETs from one province in a study conducted by Makgato (2019) to 26. The scope was also increased in this study to all the nine provinces of South Africa. The interview participants were the management who were directly responsible for providing the teaching and learning technologies and all the logistics required in the running of the day-to-day teaching and learning activities, decision makers in the procurement of technologies and training of the relevant staff in using the available technologies. The study concentrated on a specific sector of education unlike the Oke and Fernandes (2020) study which looked at the same issue of readiness but generally on the education sector. This study provided some depth in determining readiness in the public TVET sector.

In all the indicators assessed and presented in the findings, it was only the policy direction that totally lacked but all other indicators had some percentages of presence. This is a clear indication that there was a positive move and effort by public TVET colleges towards preparedness for 4IR. The different percentages of the indicators' existence correspond to the levels of preparedness for 4IR and could be attributed greatly to the Covid-19 pandemic. The lockdown could not allow for face-to-face classroom interaction anymore and TVETs were left with no choice except to do everything necessary to allow for continuation of teaching and learning. This situation prompted a number of colleges to procure teaching and learning technologies, train their staff on the use of the available and newly procured technologies, formulate ICT strategies, identify key personnel to drive the ICT strategies, and develop skills plans for their staff among other things. Covid-19 accelerated the move towards web-based learning.

Though a case study cannot be used to generalise findings, in this case 26 out of the 50 public TVETs in South Africa is a 50% representation and since these are funded and regulated by the same authority, findings from this study could be generalised to apply for all the public TVETs in the country. A similar study could also be conducted in private Higher Education Institutions in South Africa to compare how these are doing in terms of preparedness for 4IR.

6. Conclusion

4IR has impacted on all aspects of life causing the fusion of physical, digital and biological worlds. The impact of this technological revolution has not spared the education and training sector whose role is to deliver relevant cohorts of future employees in the industry that is dominated by rapid technological changes. This study assessed the indicators of preparedness to operate in the 4IR by public TVET colleges through interviewing participants. It was established that most of the colleges had realised the need for the use of technology for teaching and learning hence they had some in place prior to this study and some colleges also made additional procurements. It was also established that the majority of staff were competent in using the technologies at their disposal and that training was ongoing in some colleges for the recently procured technologies. Some challenges that were experienced during institutionalising technology stalled preparedness towards 4IR. Most of the colleges identified key personnel for championing technology and driving the ICT strategies and developed skills plans. The students in all colleges had access to the online learning materials on campus but could not access it once they were off campus. It was not encouraging to note that there was no policy directive on 4IR for TVET colleges from the Department of Higher Education, Science, and Technology. Basing on all these findings, it was concluded that public TVETs in South Africa had embarked on the road to preparing for 4IR but they were not yet fully prepared because of lack of policy direction from authorities; incompetence of some teaching staff from some of the colleges; challenges experienced in institutionalising technology; lack of ICT Strategies, lack of key personnel to drive the ICT strategies, and lack of skills plans; inability by students to access online teaching and learning material off campuses; and the additional support they needed to operate in the 4IR.

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