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The WRC operates in terms of the Water Research Act (Act 34 of 1971) and its mandate is to support water research and development as well as the building of a sustainable water research capacity in South Africa.

DEVELOPING OCCUPATIONAL QUALIFICATIONS AND SKILLS PROGRAMMES FOR THE SOUTH AFRICAN WATER SECTOR

Lesego Gaegane[a], Yazeed van Wyka, Brian Delcarme[b]
[a]Water Research Commission, [b]Earthstep Environmental Academy

South Africa's principal challenge is to reduce poverty and inequality. Across the globe, there is a growing interest in young people engaging in work-based learning (WBL) provisions as part of their initial occupational preparation and vocational training. In particular, young people deserve better educational and economic opportunities, and focused efforts are required to eliminate gender inequality, especially in the workplace. Promoting gender equality and greater employment opportunities for young people are integrated themes throughout South Africa's National Development Plan. Education has intrinsic and instrumental value in creating societies that can better respond to the challenges of the 21st century. Lifelong learning, continuous professional development and knowledge production alongside innovation are central to building the capabilities of individuals and society as a whole.

Freshwater availability is essential for human life and for economic and ecosystem stability, however, the amount of water available to meet demands is more than what is available. This necessitates a sustainable approach to water resource management which not only addresses the scientific and technological solutions but the skills that are required to leapfrog the water sector to meet sustainable development goal 4 and 6. South Africa's main water resources are surface water (rivers, lakes, wetlands, dams), groundwater, rainwater, desalination and recycled water. These resources are being diminished rapidly, requiring skilled professionals with scarce siltation management, groundwater, and water infrastructure skills to develop sustainable water security solutions. These challenges within the water sector created an opportunity that requires a transformative approach to capacity building and skills development. The Department of Water and Sanitation and key sector roleplayers identified the need for critical occupational qualifications and skills programmes to be developed for siltation management and water resource infrastructure. This paper synthesises the Water Research Commission's approach to developing FETWater III occupational qualifications and siltation management skills programmes from research outcomes to transform water resource management and, more importantly, plug the critical artisanal skills gap as a mechanism to develop a critical mass of skilled professionals and reduce youth unemployment respectively.

1. Introduction

1.1 Background

The South African water sector is a critical industry that requires a skilled workforce to ensure the reliable and sustainable provision of safe water and sanitation services to communities across the country. Occupational skilled professionals are in high demand in South Africa; however, there is a shortage due to a lack of occupationally directed education and training. The 2019 ManPower Group skills shortage report highlighted a global skills shortage of 54%, while South Africa has a 34% skills shortage, with skilled trades among the most challenging skills to find (ManpowerGroup, 2018). Early in 2022, the Department of Basic Education announced its plans to introduce a new set of subjects for grade 10 to 12 learners focusing on technical and artisanal skills. These new subjects will enable learners to focus on a vocational stream early in their education rather than an academic one, which all learners might not prefer, and this will prepare them for the workplace (schools, 2022). This stems from the Department seeing a rise in the demand for vocational skills and occupational-based professionals. This approach also equips the learner with adequate knowledge and practical experience to become employable. The Department of Basic Education also uses this approach to uplift and amplify the value of artisanal trades.

The water sector is multifaceted and requires technical, managerial, trade, engineering, and scientific skills. The general perception within South Africa, and the water sector at large, is that professionals with traditional academic education are more suitable and qualified than their vocational-educated counterparts. However, in most instances, water sector organisations and municipalities employ vocationally educated professionals to implement certain projects due to their skills. The water sector needs to have a paradigm shift in how occupational-based professions are viewed, as they are not inferior to academically educated professionals. According to Allen Gray, for South Africa to close its skills gap shortage, the country needs to produce approximately 30 000 qualified artisans annually by 2030 (Kriel, 2022). However, the country only produces half that number (Malik, 2022) and needs to expedite the transition to growing the occupationally directed education, training, and development stream.

For a thriving water sector that contributes towards meeting the United Nations (UN) Sustainable Development Goal (SDG) 6 and, in this context, SDG 4, groundbreaking solutions must be supported by appropriate skills. Water sector professionals require upskilling, reskilling, and capacity development. This paper details the process that the WRC followed to develop and register skills programmes and occupational qualifications for the water sector, gaps identified in the development process, and recommendations outlining how future occupational-directed and work-based learning can be streamlined and applied in other sectors.

1.2 Occupational qualifications and skills programmes

The Quality Council for Trades and Occupations (QCTO) is mandated to oversee the design, implementation, assessment, and certification of occupational qualifications, including trades, on the Occupational Qualifications Sub-Framework (OQSF). The QCTO began updating and redesigning national qualifications for the occupations on the DHET's National List of Artisan Trades in 2012 and the Organising Framework for Occupations (OFO). The QCTO offers guidance to skills development providers whom the QCTO must accredit to offer occupational qualifications. The methodology adopted to ensure that a practitioner is competent and confident in carrying out his/her job effectively was to consult with industry experts on defining the work involved in each of the proposed trades. This resulted in the development of an occupational profile – which is an up-to-date description of the work involved and the knowledge, skills and competences required - for each trade.

The syllabus developed for the 21st century referred to as the National Occupational Curriculum Content – A21 (NOCC-A21) is used as a guiding step-by-step process for all registered occupational qualifications to be translated into a detailed syllabus. The important design principle of the NOCC-A21 is that it ties in simulated practice, theoretical knowledge on the subject matter and workplace-based experience into a single, integrated learning programme. One fundamental change that has been introduced into this approach, compared to the QCTO curriculum framework, is that the practical skills module is the starting point of each learning project instead of the knowledge module. This illustrates that knowledge is a supporting element to practical skills and not the driver of all learning. The whole process is structured in such a way that the NOCC-A21 approach is strongly aligned to the QCTO curriculum framework to ensure that all the elements in the original QCTO qualification has been adequately covered. The NOCC-A21 approach is summarised in the flow chart in figure 1.

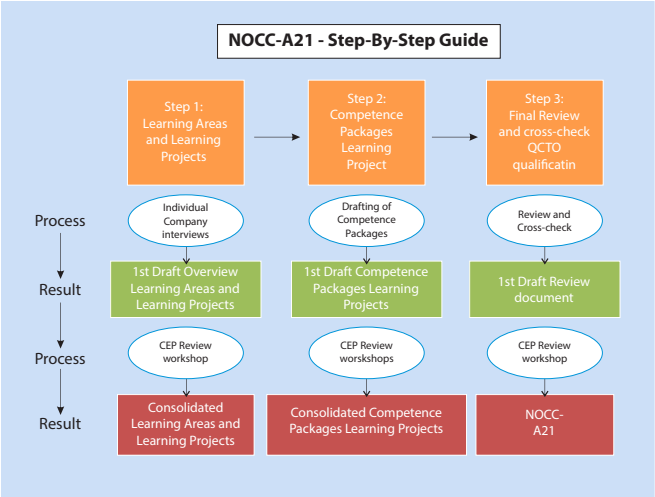

Figure 1. NOCC-A21 flow chart summarising key steps (DHET, 2016).

2. Occupational qualification and skills programme development in South Africa

The development of occupational standards and qualifications is one of the QCTO's main priorities in supporting learning for the workplace. It is vital that an occupational qualification responds and addresses South Africa's skills development priorities, labour market needs and development state initiatives. The QCTO manages the Occupational Qualifications Sub-Framework (OQSF), which is one of the three integrated sub-frameworks of the National Qualifications Framework. In addition, SAQA registers occupational qualifications on the OQSF as recommended by the QCTO. An Occupational qualification is a qualification associated with a trade, occupation or profession resulting from work-based learning. Occupational qualifications make work experience an important part of learning. Skills programmes are a combination of specific knowledge, practical and work experience modules extracted from the registered parent (full) occupational qualification. This combination not only leads to an employable skill, but also allows the acquiring of credits on the National Qualifications Framework (NQF) leading towards a full occupational qualification. The two widely used occupational classification systems in South Africa are the South African Standard Classification of Occupations (SASCO) and the Organising Framework of Occupations (OFO). The skills programmes-centered approach builds on existing skills and knowledge, driving a dynamic and flexible process of change, borne by local stakeholders (Zamfir, 2017). This approach is meant to strengthen quality from formulation to implementation, and ensure it fosters sustainable results by building relevant national capacities (Zamfir, 2017). The main emphasis is on training employees in the water sector and providing them with skills, knowledge and workplace exposure which is not only beneficial to the individuals concerned but more importantly to water related service delivery and the broader community. Skills programmes-centered approaches attempt to increase the water sector's capacity to solve its collective problems. The skills programmes-centered approach was chosen for siltation management because traditional ways of teaching and learning often tends to compartmentalise learning into small 'un-connected units', teach out of context, and most importantly not always demonstrate the connection between theory and practice. This approach to siltation management will benefit the water sector by addressing skill gaps through tailored learning and development, continued professional development for leadership and growth, improved productivity and performance, and enhanced employee recruitment and retention.

Education, training, and development are often used interchangeably; however, they are different. Training is the learning of new on-the-job skills that are needed for a specific job. Effective training programmes usually include a combination of instructor-based intervention and hands-on experience that helps practice the newly acquired skills or knowledge. Education refers to more theoretical knowledge that is meant to improve employees' reasoning and judgment. Development is related to the acquisition of knowledge and skills that are wider in their scope and that are seen as contributing in a broader sense to employees' overall personal and professional growth (Dolan & Capell, 2015). Occupationally directed education training and development practice is an innovative way to create opportunities that are contextualized to industry specific needs.

2.1 Framework Programme for Research, Education and Training (FETWater)

In 1996, the then Department of Water Affairs and Forestry (DWAF) requested support from the United Nations Educational Scientific and Cultural Organisation (UNESCO) and the World Meteorological Organisation (WMO) to assess

education and training needs for integrated water resources management in South Africa. These organisations agreed, and the assessment was conducted in 1998 at national, provincial and community levels. The assessment evaluated the education and training needs and capacities of DWAF and linked them with the needs of other government departments, non-governmental organisations and the private sector. The assessment considered various imperatives, including South Africa being a country in transition, its affirmative action policy, staff and career development concerns, capacity building required for achieving sustainable development, and the need to link and interact with efforts by Southern Africa and the international community. The assessment identified gaps in structured networking among water academics about curricula and employers' needs and that recent concepts in water resources management have direct implications for South Africa's integrated water resources management approach, thus, education and training would be required for its practical implementation. The outcomes of the assessment stimulated the DWS to establish the Framework Programme for Research, Education and Training (FETWater) to foster effective cooperation for the provision of education, training, and capacity building needs in the water sector.

FETWater Phase III (2014 – 2020) focused on six thematic areas, with the objective of achieving proper uptake and sustainability beyond 2020. The thematic areas were listed as Water Resources Infrastructure, Water Monitoring and Assessment, Water Resources Planning and Implementation, Water Regulation Requirements, Water Use Services and Sanitation, and Institutional Management and Governance. To enhance the sustainability of FETWater offerings in the capacity building and training (CB&T) environment, an occupationally directed approach aligned with professional bodies and the QCTO requirements was seen as imperative for planning and developing of learning materials, registering the qualifications, and piloting the developed materials and qualifications in appropriate but agreed upon settings. The emphasis of which was to address the limitations of the previous phases, and establish closer links between networks, QCTO, Sector Education and Training Authority (SETA's), Water and Sanitation Sector Leadership Group Skills Task Team (WSSLG STT) initiatives in support of the National Water Resource Strategy (NWRS) 2 and the National Skills Development Strategy (NSDS).

Networks were convened in the form of a Community of Expert Practitioners (CEPs) to look at Pre-Scoping, Scoping, Qualifications, Curriculum, Assessment Specification and Verification of the various occupational qualifications. The NOCC A21 approach was used to develop purpose statements, occupational tasks, details for each task and its accompanying occupational responsibilities remained the same. The EWSETA and LGSETA played a fundamental role in FETWater III as the Development Quality Partner (DQP) for the Water Resource Management Practitioner, Water Regulation Practitioner, Water Infrastructure Manager, Water Reticulation Officer, Water Liaison Practitioner, Water Process Controller, Water and Sanitation Coordinator, Water Use Specialist and Water Data Collector qualifications.

The OCTO described FETWATER III as a flagship sector programme when it comes to sector coherence and collaboration. This has been due to EWSETA and LGSETA playing a pivotal role in the programme by taking on the DQP role. The assessment methods, tools and competency ladder to develop practical skills in learners was developed following the National Occupational Curriculum Content (NOCC) approach. The learning material has been developed, written and reviewed for each qualification and has since been piloted, refined and mainstreamed on a block-release basis for 18 months. The FETWater website can be consulted for more in depth information regarding each of the occupational qualifications. (www.fetwater.co.za)

2.2 The National Dam Siltation Management Strategy for Dams (NatSilt) skills programmes

Due to institutional fragmentation in South Africa, it is currently difficult to implement siltation management holistically. The DWS required a multi-disciplinary approach to sustainable dam management while simultaneously developing new skills and creating a community of practitioners to support the implementation of the National Dam Siltation Management strategy. There was a need to understanding specific dam siltation management skills requirements and support institutional structures which will allow for the development of appropriate and relevant training and capacity development.

In 2018 the DWS acknowledged that adequate and well-maintained water infrastructure is an essential component for economic growth to improve the quality of life of South Africans and for poverty reduction, which was being compromised by siltation. Through engagements with researchers, academia and water sector specialists, it was highlighted that an understanding was needed of catchment systems and siltation processes sufficient to oversee activities designed to reduce dam sedimentation and enhance water supply and water storage capacity. A directive was issued to the WRC by the DWS in 2019, siltation management skills programmes were conceptualised to develop a new cohort of skilled siltation management professionals and enhance the contribution to better long-term dam siltation management. The approach was to develop skills programmes that would embed training, skills and capacity development to the water sector that will enable organisations and individuals to adapt to the technological changes and challenges by effectively adopting new systematic ways of managing siltation.

With a shortage of the key and scarce skills required for dam siltation management, the WRC recognised that the skills programmes needed to provide water professional, dam practioners and learners with essential knowledge

and skills in the workplace for both technical and managerial focus areas related to siltation management. Through an assessment of the siltation management value chain, four skills programmes that cover the spectrum of integrated dam catchment management were conceptualised in 2020. The four skills programmes entail the stakeholder engagement, technical, engineering, socio-ecological, scientific, governance, policy, catchment rehabilitation consideration aspects required in integrated siltation management that will enhance water resource management that ultimately leads to water security.

The external environment and dam siltation management practices revealed that dam siltation management takes place at the level of management, technical, operational and advocacy. A Community of Experts Practitioners (CEP) was established similar to that carried out under FETWater III from the water sector to identify and determine what the specific water sector professional skills needs were to implement siltation management confidently and competently. The CEP then consolidated the dam siltation management activities and practices into respective skills programmes. The CEP developed an occupational purpose for each of the specific skills programmes. The occupational purpose was subsequently translated into knowledge, practical and work experience modules which replicated what the professional needed to do confidently and competently. Thereafter the skills programmes were workshopped within the constructs of the QCTO.

Figure 2 illustrates the four NatSilt skills programmes developed with their parent SAQA registered qualifications and their competency levels.

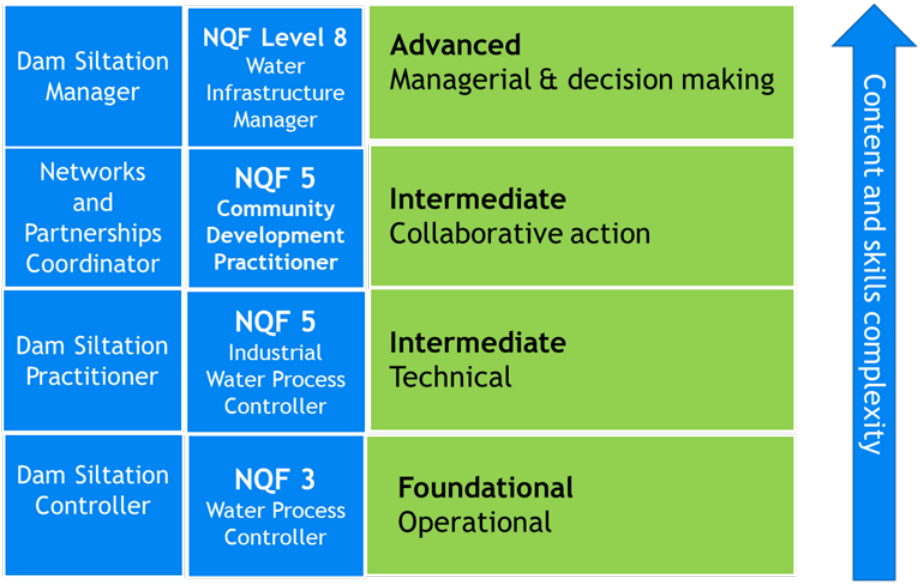

Figure 2: Siltation Management Skills Programmes.

3. Key Challenges for the effective implementation of both occupational qualifications and skills programmes

There are several key challenges that can affect the effective implementation of both occupational qualifications and skills programmes. It has been shown that the turnaround time between qualification development until the point that it can be offered by an accredited provider is too long. A more streamlined approach is needed, in terms of 'unblocking' the system and building credible occupational qualifications that meet industry requirements. Accreditation is essential for ensuring that occupational qualifications and skills programmes meet national and international standards. Accreditation processes can be complex and time-consuming, and navigating them can be a challenge for training providers and learners. Occupational qualifications and skills programmes need to be recognized by industry and government to ensure that learners can use their qualifications and skills to find employment or advance their careers.

Low uptake of qualifications is regarded as a huge challenge to the system. The SAQA website shows that many qualifications have no learning programmes recorded against them and no providers are currently accredited to offer the qualification (Blom, 2016). SETA Sector Skills Plans report no or low uptake of qualifications since their registration. SAQA also reports that qualifications often cannot be registered because of a lack of alignment between the whole and part-qualifications (Blom, 2016). Part-qualifications are recommended with more than 120 credits while full qualifications are recommended with credits less than 120 without providing the rationale for such a recommendation. Different entry requirements for parent qualification

and part-qualifications similarly cause systems blockages (QCTO, 2019). Entry requirements for part-qualifications are often lower than the entry requirement for the parent qualification; moreover, the part-qualification does not provide modules to allow the learner to enrol for the parent qualification. An example given was that the parent qualification may require mathematics and communication at NQF level 4, but the part-qualification requires mathematical literacy at NQF level 3. There are no modules in the part-qualification that provide opportunities to obtain mathematics or communication at NQF level 4.

Effective assessment and evaluation are critical for ensuring that learners have gained the necessary skills and knowledge from occupational qualifications and skills programmes. Developing and implementing effective assessment and evaluation processes can be challenging, particularly in cases where learners have different learning needs and styles.

Keeping learners engaged and motivated throughout the duration of occupational qualifications and skills programmes can be a challenge. Developing effective support mechanisms and strategies to keep learners engaged and motivated is essential to ensure that they complete their programmes successfully.

These are just some of the challenges that South Africa is dealing with when it comes to offering quality apprenticeships.

4. Discussion

Youth unemployment is almost 60% (Maluleke, 2021), and South Africa has only 50 TVET colleges, there is an opportunity to reduce the unemployment rate by strengthening the apprenticeship model and putting in place enablers to support the work-based learning approach. This can be achieved through implementing the following policy recommendations; effective institutional and legal frameworks, effective governance, enhancing the standing and status of TVET colleges and the occupations it serves, developing the capacity of workplaces to provide effective learning experiences, aligning TVET provisions with employment opportunities in terms of the needs of industry sectors and occupational fields, building and sustain social partnerships that support TVET and WBL experiences across all speres of government and private sector, promoting gender inclusivity and promoting localised engagement between TVET institutions and workplaces.

The Water Research Commission is developing its firm innovation capabilities that could lead to sector disruption in developing new cohorts of professionals for the water sector. Both the FETWater III qualifications and the NatSilt skills programmes could be seen as policy innovations where the DWS and local municipalities mandate all their staff working within the relevant thematic areas to enrol for these qualifications to further build their skills set and for those who already have some form of qualification to be upskilled through the recognition of prior learning (RPL) policy. This will allow not only DWS and municipal officials, but everyone enrolled for a particular qualification or skills programme to be better prepared for the workplace and competently carry out their day to day work activities. In addition, this can also allow for Continuous Professional Development (CPD) points to be earned as it is often required for maintaining professional licenses or certifications.

Although the development of skilled siltation management professionals is still in its infancy, this could start a disruptive innovation in the water sector and change dam management worldwide. The social impact that will be seen from both the FETWater and NatSilt qualifications could be monumental in not only creating and sustaining jobs, but also ensuring that continuous upskilling and pioneering approaches to capacity development are institutionalised within the water sector.

The development of the nine occupational qualifications under FETWater III is an entirely new product and application which was lacking in the water sector. This new product was derived from the various unique knowledge and experiences of diverse water expert practitioners. The water sector will now have the ability to transform capacity building into a competitive advantage and address the challenges posed by the proficiencies of other sectors. The knowledge, skills and ideas obtained through these occupational qualifications can also be transferred to industry and other sectors by means of collaboration, partnership, and joint ventures. The qualifications and skills programmes have been developed for occupational training to produce competent and skilled workers in the water sector, although some materials can be used for academic training in tertiary institutions. The role played by WISA, EWSETA, LGSETA, QCTO in the FETWater qualification design and development cannot be underscored as they have assisted in the potential commercialisation within the education and water sector, respectively. "By industry for industry" is a key concept driving the new approach to skills development. Industry is actively encouraged to get involved in the qualification development process to ensure the relevance of the qualification.

The four skills programmes developed under the National Dam Siltation Management Programme each have a Recognition of Prior Learning framework allow water sector professionals who do not have the pre-requisite NQF level qualification but have years of experience to benefit from the process. This allows them to be able to access entry into the skills programmes ad upskill themselves.

The water sector will benefit from a pool of skilled and qualified Siltation Management practioners by providing the skills to manage the operations and maintenance of dam infrastructure efficiently to achieve sustainable water

services to all consumers. Society will benefit from improved and sustainable long-term asset performance as a basis for water security through the efficient management of dam infrastructure. The economy will benefit from improved asset management, optimizing maintenance and refurbishment expenditures and cost reduction, as well as the creation of income generation and employment opportunities associated with dam siltation management activities.

The NatSilt skills programmes will be adopted by the DWS Infrastructure Branch Training Centre (IBTC) which is the Departments education and training service centre for water infrastructure related qualifications. Through the IBTC, DWS staff will be enrolled to the various skills programmes which will see the institutionalising of Siltation Management within the Department.

The WRC was able to take outcomes of the research and implementation projects and develop critical occupational qualifications and skills programmes that will enhance the water sector capabilities. The FETWater qualifications and NatSilt skills programmes have enabled operationalisation of research outcomes.

5. Recommendations

The water sector is expected to undergo significant changes in the coming years, driven by factors such as climate change, population growth, and technological advancements. As a result, there will be a growing need for skilled workers who can adapt to these changes and effectively manage water resources.

- The following recommendations are outlined to streamline future occupational-directed and work-based learning in the water sector and applied in other sectors.
- Challenges critical to water safety and security needs to be identified. Future skills programmes and occupational qualifications then need to be developed which will enable water professionals to effectively address those challenges
- Skills programmes must be linked to the key performance areas of the water sector professionals to facilitate immediate uptake
- The water sector should be agile enough to develop systems that allow the continuous reviewing of job descriptions and roles of the workforce
- Attaining continuing professional development accreditation for occupational based qualifications and professions will elevate the profile
- With climate change and other environmental pressures placing greater demands on water resources, there will be a growing need for workers who can develop and implement sustainable water management practices. Occupational-directed and work-based learning programs will likely focus on topics such as water conservation, reuse, and recycling
- Technology: Advances in technology are rapidly transforming the water sector, with new tools and systems being developed to monitor, manage, and treat water resources. Future occupational-directed and work-based learning programs will need to equip workers with the skills and knowledge to effectively utilize these technologies, including topics such as data analytics, automation, and machine learning
- When developing occupational based qualifications, RPL frameworks should be developed simultaneously so not to prejudice learners from accessing entry
- Overall, future occupational-directed and work-based learning in the water sector will need to be flexible, adaptable, and responsive to the changing needs of the industry. By providing workers with the skills and knowledge they need to manage water resources effectively, these programs can help ensure a sustainable and prosperous future for the water sector

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