Implementation of the Revised Electrical Technology Curriculum in Selected South African Secondary Schools

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Abstract: Curriculum revision has always been a continuous feature in the South African educational system for the past two decades. This was intended to address the issue of scarce skills shortages in key secondary school areas for the development of the curriculum, one of which is Electrical Technology. The study investigated the effectiveness of the revised Electrical Technology curriculum and how it is implemented, with the goal of determining the successes and challenges encountered by teachers during the process. The interpretivist case study with a narrative review and data were gathered using the qualitative method of semi-structured interviews. Four Electrical Technology subject teachers from four geographically linked case study schools were chosen as a pragmatic sample. Thematic analysis was used to analyse the interviews, which were conducted in accordance with the study objectives. Inadequate teacher training on curriculum implementation and a lack of relevant teaching and learning support material are among the findings. The study concludes that teachers should be given opportunities for continuing professional development as well as the chance to further their education studies in order to improve their content knowledge. The provision of adequate teaching and learning support material, as well as well-equipped infrastructure, will fundamentally play a critical role in the effective teaching and learning of Electrical Technology subjects in schools.

Keywords: Electrical Technology, Technology subjects, Revised curriculum, Curriculum implementation, experiences

1. Introduction

Most African countries began the process of curriculum revision as soon as they gained sovereignty and independence from colonial masters. They modified their school curriculum to decolonize the previous curricula in order to accommodate the increasing expectations of their communities and focus on promoting their cultural identities. South African Education Departments (Higher and Basic) initiated a curriculum reform and restructuring as an effective means of meeting the citizens' and society's needs for rapid economic growth (Molapo, 2016; Kokela, 2017). This restructuring was meant to make the curriculum more impactful and able to respond to social and economic needs by providing learners with actual knowledge, expertise, and meaningful competencies (Mulenga & Kabombwe, 2019).

In South Africa, all curriculum reforms since the advent of democracy have been taken as disastrous because teachers frequently feel unsupported or undertrained to meet the demands of the revised curriculum and lack the necessary content knowledge to carry out their teaching duties (Lidegran, Hultqvist, Bertilsson & Börjesson, 2021). Teachers lack pedagogical content knowledge and familiarity with philosophies that inform the implementation of curriculum change. Despite extensive research on national curriculum reform, understanding the way in which South African teachers have been supported in adapting and adjusting to curriculum change remains a question (Themane & Thobejane, 2019). Complicating the implementation of the revised Electrical Technology curriculum, there has been a shortage of subject education specialists who specialize in Electrical Technology so that they can give support to ET teachers in schools during curriculum implementation (National Planning Commission, 2012). A change in curriculum necessitates a change in the function of the teacher (Van der Nest, 2012).

Electrical Technology (ET) is one of the technology subjects that was revised in 2013 and that put more emphasis on the application and comprehension of electronic and electrical concepts (Department of Basic Education, 2014a). As a revised subject, ET focuses on three major areas of specialization that are: Power Systems, Electronic Systems, and Digital Electronics and this affects the current teacher's pedagogical content knowledge. The revised curriculum is based on NATED 550 subjects that were

implemented prior National Curriculum Statement's (NCS) inception in 2004. There were several systems in place to support the revised curriculum's implementation. First, there were trainings for teachers and subject education specialists on the revised curriculum before it was implemented. Other district personnel were keeping an eye on the implementation procedures to make sure the curriculum was being implemented correctly. In addition, policy documents, textbooks and other materials were offered without regard for the state of the schools.

Many researchers (Eyitayo, 2021; Mpungose, 2021; Nkosi & Adebayo, 2021; Willemse, Venketsamy & Swanepoel, 2022) concentrated on the successful implementation and implications of the Curriculum Assessment Policy Statement (CAPS) for classroom instruction rather than the difficulties involved with it. However, beyond the opportunities and challenges of implementing the CAPS curriculum, the researcher in this study observed ways that can be flexible for the teaching process while meeting the goals of the revised Electrical Technology curriculum. The study's goal was to examine the effects of implementing the revised ET curriculum across a number of schools in the Alfred Nzo East area and the main goal of the South African DBE is to achieve the necessary objectives and outcomes in order to provide quality education (Seme, Gamede & Uleanya, 2021).

2. Literature Review

2.1 Theoretical Literature

The study views the constructivist theory of teaching and learning as the fundamental perspective through which the revised curriculum should be examined. To improve teachers' expertise and engagement, the constructivist theory of teaching and learning theory in this study focuses on naturally incremental teaching by establishing special relevance through authentic interactions that focus on hands-on and active learning engagements. It is a theory that is thought to place a strong emphasis on ET learners' naturally cumulative learning by establishing personal relevance through their inquiry-based learning, with an emphasis on interactive involvement and exposure to new discoveries so that it boosts engagement and learning retention. Constructivism, according to Kayii and Akpomi (2022), is a learning theory that suggests unique knowledge construction through the engagement and interaction of background experience to establish new knowledge and it is cutting-edge in the teaching of technology subjects at all educational levels. Constructivist theory assists teachers in transitioning from highly dependent on developing performance and computational skills in learners to more challenging twenty-first-century skills that necessitate high levels of competence but within the context of a more well-rounded skill that encourages critical reasoning, problem-solving, effective communication, and perceptiveness. While Technology subject teachers can use this approach to promote higher-order thinking skills, the theory also assists learners to acquire these skills in a progressive process as they are given an opportunity to develop meaning and also help each other. Technology subject teachers experienced in teaching Technology are able to administer learning and their learners as they cooperate in their groups in order to achieve higher-order thinking skills.

2.2 Empirical Literature

2.2.1 Electrical Technology as a Curriculum

Electrical technology (ET) is one of the subjects that intend to provide learners with a solid understanding of electrical, electronics and digital principles. This is a learning program that aims at the knowledge and implementation of electrical and electronic concepts, preparing learners to demonstrate the technological skills and knowledge required to set up, manage, sustain, and restore electrical and electronic equipment. (Department of Basic Education, 2014b). The subject covers safe work practices and first aid, workshop practices, analyzing circuit diagrams, purchasing circuit components and assembling circuits, testing, installation, and circuits troubleshooting. In this study, ET is construed as a curriculum that can contribute to enhancing learners' competencies at the school level (Grade 10-12), designed to allow them to choose a future career when entering institutions of higher learning (Further Education and Training College or a university), as well as preparing other learners to enter apprenticeship programs for a trade (Department of Basic Education, 2014c). It gives access to specialized employment or occupational workplace-based learning and lays the groundwork for high-quality, systematic education that fulfills the needs of learners and prepares them for future occupations.

2.2.2 Understanding the Curriculum and its Implementation

In various studies (Aronsson, 2022; Englund & Stockhult, 2022; Licaros, 2022; Rosvall & Nylund, 2022), the idea of curriculum and how it relates to

education are closely intertwined. Likewise, education is regarded as an essential basic right to humans and is a valuable legacy that a nation leaves to its citizens. A curriculum is a collection of productive assets used by teachers to apply a set of content (Madondo, 2021). The curriculum implementation includes a proper meaning of what is in the approved curriculum content and everyone is responsible for ensuring that it is effectively put into practice. Many researchers (Little & Paul, 2021; Madondo, 2021; Manyage, Sithubi, Mudau & Ravhuhali, 2022) expressed the need to monitor and support the revised curriculum implementation where program policy designers and Subject Education Specialists (SES) design the curriculum at the macro-level and the implementers (teachers) incorporate it at the micro-level. Teachers must be fully involved in curriculum planning and design in order for it to be properly implemented, as their participation can bring them ownership, which is viewed as a critical source of legitimacy for policy decisions. Mbongwe (2018) believes that teachers may exhibit a variety of characteristics, opinions, and perspectives as a result of their particular subject, experience, previous knowledge, interactions, as well as other aspects discussed in previous studies. If teachers perceive curriculum development as something beyond their control due to a lack of resources, even if they have positive attitudes, they may not be able to incorporate it (Park & Sung, 2013). The curriculum is made up of details that provide the necessary instructional equipment and classrooms that are frequently conducive to learning. It includes the learner-teacher relationship as well as other work experiences related to school.

2.2.3 Teacher Support for Curriculum Change

Curriculum change necessitates the implementation of new teaching and learning regulations, showing that all steps involved must demonstrate sound rules and processes for dealing with all emerging threats (Law, 2022). Curriculum change may impact teaching and learning negatively or positively depending on how teachers perceive it, and many teachers appear to be unsure and confused about the curriculum change (Loo & Sairattanain, 2022). According to Attia (2017), curriculum developers' curricula and innovations are frequently required to be implemented by teachers. Quality education, technology integration, personal accountability, personal consciousness, dealing with uncertainty, creativity and innovation, pedagogical knowledge, and practice orientation are critical goals of the curriculum change. Teachers react in different ways to curriculum change, which is greatly determined by their teaching methods; in other words, they do not simply apply the change; rather, they perceive and adjust it based on their various frames of expertise (Phakathi, 2018). The success of the curriculum changes and revision requires teachers to have more background in curriculum and instruction practices.

It is acceptable to assume that how teachers implement a curriculum will correspond to how they measure it, as well as the effectiveness of training assistance and development courses they receive (Foulger, Wetzel & Buss, 2019). Curriculum developers may not always be acquainted with teachers' views and perspectives, and even the actual classroom situation in which all the invention is to be incorporated and if teachers' perspectives are not adequately considered, the already difficult aspect of adapting to new changes can be adversely affected (Mathura, 2019). The School Management Team (SMT) as the curriculum leader is responsible for monitoring and supporting curriculum implementation and change.

2.2.4 Infrastructural Resources and Material

Technology education is a method that includes the expertise and study of learner efforts in constructing including using tools, methods, materials, and processes to control man-made and natural settings with the goal of enhancing human ability and learners' interactions with the community (Baharin, Kamarudin & Manaf, 2018). According to Barret, Treves, Shmis, Ambasz and Ustinova (2019), technology education is important in the education system, however, the structures chosen must be appropriate for each specific school's pedagogical approach and learning process, and additional study is required to match technology use with educational needs including not only learning environments but also school planning and construction. The resources necessary for successful implementation of the school curriculum include basic infrastructure which is regarded as the foundation of academic institutions without which it is impossible to accomplish the academic goals at all levels (Ogunode & Hadi, 2021). Structures, practical facilities and educational equipment are critical components of educational spaces in schools hence there is strong research that suggests relevant infrastructure to facilitate better instruction and improve learner attainment and other benefits (Barrett *et al*., 2019).

3. Research Methodology

This study used an interpretive qualitative research design, and the four secondary schools (Technical High Schools) in the Alfred Nzo East District of the Eastern Cape were selected for the study. The study used the purposive sampling method to select four Electrical Technology teachers who could best meet the objectives of the study and achieved several desired criteria for the required knowledge (Etikan & Bala, 2017). The researcher made certain that teachers taught Electrical Technology from grade 10 to grade 12 and were part of implementing the revised curriculum.

A case study design was chosen to obtain detailed knowledge and discover more about the teachers' opinions and experiences in implementing the revised ET curriculum, as well as the kind guidance and support to assist with curriculum implementation. The researcher used audio-taped semi-structured interviews with four teachers to collect qualitative data, and diary notes were taken to supplement the information. The classroom observation was then conducted to learn more about how teachers view the revised ET curriculum. During the observation, diary notes were also used. Classroom observation was useful in gathering data because, as stated in the review of literature, resources are the most important factors in the implementation of curriculum changes. This is known as data triangulation, and it is used for cross-validation of data sources and data gathering methods. The goal of data triangulation was to obtain multiple perspectives on the same phenomenon while increasing the amount of information in the data. For the reasons stated above, the study agrees with Yin (2011) that data should be used as the foundation for any research study.

On the day of the interview, each teacher was reminded of the study's purpose and their voluntary role in helping with the data. They were made aware of their research rights as well as how their responses would be used. Before beginning the semi-structured interview, permission was obtained to record the session so that the researcher could review the recorded information over and over again and jot down the taped interview into textual content for data interpretation and discussion. Each interview process lasted from 40 to 60 minutes. The information was then transcribed verbatim and was then segmented and sorted according to relating ideas in organized themes, allowing it to make sense of qualitative data in a systematic and flexible manner. Pseudonyms are used to protect teachers' and schools' identities. PL1-PL4 are used as pseudonyms to describe the names of the teachers. In addition, minor editing of grammatical errors in interview transcripts was performed, but without compromising the teachers' original comments.

4. Results and Discussion

The study's conclusions identify three main challenges that could delay or hold back the revised ET curriculum from being successfully implemented. These findings came from interviews and classroom observations conducted to learn more about how teachers perceive the revised ET curriculum.

4.1 Educational and Professional Development for Teachers

The first theme from the findings was the need for teachers to receive training and professional development in order to apply the revised ET curriculum. The majority of teachers expressed their displeasure with the quantity and caliber of workshops offered by the DBE to complement the redesigned ET curriculum. For instance, one teacher (PL1) indicated that:

> *"The Department can make so many adjustments to the curriculum, and we are not prepared because we are still adapting to the changes brought about by the implementation of CAPS, now this one. These changes really confuse us, we need time to adjust and adapt, and we need help in the form of workshops and training to do this. We were only trained for three days per year per class for the content that required us to deliver this content for the whole year. The workshops were not enough at all. I still need more assistance in some areas of the subject".*

The following teacher's response exemplifies the frustration felt by many teachers:

> *"The Department of Education should have spent more time training and preparing us by allowing us to thoroughly digest and comprehend the material. We needed more time for longer and more effective training. We only had three days, which was insufficient. The amount of content could not have been covered in the required timeframe. Many of*

us returned to school without understanding some of the new topics included in the curriculum. I'm still perplexed. We weren't even convinced of the importance of learning more about the subject. For me, the shortness of the training created a negative attitude toward this revised curriculum, and I'm better off with the old Electrical Technology curriculum" (PL3).

"The workshops did not adequately prepare us to implement the changes in the Electrical Technology curriculum; a three-day session is insufficient, but we also do not properly understand some of the adjustments we must now make in our lessons" (PL4).

The above statements show that the duration of the training workshop was believed to be insufficient to cover all aspects of a revised curriculum. As a result, according to the teachers as study participants, the training was rushed. They believed that the training had raised more questions than answers, which is why they continued to refer to the workshops as complicated. Most of them during the follow-up questions also expressed concerns about the training's quality, claiming that the trainers themselves were unfamiliar with some of the content revised curriculum. These comments lend weight to numerous previous studies (Molapo & Pillay, 2018; Adewumi & Mosito, 2019; Du Plessis & Mestry, 2019; Jojo, 2019), that have demonstrated problems in curriculum renewal and implementation due to curriculum leaders' inadequate provision of chances for teachers to engage in professional development.

4.2 Teaching and Learning Support Material

It can be deduced from the transcripts that teachers revealed the teaching and learning support material as inadequate in their schools for the ET curriculum to be implemented successfully. The following are teachers' comments regarding the state of teaching equipment and material available at their schools were as follows:

"I take my learners to the other school for the practical activities and demonstrations because we do not have enough equipment and space at my school" (PL1).

"I usually go to another school because we don't have laboratories to do practicals at my school, there are no resources at all even the tools and other equipment that need us to do projects and practical activities are not provided" (PL2).

"We do have some practical resources and equipment though they are not enough. We are not able to test some practicals because our workshop does not have the three-phase supply; we only have single-phase supply and that makes me feel uncomfortable because I will be seen as someone who is incompetent" (PL3).

Some teachers indicated that they usually go to other schools for assistance especially since they were required to do projects and simulations that contribute to the marks of the learners at the end of the year. Electrical Technology is a subject that requires a hands-on application and does not consist of only the theory part but also the practical component. That is why teachers have to make sure that they make plans to support their learners to achieve the practical part of learning, especially the Practical Assessment Tasks (PAT). Problems that have been noted in all schools were that there were inadequate or no resources at all. Other resources were said to be in bad condition, and that means teachers were unable to use them as they mostly require an electricity supply.

4.3 Curriculum Support and the Content Gap

The researcher saw it necessary to determine the views of teachers concerning content gap challenges they face in implementing the revised curriculum. It was also noted that PL2's school does not have HOD for technology subjects. The data shows that support from that school is minimum.

PL3 and PL4 articulated their views by saying:

"I can say that in grade twelve there is a chapter on PLCs and it was termed the other way in the old Electrical Technology. It was the chapter on Logics, which did not have practical. Then for this one, we are doing the PLCs on the computers and laptops. Then for that practical, we need software to be able to teach and demonstrate it but we do not have anything to show our learners. How are we going to set questions yet they do not have a clue of the lesson itself? How will they perform during their examinations when we as teachers do not have the required information? This makes me frustrated really." (PL3).

Teachers need financial support in order to have the software purchased.

> *"There are topics that are yet not clear to me, as I have never attended any workshop or training concerning the content gap or some of the practical activities, for example, the chapter on PLCs. Even in our WhatsApp group, teachers are having the same concerns, but they help us where they can. Here at school, we do not have a three-phase supply of electricity and that makes it difficult for me to do some of the practicals that require a three-phase supply. I only rely on the videos just for demonstration purposes" (PL4).*

This shows that there is a content gap that needs immediate attention from the DBE and the school management. Teachers expressed views of being unhappy about the chapter on the Programmable Logic Controllers (PLCs) that was added to the content of specialisation subjects in the revised curriculum and also need software to be able to cover it. They indicated that it was difficult to teach it as they do not have a clue on how to teach it. This shortfall seems to be common among all teachers and needs to be resolved for better implementation of the subject.

Teachers also indicated that they did not get any content-based training. According to Bantwini (2019), one of the issues facing the South African education system, in general, is the failure to successfully translate new curriculum reform from theory into the teaching process. Krulatz and Christison's (2022) study revealed that content-based knowledge enables teachers to teach more effectively. Teachers' lack of subject knowledge indicates that the Department of Education should intervene and organize content-based workshops.

Electricity supply was one of the concerns of PL1, as his community does not have an electricity supply. He responded by saying:

> *"There is no electricity in the community and it's really hard to teach the chapter on PLCs and we do not have a HOD for technology subjects and that makes it difficult for us technology teachers to get the help that we need".*

This concern is very important, as electricity supply is one of the basic resources for effective implementation of specialisation subjects, as teachers need demonstrations and practical activities (simulations). This also denotes that teachers may either be implementing the curriculum incorrectly or have reverted to traditional methods of teaching as they do not have managerial support. This can make it more difficult to successfully apply the revised curriculum.

5. Discussion of the Findings

The study looked into teachers' experiences with implementing the revised Electrical Technology curriculum, with the view to ascertaining the successes and challenges they faced. The findings confirm the important challenges proposed by Ankiewicz (2021) and Banks and Williams (2013) in their analysis of the curriculum documents for Technology education. Teachers are critical to the success of DBE policies, especially when implementing new or revised curricula. From the interviews and the classroom observations, it became clear that most of the teachers attended the teacher trainings and workshops but they were not satisfied with the time and days that were allocated for these workshops. Teacher professional development is totally necessary if the revised curriculum is to be implemented so that schools can set appropriate plans for their implementation for enhanced productivity (Jenkins, 2020).

Although teachers received some form of training, this was generally inadequate and sometimes inappropriate with little or no follow-ups from DBE for upgrading. It was stated that the inappropriate workshops did not address the implementation of the revised curriculum (teachers only attended practical workshop since the commencement of the revised curriculum). The study showed that teachers have confidence in implementing the Electrical Technology revised curriculum. However, this would be strengthened if the DBE takes the necessary steps to fulfil its obligation and responsibility of providing adequate formal training to teachers, especially on challenging topics that are newly introduced into the curriculum.

The study revealed that adequate teacher training, ongoing DBE support, and the availability of materials and resources are critical to the successful functioning of the schools offering the revised curriculum. Subject specialists and advisors must facilitate regular workshops and lead the trainings. Not only are teachers expected to work tirelessly, but every stakeholder is expected to actively participate in every learner's education. According to the study,

curriculum revision in South Africa is a versatile as well as a difficult process. All involved parties must actively engage on an equal footing. It also emerged that teachers do not have enough relevant resources for demonstrations or practical activities as required for effective teaching of the revised curriculum Electrical Technology requires hands-on application, visual representations, simulations and video clips to improve learners' understanding. Curriculum restructuring implementation is seen as lacking in some schools due to the absence of facilities like laboratories, workshops, and an insufficient supply of resources and materials.

6. Conclusion and Recommendations

The researcher suggests that the Department of Basic Education, as the main stakeholder, take the following recommendations into consideration before and during the revised curriculum implementation based on the findings of this study into teachers' experiences with implementing the revised Electrical Technology curriculum in selected Secondary Schools in Alfred Nzo East District.

Provision for continuous in-service training for teachers: Teachers should be encouraged to have discussion meetings on a fortnight basis to discuss the different strands of the revised curriculum in order to help those who may have a gap in content knowledge. Teachers need continuous support from different levels to grow professionally. Senior Education Specialists (SES) and SMT need to identify content knowledge gaps in teachers in order to develop and provide training that aims at the issues and requirements of the teachers. Support to Electrical Technology teachers is needed to help facilitate the transition to the revised curriculum. This will also help enhance their pedagogical content knowledge in the said areas – content, methods and instruction.

The SMT is in charge of making sure that teaching and learning take place in a secure atmosphere. Therefore, relevant resources and infrastructure need urgent improvement in accordance with the revised curriculum needs. The availability of instructional resources, such as practical material and tools is believed to enhance content comprehension. It is recommended that in addition to the teacher exploring alternative resources such as teaching and learning software and internet material, instead of relying solely on management to provide resources, management itself must raise additional funds or allocate a budget from the departments' funds for Technology subjects. The researcher encourages the school management to prioritise Technology classrooms and laboratories.

If the revised curriculum is well executed and everyone is actively engaged, the benefits will be seen in teachers' and learners' performance. Furthermore, if district officials, particularly Subject Education Specialists and school authorities, get involved, the revised curriculum implementation is believed and bound to improve. A significant improvement is possible if the officials involved are assertive in their operation, while the necessary support is provided and prioritized among the underprivileged schools. This suggests that effective strategic implementation intended to improve teachers' experiences with the revised curriculum will necessitate a collaborative effort from all stakeholders.

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