Exploring Teachers' Experiences of Constructive Alignment between Learning Outcomes, Activities, and Assessment in Electrostatics and Electrical Circuits in the Grade 12 Physical Sciences Curriculum

by

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ABSTRACT

Constructively aligned curriculum seeks to optimize learning by ensuring congruence between the intended learning outcomes, teaching and learning activities, and assessment. Constructively aligned curriculum emphasizes three key aspects of learning: For teachers: what teachers are expected to achieve, what are they teaching and how they teach it, and what they assess. For learners: what learners are expected to learn, what they learn, and how they will be expected to make that learning evident. The literature on constructive alignment (CA) advocates for the congruence between intended learning outcomes, teaching and learning activities, and assessment. However, not much is known about Physical Sciences teachers' experiences of constructive alignment. This study explored Physical Sciences teachers' experiences of constructive alignment between intended learning outcomes, teaching and learning activities, and assessment in Electrostatics and Electrical Circuits within the grade 12 Physical Sciences curriculum. The qualitative case study was conducted in three schools around Umlazi township, in the province of KwaZulu-Natal in South Africa. Convenient sampling was used to choose schools around the township as it was convenient for the researcher to work in these schools. Purposive sampling for choosing Physical Sciences teachers was utilized.

A variety of data collected from pre-observation interviews, observations, document analysis as well and post-observation interviews provided detailed themes of knowledge necessary to answer the main research question while allowing for triangulation of findings to increase the trustworthiness of the results. The participants were interviewed before observations using individual semi-structured interview questions to find their understanding of constructive alignment. Observation of lessons was conducted at the convenience of the participant and teaching documents were also analysed to find out how Physical Sciences teachers constructively align the curriculum in grade12 Electrostatics and Electrical Circuits. After a thorough analysis of teaching documents, individual semi-structured post-observation interviews were conducted to understand Physical Sciences teachers' rationale for constructive alignment. Among the variety of discoveries, this study discovered that there is a discrepancy between understanding and application of constructive alignment by Physical Sciences teachers. Moreover, lack of transparency in the communication of intended learning outcomes was a notable factor on the teachers' side. Findings revealed that teachers tend to keep the intended learning outcomes to themselves and did not share them with learners. The literature revealed learners' learning experiences and performances can be improved if they are involved in the learning path and the intended learning outcomes (ILOs) are made clear to them by teachers. Furthermore, findings revealed that teacher beliefs and values impact on their pedagogical practices and result in blurred assessment skills in their teaching. The study concluded by placing importance on the value of the institutionalization of transparent communication practices of ILOs to learners, incorporating continuous assessment and feedback as key pedagogical tools, teacher professional development for practical constructive alignment skills, and the establishment of regular teacher reflective sessions within schools and districts to build constructive alignment capacity of teachers.

Key words: Constructive alignment (CA), Intended learning outcomes (ILOs), assessment, Formative assessment, Summative assessment, Curriculum, Electrostatics, teaching and learning activities (TLAs),

DECLARATION

I Phelelani Persival Maphalala declare that:

- The reporting and presentation on this dissertation present my original research work and where other scholars' work was used, I used proper referencing to acknowledge them.
- This dissertation has never been submitted to any University or tertiary institution for examination.
- Moreover, it does not contain other people's data, tables, or graphs but some quotes and statistic graphs from curriculum documents that were used were specifically acknowledged using appropriate referencing.
- The work presented in this dissertation was conducted in three public schools around Umlazi under the supervision of Prof N Govender.
- The ethical clearance certificate with reference No: HSSREC/00004721/2022 was obtained before the actual research and fieldwork.

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DEDICATION

I dedicate this thesis to my late Mother Mrs. S.E Maphalala, the greatest lost in my life. We appreciate all that you have done for our family: dad, my six siblings and myself. You made sure that we all grew up with respect for ourselves and other people, ensured that you sent all of us to school, and pushed us to excel. I will forever be grateful to have had you as my mother. I would like to further dedicate this research to my father Mr C A Maphalala who took the role of a single parent and continues to unite and support our family. I am grateful to God for keeping you this long Sonkwatha.

ABBREVIATIONS

ATP	Annual Teaching Plan
B Ed	Bachelor of Education
B Sc	Bachelor of Sciences
CA	Constructive Alignment
CAM	Constructive Alignment Model
CAPS	Curriculum and Assessment Policy Statement
DBE	Department of Basic Education
DH	Departmental Head
DoE	Department of Education
FET	Further Education and Training
HE	Higher Education
HETP	Higher Education Teaching Policy
HoD	Head of Department
ILOs	Intended Learning Outcomes
MCQ	Multiple choice questions
NCS	National Curriculum Statement
PCK	Pedagogical Content Knowledge
PGCE	Post Graduate Certificate in Education
PTD	Professional Teacher Development
RNCS	Revised National Curriculum Statement
SA	South Africa
TLAs	Teaching and Learning Activities
TPD	Teacher Professional Development
USNRC	United States National Research Council

Chapter One

Introduction and Background

1.1 Introduction

I am a Physical Sciences and Life Sciences teacher in one of the schools around Durban, province of KwaZulu-Natal, South Africa. I have experiences of being a subject head for the past six years. As a subject head, I together with the departmental head of Natural Sciences (DH previously known as Head of Department/ HoD) in my school organize several workshops on the teaching and assessment of Sciences subjects. This is done to share and capacitate colleagues with teaching and assessment skills they might need in their respective subjects. However, it was noted during workshop discussions that teachers at the school level have different experiences when it comes to constructive alignment (CA) of intended learning outcomes, learning activities, and assessment. As one of the grade 12 Physical Sciences teachers in the district, I was involved in one of the discussions where the issue of CA was raised in the workshop as the reason for poor performance in Physical Sciences, particularly in the topics of Electrostatics and Electric Circuits. The discussions at the school level and those raised at the district level stimulated my interest to carry out research that will find out more about the teachers' experiences of CA regarding their intended learning outcomes, teaching and learning activities as well as assessment in the grade 12 Physical Sciences curriculum.

Constructive Alignment is an approach to curriculum design and delivery in which learning outcomes, teaching and learning activities, and assessment are integrated to create conditions of high-level learning (Gallagher, 2018). Constructively aligned curriculum seeks to optimize learning by ensuring congruence between the intended learning outcomes, teaching and learning activities, and assessment. Constructively aligned curriculum emphasizes three key aspects of learning: For teachers: what teachers are expected to achieve, what are they teaching and how they teach it, and what they assess. For learners: what learners are expected to learn, what they learn, and how they will be expected to make that learning evident (Onsman, 2015). Constructive alignment is imperative for learners' success as it encourages learners to use deep, rather than surface approaches to learning. This approach then places constructive alignment at the center of curriculum design and delivery. The study by Tarrel et al., (2001) reported major success in the curriculum when all these curriculum constructs (intended learning outcomes, learning activities, and assessment) are aligned.

This first section above introduces the reader to a piece of basic information about me (the author) and my experiences which stimulated my interest in undertaking the study and introduces the concept of constructive alignment. The second section that follows discuss the background of the study giving an overview and in-depth analysis of the concept of Constructive Alignment. The third section states the significance of the study which outlines the importance of the study in the field of education. The fourth section presents the statement of the problem while the fifth section outlines the aims of the study. The sixth section present the research questions to be answered by this study followed by the seventh section which outlines the research methodology. The eighth section informs readers about the location of the study while the ninth section gives the layout of all the chapters in this dissertation.

1.2 Background of the study

In South Africa, the curriculum has been changing from the post-apartheid curriculum to the recent Curriculum and Assessment Policy Statement (CAPS) curriculum, and all these curricula changes are informed by economic, social, and political factors (Nkosi, 2014). The changing curriculum means changing the intended learning outcomes, learning activities, and the manner through which assessment is standardized and conducted. Nevertheless, in Physical Sciences, the structuring of questions in the new curriculum is still the same as the previous curriculum and this raises a question about the extent of constructive alignment in the new curriculum. To what extent is the Curriculum and Assessment Policy Statement (CAPS) curriculum constructively aligned? This question can only be answered by undertaking a study to explore teachers' experiences of constructive alignment between intended learning outcomes, teaching and learning activities, and assessment in the grade 12 Physical Sciences curriculum.

Mhlolo and Venkat (2009) studying curriculum coherence and studying the National Curriculum Statement and exemplar papers at Further Education and Training (FET) level in South African Mathematics argued that the curriculum reforms in South Africa have happened with less emphasis on curriculum coherence when designing the curriculum. According to Fitzallen et al. (2017), quality curriculum design based on evidence of best practice is essential for DBE if they are to achieve the learning outcomes intended for learners and to improve performance. This indicates that the extent to which intended learning outcomes, learning activities, and assessments are constructively aligned could increase performance and improve higher-order cognitive skills through deep and meaningful learning to learners. The final diagnostic report of the DBE for 2017 and 2018 also outlines that 60% of Physical Sciences candidates performed well in questions that demanded lower-order cognitive skills. However, many learners performed poorly in questions that demanded analytical, evaluative, and problem-solving skills. This backs up the facts on problems brought by misalignment as discussed by Zhao (2016). If learners only manage to answer low-order (recall) questions well, likely, they did not understand the concepts and/or the teaching and learning activities were not aligned with intended learning outcomes and assessment.

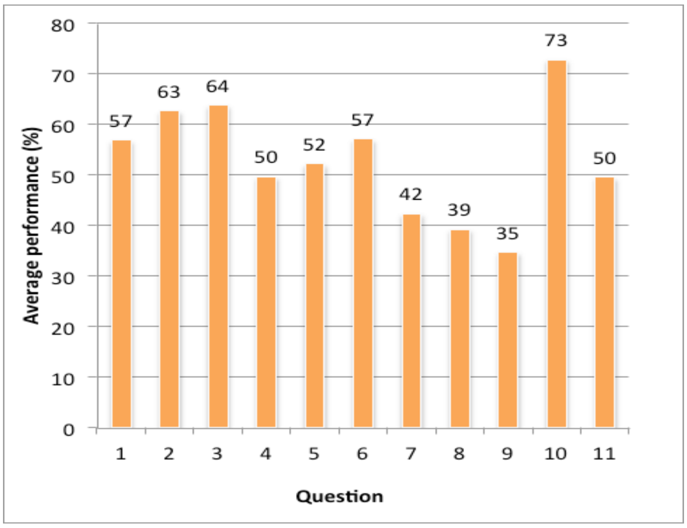
The study by Wang et al. (2013) explored Biggs' process of constructive alignment in course design at higher education and found that students in constructively aligned courses were more likely to adopt deep learning rather than surface learning, and this enabled them to perform well in higher order cognitive skills questions and the overall course. For example, they were able to answer questions that were new or never asked before than just answering routine questions. They understood the concepts better as these were aligned with what was assessed. This indicates that if there is constructive alignment between intended learning outcomes, learning activities, and assessment within the curriculum documents and in practice, then performance will be more likely to be enhanced.

1.2.1 Electrostatics and Electrical Circuits

Electrostatics and Electrical Circuits are the most important areas in Physical Sciences as they constitute a big part of the electricity and magnetism in the Grade 12 curriculum (DBE, 2011). The topic of Electrostatics is taught in detail in grades 10 and grade 11 of our Curriculum and Assessment Policy Statement (CAPS), whereas the topic of Electrical Circuits is taught from grade 10 up to grade 12. Reports from literature constantly show that there is a challenge in teaching and learning of these topics, this is also evident in the overall performance of learners in these areas for consecutive years (Dega et al., 2013). It has been reported in several studies (Ajredini et al., 2013; Maloney, 2001) that learners are having difficulties mostly in Electrostatics in concepts such as electrostatic force (expressed by Coulomb's law), electric fields and electric field strength. The reviewed literature argued that the concepts in this topic are mostly microscopic and abstract, and learners need to engage their imagination more than the prior knowledge when studying this topic (Li & Sigh, 2017). The results of average performance in Electrostatics and Electric Circuits for the past five years is presented and discussed below.

1.2.2 Electrostatics and Electric Circuits results over past

Physical Sciences has two content areas/disciplines (Chemistry and Physics) which are assessed independently as paper 1 (Physics) and paper 2 (Chemistry). Literature provided evidence that Physics is one of the most poorly performed areas in Physical Sciences as reported by the DBE Diagnostic report 2017, 2018, 2019, 2020, and 2021. Electrostatics and Electric Circuits among other mostly poorly performed topics were explored by this study to find Physical Sciences teachers' experiences of constructive alignment (CA) between teaching and learning activities (TLAs), assessment, and intended learning outcomes (ILOs). Figure 1.1 outlines the performance in different topics of Physical Sciences paper 1-2018



Q1	MCQ
Q2	Newtons' laws
Q3	Vertical Projectile M
Q4	Momentum
Q5	Work, energy & power
Q6	Doppler effect
Q7	*Electrostatics*
Q8	*Electric Circuits*
Q9	*Internal resistance*
Q10	Electrodynamics
Q11	Photoelectric effect

FIGURE 1.1: BAR GRAPH SHOWING PHYSICS PASS PERCENTAGE ON THE FINAL DIAGNOSTIC REPORT (2018) PHYSICAL SCIENCES (DBE, 2018)

It is evident from the table that Electrostatics and Electric Circuits are the most poorly performed topics in Physics. Electric Circuits are the lowest performance with 35% followed by Electrostatics at 42%. The average performance in these topics stimulated the interest in exploring teachers' experiences of constructive alignment between intended learning outcomes, teaching and learning activities, and assessment in the Physical Sciences curriculum. The literature and my past experiences as a Physical Sciences teacher as outlined in the introduction section above show that teachers do have a problem with CA and hence, we needed to explore the teachers' experiences of CA between intended learning outcomes, learning activities and assessment in grade 12 Physical Sciences curriculum. The diagnostic reports for the years 2019, 2020, 2021 and 2022 are discussed further in the following chapter (Chapter 2) to further explain the need for exploration of teachers experiences on CA in these specific topics.

1.3 Significance of the study

Teachers as the leaders of curriculum implementation need to be clear about curriculum concepts like constructive alignment. Studies on constructive alignment advocate for the alignment of intended learning outcomes, learning activities, and assessment by teachers. Moreover, the studies suggest that with constructive alignment understood and practiced by teachers on their respective subject's, improvement in results may be achieved (Squires, 2012).

Zhao (2016) argues that if the curriculum is not constructively aligned, learners will know only the process of finding answers, but they will lack critical skills and fail to comprehend the new knowledge extensively. The study by Lopez (2013) revealed that the lack of the three constructs of CA alignment as prescribed by the curriculum can result in surface learning and great prioritization on assessment and these can result in poor performance. Although we cannot directly link performance and CA, it is important that teachers' experiences of CA are explored in Physical Sciences. Studies by Gallagher (2018), Biggs (2014), Gibbs (2010), and Mhlolo and Venkat (2009) advocated for the need for constructive alignment in intended learning outcomes, teaching and learning activities, and assessment. I have not come across studies that have been conducted to check for the teachers' experiences of constructive alignment between intended learning outcomes, learning activities, and assessment in grade 12 Physical Sciences curriculum specifically for the CAPS.

Most of the studies focus on the alignment between intended learning outcomes and assessment and neglect the teaching and learning activities that are necessary for deep learning as Squires (2012), Lopez (2013), and Zhao (2016) argue. One study by Edwards (2010) investigated the alignment between the South African Grade 12 Physical Sciences core curriculum content and the exemplar papers of 2008, as well as the final examination papers of 2008 and 2009. His study had a great emphasis on cognitive levels representation in examination papers without taking into consideration teachers' experiences. This study focused on exploring the experiences of high school Physical Sciences teachers of CA between intended learning outcomes, teaching and learning activities, and assessment in the grade 12 Physical Sciences curriculum.

1.4 Statement of the problem

In the South African context, the school curriculum for Physical Sciences is designed by the Department of Basic Education (DBE) subject officials and curriculum specialists from tertiary education. The official curriculum documents are then handed to schools for implementation. With the generally increasing pass rate in the country's NSC results over the past 10 years, Physical Sciences remain one of the country's worst-performed subjects as presented by the final diagnostic report of the DBE 2018, 2019, 2020 and 2021 (DBE, 2018, p. 22). Pointing fingers between the DBE and Physical Sciences teachers about the poor matric results has been happening for these past years. However, Physical Sciences teachers are complaining about the growing pressure to increase pass rates by the DBE officials (DBE, 2018).

Physical Sciences teachers claim that there should be guidance provided by DBE on constructive alignment (CA) of intended learning outcomes (ILOs), teaching and learning activities (TLAs) as well as assessment. According to Fitzallen et al. (2017) , quality curriculum design based on evidence of best practice is essential for DBE if they are to achieve the learning outcomes intended for learners and to improve performance. This indicate that the extent at which intended learning outcomes, learning activities and assessment are constructively aligned could increase performance and improve higher order cognitive skills and ease the pressure on teachers by DBE officials to increase pass rate. It is hoped that by exploring teachers' experiences on constructive alignment, the pointing finger between teachers and DBE officials may be addressed. This research was conducted to develop understanding of how teachers perceive the concept of CA and incorporate it in their teaching and assessment.

1.5 The aims of the study

The study aimed to:

Firstly, to develop an understanding of Physical Sciences teachers' experiences of constructive alignment between learning activities, assessment, and intended learning outcomes in Electrostatics and Electric Circuits in the Physical Sciences Grade 12 curriculum. Secondly, to explore how teachers align learning activities, assessment, and intended learning outcomes in the Physical Sciences grade 12 curriculum (Electrostatics and Electric Circuits). Thirdly, to explain why teachers enact the curriculum the way they do.

1.6 Research questions

This study explored Physical Sciences teachers' experiences of constructive alignment between learning activities, assessment, and intended learning outcomes in Electrostatics and Electric Circuits in the grade 12 Physical Sciences curriculum. Thus, the main research question below with the accompanying sub-research questions were set to achieve the aims of this study.

- ✓ What are Physical Sciences teachers' experiences of constructive alignment between learning activities, assessment, and intended learning outcomes in Electrostatics and Electric Circuits in the Physical Sciences Grade 12 curriculum?

The following sub-questions were used to answer the main question above.

- ✓ What are Physical Sciences teachers' understanding of the constructive alignment between learning activities, assessment, and intended learning outcomes?
- ✓ How do Physical Sciences teachers apply constructive alignment when enacting the curriculum within Electrostatics and Electric Circuits?
- ✓ Why do Physical Sciences teachers apply constructive alignment in the way they do when enacting the curriculum within Electrostatics and Electric Circuits?

1.7 Research Methodology

1.7.1 Research paradigm

This study employed the interpretivist paradigm. Cohen et al., (2018) define the Interpretivist paradigm as a paradigm concerned with understanding or exploring the phenomenon through two lenses that is, the objective and subjective lenses. This definition argues that the truth is many, and participants bring with them ideas and reasoning regardless of the existing truth about that phenomenon. In support of this, Creswell and Creswell (2017, p. 37) stated that "Individuals develop subjective meanings of their experiences and meanings directed toward certain objects or things. These meanings are varied and multiple, leading the researcher to look for the complexity of views rather than narrowing meanings into a few categories or ideas". This research explored the truth about constructive alignment from the participants' and literature perspectives, thus different themes of knowledge emerged from both the literature and participants. "The researcher intends to make sense of (or interpret) the meanings others have about the world" (Creswell & Creswell, 2017, p. 37). The strength of this paradigm is that the data is generated through the understanding that the participants are the primary source of data, and the findings are not biased but portray the complexity of views possessed by Physical Sciences teachers and those expressed in the curriculum. Thus, I used this paradigm to explore teachers' experience of constructive alignment between learning activities, assessment and intended learning outcomes in Electrostatics and Electric Circuits in the Physical Sciences Grade 12 curriculum.

This study explored teachers' experiences of CA by analysing teaching documents and observing curriculum delivery where all the data generated was used as the primary source of data as Creswell and Creswell (2017) contends and it forms the findings of this study as the interpretivist paradigm suggests. This was chosen as the suitable paradigm for the study since it only explored teachers' experiences of constructive alignment between learning activities, assessment, and intended learning outcomes in Electrostatics and Electric Circuits in Physical Sciences Grade 12 curriculum. This is the appropriate paradigm to use in case studies. However, the interpretivist paradigm does not emancipate or solve the problem its main aim is to explore and understand the phenomena, but the intervention is not mandatory.

1.7.2 Approach

The qualitative approach was used in this study. Muijs (2004) defined the qualitative approach as the explanation of a phenomenon by generating textual data that is analysed based on patterns of similarities (themes). Kumar (2018) defines the qualitative approach as the unstructured approach to inquiry where the purpose of the study is primarily to describe a situation, or a phenomenon and the analysis of data is done without quantifying. According to Creswell and Creswell (2017), the qualitative approach is an approach for understanding the meaning people or a group of people align to a human problem like lack of constructive alignment stated as the reason for poor performance in Electrostatics and Electric Circuits within Physical Sciences. This outlines that most exploratory research ascribes or uses a qualitative approach to explore any phenomenon. In this study teachers' "experiences" of constructive alignment between learning activities, assessment, and intended learning outcomes in Electrostatics and Electric Circuits in Physical Sciences Grade 12 curriculum was explored. Kumar (2018) stated that exploratory studies clarify why and how there is a relationship between the two aspects of the phenomenon.

This study attempted to understand the relationship between teachers' experiences of constructive alignment between learning activities, assessment, and intended learning outcomes in Electrostatics and Electric Circuits in Physical Sciences Grade 12 curriculum and how teachers enact the curriculum in these topics. The data in this study were analysed inductively building from pre- and post-observation interviews, document data, and lesson observations to general textual themes and interpretations were made. Creswell and Creswell (2017) support the use of the qualitative approach in cases of exploratory studies and argues that all those who engage in the qualitative approach support the inductive style of research where participants and data yield the conclusions of the study. Therefore, in this study, I used a qualitative approach to generate and analyse data.

1.7.3 Research style

The style of this research is case study research. Case studies are useful in understanding the behavioural practice of individuals through observation and interpretation of data (Creswell, 2014). Creswell and Creswell (2017) define the case study as a style of research that presents the facts about the phenomenon and inform the decisions around that phenomenon. Kumar (2018) defines a case study as a study design where the selected case becomes the basis of a thorough, holistic, and in-depth exploration of the phenomenon that is explored. Kumar (2018) further argued that this design is essential for studies where little is known and is of immense relevance when the focus is on exploring or understanding rather than quantifying.

Creswell and Creswell (2017) argued that case studies are suitable designs of inquiry to be used in qualitative research when exploring the area of minimal information and evaluating a phenomenon for understanding rather than quantifying. I found fewer studies exploring teachers' experiences of constructive alignment between learning activities, assessment, and intended learning outcomes in Electrostatics and Electric Circuits in the Physical Sciences Grade 12 curriculum, thus case study was a suitable design to explore this case as Kumar (2018) and Creswell and Creswell (2017) contend. However, the case study unlike action research did not directly affect the change in teachers' practices or the schools around Umlazi district but might inform future decisions and behavioural practices on the readers of findings and the district through reporting on the findings of the study.

1.7.4 Sampling

Obilor (2023) defined sample as a subset of population participating in the study. Moreover, Obilor (2023) alluded that sampling is a technique used in research to select a population of interest to conduct a study. Purposive sampling was used for this research. Creswell and

Creswell (2017) define purposive sampling as a technique that involves selecting certain units or cases based on a specific purpose rather than randomly. Kumar (2018) defined purposive sampling which he called judgemental sampling, as a judgment of who can provide the best information to achieve the objectives of the study and argued that it is common to qualitative studies with a less predetermined number of participants. Purposive sampling can also be defined as a non-probability sampling method where the researcher selects the population that will assist in achieving the objectives of the study (Abilor, 2023). This technique was suitable to this study since the participants are Physical Sciences teachers, thus they were purposively selected to participate in the study and were able to provide the best information to achieve the objectives of the study. Physical Sciences teachers are the most suitable participants since they teach the subject in question. Furthermore, Kumar (2018) argued that judgemental sampling also known as purposive sampling allows a sampling population that comprises experts in the field of inquiry.

Convenient sampling was used to select three schools around Umlazi District as it was convenient for the researcher to access the participants since the researcher is the teacher at Umlazi district as well. The researcher was able to work perfectly around Umlazi in a familiar context with less traveling costs. The invitation to participate in the study was sent to 6 teachers teaching Physical Sciences in these schools. However, three teachers based on availability were interviewed and observed to explore their experiences of constructive alignment on their teaching when teaching the grade 12 Physical Sciences curriculum in particular at high schools around Umlazi District. Kumar (2018) and Creswell (2014) argue that qualitative research and case studies in particular decide on a smaller number of participants who are best positioned to provide the needed information for the study. According to Taherdoost (2016), convenience sampling refers to the sampling method where the participants or population is selected based on availability and accessibility.

To reduce the size and scale of the study, the topics Electrostatics and Electric Circuits were purposively selected amongst other topics due to their poor performance as outlined in the 2018 diagnostic tool presented in the background above. It was also selected because it is one of the topics where learners perform poorly even when teaching and learning have occurred. It was also purposively selected as it was the main topic raising concerns of constructive alignment in the teachers' workshop I attended at Umlazi and discussed in the background above. Among other limits, the purposive sampling limits the number of participants in the study as some

Physical Sciences teachers decided to withdraw or not participate due to workloads in schools. However purposive sampling was used to select the most suitable participants for this study.

1.7.5 Data generation methods

Pre-observation and post-observation interviews: Creswell and Creswell (2017) allude that interview with individual participant gives information about their understanding of the phenomenon. Moreover, Cohen et al (2018) argue that individual interviews expose gaps in logical understanding and enrich the study. Cohen et al. (2018) further maintained that the interview is a flexible data collection tool with a multi-sensory channel to be used while conducting it. This study used both pre-observation and post-observation interviews to explore Physical Sciences teachers' experiences of constructive alignment.

Document analysis: The document analysed for this study involved analysing the CAPs document, Lesson plan (teaching materials), Annual teaching plan (ATP), and examination guidelines for grade 12. Creswell and Creswell (2017) maintained that it is necessary for qualitative research to adopt document analysis provided the guiding documents to the phenomenon are available at the researchers' disposal. Documents were also analysed as a supplement to the data from other sources necessary for the triangulation of the findings.

Observations: Observation in research according to Steber (2017) is a research method designed to watch behaviour of individuals as it organically and spontaneously unfolds in a natural environment. This study used the observation schedule to generate data based on what happens in the classroom when teachers are teaching Electrostatics and Electric Circuits. The observation schedule assisted in finding out how teachers enacted the curriculum. Thus, the data generated was used to understand teachers' experiences of constructive alignment between learning activities, assessment, and intended learning outcomes in Electrostatics and Electric Circuits in the Physical Sciences Grade 12 curriculum. Cohen et al., (2018) contends that observations are processes that offer investigators live data from naturally occurring social situations.

Triangulation of findings increases the validity and trustworthiness of the study (Cohen et al., 2018). It was therefore important for the study to interview the participants, analyse the teaching documents, observe lessons, and do post-observation interviews to answer the main research question.

1.7.6 Data analysis

The study followed a guided qualitative descriptive analysis method, also called inductive thematic data analysis. Creswell (2014) defines thematic data analysis as the technique of categorizing and grouping ideas with similar meanings together to record a trend in responses to themes. This is useful when finally presenting the findings since it is simple to understand the ideas if they are grouped or recorded in tables of similar categories or themes of knowledge. In analysing data, the study followed the sequence below:

(a) Reading and writing down all the information in the interview schedules, and observation schedule.

(b) Select the richest parts and listing of emerging ideas and categorizing them into themes.

(c) Identify major themes and sub-themes from all research tools.

(d) Analyse categories of the themes accordingly as well as sub-themes.

1.8 Location of the study

The study targeted Physical Sciences teachers as participants, thus it was located in schools around the Umlazi District where the researcher is currently teaching Physical Sciences in one of the schools. According to the Snap survey report for ordinary schools (2011), Umlazi district has 490 schools in total, 469 public schools, 8 special schools, and 21 state-funded independent schools. Schools are separated into Circuits and then wards. This study was located in three schools under the Phumelela circuit of the Umlazi district and the choice of schools in this study was purposive based on availability and accessibility.

1.9 Chapters representation of the study

The first of five chapters is the introduction and background of the study. It introduces readers to the concept of Constructive Alignment (CA) and highlights the background of the study. The first chapter further presents the statement of the problem, outlines the significance of the study, aims, questions asked to address the problem, location of the study, methodology as well as the location of the study.

The second chapter reviews literature dealing with constructive alignment and its' constructs. The literature reviewed also deals with teachers' experiences in CA as well as studies in CA. Chapter two also presents the conceptual framework that the study is based upon.

Chapter three gives the complete research design and methodology. This gives a layout of how the research was carried out from choosing the paradigm, approach, and research style to designing research methods and research tools corresponding to the paradigm and style. Chapter three also provides an outline of data analysis.

Chapter four presents the data and findings of the study. This includes the analysed data from the pre-and post-interview, document analysis template, and observation schedule. The fourth chapter also presents the themes of findings emerging from the data collected using all the data sources and triangulated.

The fifth chapter summarises the findings of the study and the discussion that arises based on the findings of the study. Chapter five also presents the impact of these findings based on literature and later provides the recommendations and limitations of the study.

Chapter Two

Review of Literature and conceptual framework

2.1 Introduction

This study explored Physical Sciences teachers' experiences of constructive alignment (CA) between intended learning outcomes (ILOs), teaching and learning activities (TLAs), and assessment in Electrostatics and Electric Circuits in the Physical Sciences curriculum grade 12. The literature reviewed in this study comprises mostly recent literature although few articles are taken from old literature due to their relevance to this study. Literature research in this area is necessary because the area of research has been visited a few times by other scholars and many studies conducted in constructive alignment (CA) are based on tertiary education rather than high school education. Moreover, this literature attempts to unpack the phenomenon of the study (experiences), outline the purpose of Sciences education, the teacher's role in Sciences education and constructive alignment, and also give a broader definition of CA and its constructs. This chapter provides a comprehensive literature review relevant to the research.

The term "experiences" as the phenomenon of the study is discussed in the second section followed by Sciences education and the purpose of Sciences education which are discussed in the third section as well as scientific literacy. While the fourth section unpacks Sciences process skills and epistemological beliefs in science. The fifth section defines the curriculum and then discusses all the constructs of the curriculum (intended learning outcomes (ILOs), teaching and Learning activities (TLAs), and Assessment). The sixth section presents the definition of the concept constructive alignment (CA) referring to the available literature and concludes by discussing the importance of constructive alignment in the curriculum. Moreover, the sixth section discusses the role of a sciences teacher in constructive alignment. In the seventh section, difficulties in teaching and learning Electrostatics and Electric Circuits are discussed followed by the suggestions on teaching and learning Electrostatics and Electric circuits from literature. Moreover, the seventh section presents the percentage pass in Electrostatics and Electric Circuits. In section eight a wide range of models and approaches to curriculum analysis are examined. The ninth section discusses the conceptual frameworks on which this project's research was based by looking at how assessment, teaching and learning activities, and intended learning outcomes affect student learning as well as how alignment can be created. The summary and a brief synopsis of the major topics covered in the literature review are provided in the tenth section. The following section unpacks “experiences” as defined and understood by other Scholars. This is done because the phenomenon of the study are teachers’ experiences, it was necessary for the literature on experiences to be reviewed to give readers a clear definition of the phenomenon.

2.2 Experiences

This study explored Physical Sciences teachers’ experiences of constructive alignment (CA) between intended learning outcomes (ILOs), teaching and learning activities (TLA), and assessment in electrostatics and Electric Circuits in the grade 12 Physical Sciences curriculum. The concepts relevant to teachers’ experiences are explored in this section accompanied by a broader definition of the term experience. Marton and Alwast (2002) maintains that immediate experience manifest in the form of physical behaviour or conceptual reasoning. This definition is in line with that of Collins (2006), who defined the term experience as the tendency of one having direct involvement in the subject. This definition is relevant in this study as it alludes that teachers have a direct involvement in constructive alignment between intended learning outcomes, learning activities, and assessment. The study by Kardos and Johnson (2010) conducted on novice teachers experiences of formal coaching revealed that the term experiences involve perceptions, knowledge, and skills of individuals about the subject. This definition is also relevant to this research since Physical Sciences teachers as professionals should possess knowledge and skills of constructive alignment between ILOs, learning activities as well and assessment. The term experience is defined in this study as the acquired knowledge and skills accompanied by perceptions possessed by the individual about the subject.

Moreover, the work of Kardos and Johnson (2010) alluded that experience is an influential factor in deciding on teaching resources, methods, and content to be taught. Browder et al. (2008) contend that experience can be used as a tool for improvement in classroom practice. However, within the term experience, there are also challenges faced by the novice teachers in Kardos and Johnson (2010) study and these challenges form part of their experiences. These challenges included insufficient time to cover subject content, creating learning activities, and choosing the appropriate teaching method suitable for learners for the attainment of ILOs. The literature above suggests that experiences directly and indirectly influence classroom practice and the awareness of constructive alignment by physical Sciences teachers. The following section discusses the purpose of Sciences education as well as scientific literacy.

2.3 Science Education

2.3.1 Purpose of Science Education

In South Africa, unlike other countries, Sciences comprises many different subjects from primary school until tertiary level education. This distribution of science subject is aimed at introducing learners to Sciences concepts and early development of Sciences literacy (DBE, 2017). Subjects like Natural Sciences at lower levels of education assist learners to develop scientific methods, skills, and literacy. Parallel to the foundation subjects like Natural Sciences, studies by Chinn and Malhotra (2002) and Rennie et al. (2001) suggested that the major purpose of Sciences education is to develop scientific literacy in the early years of schooling. The evidence of this is the introduction of the CAPs curriculum with a great number of inquiry-based Sciences (Yapıcıoğlu, 2021). Osborne and Dillon (2008) alluded that the emphasis in sciences education should be on engaging students with scientific phenomena and scientific views at an early age. Sciences in high school is distributed into different subjects namely, Physical Sciences, Life Sciences, Agricultural Sciences as well as natural Sciences. However, this study focuses on Physical Sciences which have two strands: Physics and Chemistry. Physical Sciences has many inquiry-based tasks that can be undertaken by learners to develop their scientific literacy (Roche et al., 2020), although some of these tasks are just recommended and not prescribed by the Annual Teaching Plan (ATP). All the stakeholders involved in the teaching and learning of science need to understand the term and become scientifically literate. The following section defines Scientific Literacy.

2.3.2 Scientific Literacy

The term scientific literacy is associated with the ability to ask, find, or solve scientific problems derived from curiosity and engage in the social conversation about the validity of the conclusion (Peffer & Ramezani, 2019). The United States National Research Council (USNRC) of 1996 used the definitions as quoted below to clarify Scientific Literacy.

> "*Scientific literacy means that a person can ask, find, or determine answers to questions derived from curiosity about everyday experiences. It means that a person can describe, explain, and predict natural phenomena. Scientific literacy entails being able to read with*

understand articles about Sciences in the popular press and to engage in social conversation about the validity of the conclusions. Scientific literacy implies that a person can identify scientific issues underlying national and local decisions and express positions that are scientifically and technologically informed. A literate citizen should be able to evaluate the quality of scientific information based on its source and the methods used to generate it. Scientific literacy also implies the capacity to pose and evaluate arguments based on evidence and to apply conclusions from such arguments appropriately" (NRC, 1996, p. 22)

The quote above presents a broad definition of scientific literacy which can be narrowed by this study to a measure of problem-solving skills and meaningful scientific response. Rennie et al. (2001) contend that a scientifically literate individual should understand the world around them, be sceptic and make scientific judgments about scientific matters, and be able to investigate and draw evidence-based conclusions on science matters. This literature on the purpose of science education demonstrates a scientifically literate person as someone who can think about problems, solve them, and present scientific explanations on how to solve scientific problems. In the context of this study, scientific literacy is important to both the teachers and learners as it describes the ability to observe, analyse, and solve scientific problems as well as communicate scientific ideas and information. Scientific literacy is necessary as it contains learning outcomes that should be achieved by aligning teaching and learning activities to assessment (Peffer & Ramezani, 2019). However, the epistemological beliefs of teachers and learners may affect scientific literacy and thus they can never be ignored. The following section discusses scientific process skills and epistemological beliefs.

2.4 Process skills and epistemological beliefs

Individuals hold different beliefs about the nature of knowledge and what they know, these are called epistemological beliefs (Peffer & Ramezani, 2019) . Carley (1989) defined epistemological beliefs as important aspects of scientific literacy. The need for the development of process skills and epistemological beliefs in teachers and learners is emphasized by She et al. (2019). Zeineddin and Abd-El-Khalick (2010) suggest that epistemological commitments can influence how students' reason about a science problem and may explain the disconnection between how one thinks in a formal science context versus their day-to-day life. Studies by Sengul et al. (2020) argued that learners develop different beliefs about the nature of their knowledge if they are not guided by a scientifically literate teacher. Therefore, the science curriculum according to scientific literacy should have processes involved in reliable scientific investigations and development of a better understanding of the nature of science for better development of learners' epistemological beliefs (Lederman, 2006). Epistemological beliefs are an important aspect of scientific literacy as (Roche et al., 2020) contends since they can influence the reflective scientific judgment and response of each individual.

It cannot be denied that teachers beliefs and knowledge can limit the extent to which they engage their learners in a scientific dialogue. Teachers pedagogical content knowledge (PCK) and epistemological beliefs shape how they plan their lesson and affects their teaching (Sengul et al., 2020). Epistemological beliefs of teachers can be used to amplify teachers' confidence in teaching, and it can be translated into their teaching (Gess-Newsome et al., 2019). It is evident from the study by Sengul et al. (2020) that there is a direct relationship between science teachers' PCK, epistemological beliefs, and classroom practices. This study explored Physical Sciences teachers' experiences of constructive alignment between ILOs, teaching and learning activities as well as assessment in teaching Electrostatics and Electric Circuits topics in grade 12. Therefore, it was important for the researcher to do a literature review on epistemological beliefs as they have a direct influence on the classroom practices of teachers as argued by Sengul et al. (2020). The following section defines the curriculum and its constructs (Intended learning outcomes, Learning activities, and assessment).

2.5 Defining curriculum and its constructs (ILOs, LA, Assessment)

The study explored Physical Sciences teachers understanding of the constructive alignment between intended learning outcomes (ILOs), teaching and learning activities, and assessment when teaching Electrostatics and Electric Circuits in grade 12. The researcher needs to define the terms curriculum, Intended learning outcome (ILOs) as well and assessment. This is done for a better understanding of the topic by readers and to position the definitions of these constructs that are used in this study in the official literature. The researcher later defines constructive alignment and unpack the role of the teacher in constructive alignment. The following section defines the curriculum.

2.5.1 Curriculum

Defining the concept curriculum is not an easy task for any scholar as this is the umbrella concept with ten concepts linked to its definition. Bhuttah et al. (2019) wrote a paper that analysed the curriculum development stages from Tylers's perspective and defined curriculum as "a set of goals which provides opportunities for engaging learners with various kind of information and learning techniques" (Bhuttah et al., 2019, p. 14). Moreover, (Tyler, 2013) gave a similar definition alluding that curriculum is the plan of instruction that take into consideration the educational purposes to be attained, educational experiences that can be used to attain those purposes, how can these experiences be organised and lastly how to determine whether the educational purposes are attained. Their definitions are in line with Khoza (2016), who argues that teaching without an understanding of curriculum vision or rationale is high risk. The sub-concepts or curriculum concepts that inform the definition of the curriculum are rationale or vision, goals, time, content, assessment, resources, activities, teacher's role, accessibility, and the environment (Van den Akker et al., 2003). Van den Akker et al. (2003) argued that understanding the definition of curriculum and its constructs is necessary for both curriculum designers and implementers. This reveals the importance of teachers in curriculum design as the implementers of the curriculum. "Understanding the curriculum concepts and visions helps teachers to reflect on their teaching to improve teaching and learning" (Khoza, 2016, p. 105). This study will unpack the concept of curriculum as defined by other scholars, tap into curriculum concepts by literature, and further look at the definition of some different forms of assessment.

Recent studies do not define curriculum but give curriculum concepts and roles that can shape the curriculum. Egan (1978) defines the term curriculum as the plan to run a course or short career. Jansen (2003) defined the curriculum as the guiding plan for undertaking the desired journey. Combining these two views can bring the consensus that the word curriculum involves a plan tied by curriculum concepts that are used to undertake a course of knowledge. Thijs and Van Den Akker (2009) defined curriculum as a carefully prepared plan for learning. This definition of curriculum is based on the intended curriculum, however, Thijs and Van Den Akker (2009) and Van den Akker et al. (2009) came up with three forms of curriculum namely; intended curriculum, implemented curriculum, and attained curriculum.

Van den Akker et al. (2003) used the vulnerable curricular spider web to show the interdependence of curriculum concepts that form the core curriculum. These concepts are assessment, learning activities, aims and objectives, educator role, content, accessibility, materials and resources, location, time as well and rationale. Curriculum concepts assist in shaping a good curriculum and specify the vision of a good curriculum. "The vision is very important because it is at the centre of any curriculum and it controls all curriculum concepts"

(Khoza, 2016, p. 105). This study draws from all the definitions by Tyler (2013), Van den Akker et al. (2009), Egan (2003) and Bhuttah et al. (2019) to define curriculum as the planned tool that specifies vision, goals, time, content, resources, teachers' role, and learner activity used to reinforce and measure knowledge. Biggs (2003) alluded that for the curriculum to be meaningful, there is a need for an ideal synergy between the intended learning outcomes, learning activities that meet those outcomes well and assessments that demonstrate the attainment of those outcomes. Therefore, it was necessary that in this study I also define the constructs of the curriculum as stated by Biggs (2003). The curriculum development models by Tyler (2013) and others will be discussed in the conceptual framework section. The following section defines intended learning outcomes (ILOs).

2.5.2 Intended learning outcomes

Intended learning outcomes (ILOs) can be defined as a statement describing knowledge, values, and skills that students need to acquire at the end of a section or course (DBE, 2011). Each subject or module has its intended learning outcomes set to be achieved upon completion. However, these specified intended learning outcomes describe the desired outcome in each area of the subject. Gillespie (2011) contends that intended learning outcomes are module-intended goals that shape the learning process and clarify the appropriate activities that will result in the realization of these intended goals. Martin et al. (2021) alluded that intended learning outcomes assist in moving the centre of attention from the teacher to the results of the learners' learning process. This suggests that setting ILOs needs to take into consideration what learners need to achieve at the end of the lesson thus informing what learning activities a teacher should use to achieve these outcomes. Siebörger (2004) argued that intended learning outcomes consist of action verbs that indicate performance, competency, and achievement expected to be acquired by learners during the course or the lesson.

These action verbs are stressed by Martin et al. (2021) as indicators of the depth of knowledge that needs to be acquired by learners at the end of the lesson. This study defines intended learning outcomes as a guiding tool or statement that assist teachers in choosing appropriate learning activities which will lead to the realization of the curriculum goals. It is for this fact that the following section defines learning activities and positions the definition of learning activities used by this study in the current literature.

2.5.3 Teaching and Learning activities

Ali (2018) defines teaching and learning activities (TLAs) as a series of tasks that are carefully selected by the teacher for learners to do. The latter is stressed by Zahara et al. (2020) who define teaching and learning activities as the two directional tasks that are selected by the teacher to achieve intended learning outcomes. It can be understood from the definitions above that teaching and learning activities do not only involve what a teacher is doing but also what learners are doing to achieve the ILOs. Martin et al. (2021) alludes that the sharing of ILOs with learners is primarily their right and secondary allows them to adjust their learning to achieve the well-announced learning outcomes. Gillespie (2004) defines teaching and learning activities as any pedagogical method used to achieve intended learning outcomes. This definition is in line with those presented by Ali (2018) and Zahara (2020) as well and Martin et al. (2021) as they all allude that teaching and learning activities should lead to the attainment of IOLs.

In their definitions, Ali (2018) takes into consideration teachers' input or practices in teaching and learning activities as they are the facilitators of learning. Therefore, it is not only the learner's effort that will lead to the teaching and learning activities achieving intended learning outcomes, but the cautiousness of the teacher in selecting the appropriate activities for learners that results in acquiring the intended learning outcomes. This study defines teaching and learning activities as the series of learning tasks and pedagogical methods carefully selected by the teacher to realize the intended learning outcomes of a certain course or lesson. Part of the problem that evoked this study is the debate on who should choose the appropriate learning activities for the attainment of intended learning outcomes. The Physical Sciences educators were calling for curriculum designers to include the learning activities that are appropriate in all the documents including textbooks to improve the extent of alignment (Edwards, 2010). On the other hand, the DBE officials point to educators failing to choose or create appropriate learning activities (Terrell et al., 2011). The study by Terrell et al. (2011) found that learning activities given to learners do not coincide with assessment and do not lead to the attainment of intended learning outcomes. The pedagogical methods involve assessment which is an important aspect of the curriculum (Khoza, 2016). The following section defines assessment according to other scholars and draws a definition of assessment for this study.

2.5.4 Assessment

Assessment can be divided into summative and formative assessment fitting to their purposes at a particular instance (Black & Wiliam, 2009; Dolin et al., 2018; Zahara, 2020). According to the DBE (2011), assessment can be defined as the continuing planned process of identifying, gathering, and interpreting information about learner's performance and teachers' teaching. According to Ali (2018), assessment is defined as the act of finding and evaluating while reflecting on both teacher and learner activities to improve learning and adjust teaching. This definition can be summarised as the process of measuring, evaluating, reflecting, and reporting about learners' performance and the teachers' teaching. Moreover, "Assessment is seen as the practice of detecting and defining the students' knowledge, understandings, abilities, and skills" (Madani, 2016, p. 127). In clarifying assessment, the following propositions can be regarded as forms of assessment: formative and summative assessment. The above-mentioned types of assessments can be understood using their forms and definitions. The following section unpacks the definitions of formative assessment as used in the study and by other scholars.

2.5.4.1 Formative assessment

Formative assessment can be defined as the process of gathering information about learners' progress to enhance teaching and learning (DBE, 2011). formative assessment is also known as the assessment "for" learning and reinforces student learning during the learning process (Nieminen & Tuohilampi, 2020). The two definitions allude that formative assessment occurs while teaching and learning are still in progress as it is used to enhance teaching and learning rather than to judge or evaluate the learning process. Formative assessment is defined broadly by Black and William (2009) as a practice in the classroom where learners' achievements are traced, interpreted, and utilized by educators to make informed conclusions about the next step in learning and formulate feedback to enhance the learning process. Moreover, (Williams, 2020) provided the following definition of formative assessment as an update to the one they presented with Black in 2009. "Formative assessment refers to frequent, interactive assessments of students' progress and understanding to identify learning needs and adjust teaching appropriately" (Williams, 2020, p. 4). This definition as quoted from Williams (2020) provides a clear view and purpose of formative assessment, thus it is relevant to this study as it explored "Physical Sciences teachers' experiences" of constructive alignment (CA) between intended learning outcomes, teaching and learning activities, and assessment in electrostatics and Electric Circuits.

The definition of experiences includes practical involvement on the subject as described in section 2.2 above. Ali (2018) adds to the significance of formative assessment and contends that it is an important component of assessment as it allows teachers to reflect, give feedback, and re-align their lessons using CA. The following are the key elements of formative assessment as presented by the United States Ministry of education (2006).

Key elements of formative assessment are:

> *"• identification by teachers and learners of learning goals, intentions or outcomes and criteria for achieving these;*
>
> *• rich conversations between teacher and learner that continually build and go deeper;*
>
> *• provision of effective, timely feedback to enable learners to advance their learning; and*
>
> *• response by teachers to identified learning needs and strengths by modifying their teaching approaches".* (United States Ministry of Education, 2006)

The study by Yorke (2011) attests that the most important value of formative assessment on learning is that it allows an opportunity for both teachers and students to get feedback, reflect, and adjust accordingly on their learning and teaching. In support of Yorke (2011), the study by Siebörger (2004) maintained that the value of using formative assessment in teaching is that it convinces teachers to improve their teaching and assessment skills as they will try different teaching and assessment strategies to assess students to track students learning and further help learners improve performance by achieving the ILOs. These studies emphasize the purpose of formative assessment and the need to constructively align teaching and learning activities, ILOs, and assessments. However, the study by Dolin et al. (2018) which explored relations between formative and summative assessment found that although formative assessment is recommended in curriculum documents, no obligation commits teachers to conduct formative assessment. Moreover, Dolin et al. (2018) argued that teachers view the formative assessment as an add-on to the curriculum which overloads the curriculum and limits their teaching time. This argument illustrates that some teachers do not view formative assessment as part of their teaching but just an add-on. Hence, a need for the exploration of teachers' experiences of constructive alignment between ILOs, teaching and learning activities, and assessment. Drawing from the reviewed literature this study defines formative assessment as a frequent, interactive assessment of students' progress and understanding to track their progress in achieving ILOs, identify learning needs and adjust teaching appropriately. The following section unpacks the summative assessment definition by other scholars and as it is used in this study.

2.5.1.2 Summative assessment

The assessment of learning or the summative assessment can be defined as the process of evaluating, grading, and reporting on learners' performance using any form of assessment (DBE, 2017). Summative assessment also known as assessment "of" learning (Williams, 2020) involves collecting, interpreting, and reporting on evidence of teaching and learning as well as attainment of intended learning outcomes (ILOs). Methods of collecting evidence for summative purposes includes examinations, learner portfolio, report issuing, and others (Dolin et al., 2018). The idea portrayed by the definitions above views summative assessment as the last step of curriculum implementation but the first step in curriculum design. The latter is stressed by Joseph and Juwah (2012) as the backward design in constructive alignment where the ILOs as portrayed by the action verbs in summative assessment are used to plan teaching and learning activities to achieve those ILOs.

Harlen (2014) and Yorke (2011) argued that summative assessment is associated with progress toward the big ideas rather than with learning in specific activities. Summative learning does not only report on learners' performance but assists in adjusting possible feedback for both the teachers and learners, hence the summative assessment can be used for both formative and summative purposes (Brookhart, 2015). The study by Gezer et al. (2021) explored the relationship between formative assessment and summative assessment in primary-grade mathematics classrooms and found that formative assessment can be beneficial in bringing hope to poor-performing learners in primary-grade mathematics and recommended that teachers use formative assessment frequently before summative assessment. This study defines summative assessment as the process of evaluating learners' performance and the measure of attainment of intended learning outcomes (ILOs) using the appropriate learning activities. The following section highlights other scholars' definitions of constructive alignment and attempts to position this study's definition of constructive alignment in current literature.

2.6 Defining constructive alignment (CA)

This study define Constructive Alignment (CA) and evaluate other scholars' definitions of constructive alignment. Biggs (1999) outlined that in the aligned curriculum there is consistency throughout the system, clear intended learning outcomes (which are at the level of understanding required rather than the list of topics to be covered) are aligned to teaching and learning activities and teaching methods that are likely to realize those intended learning outcomes. He further argued that the assessment should address the same agenda and support other components. Biggs (1999) as quoted contends that in a constructively aligned curriculum consistency between intended learning outcomes, teaching and learning activities as well as assessment is required. Biggs (1999) argued that following an integrated approach to teaching, learning, and assessment should result in the congruence between what is taught, what is assessed in formative and summative, and what is intended to be learned. Spady (1994) uses "matchmaking" as a synonym for alignment. He (Spady, 1994) explains that alignment basically means the "perfect match" of four things, namely:

> "1. what is important for the learners to learn.
> 2. what we teach them and what they learn.
> 3. how we teach them and how they construct knowledge; and
> 4. what we assess when we ask them to perform."

What is important to learn will be determined by the intended learning outcomes (ILOs) to be achieved. What the learners are taught and how the learners are taught will be contained in the assessment standards and the learning activity. The learning activity must be appropriate for the intended learning outcome and assessment standards. The learners must be assessed on what they have been taught and what they have learned. Therefore, the assessment must match the assessment standards.

The two main perspectives of constructive alignment were presented by Ali (2018):

1. Learners' perspective – it implies what learners do to learn.
2. Teachers' perspective – it implies a complete link of planning and carefully selecting learning activities and assessment activities that leads to learners attaining the ILOs.

According to Ali (2018), in a constructively aligned curriculum educators must have proper objectives of what they want their leaners to achieve at the end of the lesson or topic. Ali,

(2018) and (Biggs, 2014) defined CA as an approach to curriculum development and implementation where the intended learning outcomes on the curriculum design, curriculum delivery, and assessment are all aligned. Other scholars defined CA as a curriculum design approach that ensures that what is tested is prescribed in the curriculum and is taught or learned by learners at the corresponding level (Cain et al., 2017; Fitzallen et al., 2017; Ruge et al., 2019). Both the definitions above refer to the approach that should be followed when developing and implementing a curriculum. The second definition differs from the first in that it outlines that there should be a direct link between what the documents prescribe, what happens in the classroom, and what is assessed. Bester and Scholtz (2012) defined CA as the construction of student-centred activities and international alignment of outcomes, activities, and assessment that ascribe to appropriate cognitive levels of learning. This study defines constructive alignment as the learner-centred approach to curriculum design and delivery which aligns intended learning outcomes, teaching and learning activities, and assessment that is set at appropriate cognitive levels.

The article by Loughlin et al. (2020) on reclaiming constructive alignment (CA) argued that CA is more relevant as an educational theory or framework for curriculum design and teaching. The article by Loughlin et al. (2020) further mentioned that if CA is used as a higher education teaching policy (HETP) then it will lack the constructivism part as originally stated by Biggs (1996). Furthermore, they argued that "constructive in CA originally came from constructivism where learners' knowledge is constructed in a learner-centred approach than lecturing. In their presentation they alluded that there is nothing constructive done by students in higher education (HE), rather the framework of CA can be used by teachers in basic education to constructively align ILOS, teaching and learning activities, and assessment because in schools' learners' knowledge is constructed in a learner-centred approach and not in a form of lecturing.

The study by Cain et al. (2017) found that a constructively aligned assessment elicits meaningful learning approaches from all students where participation in learning activities of appropriate cognitive levels ensures a better performance in assessment. The studies by Edwards (2010) and Mhlolo and Venkat (2009) investigated the constructive alignment in the curriculum design and curriculum assessment using past Revised National Curriculum Statement (RNCS) exemplar papers, with Edward's study in Physical Sciences. The researchers found that less alignment in assessment compromises meaningful learning and leads to learners failing to perform in questions that demand higher cognitive levels.

Furthermore, Mhlolo and Venkat (2009) mentioned that if there is no or less constructive alignment in assessment, this will report the false impressions of what was happening in class, whether learning took place or not. Moreover, Cain et al. (2017) revealed that constructively aligned assessment yields proof of attainment of intended learning outcomes (ILOs) and meaningful learning thus improving performance. The studies by Edwards (2010), Fitzallen et al. (2017) and Mhlolo and Venkat (2009) concluded that more constructively aligned assessment does not only report on the attainment of intended learning outcomes but assists in building confidence in learners while they construct their knowledge and trust towards their educator as they will be in better position to understand all forms assessment. The following paragraph outlines a few international studies on constructive alignment.

Constructive alignment ensures the adoption of a holistic systematic vision to curriculum design and maximizes the effectiveness of curriculum design by interrelating different components of the curriculum Alfauzan and Tarchouna (2017). Moreover, the study by Alfauzan and Tarchouna (2017) found that the use of constructive alignment as the learner-centred approach to curriculum design increases the appropriateness and consistency in all the intended outcomes, learning activities, and assessment. However, the study by McKimm (2003) revealed that curriculum design cannot be treated in isolation as a systematic tool to enhance performance it should be constructively aligned with learning activities and assessment. Moreover, McKimm (2003) further argued that constructive alignment of the intended learning outcomes to the learning activities and assessment is the precondition for the achievement of the intended learning outcomes (ILOs) and improvement of performance.

The study by Ruge et al. (2019) focused on both the conceptual and methodological perspectives of constructive alignment with a cross-institutional study from two Australian universities. Their study found that commitment and clear motivation for constructive alignment are expressed to stakeholders; roles, responsibilities, and support are provided at each level. An additional finding in both cases is that the potential “implementation gap” in the middle is caused by not aligning intended learning outcomes to learning activities and assessment. This study by Ruge et al. (2019), alluded that even though the assessment and ILOs in the Australian university course are aligned, there is still a component that is missing in constructive alignment (learning activities) to cover the implementation gap of the three-curriculum construct. The study by Little (2017) found that the most appropriate response to learner diversity is to stick to constructive alignment of the curriculum by aligning intended learning outcomes (ILOs) to learning activities and assessment thereof.

Studies by local and international scholars, that is, Biggs (2014), Edwards (2010), Ruge et al. (2019) and, Mhlolo and Venkat (2009) advocated for the need for constructive alignment in intended learning outcomes, learning activities, and assessment. Hailikari et al. (2022) in their study of "student perspectives on how different elements of constructive alignment support active learning" found that the intended learning outcomes did not inform student learning and students were not made aware of the ILOs from the beginning of the course. However, Hailikari et al. (2022) does not explore teachers experiences and it is not in the South African context. Although there are few studies in CA, none of the reviewed literature includes the teachers' experiences of constructive alignment between ILOs, TLA, and assessment. The literature reviewed analyses the alignment of past exam papers or course documents. All the above studies do not explore teachers' experiences of constructive alignment in the school context, and they mostly explore the constructive alignment of the programs or course rather than the topic. This creates a gap in the literature on constructive alignment, nevertheless, the findings of this study attempt to fill that gap. The following section presents the importance of constructive alignment in the curriculum.

2.6.1 Importance of Constructive alignment in the curriculum

Part of the problem that evoked this study is the debate on who should choose the appropriate learning activities for the attainment of intended learning outcomes and improved performance. The Physical Sciences educators are calling for curriculum designers to include the learning activities that are appropriate in all the documents including textbooks to improve performance (Edwards, 2010). On the other hand, the DBE officials point to educators failing to choose or create appropriate learning activities (Terrel et al., 2011). The study by Terrell et al. (2011) found that learning activities given to students are not of the same standard as the assessment and do not lead to the attainment of intended learning outcomes. Their study proposed that learning activities should be of the same appropriate cognitive levels as those assessed and should converge to attain the intended learning outcomes (ILOs) and improve performance. The literature above stimulated the need for this research to review studies on the importance of constructive alignment (CA). Reviewing studies on the importance of constructive alignment did not only support the need and validity of this research but also assisted in understanding teachers' experiences of CA and discussing the findings. The following section presents studies on the importance of CA in the curriculum.

Aligning the constructs of the curriculum allows learners to engage meaningfully in their lessons and increase their chances of attaining ILOs (Biggs, 1996; Biggs & Tang, 2011; Trigwell & Prosser, 2013). The framework of constructive alignment is known to lead to the attainment of ILOs and help learners to have a clear picture of what they need to learn, how they learn it as well as what is going to be assessed and how will it be assessed (Zhao, 2016). The insight brought by these scholars is that CA does not only benefits the teacher but learners and curriculum designers as well since it has a good impact on the attainment of ILOs. The study by Larkin and Richardson (2013) titled: "Creating high challenge/high support academic environments through constructive alignment: student outcomes", found that the importance of CA is not only to contribute to academic grades but also to facilitate student learning and experiences. Moreover, Larkin and Richardson (2013) presented CA not only as the curriculum design model but as a teaching and learning approach that learners and their teachers can adopt to attain ILOs. The teacher is also an active role player in CA as alluded to by Bigg and others above, thus the following section attempts to present the role of the Sciences teacher in CA.

2.6.2 The role of the science teacher in constructive alignment

Although the CAPS document is not clear on Physical Sciences teacher's role in assessment and learning activities, the literature provides some roles that can be performed by teachers during teaching (Mpungose, 2020). This silence by the CAPS document on teacher's role causes confusion on teacher autonomy and professionalism, they struggle to understand whether to implement changes into the document, decide on appropriate strategies or wait to be given the roles by curriculum designers. The major part played by the sciences teacher in CA is to expose learners to teaching and learning activities that lead to the attainment of ILOs (Biggs, 1996). This teacher's role as described by Biggs (1996) moves the teaching approach from being teacher-centred to a most learner-centred approach to curriculum implementation, hence the learner is viewed as the constructor of their own knowledge (Tran, 2016). Biggs and Tang (2011) alluded that the teacher selects appropriate teaching and learning activities while aligning assessment with ILOs thus successfully guiding students towards the attainment of intended learning outcomes (ILOs). The study by Hailikari et al. (2022) found that the crucial role of the teacher in CA involves guiding, encouraging, and carefully selecting appropriate tools for learners to attain the ILOs. The study by Hailikari et al. (2022) emphasized the learner-centred purpose of constructive alignment (CA) and positions a teacher as the initiator and a guide to the attainment of ILOs.

The roles of the science teacher in CA as presented by Hailikari et al. (2022) above indicated that it is important for the teacher to possess skills of CA as well as the appropriate level of pedagogical content knowledge (PCK). The case study by Melo et al. (2020) explored pedagogical content knowledge (PCK) of physics teachers in Colombian secondary schools and found that when teachers can reflect on what they design and whether it results in the attainment of ILOs, then their reflections can lead to the progression towards teaching and learning that is more focused. Melo et al. (2020) further alluded that PCK is an important framework as it helps novice teachers to adjust their teaching while offering seasonal teachers self-regulated reflections. The study by Mellati and Khademi (2018) explored the impact of teacher assessment literacy on learners' achievement and concluded that "teachers assessment literacy has a statistically significant impact on learners' writing achievements and teachers' assessment awareness leads teaching environments into effective and motivated assessment design" (p. 17). These findings advocate for the teacher assessment literacy as an additional important factor that should complement PCK to help teachers create the necessary conditions for the attainment of ILOs. In determination, these studies found that a Sciences teacher in CA should possess skills CA by carefully selecting teaching and learning activities that are aligned to assessment and lead to the attainment of ILOs. Furthermore, the study by Melo et al. (2020) suggests that Sciences teachers in CA should be guided by self-regulated reflections and assessment literacy to align teaching and learning activities and assessment in their classroom practices for proper attainment of ILOs by learners.

2.6.3 Constructive alignment studies and gap in Literature

Biggs (1999) and Ali (2018) defined CA as an approach to curriculum development and implementation where the intended learning outcomes on the curriculum design, curriculum delivery, and assessment are all aligned. Jacobs (2004), Rudnitsky (2006) and Squires (2012) defined CA as a curriculum design approach that ensures that what is tested is prescribed in the curriculum and is taught at the corresponding level. This section presents studies on constructive alignment and alignment in general.

The study conducted by Jaiswal (2019) concluded that:

'*Constructive alignment is a useful model for formulating teaching learning activities and assessment tasks that directly address the intended learning outcomes in a manner not typically accomplished in traditional lectures. Moreover, it is pivotal to write clear and constructively aligned learning outcomes that indicate what a learner is expected to accomplish at the end of a program of study, as well as what standard or level of achievement is anticipated and how they are expected to demonstrate their learning.'* (p. 20-21)

This study advocated for the transparent and well communicated CA and intended learning outcomes (IOLs) between learners and teachers to enhance clear knowledge construction by learners. The study by Terrell et al. (2011) on constructive alignment found that learning activities given to students are not of the same level as the assessment and do not lead to the attainment of intended learning outcomes. These findings report on the study conducted in HE institution and do not consider the experiences of either the lecturer or students of constructive alignment. Parallel to Terrell et al. (2011), the study by Munsamy (2014) undertook a study analysing the alignment of cognitive demands in previous Physical Sciences question papers from 2008 to 2013 and found that almost 94% of the questions were lower-order questions and did not match the weighing of cognitive demands in National Curriculum Statement (NCS). Although the study by Munsamy (2014) analysed the question papers from high school syllabi it did not involve teachers' experiences, actual practice by teachers, and learning activities.

Although studies by Biggs (2014), Mhlolo and Venkat (2009) and Squires (2012) advocated for the need for constructive alignment in intended learning outcomes, teaching and learning activities, and assessment, I have not come across studies that have been conducted to check for the teachers' experiences of constructive alignment between intended learning outcomes, learning activities and assessment in Physical Sciences curriculum specifically for the Curriculum and Assessment Policy statement (CAPS). Most of the studies focus on the alignment between intended learning outcomes and assessment and neglect the teaching and learning activities that are necessary for meaningful learning as Squires (2012), Zhao (2016) and Lopez (2013) argue. The other study by Munsamy (2014) found that there is a de-emphasis on higher-order thinking skills and an over-emphasis on lower-order thinking skills in the NSC Physical Sciences examinations. The difference in cognitive levels prescribed by the curriculum and those in the examination can only be addressed by finding the teachers experiences of constructive alignment between the intended learning outcomes, teaching and learning activities, and assessment in the Physical Sciences curriculum.

2.7 Electrostatics and Electric Circuits

The literature on CA discussed above advocate for the utilisation of CA as a teaching approach to possibly address underperformance within the subject or the topic. After reviewing literature by Biggs (1999), Biggs (2003), Biggs and Tang (2011), Edwards (2010), and Zhao (2016), advocating for the CA to be used to improve grades and coherence understanding within the course or the topic. The researcher analysed the DBE diagnostic reports for the past five years and discovered that the topic Electrostatics as well as Electric Circuits are the most poorly performed topics over the years (DBE, 2018; 2019; 2020; 2021 & 2022). Furthermore, the literature acknowledges the exploration of CA in topics that are poorly performed (Little, 2018). The facts from the diagnostic reports and literature provided the strong reason for the researcher to explore teachers experiences of CA in these topics.

This part of the review presents literature on the teaching and learning of the topics Electrostatics and Electric Circuits. The first section defines the topic Electrostatics, outlines the difficulties teachers and learners face during the teaching and learning of the topic Electrostatics locally and internationally. Moreover, the first section will outline the misconceptions and results of Electrostatics outlined by the DBE 2018, 2019,2020, 2021, and 2022 diagnostic reports and further discuss the suggestions by the examiners and scholars. The second section defines the topic Electric Circuits, outlines the difficulties teachers and learners face during the teaching and learning of the topic Electric Circuits locally and internationally. Furthermore, the second section outlines the results and misconceptions presented by DBE 2018 – 2022 diagnostic report and further discuss the suggestions by examiners and scholars.

2.7.1 Electrostatics

Li and Singh (2017) allude that the topic Electrostatics is the most important in the area of Electricity and Magnetism as it form the foundation of topics like Electric Circuits and Electrodynamics. The topic Electrostatics is taught in detail in grade 10 and 11 and only gain minimal attention in grade 12 where teachers only get to revise the topic based on grade 11 examination guidelines. Dega et al. (2013) alluded that the term Electrostatics refers to the study of the non-moving charges, and further stated that it contains concepts that are difficult to learners as reported by local and international literature.

2.7.1.1 Difficulties in teaching and learning of Electrostatics

The topic of Electrostatics contains the three different concepts in the CAPS curriculum that should be addressed to meet the needs of curriculum coverage. These three concepts are electrostatic force, electric field, and electric field strength. Literature reveals that the invisibility of electric charges and electric fields is the reason why learners find it difficult to conceptualise the topic Electrostatics (Senthilkumar et al., 2014).

Difficulties in teaching and learning electrostatic force: Literature has reported several difficulties associated with new concepts as well as application to prior knowledge. Coulomb's law has been reported to be poorly understood by learners in the CAPS curriculum. Coulomb's law presents the inverse square law relationship between the electrostatic force between the two charges/charged particles and the distance between the two charges/charged particles. Prior knowledge application has been reported to be another difficulty faced by learners as well as integrating Electrostatics with Newton's third law of motion. The following section briefly outlines these difficulties of teaching and learning electrostatic force.

The inverse square law: This inverse square law has been reported to be misunderstood by learners and the possibility of teaching difficulty by teachers may exist (Ajredini et al., 2017; Maloney et al., 2001). A common misconception of learners is perceiving that if the magnitude of distance between the two charges/charged particles is doubled then the magnitude of the force will be halved instead of quartered still exist (DBE, 2017, 2018, 2019, 2020; Ajredini et al., 2017). This recurring misconception elicits the difficulty in the teaching and learning of this inverse square law in electrostatics. Moreover, it is reported in the diagnostic report that some learners are still struggling to determine the electrostatic force between the two charges as they substitute the negative signs in Coulomb's law, therefore complicating the direction of the force as they regard the negative sign as their direction (DBE, 2017, 2018). It is further reported in the literature that the choice of positive direction by learners when there is a superposition of Electrostatic forces on one charge is still not clear (Mazibe et al., 2020)., 2010). Thus, the exploration of Physical Sciences teacher's experiences of constructive alignment (CA) was pivotal.

Prior knowledge application in Electrostatics: It was reported by literature that learners find it difficult to use vector diagrams to show the magnitude and direction of the electrostatic force in the NSC examinations (DBE, 2017). Vectors are part of the important prior knowledge for the topic of Electrostatics that learners and teachers need when solving problems in Electrostatics (Saarelainen & Hirvonen, 2009). The literature reveals that learners find it difficult to identify the reference charge when they draw vector diagrams in Electrostatics, the previous diagnostic analysis showed that learners are still struggling to integrate their prior knowledge into different problems of Electrostatics.

Application of Newton's third law of motion: According to Ajredini et al. (2013), and Maloney et al. (2001), learners believe that bigger charges exert stronger electrostatic forces as compared to smaller charges. In the study by Saarelainen and Hirvonen (2009)), students used different lengths for the vector diagrams representing forces exerted by one (small) charge on another (big). This misconception revealed that there is a lack of integration of Newton's third law of motion in the topic. Furthermore, the misconception of integration is outlined in the diagnostic report (DBE, 2018).

2.7.1.2 Difficulties in teaching and learning of electric field and electric field strength

The following concerns have been raised in literature as challenges of understanding electric field and electric field at point (also known as electric field strength). 1. Identifying the source of the electric field., 2. Representing the electric field using electric field lines., 3. Calculating the net electric field and lastly., 4. Displaying an understanding of the relationship between electric field and electrostatic force (Li et al., 2017; DBE, 2018; 2019; 2020 & 2021). Studies revealed challenges in identifying the charge that creates the electric field and the reference charge that tests the electric field at that particular point. The learners believed that if the positive test charge is removed from the particular point, that point will no longer have an electric field (Ajredini et al., 2013). Li et al. (2017) alluded that this misconception can be a result of teaching that occurred in class that the electric field is only present when there is a positive test charge. It is due to this reason that the study to explore Physical Sciences teachers' experiences of Constructive Alignment in Electrostatics and Electric Circuits was necessary. However, since Electrostatics provides the basic concept of charge that is later used in Electric Circuits, it is important to note that inaccurate teaching of electrostatics and its misconceptions can be transferred and affect the performance in Electric Circuits as well. The following sub-section presents recommendations from the diagnostic report and suggestions from the literature for teaching electrostatics with CA in mind. The DBE (2019; 2020; 2021 & 2022) diagnostic reports report the same misconceptions from the past 6 years and the suggestions provided are still similar. The misconceptions in Electrostatics over the past years are given below.

"*1. Candidates swopped/mixed the formulae for E and F; $E = F/q$ and $E = kQ/r^2$ instead of E they substituted F. Note E= Electric field strength and F = Electrostatic force.*
2. Many candidates failed to realise that the forces acting on the sphere are in equilibrium and a closed vector diagram would have assisted them in calculating the tension in the string.
3. Candidates did not use the absolute value of the charges when substituting in the formula of Coulomb's Law or the electric field at a point." (DBE, 2022, p. 211).

With these misconceptions one can conclude that the basics of Electrostatics are clearly not understood by the learners and a possible shortcoming in teaching the topic may exist. The graph below represents the percentage performance in electrostatics for the past five years.

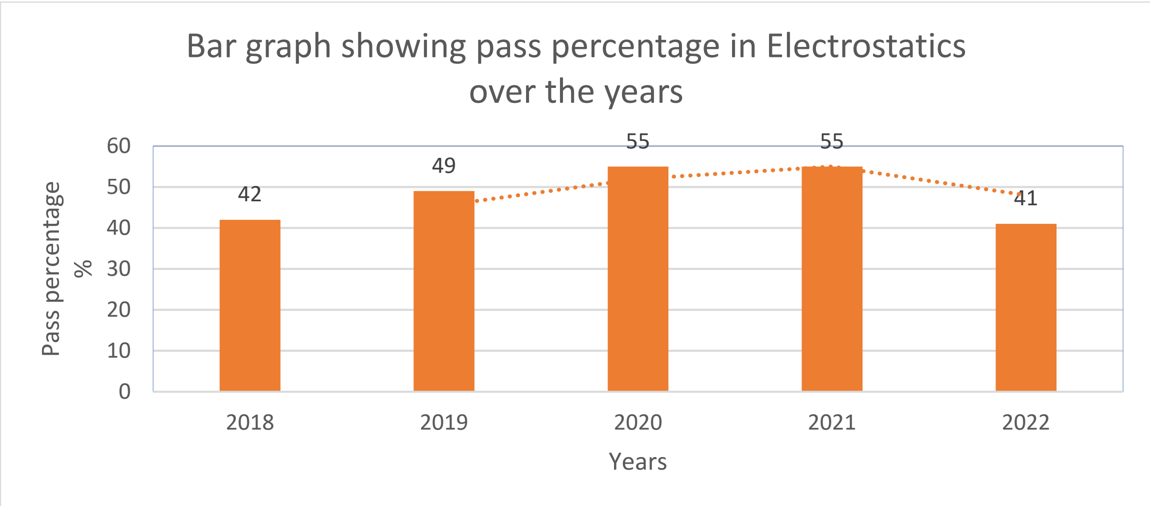


FIGURE 2.1: GRAPH OF PASS PERCENTAGE IN ELECTROSTATICS OVER THE PAST FIVE YEARS (DBE, 2018;2019; 2020; 2021& 2022)

2.7.1.3 Suggestions on teaching Electrostatics

The examiners reported on these misconceptions expressed by the learners' responses in the past examinations without a valid solution to address these. However, literature by Mpungose (2020), Ajredini et al. (2013), and Maloney et al. (2001) advocates for the Physical Sciences teachers to use their autonomy and professionalism to address the issues of teaching and learning where a clear solution is not provided by the CAPS document. Moreover, Khoza (2016) and Mpungose (2020) advocated for the use of Physics Education Technology (PhET) simulations as the more convenient approach when teaching some topics. However, the CAPS document does not specify these digital approaches when teaching and learning Electrostatics.

These are the suggestions provided by the examiners in the DBE (2019; 2020; 2021 & 2022) diagnostic reports.

"*1. Teachers need to emphasise that calculations of net electrostatic force and electric field are similar in terms of their vector considerations.*
2. Teachers need to clarify the distinction between the two equations, for example, it is important that learners understand which charge 'q' and 'Q' refer to in each of these formulae.
3. Expose learners to vector diagrams (1D and 2D) and vector triangles when determining the resultant of forces (e.g., electrostatic, gravitational and tension) acting on a body and net electric fields." (p. 211)
It is important to note that these suggestions are not including any innovative strategy in the teaching and learning of Electrostatics. It is equally necessary to note that these suggestions are in no relation to literature referred to above. This repetition of similar misconception for over six years and silence in suggesting a sound, innovative and clear solution by the examiner shows gaps in the design and teaching of Electrostatics. Hence, the need for the exploration of teachers experiences of CA between ILOs, TLAs and assessment.

2.7.2 Electric Circuits

Electric Circuits is the most complex topic in the area of electricity and magnetism as the background of the Electrostatics is pivotal in understanding the topic (Alexander, 2009; 2013 & Nahvi et al., 2003). Moreover, Nahvi et al. (2003) defined electric circuit as the flow of charge across the closed path. Their definition of Electric Circuits was linked to the definition of Electric Current that they defined as the as the flow of one coulomb of charge per second. They used laws of circuits like Kirchhoff's current law and Kirchhoff's voltage law to understand the operation of each circuit. These basic laws of understanding Electric Circuits are not presented in the CAPS curriculum from the lower grades until grade 12 in high school.

2.7.2.1 Difficulties in teaching and learning of Electric Circuits

Teaching and learning difficulties in Electric Circuits is the area in Physical Sciences with minimal research. Electric Circuits are taught from the lower grades until grade 12 unlike Electrostatics that is revised at grade 12. Burde et al. (2021) maintained that the learning difficulties in teaching and learning of Electric Circuits is caused by the intangibility of the most important physical quantities in the topic like: Electric Current, Electric charge, Potential energy, and others. Burde et al. (2021) share the same idea with Khoza (2016) on the use of digital curriculum models to teach topics like Electric Circuits. McDermott (1998) alluded that due to the inconsistencies within the topic Electric Circuits in the secondary school curriculum, teachers tend to teach this topic the way they were taught in their secondary schools or tertiary institutions. She further argued that there are no shortcuts in understanding the Electric Circuits besides the foundational understanding of Electrostatics and Circuits laws as mentioned in 2.7.2 above. The misconceptions identified by the DBE are given below.

"1. *Many candidates had difficulty interpreting the circuit. They failed to identify which resistors were in series, and which were in parallel and therefore could not apply the relevant principles of resistors in series and parallel*" (DBE, 2021, p.218).

2. "*Most candidates had difficulty interpreting the circuit. Candidates could not correctly identify the resistors that are in series and those in parallel. This has been a serious misconception for many years. Candidates seemed to think that parallel resistors must be in lines that are parallel to each other*" (DBE, 2022, p. 230).

In light of this misconception repeating itself for years, even the previous are years not mentioned above, the teaching and learning of Electric Circuits can be deemed dysfunctional. This shows that there might be a serious concern regarding teaching and learning of the topic and the exploration of Physical Sciences teachers experiences of CA in this topic was also necessary. The graph below shows the pass percentage in Electric Circuits over the past five years.

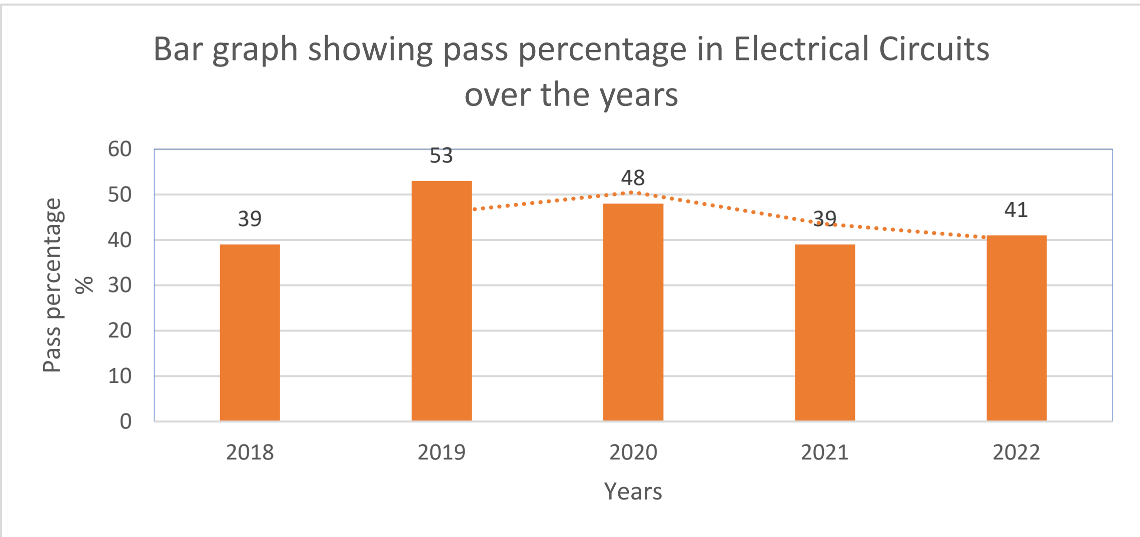


FIGURE 2.2: BAR GRAPH SHOWING PASS PERCENTAGE IN ELECTRIC CIRCUITS OVER THE PAST FIVE YEARS (DBE 2018; 2019; 2020; 2021 &2022)

2.7.2.2 Suggestions on teaching and learning Electric Circuits

Burde et al. (2021) advocate for making circuits more accessible to learners in introductory courses or grades as the precondition of constructing knowledge of circuits by learners. Literature by Khoza (2016) advocated for the use of digital technologies to explain most demonstratable concept of the curriculum. Although the literature is shedding some light on the teaching and learning of Electric Circuits, the DBE (2019; 2010; 2021 & 2022) diagnostic reports keep on repeating the same misconceptions with minimal innovative and relevant approach to address the misconceptions and improve performance. The suggestions by the DBE to address the misconceptions are given below.

1. "*Use PhET simulations to demonstrate the relationship between V_{ext} and V_{int} and the effect of adding resistors or removing resistors in series and parallel can also be demonstrated*" (DBE, 2021, p. 219).

This suggestion of using Physics Education Technology simulations (PhET) to demonstrate the topic Electric Circuits was only recommended in DBE diagnostic report 2021 whereas the misconception have been happening for years. However, the recommendation is the first to address the actual misconception directly. Nevertheless, the literature by Mpungose (2020) allude that some recommendation in the CAPS document and by DBE are not taking into consideration the availability of resources in schools. The use of simulations might be challenging in areas or schools with limited resources.

2.8 Approaches to analyse curriculum alignment

The alignment of the curriculum can be analysed differently by different studies depending on the purpose of the study and the aspect of the curriculum that needs to be analysed (Biggs, 2003). The study by Smith (2012) presented seven different approaches to analyse curriculum alignment. These approaches are Kesidou and Roseman (2002), Webb analysis (Webb, 1997), project 2061 (Stern & Algren, 2002), Achieve (Rothman, et al. (2002), Surveys of enacted curriculum (Porter et al., 2001), La Marca method (La Marca et al., 2000) and Haskins and Aul Method (Haskins et al., 1996). Out of the seven approaches to curriculum analysis, this study used only two based on their relevance to the study and their effectiveness in research. Kesidou and Roseman's approach as well as Webb's (1997) analysis were used in this study to collect data from curriculum documents and were in line with the research questions and aim of the study. The following section explains Kesidou and Roseman's (2002) approach to curriculum analysis as well as Webb's (1997) analysis.

Kesidou and Roseman (2002) explained the approach to analyse curriculum documents with the accompanying pedagogy. Their approach uses research-based criteria to analyse curriculum documents as well as teachers planning to see if they are likely to lead to the attainment of ILOs (Smith, 2012). This curriculum analysis approach has a proven accuracy and is highly acknowledged by other studies (Stem et al., 2002) that used Kesidou and Roseman's (2002) approach to analyse the curriculum. The Kesidou and Roseman (2002) approach was a suitable approach to be used to analyse the curriculum documents in this study (document analysis). The Kesidou and Roseman approach was adapted from that used by Smith (2012) in their study that explored the "Alignment of intended learning outcomes, curriculum, and assessment in a middle school Sciences program" at Edith Cowan University. The approach was adapted to meet the needs of this current study, but its content and meaning were not compromised in any way.

Webb's (1997) analysis is pinned on five key aspects: applicability, equity and fairness, content focus, pedagogical implication as well and articulation across grades (Smith, 2012). Martone and Sireci (2009) alluded that the advantages of using a Webb (1997) analysis are its' clear measures of an acceptable standard of alignment. Moreover, they added that it provides the measure of alignment to show the relationship between ILOs, assessment, and teaching and learning activities. This alignment analysis approach is used in this study to gather data from observations as well as other curriculum materials. Table 2.1 below illustrates the summary of the two curriculum alignment analysis approaches used by this study. The following section after Table 2.1 unpacks the conceptual frameworks associated with teacher experiences and later explains how the constructive alignment model (CAM) will be used as the underpinning conceptual framework for this study.

Kesidou and Roseman (2002)	**Webb (1997) analysis**
Are the ILOs of the curriculum addressed?	Communication of ILOs, made clear to learners before the lesson.

What is the extent of teaching documents supporting the ILOs?	The link between ILOs, assessment, and activities.
Is there an identification and maintenance of action verbs used in activities and assessment as they are intended?	Depth of knowledge consistency compared to ILOs.
Do the teaching activities address the same outcome as the test and (or) exam?	Range of knowledge tested.
Does the assessment given to learners match the standard of the final exam question paper?	Ability to link activities to the actual assessment (examination).
Do the teaching documents enforce meaningful learning by relating to assessment and activities?	

TABLE 2.1: CURRICULUM ALIGNMENT ANALYSIS APPROACH BY KESIDOU AND ROSEMAN (2002) AND WEBB (1997) (SMITH, 2012)

2.9 Conceptual framework

It is imperative that all four constructs the problem, purpose, significance, and research questions are tightly aligned and intricately interwoven so that the conceptual framework can serve as the foundation for the study and guide the choice of research design and data analysis (Creswell & Creswell, 2017). Moreover, Creswell and Creswell (2017) contend that the researcher's choice of a framework provides structure to the entire study. It provides a common worldview or lens from which to support one's thinking on the problem and analysis of data (Bertram & Christiansen, 2014). Bertram and Christiansen (2014) contend that the conceptual framework contains key ideas about the focus area of the study and guides the data analysis in qualitative studies. The Biggs (1999) constructive alignment model (CAM) has been adopted as the conceptual framework used by this study. In the following section, I present Biggs CAM as the underpinning conceptual framework for this study and briefly highlight some studies that used Biggs CAM.

2.9.1 Constructive alignment model (CAM)

The conceptual framework to be used in this study is the Constructive Alignment Model (CAM) and is based on Biggs' (1999) Constructive Alignment Model (CAM). "Constructive alignment from the perspective of teachers implies the synchronization of teachers' planning of teaching and learning activities with intended learning outcomes as well as assessment"

(Biggs, 2003, p. 5). Using Biggs (1999) CAM, this study explored teachers' experiences of constructive alignment (CA) between teaching and learning activities (TLAs), assessment, and intended learning outcomes (IOLs) in the Physical Sciences curriculum within the topic of electrostatics and Electric Circuits. Thus, the Biggs' (1999) CAM will be re-structured to analyse the data generated by this study placing intended earning outcomes in the centre of the alignment determination.

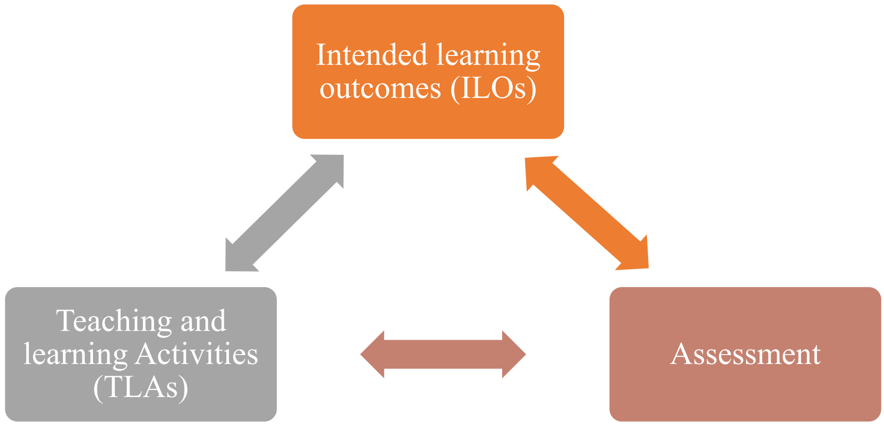


FIGURE 2.3: ADAPTED BIGGS (1999) CONSTRUCTIVE ALIGNMENT MODEL (UNIVERSITY OF NORTHAMPTON, 2019)

The above CAM model will be utilized in this research to create themes and analyse the generated data. It assumes that constructively aligned teaching and learning activities (TLAs), assessment, and intended learning outcomes (ILOs) in Physical Sciences Electrostatics and Electric Circuits in particular could enhance the understanding of the topics. "Proper curriculum is the one which can make sure the aims of the program, intended learning outcomes, teaching and learning activities, and assessment strategies are aligned and take into account all relevant factors" (Biggs, 2003, p. 6). This model worked parallel with the curriculum alignment approaches discussed in section 2.5 above. The following diagram shows the interdependence of the curriculum construct in the attainment of the ILOs.

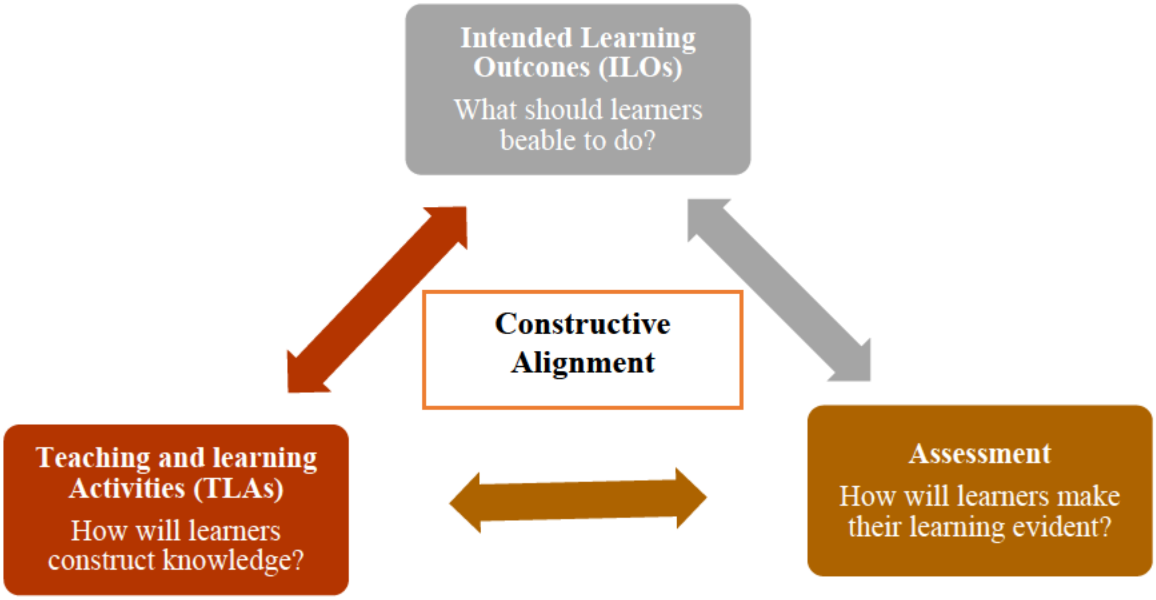


FIGURE 2.4: ADAPTED CONSTRUCTIVE ALIGNMENT MODEL (BIGGS, 1999)

The CAM model by Biggs (1999) above is color coded and adapted to suit the needs of this study. It places the constructs of the curriculum in the centre and demonstrates by arrows that a complete synchronization of these constructs results in to constructively aligned curriculum. Smith (2012), alluded that using CAM parallel to Kesidou and Roseman (2002) curriculum alignment analysis approach can reveal the extent of alignment within curriculum documents and in the actual teaching and learning process. Teachers' experiences of constructive alignment are analysed using CAM as the underpinning conceptual framework. The following table 2.2 and table 2.3 below presents the ILOs of the topics Electrostatics and Electric Circuits respectively, that are supposed to be communicated by the teachers prior to the learning process and be constantly visited during the learning process. It is important to note that the CAPS document does not prescribe or suggest any activities or resources regarding the teaching and learning of Electrostatics. However, some activities and resources are prescribed for Electric Circuits.

Electrostatics (ILOs)	**Guidelines for Teachers**
Coulomb's Law 1. State Coulomb's Law	Here is another context in which to apply superposition— the forces exerted on a charge due to several other charges can be superposed to find the net force acting on the charge.

2. Solve problems using Coulomb's Law to calculate the force exerted on a charge by one or more charges in one dimension (1D) and two dimensions (2D)	Get learners to draw free body diagrams showing the forces acting on the charges. Also link to N3- two charges exert forces of equal magnitude on one another in opposite directions. When substituting into the Coulomb's Law equation, it is not necessary to include the signs of the charges. Instead, select a positive direction. Then forces that tend to move the charge in this direction are added, while forces that act in the opposite direction are subtracted. Make a link with Grade 11 Mechanics, Newton's Law of Universal Gravitation, that is, Coulomb's Law is also an inverse square law. The two equations have the same form. They both represent the force exerted by particles (masses or charges) on each other that interact by means of a field. NOTE: Restrict 2D problems to three charges in a right-angled formation.
Electric field 1. Describe an electric field as a region of space in which an electric charge experiences a force. 2 The direction of the electric field at a point is the direction that a positive test charge (+1C) would move if placed at that point 3. Draw electric field lines for various configurations of charges. 4. Define the magnitude of the electric field at a point as the force per unit charge E = F/q; E and ⟶ F are vectors. 5. Deduce that the force acting on a charge in an electric field is F = qE 6. Calculate the electric field at a point due to a number of point charges, using the equation $E = kQ/r^2$ to determine the contribution to the field due to each charge.	Discuss the fact that electric field lines, like magnetic field lines (see Grade 10), are a way of representing the electric field at a point. Arrows on the field lines indicate the direction of the field, that is, the direction a positive test charge would move. Electric field lines therefore point away from positive charges and towards negative charges. Field lines are drawn closer together where the field is stronger. Also, the number of field lines passing through a surface is proportional to the charge enclosed by the surface. The electric fields due to a number of charges can be superposed. As with Coulomb's Law calculations, do not substitute the sign of the charge into the equation for electric field. Instead, choose a positive direction, and then either add or subtract the contribution to the electric field due to each charge depending upon whether it points in the positive or negative direction, respectively.

Table 4.1: showing ILOs for the topic electrostatics and guidelines for teachers (DBE, 2011)

Electric Circuits (Concept and skills, Resources and Guidelines for teachers)		
Concepts and skills	**Resources**	**Guidelines for teachers**

1. Solve problems involving current, voltage and resistance for circuits containing arrangements of resistors in series and in Parallel. 2. State that a real battery has internal resistance 3. The sum of the voltages across the external circuit plus the voltage across the internal resistance is equal to the emf: ε = Vload + Vinternal resistance or $\varepsilon = IRext + Ir$ • Solve circuit problems in which the internal resistance of the battery must be considered. • Solve circuit problems, with internal resistance, involving series-parallel networks of resistors.	**Materials:** Battery, connecting wires resistor, voltmeter, ammeter and switch. **Materials:** Battery, connecting wires, several resistors of different values, voltmeter, ammeter and switch. **Materials:** Battery, connecting wires, several resistors of different values, several voltmeters, several ammeters, switches, a length of low resistance wire.	Some books use the term "lost volts" to refer to the difference between the emf and the terminal voltage. The voltage is not "lost", it is across the internal resistance of the battery, but "lost" for use in the external circuit. The internal resistance of the battery can be treated just like another resistor in series in the circuit. The sum of the voltages across the external circuit plus the voltage across the internal resistance is equal to the emf: ε = Vload + Vinternal resistance

TABLE 4.2: SHOWING ILOS FOR THE TOPIC ELECTRIC CIRCUITS, RECOMMENDED RESOURCES AND GUIDELINES FOR TEACHERS (DBE, 2011)

2.10 Chapter 2 summary

Chapter 2 provided an extensive review of the literature associated with the topic. The first section provided a recap on the previous chapter and an introduction to this chapter. The second section unpacked the definition of the phenomenon with other scholars' definitions. The third section provided literature on Sciences education starting by unpacking the purpose of Sciences education, followed by defining scientific literacy. The fourth section is unpacked science process skills and epistemological beliefs in science education. This was done since the literature reviewed showed that there is a direct link between scientific literacy, science process skills, and epistemological beliefs as well as the actual practice of teachers and learners during teaching and learning. The fifth section reviewed the literature on curriculum, starting by defining curriculum and concluding by defining the constructs of the curriculum (ILOs, TLAs, and assessment. Moreover, the fifth section also gave descriptions of different forms of assessment (formative and summative). The sixth section reviewed the literature on constructive alignment (CA), followed by the importance of CA, and concluded by highlighting the role of the Sciences teacher in CA. The seventh section outlined the approaches that can be used to analyze alignment in the curriculum and presented Webb's (1997) analysis as well as Kesidou et al. (2002) analysis as the approaches to be used in this study. The eighth (last) section outlined the conceptual framework and presented Biggs (1999) CAM as the underpinning conceptual framework for this study. The following chapter presents the research design and methodology of this study.

Chapter Three

Research Design and Methodology

3.1 Introduction

This study explored Physical Sciences teacher's experiences of constructive alignment between intended learning outcomes, learning activities, and assessment. The previous chapter covered a literature review as well as the conceptual frameworks underpinning this study. This chapter discusses the research design and methodology relevant to the study. The first section outlines the paradigm used in this study. The research approach will be discussed in the second section followed by the research design in the third section. The fourth section in this chapter discusses the sampling used in this study, whereas the fifth section outlines the data generation methods used to generate data for this study. Issues of trustworthiness and ethical considerations are discussed in the fifth section. Finally, the last section presents the limitations of this study.

3.2 Paradigm

This study employed Interpretivist paradigm. Cohen et al. (2018) define the interpretivist paradigm as a paradigm concerned with understanding or exploring the phenomenon through two lenses, that is the objective and subjective lenses. This definition means that the truth is many, and participants bring with them ideas and reasoning regardless of the existing truth about that phenomenon. In support of this, Creswell and Creswell (2017, p. 37) stated that "Individuals develop subjective meanings of their experiences and meanings directed toward certain objects or things. These meanings are varied and multiple, leading the researcher to look for the complexity of views rather than narrowing meanings into a few categories or ideas". This research explored the truth about constructive alignment from the participants' and works of literature, thus different themes of knowledge emerged from both the literature and participants. "The researcher intended to make sense of (or interpret) the meanings others have about the world" (Creswell & Creswell, 2017, p. 36).

The strength of this paradigm is that the data were generated through the understanding that the participants are the primary source of data, and the findings are not biased but portray the complexity of views possessed by Physical Sciences teachers and those expressed in the curriculum. Thus, I used this paradigm to explore teachers' experience of constructive alignment between learning activities, assessment, and intended learning outcomes in Electrostatics and Electric Circuits in Physical Sciences Grade 12 curriculum.

Teacher experiences of Constructive Alignment (CA) is a phenomenon that can be explored by analysing teaching documents and observing curriculum delivery where all the data generated is used as primary source of data as Creswell and Creswell (2017) contends, to produce the findings of the study using the interpretivist paradigm. It was an appropriate paradigm to answer the question of "How do Physical Sciences teachers enact the curriculum using constructive alignment between learning activities, assessment, and intended learning outcomes when teaching Electrostatics and Electric Circuits?'. The question 'how' was answered by exploring the phenomenon and understanding the meanings that people attach to certain events and formulating themes of knowledge using themes (Creswell & Creswell, 2017). This is the appropriate paradigm to use in case studies as this study is also a case study. However, the interpretivist paradigm does not emancipate or solve the problem as its main aim is to explore and understand the phenomena, as intervention is not mandatory.

3.3 Approach

The qualitative approach was used in this study. Muijs (2004) defines qualitative approach as the explanation of a phenomenon by generating textual data that is analysed based on patterns of similarities or themes. Kumar (2019) defines qualitative approach as the unstructured approach to inquiry where the purpose of the study is primarily to describe a situation or a phenomenon and if the analysis of data is done without quantifying. According to Creswell and Creswell (2017) the qualitative approach is an approach used for understanding the meaning of people or a group of people aligned to a human problem. In this study, the lack of constructive alignment in planning and delivering their lessons is stated as one of the main reasons for the poor performance in Electrostatics and Electric Circuits within grade 12 Physical Sciences.

Most exploratory research ascribes or uses a qualitative approach to explore any phenomenon. In this case, the phenomenon is teachers' experiences of constructive alignment between learning activities, assessment, and intended learning outcomes in Electrostatics and Electric Circuits in the Physical Sciences Grade 12 curriculum. Kumar (2019) stated that exploratory studies attempt to clarify why and how there is a relationship between the aspects of the phenomenon. In this study, attempts are made to explore the relationships between teachers' experiences of constructive alignment, namely, the relationship between the three variables:

learning activities, assessment, and intended learning outcomes in Electrostatics and Electric Circuits in Physical Sciences Grade 12 curriculum. It also explores how teachers enact the curriculum through constructive alignment. The data in this study are analysed inductively building from pre- and post-observation interviews, document analysis, and lesson observations to general textual themes and interpretations. These will be discussed in the following chapter. Creswell and Creswell (2017) support the use of the qualitative approach in cases of exploratory studies and argue that all those who engage in the qualitative approach support the inductive style of research where participants and data yield the conclusions of the study. Therefore, this study used a qualitative exploratory approach to generate and analyse data.

3.4 Research Design

The design of this research is case study research. Case studies are useful in understanding the behavioural practice of individuals through observation and interpretation of data (Creswell, 2014). Furthermore, Creswell and Creswell (2017) define the case study as a style of research that will present the facts about the phenomena and inform the decisions around that phenomenon. Kumar (2019) defines a case study as a study design where the selected case becomes the basis of a thorough, holistic, and in-depth exploration of the phenomenon that is explored. Kumar (2019) further argued that this design is essential for studies where little is known and is of immense relevance when the focus is on exploring or understanding rather than quantifying. Yin (2009) explains the case study as research design that focuses on answering the questions how and why and the researcher have minimal control over the events that happens. Furthermore, Yin (2009) contends that case studies must have a sound design, pre-described data collection and analysis methods. This is in line with Creswell (2014), who argue that case studies are suitable designs of inquiry to be used in qualitative research when exploring the area of minimal information and evaluating a phenomenon for understanding rather than quantifying.

The literature that explores teachers' experiences of constructive alignment between learning activities, assessment, and intended learning outcomes in Electrostatics and Electric Circuits in the Physical Sciences Grade 12 curriculum is limited, thus the case study was a suitable design to explore this case as Kumar (2019) and Yin (2009) contend. However, the case study unlike action research will not directly affect the change in teachers' practices or the schools around Umlazi District, but it will inform future decisions and behavioural practices on the readers of its findings and through reporting on the findings of the study to the local district education office.

3.5 Sampling

According to Etikan et al. (2016), purposive sampling is the non-probability sampling technique where the researcher selects only those subjects or participants relevant to the study and with knowledge about specific phenomena. Purposive sampling was used for this research. Creswell (2014) defines purposive sampling as a technique that involves selecting certain units or cases based on a specific purpose rather than randomly. Kumar (2019) defined purposive sampling which he called judgemental sampling, as a judgment of who can provide the best information to achieve the objectives of the study and argued that it is common to qualitative studies with a less predetermined number of participants. This technique was suitable to this study since the participants are Physical Sciences teachers, thus they were purposively selected based on years of experience (all above 3 years) to participate in the study and were able to provide the best information to achieve the objectives of the study. Physical Sciences teachers were the most suitable participants since they teach the subject in question. Furthermore, Kumar (2019) argued that judgemental sampling also known as purposive sampling allows a sampling population that comprises experts in the field of inquiry. Moreover, Obilor (2023) argued that although purposive sampling is not effective in collecting data from a large population it has several advantages in a small population. Isaac mentioned cost-effectiveness, less period of data collection, lowering of sampling error, and others as advantages of purposive sampling.

Convenience sampling also called opportunity sampling was used to select three schools around Umlazi District as it was convenient for the researcher to access the participants since I am a teacher at Umlazi District as well. Obilor (2023) defined convenience sampling as a non-probability sampling technique used in qualitative research to collect data from easily accessible participants. I was able to work perfectly around Umlazi in a familiar context with less traveling costs. Obilor (2023) further argued that the convenience sampling technique is inexpensive and data collection in this technique is quick and easy. The invitation to participate was sent to six teachers teaching Physical Sciences in these three schools. However, the sample consists of three teachers who volunteered and were interviewed based on availability for the researcher to observe and explore their experiences of constructive alignment on their teaching when teaching the grade 12 Physical Sciences curriculum in the three high schools around

Umlazi district. Kumar (2019) and Creswell and Creswell (2017) argue that qualitative research and case studies in particular decide on a smaller number of participants who are best positioned to provide the needed information for the study.

To reduce the size of the study, the topics Electrostatics and Electric Circuits were purposively selected amongst other topics due to their poor performance as outlined in the 2018 diagnostic tool in the background of the study (Chapter One). They were also selected because they are part of the topics where learners perform poorly even when teaching and learning has happened as discussed in the literature in Chapter 2. They were also purposively selected as they were the main topics raised by teachers regarding constructive alignment in a teachers' workshop that I attended in the Umlazi district. Among other limits, the purposive sampling limits the number of participants in the study Obilor (2023) as some Physical Sciences teachers could not participate due to workloads in schools and my schedule as a teacher. However, using the purposive sampling technique, did assist me in selecting the most suitable participants for this study.

3.6 Data Generation Methods

Three data generation methods were selected for this study: document analysis, classroom observations, and interviews. These are discussed in the following section.

3.6.1 Document analysis

Document analysis is a qualitative research method that requires the examination and interpretation of data from documents to elicit meaning and develop both understanding and empirical knowledge (Creswell and Creswell, 2017). The document analysed for this study involves CAPs document, Lesson plan (teaching materials), Annual teaching plan (ATP), and examination guidelines for grade 12. Creswell and Creswell (2017) alluded that it is necessary for qualitative research to adopt document analysis provided the guiding documents to the phenomenon are available at the researchers' disposal. This study used document analysis (refer to Annexure B) to trace how Physical Sciences teachers apply constructive alignment when enacting the curriculum.

3.6.2 Classroom observations

Observation in research according to Steber (2017), is a research method designed to watch behaviour as it organically and spontaneously unfolds in a natural environment. This study used the observation schedule (see annexure A) to generate data based on what happens in the classroom. The observation schedule assisted in finding out how teachers enacted the curriculum. Thus, collected meaningful data that was used to understand teachers' experiences of constructive alignment between learning activities, assessment, and intended learning outcomes in Electrostatics and Electric Circuits in Physical Sciences Grade 12 curriculum. Cohen et al., (2018) believe that observations are processes that offer investigators live data from naturally occurring social situations.

3.6.3 Interviews

Creswell and Creswell (2017) allude that interview with individual participant gives information about their understanding of the phenomenon. Moreover, Cohen et al. (2018) argue that individual interviews expose gaps in logical understanding and enrich the study. Cohen et al. (2018) further maintained that the interview is a flexible data collection tool with a multi-sensory channel to be used while conducting it. Cohen et al. (2018) mentioned verbal and non-verbal, seen, and heard multi-sensory channels as means of collecting data during the interview. The individual semi-structured pre and -post-observation interviews were conducted in this study. McGrath et al. (2019) advocated that:

> *"Qualitative interviewing is a data-collection tool that is useful in a range of methodological approaches and may therefore be applied to address a number of research questions. However, qualitative research interviews are preferable when the researcher strives to understand the interviewee's subjective perspective of a phenomenon rather than generating generalizable understandings of large groups of people, for example, the qualitative interview may lend itself well to exploring a patient's experience of illness, or a clinician's conceptions of learning in the workplace*." (p. 2)

The quote by McGrath et al. (2019) is relevant to this study as it portrays the ability of the interviews to uncover the subjective perspective of the phenomenon from a small group of participants. This study used both the pre-and post-observation interviews to uncover the subjective perspective of the participants on their experiences of constructive alignment. Moreover, qualitative interviews present a deep overview of the phenomenon in which the participant has an astonishing experience (Roberts, 2020). Rubin and Rubin (2011) as quoted by Roberts (2020) alluded that qualitative researchers are holding a view that reality is subjective and through subjectivity, they can understand the perspective of the participants about their experiences of the phenomena. It was therefore pivotal to utilize the interviews in this study to attain subjective responses from the participants about their experiences of constructive alignment (CA).

3.6.3.1 Pre-observation interviews

Pre-observation interviews help the researcher find a basic understanding of the phenomenon and work well with observations to enhance the trustworthiness and crystallization of findings (Cohen et al., 2018). The pre-observation interviews were conducted in this study to attain the participants' understanding of constructive alignment and further understanding of their experiences of constructive alignment between intended learning outcomes (ILOs), teaching and learning activities (TLAs) as well as assessment in electrostatics within the Physical Sciences grade 12 curriculum. The pre-observation interview schedule was validated by asking colleagues teaching Physical Sciences in my school to respond to the questions on pre-observation schedule prior their Physical Sciences lesson. This was used by the researcher to ensure that the data collection instrument provides the data that is appropriate to answer the main research question. Refer to annexure A to see the questions used on the pre-observation interview schedule to guide participants on their responses. However, where the response is not clear the participant was requested to elaborate further.

3.6.3.2 post-observation interviews.

McGrath et al. (2019) argued that post-observation interviews provide a holistic reflection on the behaviour of the participants, thus motivating their actions or practice. In this study, post-observation interviews were conducted to obtain Physical Sciences teachers' rationale for aligning the curriculum the way they do. Cohen et al. (2018) alluded that using post-observation interviews allows the participants to subjectively explain their behaviour and outline the challenges of the phenomenon. It was then assumed based on the Scholars' arguments above that using the post-observation interviews in this study will uncover subjective explanations of participants and critical reflections on their experiences of constructive alignment (CA). The post-observation interview schedule was validated by asking colleagues teaching Physical Sciences in my school to respond to the questions on post-observation schedule after their Physical Sciences lesson. This was used by the researcher to ensure that the data collection instrument provides the data that is appropriate to answer the main research question. Refer to annexure D to see the questions that were used in the post-interview schedule to get teachers' reflections on their lessons and understand why they enact the curriculum the way they do?

Creswell and Creswell (2017) maintain that using a variety of data sources assists the researcher in triangulating the data from all these sources, hence increasing the trustworthiness of the results. Therefore, it was important for this study to do pre-observation interviews, analyse the teaching documents, observe lessons, and do post-observation interviews to answer the main research question. The table below presents each data generation method with its purpose and role in answering the question.

1. **Data generation method**	**Instrument**	**Purpose and Role in answering question**	**Rationale**
1. **Pre-Observation interviews**	**Interview schedule.** Semi-structured, using an interview schedule (refer to annexure A) prior to lesson observations	Pre-observation interviews were done (refer to annexure A) to find out what teachers understand about constructive alignment. Thus, answer the following sub-questions as part of answering the main question: - What are Physical Sciences teachers' understanding of the constructive alignment between learning activities, assessment, and intended learning outcomes? ➢ Answering this sub-question will enable this study to answer the main research question "What are Physical Sciences teachers' experiences of constructive	Pre-observation interviews help the researcher find a basic understanding of the phenomenon and work well with observations to enhance the trustworthiness and crystallization of findings (Pani, 2015). Interviews (pre- and post-observation) were used to complement the data obtained from the teaching and learning activities regarding the teachers' understanding of constructive alignment.

		alignment between learning activities, assessment, and intended learning outcomes in Electrostatics and Electric Circuits in Physical Sciences Grade 12 curriculum?"	

2. **Document analysis** (Lesson plan, teaching and Learning activities, and exam paper, 2021)	Analysis template (questionnaire) (refer to annexure C)	- To find how teachers plan their lessons and which document they use when planning their lessons. This assisted in finding out about their understanding of constructive alignment. Thus, answer the following sub-questions as part of answering the main question: - What are Physical Sciences teachers' understanding of constructive alignment between learning activities, assessment and intended learning outcomes? Answering these sub-questions enabled the study to answer the main research question "What are Physical Sciences teachers' experiences of constructive alignment between learning activities, assessment, and intended learning outcomes in Electrostatics	Documents can provide supplementary research data, making document analysis a useful and beneficial method for most research (O'Leary, 2014). This method generated primary data from official documents and, thus is highly recommended for qualitative study as Creswell and Creswell (2017) explained.

		and Electric Circuits in Physical Sciences Grade 12 curriculum?"	

3. Observations	**Observation schedule**. Semi-structured, using an observation schedule (refer to annexure B) was used to observe original lessons.	- To see the behavioral practices of educators when enacting the curriculum. This worked to find out how they understand and use constructive alignment during their teaching. Thus, answer the following sub-question as part of answering the main question: - How do Physical Sciences teachers apply constructive alignment when enacting the curriculum? Answering this sub-question enabled the study to answer the main research question.	Observation in research according to Simpson and Tuson (2003) is a research method designed to watch behavior as it organically and spontaneously unfolds in a natural environment.

4. Post Observation interviews	**Interview schedule.** Open-ended Semi-structured, using an interview schedule (refer to annexure D) post-lesson observation were used.	The post-observation interviews were used (refer to annexure D) to get teachers' reflections on their lessons and understand why teachers enact the curriculum the way they do. Thus, answer the following sub-question as part of answering the main question: - Why do Physical Sciences teachers apply constructive alignment in the way they do	Creswell and Creswell (2017) allude that interview with individual participants gives information about their understanding of the phenomenon. Moreover, Cohen et al (2018) argue that individual interviews expose gaps in logical understanding and enrich the study. The individual semi-structured - post-interviews enabled the

		when enacting the curriculum within Electrostatics and Electric Circuits?	study to uncover teachers' experiences of constructive alignment between learning activities, assessment, and intended learning outcomes while giving ideas about their reasons for enacting the curriculum the way they do.

TABLE 3.1: DATA GENERATION METHOD FITTING TO PURPOSE

3.6.4 Pilot Study

The study used adapted data generation instruments to generate data for this study. It was therefore important to conduct a pilot study to verify the data generation instruments. Van Teijlingen and Hundley (2001) defined the pilot study as the pre-testing of the research instrument by the researcher. Moreover, Van Teijlingen and Hundley (2001) contends that conducting the pilot study is advantageous as this could detect in advance if the research instruments are appropriate for the study. Teresi et al. (2022) adds that the pilot study is important as it may be used to obtain preliminary answers to the research questions. This study conducted the pilot study to pre-test the data generation instruments if they lead to the generation of relevant data with thick descriptions. The following steps were followed.

Step 1: Two colleagues from my school teaching Physical Sciences were asked to participate in the pilot study.

Step 1: Explanation of the main study and pilot study to participants (of the pilot study)

Step 2: Interviews were conducted prior and after their lessons.

Step 3: Observations and document analysis were conducted.

Step 4: Results of the pilot study were discussed with the two teachers followed by workshop and training to analyse the curriculum.

Step 5: The participants from the pilot study were asked to assist cross checking the document analysis template results in the main study.

3.7 Data Analysis

According to Creswell and Cresswell (2017), data analysis should be parallel to the proceedings of the research. Efforts to analysed participants' responses and general data enable the researcher to employ simplified steps like coding the data, developing descriptions and themes, representing findings, and interpreting those findings (Creswell & Creswell, 2017). This study analysed several documents with a variation of data and different presentations, on an attempt to increase the trustworthiness of the results and uncover the most accurate answer to the main research question the data from the three sources of data was triangulated.

The inductive data analysis approach was utilized in this study as all the data was primarily generated from the participants and related to the literature. Bertram and Christiansen (2014)

alluded that in the inductive data analysis approach, the data generated is categorized, and formed themes of findings which are utilized to answer the main research question. In this

study, the sub-themes emerging from the participants' responses were categorized, and presented for each data source all these sub-themes from each data source were triangulated.

and later presented major themes for this study; with the first data source producing three themes as follows:

- Understanding constructive alignment.
- Applying constructive alignment.
- Rationale for constructive alignment.

Each of the sub-themes above was analysed and discussed separately in relation to the literature relevant to the study.

The second data source (observations) also revealed sub-themes in the data which played a vital role in addressing the question "How do Physical Sciences teachers apply constructive.

alignment when enacting the curriculum?". The following themes emerged from the observations: Communication of ILOs made clear to learners before the lesson.

- The link between ILOs, Assessments, and Activities.
- Depth of knowledge consistency compared to ILOs.

- Range of knowledge tested.
- Ability to link activities to the actual assessment and (or) examination.

Each of the sub-themes above was analysed discussed using relevant literature and later triangulated with other data sources to form the major themes.

The third data source (document analysis) presented data that coincide with data from observations as they concur to answer the research question "How do Physical Sciences

teachers apply constructive alignment when enacting the curriculum?". However, the sub-themes that

emerged from this data source differed from those emerging from the observations to a certain degree. The following sub-themes emerged from the document analysis:

- Addressing ILOs of the curriculum.
- Extent of teaching documents supporting the ILOs.
- Identification and maintenance of action verbs used in activities and assessment as they are intended.
- Teaching activities addressing the same outcome as the test and (or) exam.
- The assessment given to learners matches the standard of the final exam question paper.

The sub-themes in all the data generation methods were analysed and discussed in relation to the relevant literature. Creswell and Creswell (2017) advocated for the data analysis to be compared with relevant literature and the theory or framework underpinning the study.

Upon triangulation of all the findings and thorough analysis and discussion of sub-themes, the major themes emerged as follows:

- Understanding constructive alignment (CA) in Principle versus practice.
- Lack of transparency in communicating intended learning outcomes (ILOs) as part of CA.
- Assessment is as less used (underutilised) learning tool.
- Consideration of teacher beliefs and values.

The major themes were then discussed extensively in relation to relevant literature and the conclusion of findings was done using the merits of the major themes.

3.8 Trustworthiness

Qualitative researchers deal mostly with trustworthiness, as it emphasizes the need for the results to be reliable and trusted (Korstjens & Moser, 2018). The trustworthiness of a study refers to the confidence that can be placed in the data collected, interpreted, and generally ensuring the quality of research (Lincoln & Guba, 1985). Credibility, transferability, dependability, and confirmability were developed by Lincoln and Guba (1985) as a guide to maintain and ensure the trustworthiness of any study. This study followed the criterion by Lincoln and Guba (1985) to ensure trustworthiness.

Credibility refers to ensuring that the findings of the study reflect the actual ideas of the participants and that the data is interpreted in an appropriate manner. Using different research methods; pre-observation interviews, observations, and document analysis assisted the researcher in triangulating the findings. Triangulation helps to provide a convergence of data that improves credibility (Bowen, 2009). Supporting results across different types of data can help reduce the impact of bias through the use of other methods for examining data. The lesson observation schedules, and the transcripts of interviews were given to the respective participants for comments and verification if their views were presented correctly and accurately. All the participants agreed that there was no discrepancy in their views in relation to what the researcher recorded.

Transferability relates to the degree to which the results of qualitative research can be transferred to other settings (Moser & Korstjens, 2018). The findings of this study can be applied or transferred to similar contexts or schools in the Umlazi district as all educators in Umlazi are attending the same workshops facilitated by the same facilitators. Dependability will be ensured through the participants' involvement in the whole process, such as confirming that the reported findings represent the data received from them.

Confirmability speaks about the appropriate interpretation of findings, thus authenticating the actual participants' ideas (Tobin & Begley, 2004). The analysis of data was given themes and codes to allow for the triangulation between all the research methods used. Giving the data themes and codes allows for the analysis of data not to be biased but to reflect the participants' views (Creswell & Creswell, 2017). To ensure reliability and trustworthiness, this study also transcribed the real data as a primary source from the teaching documents and participants, and no fact about the study was generalized. Cohen et al. (2018) presented the reliability and trustworthiness of the study as honesty, depth, and scope of the data achieved with the objectivity of the researcher. The findings of this study can be transferred to the school or country of the same context, curriculum, and magnitude of students and they can be generalized in the school or country of the same context, curriculum, and magnitude.

3.9 Ethical considerations

According to Creswell and Creswell (2017), the study should always protect the participants and not in any way harm the participants (emotionally, financially, or physically). To ensure that it is ethically considerate, the study used pseudonyms and not the real names of the participants (to ensure anonymity) and participating schools. Letters were used to identify schools and participants. The first school is named School A, with their teacher named Anele. The second school was named school B, with their teacher named Bhengu. Moreover, the third school was named school C and their teacher was named Cebo. The textbook activities and other documentation were analysed for research purposes and were not in any way revealing the real names and publishers of the book. The consent letters of participants also stated that the participant has a right to withdraw from a study at any time. Fortunately, no participant decided to withdraw from the study until completion.

3.10 Limitations of the Study

Limitations of this study were the limited time for participants during lesson observations since in some schools a lesson is only 45 minutes. Thus, it was difficult to observe all aspects of the lesson from delivery to assessment, the researcher had to do the observations in more than one lesson. The purposefully selected participants had less time since the study is working with matric teachers, their time is always limited due to the pressure of expectations by the school principal and the Department of Basic Education (DBE). However, the researcher used the time preferred by the participants to allow for their voluntary participation and flexibility some observations were done during weekends as some teachers taught these topics on weekends while other teachers did not teach according to the Annual Teaching Plan (ATP). The researcher allocated more time to generating, presenting, and analysing data which enabled participants to teach at their own pace and according to their preferred sequence. The data generation by the researcher did not in any way interfere with the teaching and learning of each school as it was conducted at the convenience of the participant. The section on data generation, presentation, and analysis was given a maximum period of five months and this was the appropriate period to overcome the acquired limitations.

3.11 Chapter Three summary

Chapter three provided a comprehensive layout of the research design and methodology. While the first section is an introduction that provided a brief recap for the previous chapter and introduced the breakdown of topics in chapter three. The second section provided the paradigm used in this study and motivated why it was a suitable paradigm to use in this research. The third section presented the qualitative approach as the suitable approach for this study. The fourth section provided the research design for this study. While the fifth section provided sampling method used by the study and advocate for the purposive sampling for choosing the participant, the sixth section provided data generation methods and explained how they were verified and used in this study. Data analysis is discussed in the eighth section and ethical considerations on the ninth section. The last section presented the limitations of the study. The following Chapter presents data, analyse data, and discuss the findings of this study.

Chapter Four

DATA PRESENTATION, ANALYSIS AND DISCUSSION OF FINDINGS

4.1 Introduction

The previous chapter discussed the research methodology and research design used in this study. It unpacked the rationale for the use of qualitative research and each method of data collection fitting it to its purpose. Sampling, issues of trustworthiness, and ethical considerations were also discussed in the previous chapter. This chapter presents data generated from pre-observation interviews, observations, document analysis as well and post-observation interviews. The themes emerging from all the data collected will be discussed in this chapter as well. The responses of all participants are given in a narrative form and analysed thematically whereas document analysis is linked to each participant's response as part of triangulation to verify the data from all the interviews and observations. Participants in this study are grade 12 Physical Sciences teachers from three different schools in Umlazi district. The biographical data of participants is given below to contextualize their responses.

4.2 Biography of Participants from three different schools

Biographies of the three participants are provided below to put their responses in context such that the reader understands factors that might inform their responses. Pseudonyms were given to each participant to ensure anonymity throughout the study. Anele is used for the first participant, Bhengu for the second, and Cebo for the third participant.

4.2.1 Teacher 1: Anele

Teacher A is a male Physical Sciences teacher with a Bachelor of Education degree (B.Ed). He is 28 years old and has taught Physical Sciences for the past five years in grade 12. He is working in a school with more than 800 learners. The participant expressed many frustrations about the way things happen within the Education Department as well as the demands and expectations of the Education Department. He outlined the provision of materials with varying information and insufficient textbooks in schools as part of his frustrations.

4.2.2 Teacher 2: Bhengu

Teacher B is a 43-year-old male Physical Sciences teacher with 10 years of teaching experience. He has a Bachelor of Sciences (B.Sc) degree and a Post Graduate Certificate in

Education (PGCE). He is working in a school with more than 800 learners. The participant expressed frustrations about his Departmental Head (DH) demanding a lot of paperwork, files, and good results without providing guidance on the subject. He argued that the DH was a Physiology teacher in the earlier days and did not have any clue about Physical Sciences. He raised concerns about the Education Department failure to appoint relevant curriculum leaders who can guide and assist teachers in their departments.

4.2.3 Teacher 3: Cebo

Teacher C is a 38–year–old male Physical Sciences teacher with 12 years of teaching experience at grade 12. He has a Diploma in Chemical Engineering and PGCE as qualifications. He is teaching in a school with an enrolment of around 1000 learners. However, due to the limited floor spaces in the school, the classrooms are overcrowded. His frustrations come from overcrowded classrooms which limits the effectiveness of assessment and feedback to learners. He raised concerns regarding the admission of learners in his school and mentioned that over-admission of learners leads to overcrowding in the classrooms, thus compromising the quality of teaching and learning.

4.3 Presentation of Findings and Data Analysis

This study aimed to explore Physical Sciences teachers' experiences of constructive alignment between intended learning outcomes, learning activities, and assessment in electrostatics and Electric Circuits in the grade 12 Physical Sciences, curriculum. Thus, the following research questions were used to guide the study.

- ✓ What are Physical Sciences teachers’ understanding of the constructive alignment between learning activities, assessment, and intended learning outcomes?
- ✓ How do Physical Sciences teachers apply constructive alignment when enacting the curriculum?
- ✓ Why do Physical Sciences teachers apply constructive alignment in the way they do when enacting the curriculum within Electrostatics and Electric Circuits?

Findings in this study are presented in a narrative form as responses to the questions asked during data collection. Although not all questions in data collection tools are presented in this section, Annexures A, B, C, and D are attached at the end for readers’ perusal. These findings are in order of the research questions of the study and the themes presented in pre-observation interviews are in order of the research questions as well. After each presentation, these findings are discussed in relation to the literature and later the data is analysed using Bigg's Constructive Alignment Model (CAM).

4.3.1 Conducting pre-observation interviews

Convenient time for the participants was used to conduct the pre-observation interviews. Most interviews took place during non-teaching time (weekends and after school). The researcher explained to each participant that any discussion made during the interview was confidential and the purpose of the research was made clear to participants before each interview. Semi-structured questions were used to lead and guide the interview and where needed the participant was asked to give examples.

The researcher made notes from the participants' responses during the interview and asked the participants to elaborate where necessary. These notes were responses given by the participants to questions and were later given to participants to read them and verify their correctness. The researcher also recorded observations by utilizing field notes as they might be useful in the analysis of data. These observations included facial expressions, and physical/body language of the participant when different questions were asked. The data was then transcribed, and the complete transcripts of pre-observation interviews were made (refer to annexure A). The following sub-section presents, analyses, and discusses the findings from pre-observation interviews.

4.3.1.1 Presentation of findings and analysis from pre-observation interviews

Semi-structured interviews were conducted to provide information about the teacher's experiences of constructive alignment. It also shows a basic understanding of the concept of Constructive Alignment (CA) between intended learning outcomes, teaching and learning activities, and assessment. Findings are presented in this section with emerging key themes based on research questions as sub-sections with data from each participant. After each theme, the findings are discussed, and literature is engaged to understand the analysis and responses from participants. Theme one includes questions that seek to address the first research question, "What are Physical Sciences teachers' understanding of the constructive alignment between learning activities, assessment and intended learning outcomes?". Theme two includes questions that seek to address the second research question "How do Physical Sciences teachers apply constructive alignment when enacting the curriculum?". The third theme includes questions that seek to address the last research question “Why do Physical Sciences teachers enact the curriculum the way they do?”. Three themes corresponding to the research questions are presented below.

4.3.1.1 (a) Theme 1: Understanding Constructive Alignment

This theme includes questions that seek to address the first research question,” What is Physical Sciences teachers’ understanding of constructive alignment between learning activities, assessment, and intended learning outcomes?”. Teachers' understanding of constructive alignment is a key factor that influences how they enact curriculum in the classroom. Their understanding determines the extent to which they consciously and intentionally align learning activities, assessment, and intended learning outcomes when teaching. When asked to describe the process they follow when planning teaching, learning, and assessment, Teacher Anele explained:

"*Planning a lesson entails synchronization of many documents including exam guidelines, Annual teaching plan, different textbooks as well as different question papers*."

He mentioned using a variety of documents like textbooks, exam guidelines, and question papers to plan his lessons. This indicates an understanding that learning activities and assessment should align with intended learning outcomes (ILOs) and external assessment requirements.

Bhengu stated:

"*I used prescribed textbooks for my lessons and sometimes take assessment activities from other textbooks as well*."

His response shows reliance on the textbook, with minimal consideration of aligning activities and assessment with intended learning outcomes.

Cebo explained:

"*I start my planning by checking the exam guideline, to see which aspects of the topic are supposed to be covered in the topic and use my textbook to prepare*."

Cele's response indicates that he refers to exam guidelines and textbooks when planning lessons, suggesting an understanding that learning activities and assessments should align with intended learning outcomes and assessment requirements.

When asked how they align learning activities, assessment, and intended learning outcomes, Anele said:

"*Question papers are my biggest tool in linking what I teach to what will appear on the test, but I constantly check on the exam guidelines whether I am still on track*."

This shows that Anele relies heavily on past exam papers to guide his selection of learning activities and assessments, indicating an understanding of the need to align these with external assessment requirements.

Bhengu explained:

"*Class activities are usually taken from the textbook as named earlier, but formal tasks to be recorded are taken from the cluster, and term common tests are set by the Department of Education*."

Bhengu's response reveals a limited understanding of constructive alignment, as he focuses mainly on textbook activities and common assessments set externally, with minimal consideration of aligning learning activities and assessments with intended learning outcomes.

Cebo stated:

"*I use assessment in the textbook as well as previous question papers to test my learners*."

Like Anele, Cebo shows an understanding that assessment should align with exam requirements, though his reliance on the textbook for activities suggests he may not consciously align these with intended learning outcomes.

Analysis

Overall, Anele demonstrated the strongest understanding of the need to align learning activities, assessment, and intended learning outcomes, relying on exam guidelines and papers to inform his planning. Teacher Bhengu showed the most limited understanding, relying primarily on the textbook with little consideration of alignment between the curriculum constructs. Cebo's understanding was somewhat better than Bhengu’s but less comprehensive than that of Anele’s since using the textbook for assessment is a sign for lack of constructively aligned instruction.

The literature emphasizes the importance of teachers having a solid understanding of constructive alignment in order to enact curriculum effectively. Biggs (1999) states that constructive alignment involves aligning learning outcomes, activities, and assessment so that they support and reinforce each other. Studies have found that when teachers lack understanding of constructive alignment, there is poor correspondence between intended learning outcomes, classroom instruction, and assessment (English, 2016; Penuel et al., 2009).

The findings suggest varying levels of understanding of constructive alignment among the three teachers. Anele showed the strongest understanding, recognizing the need to use exam requirements and outcomes to guide the selection of learning activities and assessment. This is aligned with Biggs' notion of constructive alignment. However, his heavy reliance on past papers to dictate activities and assessments indicates a lack of understanding of how to develop learning activities focused on achieving specific outcomes.

Bhengu demonstrated the most limited understanding of constructive alignment, relying primarily on textbook activities without considering alignment with outcomes or external assessments. As Edwards (2010) found, over-reliance on the textbook can result in learning activities that are not constructively aligned with intended learning outcomes. Cebo showed some understanding but could benefit from greater awareness of designing learning activities focused on achieving particular outcomes.

Overall, the findings suggest Bhengu and Cebo would benefit from professional development focused on enhancing their understanding of constructive alignment, as research shows teachers' knowledge and beliefs around alignment strongly influence their instructional practices (Penuel et al., 2009). Even Anele, who showed the strongest understanding, could benefit from developing skills in designing constructively aligned learning activities, rather than relying on past papers to guide instruction. Targeted professional development in this area could enhance these teachers' capacity to effectively enact constructively aligned curriculum in the classroom.

Discussion

The findings from theme one reveal varying levels of understanding of constructive alignment among the three teachers. Anele demonstrated the clearest understanding, recognizing the need to align instruction with curriculum outcomes and external assessment requirements. However, his reliance on past papers to guide learning activities indicates room for growth in designing activities focused on achieving specific outcomes. Bhengu and Cebo showed more limited understanding, focusing largely on textbook activities without consciously considering alignment. The literature emphasizes teachers' understanding of constructive alignment (CA) strongly influences the effectiveness of their instructional practices (Biggs & Tang., 2011; Zhao, 2016; Edwards, 2010 & Little, 2018). Targeted professional development could enhance these teachers' knowledge, strengthen their understanding of constructive alignment, and build their capacity to enact a constructively aligned curriculum (Penuel et el., 2009).

4.3.1.1 (b) Theme 2: Applying Constructive Alignment

This theme includes questions that seek to address the second research question "How do Physical Sciences teachers apply constructive alignment when enacting the curriculum?". It looks at how teachers' understanding of constructive alignment translates into their instructional practices and curriculum enactment in the classroom. Their described approaches provide insight into how they actively apply and integrate constructive alignment concepts when teaching. When asked how often they refer to learning outcomes and whether learners understand them as outcomes, Anele explained:

"During my teaching, I make examples of different versions of questions that may appear in the question paper, showing them that the question we are dealing with can come as a different version but require similar approach."

This suggests Anele refers to learning outcomes indirectly by modeling how exam questions test the outcomes, rather than communicating the outcomes explicitly to learners. In contrast, Bhengu stated:

"I do not think learners even know of these outcomes or know if we have outcomes that they should achieve, telling them will confuse them even more."

This indicates Bhengu does not refer to learning outcomes with learners at all during instruction. Cebo said:

"I am not sure if I do honestly, learners are only curious about the next topic and want to move away from the previous topic as soon as possible."

Like Bhengu, Cebo implies he does not explicitly refer to learning outcomes with learners when teaching. When asked how they ensure learners understand what is required to achieve the outcomes, Anele explained:

"I teach and give clear instruction on what learners are expected to do, but I do few examples with them to ensure they understand the rest of the work."

This suggests Anele gives direct instructions but does not actively verify learners' understanding of how to achieve outcomes. In contrast, Bhengu stated:

"I give them examples in class of similar knowledge to that required by the class activities and or homework so that they are able to do their homework and pass at the end of the term."

While Bhengu focuses on giving examples to prepare learners for assessment, he does not relate these explicitly to intended learning outcomes. Cebo said:

"I make them answer different questions from different topics in the previous question papers to ensure that they are used to the questions."

His reliance on past papers assumes learners will figure out how to achieve outcomes by practicing exam-style questions, rather than making the link explicit. When asked about their use of formative assessment, Anele explained:

"*I use assessment learning daily on worksheets I bring to class, but assessment of learning is conducted per term to evaluate the overall work of the term and report on the subject advisor about term performance*."

This indicates Anele uses frequent formative assessment, but summative assessment is used mainly for reporting purposes rather than to provide feedback. Bhengu stated:

"*Assessment for learning is like the homework and classwork that learners do during the year, but assessment of learning refers to the common tests that they write at the end of each term*."

Like Anele, Bhengu differentiates formative and summative assessment but does not mention using assessment data to improve alignment. Cebo explained:

"*Assessment of learning is conducted per term in common tests, whereas assessment for learning occurs weekly*."

"*Conducting tests weekly allows learners to get used to assessment and different questions as they might appear on the common test at the end of the term*."

Cebo suggests he uses weekly formative assessment mainly to familiarize learners with testing, rather than intentionally using it to check alignment and improve outcomes. Overall, the findings suggest these teachers do not actively communicate learning outcomes to learners or use formative assessment data to iteratively improve alignment. Their instructional practices assume alignment is achieved if activities mirror the exam format, rather than intentionally designing activities focused on achieving specific outcomes.

Analysis

The literature emphasizes that constructively aligned instruction requires teachers to clearly communicate learning outcomes to learners and continually check alignment through formative assessment (Biggs, 2014; Dolin et al., 2018). However, the findings suggest these teachers do not actively communicate outcomes to learners during instruction. Anele refers to them indirectly by modeling exam questions, while Bhengu and Cebo do not mention outcomes at all. The literature stresses the importance of explicitly sharing intended learning outcomes with learners (Martone et al., 2009; Martin et al., 2019). Communicating outcomes clarifies for learners how activities are aligned with expectations and helps them monitor their progress (Martin et al., 2019). Bhengu and Cebo, who do not share outcomes, may be missing opportunities to promote learner self-regulation.

Additionally, the teachers treat formative assessment as routine practice rather than using it to actively improve alignment. Biggs (2014) argues teachers should use formative data to check alignment and "modify their teaching approaches" to address gaps (p. 4). However, these teachers use it simply to track learners' general progress. For Cebo, the main purpose is preparing learners for summative testing. The literature suggests formative assessment is underutilized if not used iteratively to improve alignment and enhance outcome attainment (Nieminen, 2020; Shadrack et al., 2014).

In general, these teachers seem to assume activities and assessment are constructively aligned if they mirror the examination format. However, studies emphasize alignment requires intentionally designing activities to achieve specific outcomes, not just making activities exam-like (Anderson & Rogan, 2010). The teachers could benefit from learning to communicate outcomes explicitly to learners and leverage formative assessment to actively improve alignment.

Discussion

The findings from theme two reveal gaps in how these teachers apply constructive alignment during instruction. They do not clearly communicate intended learning outcomes to learners. Their reliance on modeling exam questions assumes learners will deduce the outcomes, rather than making them explicit. They also underutilize formative assessment data to actively check and enhance alignment. Instead, formative assessment is treated as routine practice. The literature recommends explicitly sharing intended outcomes, so learners understand the focus of activities. It also stresses using formative data iteratively to improve alignment and address learning gaps. These findings suggest opportunities for the teachers to strengthen their application of constructive alignment concepts in the classroom by learning practices like clear communication of outcomes and ongoing formative assessment to actively improve alignment.

4.3.1.1 (c) Theme 3: Rationale for Constructive Alignment

This theme includes questions that seek to address the third research question "Why do Physical Sciences teachers apply constructive alignment in the way they do when enacting the curriculum within Electrostatics and Electric Circuits?”. It looks at teachers' rationale for their approaches to constructive alignment, including their beliefs, motivations and perceptions that underpin their enacted curriculum practices. Understanding teachers' reasoning provides insight into why they adopt constructive alignment strategies. When asked whether they give informal class tests aligned to learning outcomes and activities, Anele responded:

"*Yes, results from topic tests are used to reflect on the lessons we had and inform the next lesson improvement and shows a need or no need for revision in that topic. Leaners also use the result from the test to identify the topic that is still giving them problems and work with one another to find solutions*."

This suggests Anele sees value in using informal tests to check alignment and identify gaps, both for himself and learners. It provides a rationale for his efforts to align assessment with outcomes. In contrast, Bhengu explained:

"*I look at the poorly performed topics and advise learners to do more practice on it, I also give them more problems to do in class on the poorly performed topics*."

Bhengu focuses on informal assessments on difficult topics but does not mention using them to check or improve alignment. His rationale seems to be identifying challenging content for learners. Cebo stated:

"*I use this to see which topic has been performed poorly and set up a revision on this topic*."

Like Bhengu, Cebo discusses using informal assessments to identify problematic topics without mentioning alignment. Checking for learner difficulties appears to be the rationale. When asked how information from learners' work is used to improve alignment, Anele explained:

"*No there is nothing*."

This suggests Anele does not actively use learner data to refine alignment, despite his earlier response indicating he checks alignment through informal assessments. His rationale is unclear. Bhengu stated:

"*Leaners also use the result from the test to identify the topic that is still giving them problems and work with one another to find solutions*."

Bhengu focuses on learners using the data to address knowledge gaps, rather than the teacher using it to improve alignment. His rationale seems learner centered. Cebo said:

"*I do it the way the subject advisor want it to be and I ensure that I am in line with the expectations of the curriculum coverage by the subject advisor*."

This suggests Cebo's rationale is complying with subject advisor expectations and curriculum requirements, rather than intentionally improving alignment per se. His motivation is external accountability. When asked if alignment is something teachers are generally aware of, Anele stated:

"*Probably educators do perform alignment, as for me I was not familiar with the concept of constructive alignment*."

Anele acknowledges teachers likely address alignment implicitly, though the concept may be unfamiliar. This self-reflection provides a rationale for his efforts to understand and apply constructive alignment. Bhengu responded:

"*Not really, I think even the term is not used frequently but teachers use their professionalism to connect assessment to teaching and learning*."

Bhengu believes alignment happens naturally through teachers' professionalism, without consciously using the term. This rationale likely informs his limited focus on deliberate alignment. Cebo explained:

"*Some new educators from tertiary might have an idea since maybe it is part of their training, but for us and other old teachers we are not even familiar with the term constructive alignment as it sounds like a complex term*."

Cebo suggests newer teachers may be exposed to alignment concepts, while veteran teachers are unfamiliar. His lack of training in this area provides a rationale for not explicitly addressing alignment.

Analysis

The findings indicates teachers' beliefs about curriculum, assessment, and pedagogy underpin their instructional approaches (Buehl & Beck, 2015; Penuel et al., 2009). Their reasons for adopting particular alignment strategies provide insight into their curriculum enactment choices. The findings reveal differences in teachers' motivations in this study. Anele's use of informal assessments to check alignment and identify gaps suggests he values alignment and believes it can improve outcomes. However, his lack of clarity about using learner data to enhance alignment indicates a potential conflict between beliefs and practice. Bhengu's focus on helping learners address knowledge gaps, rather than checking alignment per se, reflects a learner-centered rationale that likely shapes his practice. Cebo is strongly motivated by external accountability to subject advisors and curriculum requirements, which supports his teaching-to-the-test approach but limits focus on intentional alignment.

The findings also shed light on teachers' self-perceptions. Anele recognizes alignment as an explicit concept he was not originally familiar with, driving his efforts to learn. Bhengu and Cebo view alignment as an implicit part of teachers' work rather than a discrete practice. Cebo attributes a conscious understanding of alignment to newer teachers, consistent with his admission that the concept is unfamiliar. These self-reflections illuminate why alignment receives limited intentional focus in their practice.

Ultimately, the findings reveal varied, and sometimes conflicting, rationales that provide insight into these teachers' alignment approaches. Their motivations stem from beliefs about learning, external accountability, self-perception, and past training. Teacher professional development addressing alignment should engage teachers in examining their beliefs and rationales to shift mindsets and enhance classroom practice.

Discussion

The findings from theme three highlight differences in teachers' rationale for their constructive alignment practices. Anele values alignment for improving outcomes but lacks clarity in using data to enhance it. Bhengu focuses on addressing learner needs without direct attention to alignment. Cebo is motivated by external accountability. Self-reflection also reveals limited familiarity with alignment as a discrete practice. The literature emphasizes teachers' reasons for curriculum choices are rooted in their beliefs, which should be engaged in professional learning as discussed in Chapter 2. Understanding these teachers' rationales sheds light on their alignment practices and provides insight into where teacher development efforts should be targeted. Strengthening rationale and beliefs of teachers around constructive alignment is key to shifting classroom practice.

4.3.2 Conducting observations

A number of lessons were observed from the participants as well as learners, the learner assent letter and form were sent to parents for them to give consent for their children being observed during the lesson. Classroom observations were important in answering the question “How do Physical Sciences teachers apply constructive alignment when enacting the curriculum?”. Two lesson was observed from Anele (one per topic), three lessons were observed from Bhengu, and three lessons were observed from Cebo. The varying number of lessons observed is due to the time allocated for one lesson in each school. In School B and School C, the time allocated for one lesson was 45 minutes and participants suggested that we make observations in two consecutive lessons for Electrostatics and one lesson for Electric Circuits to ensure that all aspects of the lesson were observed. However, in School A the lesson was allocated one hour, and the participant (Anele) was able to cover all aspects of the lessons. The following sub-section presents analyses and discusses the findings from the observation schedules.

4.3.2.1 Presentation of findings from the observation schedule

The observation schedule was used to record data from teaching and learning as it originally unfolded in the classroom. The participants were allowed to choose their convenient time and venue where these observations were taking place. The findings of the classroom observations are presented in narrative form and analysed using the research questions of the study and Biggs (1999) Constructive Alignment Model (CAM) as the conceptual framework. The section below shows themes that emerged from some of the scores achieved by participants during lesson observations. This section of observation attempts to address the second research question of this study "How do Physical Sciences teachers apply constructive alignment when enacting the curriculum?". The analysis and discussion of findings are presented in the narrative form where the criteria used for scoring the pedagogical practices of each teacher are transcribed into meanings and form the emerging themes for this section.

4.3.2.1 (a) Communication of ILOs made clear to learners before the lesson

The literature emphasizes the importance of teachers clearly communicating intended learning outcomes (ILOs) to learners prior to teaching and learning. Sharing learning outcomes helps provide transparency and direction for learners, clarifying the focus and purpose of activities (Hailikari et al., 2022; Martone et al., 2009). Communication of ILOs also promotes learner autonomy by empowering students to monitor their progress (Dolin et al., 2018).

The observation findings reveal differences in how effectively the three teachers communicated intended learning outcomes (ILOs) to learners. Anele provided a brief verbal overview of the ILOs at the start of the lesson. Stating that learners should be able to state Coulomb's law and use it in calculating the Electrostatic force and other ILOs. However, the outcomes were not revisited or displayed visually for the duration of the lesson. In Electric Circuits lesson, Anele stated that: at the end of the lesson learners should be able to state and use Ohm's law. Learners were not given opportunities to discuss, clarify, or ask questions about the ILOs in

Electrostatics and Electric Circuits. However, the outcomes were communicated like the "by the way" statements in all three lessons and did not engage learners during the learning process. This limited, one-time communication suggests the ILOs were not made sufficiently clear or used to actively direct learning. Anele received an "Acceptable" rating, indicating room for improvement in consistently communicating outcomes to learners.

In contrast, Bhengu did not communicate ILOs to learners at any point during the two observed lessons. The intended learning outcomes that would be the focus and goal of learning activities were never verbalized, displayed visually, or discussed for both Electrostatics and Electric Circuits. Withholding the learning ILOs from learners contrasts directly with literature recommendations for transparent communication of ILOs (Martone et al., 2009). It also represents a missed opportunity to empower learners and promote self-regulated learning, as students were not informed of the specific skills and knowledge the lesson aimed to develop. Bhengu received an "Insufficient" rating for completely neglecting to share intended learning outcomes with students.

Cebo demonstrated better practice by briefly introducing some ILOs at the start of each lesson. In the first observation, Cebo stated the main skills learners should be able to demonstrate by the end of the lesson, that is, stating Coulomb's law and using the law in calculations. In the second observation, the teacher referred to the topic that learners would be able to explain Coulombs law. In Electric Circuits lesson, Cebo introduced the lesson by stating some ILOs, that learners should be able to use $\varepsilon = IRext + Ir$ to calculate the internal resistance inside the battery. He also mentioned that at the end of the lesson learners should be able to explain the impact of increasing *Rexternal* on the potential difference to overcome internal resistance *(Vint)*. This was a communication of an ambiguous ILO in Electrostatics; it shows that the teacher did not incorporate the ILOs as presented in the CAPS document fully to their lesson. Moreover, in both lessons, the outcomes were not communicated clearly and revisited after the initial introduction. They were not displayed visually or discussed to allow clarification. Communicating ILO s only at the very start of lessons represents progress but still limits students' ability to use the ILOs to actively guide their learning process. Cebo received a "Below Average" rating, performing better than Teacher B but still with substantial room for improvement (refer to table 2.2 and table 2.3 in chapter 2).

Hence, the observation findings reveal that ILOs communication needs to become much more explicit and transparent for these teachers. The literature argues that ILOs should be communicated clearly at the outset and then continuously reinforced throughout the learning process, not just stated once at the start of a lesson (Martone et al., 2009). ILOs should also be made visible by recording them on the board or displaying them using technology (Jones & McLean, 2012). Teachers need to provide opportunities for discussion and clarification of outcomes (Hailikari et al., 2022). These practices empower learners, promote awareness of the purpose of activities, and support learner autonomy. Without clear, ongoing communication of ILOs, learners are disempowered, and opportunities are lost to leverage ILOs for self-regulated learning. These findings suggest teachers should strengthen their skills in transparently communicating, reinforcing, and discussing intended outcomes with learners to provide better chances of knowledge construction and improve performance in Electrostatics and Electric Circuits.

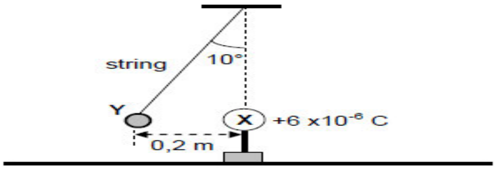
4.3.2.1 (b) Link between ILOs, Assessment and Activities

The literature emphasizes that constructively aligned teaching requires careful linking of learning activities and assessments directly to intended learning outcomes. Learning activities should be intentionally designed to scaffold the knowledge and skills defined in the ILOs (Biggs, 2014). Assessment tasks should also be aligned with the ILOs to evaluate learner progress in achieving the specific intended outcomes (Anderson & Rogan, 2010).

However, the observation findings reveal gaps in linking ILOs, teaching and learning activities, and assessment for these teachers. For Anele, the past exam questions used as a class activity did broadly address content knowledge from the overall unit. However, the direct link to the specific ILOs for the lesson was not made explicit. Students were not guided to see how the activity would help them demonstrate particular skills the lesson aimed to develop. Similarly, the informal assessment questions focused on content coverage rather than specifically assessing the ILOs. Figure 4.1 and Figure 4.2 below presents the class activities that were used by Anele in Electrostatics and Electric Circuits respectively.

7.1 A small sphere, **Y**, carrying an unknown charge, is suspended at the end of a light inextensible string which is attached to a fixed point. Another sphere, **X**, carrying a charge of $+6 \times 10^{-6}$ C, on an insulated stand is brought close to sphere **Y**.

Sphere **Y** experiences an electrostatic force and comes to rest 0,2 m away from sphere **X**, with the string at an angle of 10° with the vertical, as shown in the diagram below.



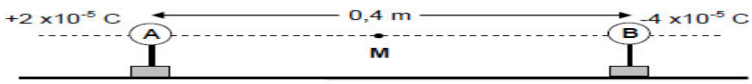
7.1.1 What is the nature of the charge on sphere **Y**? Choose from POSITIVE or NEGATIVE. (1)

7.1.2 Calculate the magnitude of the charge on sphere **Y** if the magnitude of the electrostatic force acting on it is 3,05 N. (3)

7.1.3 Draw a labelled free-body diagram for sphere **Y**. (3)

7.1.4 Calculate the magnitude of the tension in the string. (3)

7.2 Two small charged spheres, **A** and **B**, on insulated stands, with charges $+2 \times 10^{-5}$ C and -4×10^{-5} C respectively, are placed 0,4 m apart, as shown in the diagram below. **M** is the midpoint between spheres **A** and **B**.



7.2.1 Define the term *electric field at a point*. (2)

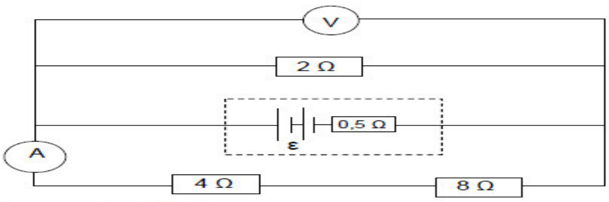
7.2.2 Calculate the net electric field at point **M**. (6)

[18]

FIGURE 4.1: ANELE'S CLASS ACTIVITY ON ELECTROSTATICS

QUESTION 2 (Start on a new page.)

A battery of an unknown emf and an internal resistance of 0,5 Ω is connected to three resistors, a high-resistance voltmeter and an ammeter of negligible resistance, as shown below.



The reading on the ammeter is 0,2 A.

2.1 Calculate the:

2.1.1 Reading on the voltmeter (3)

2.1.2 Total current supplied by the battery (4)

2.1.3 Emf of the battery (5)

2.2 How would the voltmeter reading change if the 2 Ω resistor is removed from the circuit? Write down INCREASE, DECREASE or REMAIN THE SAME. Explain the answer. (3)

[15]

Figure 4.2: Anele's class activity on Electric Circuits

The evidence of the activities directing learning towards the attainment of Electrostatics and Electric Circuits ILOs was clear in the activities besides the failure to state Coulomb's law in Electrostatics activity. The link between these activities, assessment, and intended learning outcomes was indirect and assumed rather than intentionally communicated. Anele received a rating of "Acceptable" for some evidence of general alignment between elements, but with a need for more explicit linkages and clear communication of these links with learners.

In Bhengu's lessons, learning activities like textbook problems were chosen without clear rationales tied to ILOs. The teacher selected activities believed to generally support learning the topics rather than intentionally scaffolding specific knowledge and skills. Likewise, the short quiz assessed content knowledge rather than directly measuring the lesson ILOs. Below is the snap showing class activities selected by Bhengu for his class on Electrostatics and Electric Circuits.

Activity 1 | **Answer questions on applying Coulomb's Law**

1 Explain what is meant by superposition of electrostatic forces.
2 Consider the conversion: 2,0 nC = $2,0 \times 10^{-9}$ C. Write the following in coulombs:
2.1 4,6 μC
2.2 0,54 pC
2.3 23,7 nC
3 Convert the following quantities into the submultiples shown in brackets:
3.1 3×10^{-6} C (μC)
3.2 $4,56 \times 10^{-7}$ C (μC)
3.3 $3,47 \times 10^{-10}$ C (nC)
3.4 $8,92 \times 10^{-11}$ C (pC)
4 Point charges of +3,0 nC and of −5,0 nC are 0,05 m apart.
4.1 Draw a diagram of the situation that includes the force on each charge.
4.2 Is the force they exert on each other *attraction* or is it *repulsion*?
4.3 Calculate the magnitude of the force they exert on each other.
4.4 Choose the correct word: The magnitude of the force on the +3,0 nC charge is the *greater* than, the *same* as or *less* than the force exerted on the −5,0 nC charge.
5 Two identical insulated metal spheres exert a force of repulsion of $3,6 \times 10^{-3}$ N on each other. Each sphere carries a charge of +0,6 μC.
5.1 Draw a diagram and calculate how far the charges are apart.
5.2 Write what the magnitude of the force on each charge will be if:
5.2.1 the spheres are moved so that the distance between their centres is three times further apart
5.2.2 the spheres are the original distance apart but one of them is replaced with a sphere carrying a charge of 1,2 μC.

FIGURE4.3: BHENGU'S CLASS ACTIVITY ON ELECTROSTATICS

3. A 10 Ω and a 12 Ω resistor are connected in series with a battery of emf 6V and internal resistance 2 Ω.
a) Draw the circuit diagram. (2)
b) Calculate the total current in the circuit. (3)
c) Calculate the potential difference across the 10 Ω resistor. (3)
d) Calculate the potential difference across the battery terminals. (2)
e) Calculate the power developed in the 12 Ω resistor. (3)
f) Calculate the power dissipated in the battery. (2)
g) How would connecting the resistors in parallel affect the power dissipated in the battery? Explain your answer. (3)

4. Figure 9.31 shows the main parts of a car's fuel gauge. The slider completes the circuit so that the ammeter measures a current. As the fuel level falls, the float also falls and the slider moves to the left, keeping contact with the resistance wire.

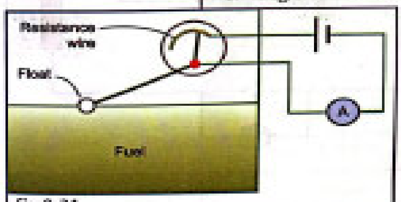


Fig 9.31

a) How does the resistance of the circuit change when the slider moves to the left (anticlockwise)? Explain your answer. (2)
b) How does the reading on the ammeter change as the fuel level falls? Explain your answer. (3)

FIGURE 4.4: BHENGU'S CLASS ACTIVITY ON ELECTRIC CIRCUITS

With no ILOs communicated to learners, creating explicit alignments was impossible. However, even without transparent ILOs, the teacher missed opportunities to explain how activities support progress toward the underlying aims and skills he had in mind for students to develop. The lack of any articulated linking between elements resulted in an “Insufficient” rating.

Cebo displayed a generally thoughtful selection of activities on Electrostatics and Electric Circuits using past exam papers and textbook material. The teacher made some effort to guide learners in recognizing the links by occasionally pointing out how certain questions helped prepare for particular exam item types, that is, he constantly made comments to learners reminding them to differentiate between an Electric field and the Electric field at a point. Figure 4.5 and Figure 4.6 below represents Cebo's activity on Electrostatics and Electric Circuits.

QUESTION 7 (Start on a new page.)

The diagram below shows two identical insulated metal spheres . Sphere **P** and **Q** each carry a charge of +6 nC.

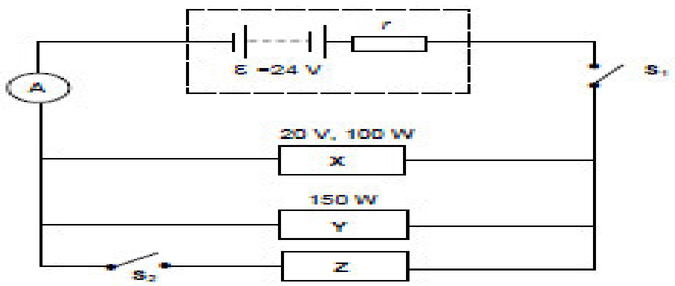
7.1	State Coulomb's Law in words	(2)
7.2	Draw the electric field pattern due to the two spheres **P** and **Q**	(3)
7.3	Calculate the magnitude of the electrostatic force between spheres **P** and **Q**	(4)

A third sphere, **R**, of charge -2 nC is now placed at a position 20 cm to the right of sphere **Q** . **X** is a point to the right of the spheres as shown in the diagram below.

7.4	Calculate the net electric field at point **X** due to spheres **P**,**Q** and **R**.	(6)
		[15]

FIGURE 4.5: CEBO'S CLASS ACTIVITY ON ELECTROSTATICS

Three electrical devices, **X**, **Y** and **Z**, are connected to a 24 V battery with internal resistance *r* as shown in the circuit diagram below. The power rating of each of the devices **X** and **Y** are indicated in the diagram.



With switch **S**$_1$ closed and **S**$_2$ open, the devices function as rated.

Calculate the:

8.2.1	Current in **X**	(3)
8.2.2	Resistance of **Y**	(3)
8.2.3	Internal resistance of the battery	(5)

Now switch **S**$_2$ is also closed.

8.2.4	Identify device **Z** which, when placed in the position shown, can still enable **X** and **Y** to operate as rated. Assume that the resistances of all the devices remain unchanged.	(1)
8.2.5	Explain how you arrived at the answer to QUESTION 8.2.4.	(2)

FIGURE 4.6: CEBO'S CLASS ACTIVITY ON ELECTRIC CIRCUITS

However, the connections to the ILOs driving the selection of activities were not explicitly outlined. Similarly, the informal assessment tasks were better aligned to the exam format than directly measuring the attainment of the lesson ILOs communicated at the start. An "Acceptable" rating was given for some linkage between elements, but without clearly articulated, intentional alignment driven by ILOs.

Therefore, the findings reveal lost opportunities to crisply articulate intentional, constructive alignments between ILOs, activities, and assessment. The literature argues that teachers should be transparent in communicating rationales, guiding learners to recognize how activities serve as scaffolding to build skills defined in the ILOs to be achieved (Hailikari et al., 2021). Assessment tasks should also be framed as a direct means of demonstrating attainment of the ILOs (Dolin et al., 2018). Vague notions of content coverage or exam preparation are insufficient. Constructive alignment requires learning activities and assessment to be deliberately designed and directly linked to the specific, communicated ILOs for the lesson. The findings reveal room for these teachers to improve in crisply articulating and helping learners recognize the intentional, constructed alignments underlying their instructional choices.

4.3.2.1 (c) Depth of knowledge consistency compared to Intended Learning Outcomes

The literature advocates that constructively aligned teaching requires consistency between the cognitive challenge of learning activities and assessments compared to the intended learning outcomes (ALOs) (Squires, 2012; Anderson & Rogan, 2010). Activities and assessments should target the same cognitive levels and skills defined in the ILOs. Alignment is undermined when the cognitive demand differs.

However, comparing the findings to this recommendation reveals some inconsistencies in cognitive alignment for these teachers. For Anele, the ILOs emphasized higher-order application skills like analyzing novel situations and solving unfamiliar problems in Electrostatics. However, the learning activities utilizing past exam papers primarily involved the repetition of previously modeled examples and procedures. While important scaffolding, this provided a limited opportunity to practice higher-order transfer. Similarly, the assessment focused mainly on factual knowledge rather than application. The cognitive demand of activities and assessment therefore misaligned with the higher-order ILOs, resulting in an "Acceptable" rating for Anele.

Bhengu's lessons, activities like end-of-chapter textbook questions presented a mix of factual recall, conceptual understanding, and some limited application items. However, since ILOs were not communicated, comparing cognitive alignment was not possible. He gave an activity with questions like, for example, explain what is meant by superposition? Converting units in Electrostatics and other recall questions. The informal assessment focused heavily on factual knowledge rather than higher-order skills. With no stated ILOs and a discrepancy between the activity and assessment cognitive level, Bhengu received a rating of "Insufficient" for cognitive alignment.

Cebo's ILOs emphasized conceptual understanding of the topic Electrostatics and Electric Circuits. The past exam paper questions used as activities provided opportunities for building conceptual knowledge along with some factual and applied items. The balance aligned reasonably with the ILOs cognitive level focus on understanding concepts. The assessment included a mix of factual and conceptual items such as stating Coulomb's law, using it in calculations and defining the Electric field and others; also targeting the understanding skills in the ILOs. The general cognitive consistency across Electrostatics ILOs, activities, and assessment resulted in a "Good" rating. However, the lack of crisp articulation of the alignment was still noted.

In general, the findings point to a need for greater intentionality in balancing cognitive challenges across ILOs, activities, and assessment in Electrostatics and Electric Circuits. Cebo demonstrated the most consistency in realizing this, though without crisply articulating the constructive alignments. Teachers should be transparent about the cognitive skills defined in ILOs of Electrostatics as well as Electric Circuits and deliberately maintain that cognitive level in activities and assessment (Anderson & Rogan, 2010). Failure to recognize and transparently communicate cognitive alignment undermines intended learning outcomes as stipulated in the CAPS document. The observation findings suggest that strengthening teachers' skills in analyzing cognitive challenges, choosing appropriate class activities and articulating cognitive constructive alignment could enhance ILO attainment.

4.3.2.1 (d) Range of knowledge tested

The literature recommends constructively aligned assessment should evaluate learner progress toward the full range of knowledge and skills encompassed in the intended learning outcomes (Dolin et al., 2018). Assessing a limited subset overlooks key objectives and provides an inaccurate picture of ILO attainment.

However, comparing the observed assessments against this recommendation indicates some limitations in assessing the full range defined by ILOs. In Anele's lessons, the ILOs highlighted developing both conceptual knowledge and applied problem-solving abilities in Electrostatics and Electric Circuits. But the brief informal assessment emphasized factual knowledge over application. Key problem-solving and analytical skills outlined in the ILOs went unevaluated. This narrow range resulted in a rating of “Acceptable” for Anele.

Likewise, Bhengu’s informal quiz focused exclusively on factual recall questions in Electrostatics. No effort was made to assess higher-order skills or conceptual grasp. However, Munsamy (2014) alluded that including higher-order skills in formative assessment tasks can improve overall performance in Physical Sciences. With no ILO communication, determining adequate range was impossible. But the exclusivity of factual knowledge suggests potential gaps, warranting an “Insufficient” rating.

Cebo provided the most balanced range in informal assessment. Factual, conceptual, and applied knowledge were incorporated, providing a better match for the ILOs focus on building conceptual understanding with some skill application. His class activities in Electrostatics and Electric Circuits are provided above to provide reference. The diversity resulted in a “Good” rating for knowledge range alignment. However, more transparency in articulating alignment to ILO range could still improve.

Henceforth, the findings point to reliance on narrow assessment of factual knowledge without consistently evaluating the fuller range of skills found in Electrostatics and Electric Circuits ILOs, like conceptual grasp and application abilities. Literature emphasizes assessment should intentionally target the complete set of knowledge encompassed in ILOs (Dolin et al., 2018). Failure to assess the full range results to inadequate evaluations. The findings suggest teachers may require support in broadening informal assessments to better evaluate total ILOs knowledge scope. Explicit alignment articulation could aid this process. Assessing a fuller range of constructed knowledge would provide better insight into achievement of all ILO facets.

4.3.2.1 (e) Ability to link activities to the actual assessment and (or) examination

The literature advocates that constructively aligned teaching requires connecting classroom learning activities directly to the types of tasks, formats, and challenge levels learners will encounter in summative or external assessments (Mhlolo & Venkant, 2009). Activities should provide authentic practice applying knowledge needed for exams (Edwards, 2010).

However, the findings point to inconsistent skill in transparently linking activities to summative assessments or the examination. In Anele's lessons, utilizing past exam papers for class activities provided strong connections to the external assessment, although not all exam type questions are evident in his class activity on Electrostatics. Anele also made occasional verbal links between activity questions, that is, differentiating between Electric field and Electric field at a point. Applying equilibrium motion and Newtons' 3rd law of motion in problem solving; and what learners may encounter on exams. However, these connections were not made explicit and systematic. Students were given little direct guidance in recognizing the relevance of activities for preparing exam competencies beyond the repetition of past items. This resulted in a rating of "Acceptable" for Teacher Anele.

In Bhengu's lessons, limited effort was made to contextualize class activities in relation to preparing for exams, since they relied mostly on textbook activities for their lessons in Electrostatics. Beyond a cursory acknowledgment that textbook questions help test basic knowledge, no crisp connections between them and the final examination were drawn. Without communicating rationales, learners were left to assume relevance rather than have it constructively articulated. Bhengu was thus rated "Insufficient" in explicitly linking activities for exam preparation.

Cebo demonstrated relatively strong practice by verbalizing connections between the exam questions used as class activities and external exams. Specific examples were provided of how certain activity item types, that is, Electric field at a point and others, Electrostatic force, and others; mirror what learners could expect on their high-stakes assessments. This intentional effort to make links explicit yielded a rating of "Good." However, room for further improvement in providing maximally transparent articulation of alignments remained.

Hence, the findings reveal inconsistent skills in making explicit connections between learning activities and upcoming assessments in Electrostatic and Electric Circuit. Crisp, transparent articulation and explanations of ILOs and linking them to the summative assessment were rare in Bhengu's lesson and not perfectly clear in Cebo and Aneles lessons. Yet, research shows directly communicating rationales for activities is pivotal for learner buy-in and self-regulation (Jones & McLean, 2012). Teachers should move beyond assumptions of intuitive relevance (assuming that the activities will be spontaneous in attaining ILOs) to constructively articulate intentional alignments of ILOs with explicit links to the summative assessments. While Cebo modeled this to some degree, all three teachers would likely benefit from further developing clear, communicative skills at overtly linking activities in Electrostatics and Electric Circuits to assessments. Explicitly conveying these constructive alignments can enhance the perceived relevance and impact of classroom activities in preparing learners for examinations.

4.3.3 Conducting document analysis

The document analysis done by the researcher studied the lesson plans, teaching notes (including textbook) as well and assessment packages and gave an insight into Physical Sciences teachers' experiences of constructive alignment between intended learning outcomes, learning activities, and assessment in Electrostatics and Electric Circuits in Physical Sciences curriculum. The findings from document analysis were necessary for triangulation and answering the second research question "How do Physical Sciences teachers apply constructive alignment when enacting the curriculum?". All three participants were informed in advance to bring along their lesson plan, teaching notes/textbook, and the assessment package for the researcher to be able to conduct document analysis. The following sub-sections present, discuss, and analyse the findings from the document analysis template.

4.3.3.1 Presentation of findings from the document analysis template

The document analysis template was used for each participant and the findings in the analysis template were discussed and analysed for each participant in each emerging theme. Biggs (1999) CAM as the conceptual framework is used to analyse the findings on the document analysis template for all participants.

4.3.3.1 (a) Addressing ILOs in Electrostatics

The literature emphasizes that constructively aligned teaching requires lesson plans and instructional materials to be intentionally designed around targeted intended learning outcomes (ILOs) from the curriculum (Anderson & Rogan, 2010). Documents should provide clear evidence that activities and assessments have been purposefully selected and developed to scaffold learners toward the defined ILOs (Smith, 2012). Refer to Table 4.1 and Table 4.2 above since they present the ILOs of Electrostatics and Electric Circuits for grade 12 Physical Sciences from CAPS document. These intended learning outcomes should be used as the reference when teachers are preparing their lessons and should link explicitly with class activities and assessment.

However, the document analysis findings reveal inconsistencies in designing teaching documents to explicitly address Electrostatics and Electric Circuits ILOs. Anele's lesson plan on Electrostatics listed only a few general ILOs without clear connection to specific curriculum standards. The limited selection suggests they were not used to deliberately guide development of activities and assessment. A rating of "Minimal" was given. Bhengu's lesson plan did not include ILOs at all, earning a "Non-existent" rating. Without explicitly documenting ILOs, activities cannot be purposefully aligned, and the plan loses direction. Cebo demonstrated slightly better practice by including some general ILOs. Cebo's sequence of planning was in good order as it start by stating the law, using the law for calculations, drawing the electric field pattern, and calculating the electric field. However, the lesson plans still lacked evidence of intentionally using curriculum standards to shape content and activities and there is no mention of superposition of charges or electric field. Failure to engage with superposition in Cebo's lesson plan made it difficult for learners to work out net electrostatic force or net electric field. An "ILOs fairly covered" rating was given to Cebo. Table 4.3 below present the outcomes of lesson plans from the three teachers in Electrostatics. Where as Table 4.4 presents the outcomes of lesson plans from the three teachers in Electric Circuits.

Participant	Lesson objectives for Electrostatics in lesson plans
Anele	NAME OF SCHOOL : [redacted] TOPIC AND GRADE : ELECTROSTATIC GRADE 12 LESSON OBJECTIVES : STATING COULOMB'S LAW : USING $F = \frac{kQ_1Q_2}{r^2}$: DEFINING ELECTRIC FIELD AT A POINT : USE $E = F/q$: USE $E = \frac{kQ_1}{r^2}$: DRAW ELECTRIC FIELD PATTERN. BASELINE ASSESSMENT : DEFINE → ELECTROSTATI FORCE → ATTRATION FORCE
Bhengu	Non – Existing

Cebo	| TOPIC | Electrostatics and Coulomb's law | **AIMS OF LESSON** **Coulomb's law** You should be able to: • State Coulomb's law in words; • Understand the relationships between physical quantities; • Solve problems using the equation $F = \frac{kQ_1Q_2}{r^2}$; and • List the values / applications of electrostatics and Coulomb's law in practice. **Electric field** You should be able to: • Describe an electric field; • Draw electric field patterns around point charges and charged spheres; • Define the electric field strength at a point; • Solve problems using the equation $E = \frac{F}{Q}$, such as calculating the electric field strength at a point due to a number of point charges.

TABLE 4.3: REPRESENTATION OF OUTCOMES IN ELECTROSTATICS LESSON PLANS

Participant	Lesson objectives for Electric Circuits in lesson plans
Anele	NAME OF SCHOOL : ~~[illegible]~~ TOPIC AND GRADE : ELECTRIC CIRCUITS GRADE 12 LESSON OBJECTIVES: DIFFERENTIATE BETWEEN PARALLEL & SERIES CONNECTIONS : STATE OHM'S LAW IN WORDS : USE $V = IR$ TO SOLVE PROBLEMS : DEFINE ELECTRICAL POWER : USE $P = W/\Delta t$ OR $P = I^2 R$ OR $P = V^2/R$ TO SOLVE CALCULATIONS. BASELINE ASSESSMENT : STATE THE DEFINITIONS FOR → Current & CHARGE → POTENTIAL difference.
Bhengu	Non - Existing
Cebo	TOPIC: Electric Circuits AIMS OF LESSONS **Ohm's Law** **To:** • State Ohm's law in words: The potential difference across a conductor is directly proportional to the current in the conductor at constant temperature. • Determine the relationship between current, potential difference and resistance at constant temperature using a simple circuit. • State the difference between ohmic conductors and non-ohmic conductors and give an example of each. • Solve problems using $V = IR$ for series and parallel circuits (maximum four resistors). **Power, energy** **To** • Define power as the rate at which work is done. • Solve problems using $P = W/\Delta t$. • Solve problems using $P = VI$, $P = I^2 R$ or $P = V^2/R$.

TABLE 3: REPRESENTATION OF OUTCOMES IN ELECTRIC CIRCUIT LESSON PLANS

The findings indicate a need for teachers to become much more intentional in anchoring teaching documents around targeted curriculum ILOs for Electrostatics and Electric Circuits. Simply including some general ILOs without clear reference to standards is insufficient for Electrostatics and Electric Circuits as they require complete synchronization of ILOs from the CAPs document and explicitly linking them to those in each learning activity. The literature argues that constructively aligned lesson planning should begin by identifying curriculum ILOs to be scaffolded, and then designing activities and assessments to align (Anderson & Rogan, 2010). These findings suggest teachers require support in shifting lesson planning practice to more deliberately select and document specific curriculum ILOs to focus instructional choices and alignment decisions in Electrostatics and Electric Circuits. Explicitly basing documents on discrete standards provides objective direction, enhancing constructive alignment (Smith, 2012).

4.3.3.1 (b) Extent of teaching documents supporting the ILOs

Research recommends that constructively aligned teaching materials should provide strong support for scaffolding learners toward the targeted ILOs selected from the curriculum (Anderson & Rogan, 2010). Documents like presentations, worksheets, and notes should include content, examples, and instruction that intentionally help build the knowledge and skills defined in the ILOs.

However, analysis of the teaching documents revealed some gaps in intentionally supporting ILOs. For Anele, the worksheet using past exam questions generally aligned with curriculum content standards in Electrostatics and Electric Circuits but lacked a clear, selective focus on scaffolding specific ILOs from the lesson plan, that is, Anele did not mention the ILO on net Electrostatic force and net Electric field. Support was also limited by the repetition of previous exam items in class activity rather than expanding practice. This resulted in a rating of "Fair support."

Bhengu's textbook worksheet provided broad practice since it involved many questions for learner practice but without clear, deliberate ILO linkages or expansive support. A rating of “Minimal details” was given. Cebo used exam papers and textbook pages that supplied some content alignment between CAPS requirements and assessment without crisp, constructed connections to the lesson plan ILOs. A rating of “Little details” was provided.

Overall, the findings point to room for improvement in deliberately focusing teaching materials to provide explicit support for scaffolded attainment of targeted ILOs from the Physical

Sciences CAPS document. Research recommends tightly integrating activities, content examples, and formative feedback in documents to progressively build ILO skills (Anderson & Rogan, 2010). General alignment without crisp support tailored to ILO needs results in missed opportunities. The findings suggest strengthening skills in intentionally designing and utilizing materials precisely focused on transparent scaffolding selected standards could enhance ILO support and constructive alignment in these teachers' documents when teaching Electrostatics and Electric Circuits. However, it is important to note that the CAPS document does not recommend any teaching resource for teaching Electrostatics. Therefore, it is important that teachers make explicit links in ILOs of Electrostatics through self-reflection to modify their teaching approach (Mpungose, 2020; Little, 2018 & Smith, 2012). Moreover, these teachers used only the traditional tools like blackboard and worksheets when teaching the two topics instead of using technological platforms like PhET simulations to reinforce understanding and increase tangibility in Electrostatics and Electric Circuits (Burde et al., 2021; Khoza, 2016).

4.3.3.1 (c) Identification and maintenance of action verbs used in activities and assessment as they are intended

The literature advocates for constructively aligned teaching materials to incorporate action verbs that reflect the knowledge and skill dimensions defined in ILOs (Anderson & Rogan, 2010). Maintaining these action verbs across materials and assessment tasks signals teaching and evaluation target the intended ILOs. The action verbs used in the curriculum represent the different cognitive demand per question in the assessment task (Munsamy, 2014). Bloom's revised taxonomy used the Verbs: Remember (list/name, describe, use etc.), Understand (interpret, predict, summarize etc..), Apply (calculate, classify, experiment etc.), Analyze (explain, differentiate, etc), Evaluate (assess, conclude etc.), and Create (plan, compose etc.) to associate different questions and allocate them according to the expected cognitive demands in the CAPS document (Munsamy, 2014; Anderson & Rogan, 2010 and Brookhart, 2015).

However, document analysis revealed inconsistencies in purposefully identifying and maintaining ILO action verbs across documents. Anele's limited lesson plan ILOs did include some action verbs like "analyze" and "solve." However, worksheets relied more on repetition than purposefully scaffolding the skills. Action verbs were not explicitly tracked into activities. A rating of "Few action verbs" was given. Bhengu's lesson plan lacked ILOs and action verbs. The worksheet action verbs like "determine" and "distinguish" were divorced from any overarching scaffolded plan. A rating of "Poor identification" resulted. Cebo had some action verbs in the general lesson plan ILOs but terms like "explain" and "describe" did not carry over with clarity into teaching materials. Although action verbs like “state” Coulomb’s law, “solve using $F = kQ_1Q_2/ r^2$ we present in both lesson plan and class activities but there was no explicit link of other action verbs in the learning process. Therefore, A rating of “Poor use of action verbs” was given.

The findings indicate missed opportunities to crisply track action verbs across ILOs, activities, and assessments in Electrostatics and Electric Circuits as reflective of targeted knowledge dimensions. The literature argues maintaining -action-verb alignment helps communicate focused skill expectations and progress to learners (Anderson & Rogan, 2010). Failure to transparently link terms makes skill and attainment of ILOs to be ambiguous. The findings suggest support in identifying relevant action verbs in curriculum ILOs and then more deliberately maintaining those action verbs across teaching and assessment documents could intensify constructive alignment and signaling of skill expectations for these teachers.

4.3.3.1 (d) Teaching activities addressing the same outcome as the test and (or) exam in Electrostatics

Research recommends that constructively aligned teaching materials should contain activities intentionally designed to build the specific knowledge and skills required to demonstrate success on external summative exams (Anderson & Rogan, 2010). Documents should reflect a purposeful effort to meet testing outcome needs.

However, the findings reveal gaps in transparent alignment between teaching activities and summative assessment targets. Anele's reliance on past exams for class activities did replicate exam items but without discussing connections or scaffolding greater skill development when answering questions in Electrostatics and Electric Circuits. There was little evidence of extending practice to intentionally meet exam needs beyond repetition. This resulted in a rating of “Adequate coverage.” Bhengu's textbook worksheet provided general practice without deliberately aligning activities to build exam competencies in Electrostatics and Electric Circuits. No summative outcome connections were communicated, earning a rating of “Minimal details.” Cebo demonstrated slightly better efforts to relate exam paper activities he used in Electrostatics (refer to Figure 4.1 above) to external exam preparation. But without crisp articulation of intentional alignment, a rating of “Few questions” addressing outcomes resulted.

Overall, the findings point to a need for much clearer efforts in Electrostatics and Electric Circuits teaching documents to transparently communicate teaching activities developed to intentionally prepare learners for the demonstration of skills on summative tests and examinations. The literature argues activities should provide scaffolded, expansive practice toward exam goals (Anderson & Rogan, 2010). Vague notions of general practice are insufficient. The evidence suggests these teachers would benefit from support in becoming more deliberate and transparent about designing activities in Electrostatics and Electric Circuits to specifically address summative assessment needs. Crisp constructive alignment articulation could enhance learner motivation by clarifying purpose and this may improve learner performance in Electrostatics and Electric Circuits.

4.3.3.1 (e) Assessment given to learners matching the standard of the final exam question paper

Research advocates that constructively aligned assessment tasks incorporated into teaching materials should intentionally reflect the cognitive challenge, format, and style of external summative exams (Edwards, 2010). Matching standards communicate performance expectations while providing authentic preparation.

However, the findings point to some discrepancies between informal assessments in teaching documents versus final exams. Anele used the past questions on worksheets did directly replicate the cognitive and item demands of formal assessments. But support in crafting expanded, scaffolded tasks was lacking, preventing a rating beyond “Adequate standard match.” Bhengu's informal worksheet provided only basic factual items unlike the higher-order skills featured on exams in Electrostatics and Electric Circuits. The misalignment resulted in a rating of “Minimal standard match.” Cebo created assessments combining recall, understanding, and application items that somewhat mirrored exam challenges in Electrostatics and Electric Circuits. But without transparent discussion of standards matching, a rating of “Evidence of standard match” resulted.

The findings indicate informal classroom assessments are not consistently developed to provide constructively aligned preparation replicating exam standards in the topic Electrostatics and Electric Circuits. Literature argues alignment requires informal tasks to authentically reflect external assessment formats and cognitive demands while providing scaffolded practice toward independence (Edwards, 2010). Only replicating basic knowledge fails to communicate performance expectations. The evidence suggests supporting these teachers in crafting a wider range of informal assessment types in Electrostatics and Electric

Circuits that transparently align with exam papers could enhance standards of communication, student preparation, performance, and constructive alignment.

4.3.4 Conducting post-observation interviews

Individual semi-structured post-observation interviews formed part of the reflections of the study as they allowed participants to reflect on their lessons and presented data that attends to the last research question "Why do Physical Sciences teachers enact the curriculum the way they do?". Individual post-interviews were conducted at the convenience of each participant and the data was recorded on the interview schedule and later handed to each participant for verification if all the responses had been captured correctly by the researcher. The findings on the post-observation interviews were analysed using the Biggs (1999) CAM as the conceptual framework. The sub-section below is the presentation, discussion, and analysis of the findings from the post-observation interview.

4.3.4.1 Presentation of findings from post-observation interviews

The post-interview schedule was used to record data from each participant and some of the responses are given in themes below. The themes emerged from the responses given by the participants and matched the research aims. The findings from the post-interviews are discussed and analysed using Bigg's (1999) CAM as a conceptual framework after the table below.

4.3.4.1 (a) Important documents for lesson preparation

The literature on constructively aligned teaching emphasizes that curriculum standards documents should provide the foundation for lesson planning (Anderson & Rogan, 2010). Teachers should prioritize selecting specific ILOs from standards to focus on instructional design (Smith, 2012). Reliance on textbooks or past exams alone risks misalignment (Edwards, 2010).

However, the findings reveal uneven reliance on standard documents for planning. Anele reported referencing "past papers, prescribed textbook, ATP [Annual Teaching Plan], and the examination guideline" without mentioning curriculum standards as core planning resources. Bhengu similarly emphasized "textbook and examination guideline" documents. Cebo described using "*exam guidelines, textbook, and the previous papers*" without standards.

The findings suggest these teachers may overemphasize summative assessments and textbooks rather than intentionally selecting curriculum ILOs from the Physical Sciences CAPS document to anchor planning. Literature argues constructive alignment requires lesson planning to begin with a careful selection of curriculum standards from the CAPS documents to scaffold, before choosing supplementary resources (Smith, 2012). Textbooks and past exams provide useful content but should support, not drive ILO-based planning in Electrostatics and Electric Circuit. Starting with standards as the core document keeps a constructively aligned focus on building specific skills from the curriculum, this is known as the backward approach to lesson planning (Tyler, 1949). These findings reveal a need to build teacher capacity and shift mindsets to properly prioritize official curriculum documents (CAPS and examination guideline) over textbooks or tests during planning for greater constructive alignment and improved performance in topics like Electrostatics and Electric Circuits.

4.3.4.1 (b) Link between intended learning outcomes, activities, and assessment in pedagogical practice and teaching documents

The literature argues teachers should provide explicit rationales verbally and in teaching documents that explain connections between ILOs, learning activities, and assessments, so students understand why particular activities are relevant (Martone et al., 2009). Communicating alignments promotes transparency and self-regulated learning.

However, the interview findings suggest gaps in explicitly articulating intentional, constructed alignments. When asked about linking ILOs, activities, and assessments in practice and documents, Anele simply stated.

"*Yes, these documents are prepared by the department... there should be a link.*"

His assumption of inherent alignment in provided resources contrasts with literature arguing teachers should actively construct alignment, not presume it (Anderson & Rogan, 2010). Bhengu similarly stated,

"*I think there is a link because the prescribed textbook I use is also used by other teachers and the examiners*."

This also suggests passive reliance on implicit alignment. Cebo said,

"*Of course, the documents are coming from the Department of Education and so they should be perfect for teaching and increasing learner understanding*."

Like Anele and Bhengu, Cebo expresses unfounded confidence in externally provided materials, rather than taking the agency to construct intentional alignment.

Hence, the findings reveal over-reliance on pre-made resources to provide alignment, without taking explicit steps to verify or construct linkages. Yet, research recommends teachers actively create and communicate alignments in practice and documents rather than assume their existence (Martone et al., 2009). These responses suggest a need to build skills in transparently explaining constructed rationales to learners and shift mindsets toward taking ownership of proactively planning aligned instruction rather than presuming alignment in provided materials.

4.3.4.1 (c) Assessment given to learners' link to intended learning outcomes and activities thereof

Literature advocates that constructively aligned teaching requires formative and summative assessments to be deliberately designed based on ILOs and learning activities. Assessments should directly evaluate learner progress on the knowledge and skills developed through the activities (Dolin et al., 2018).

However, the findings point to inconsistencies in actively designing assessments aligned to ILOs and activities. When asked if informal assessments link to ILOs/ activities, Anele simply said "*Yes*" without elaborating on how assessments are aligned. Bhengu was also vague, stating "*I think there is a link*" without explaining alignment strategies. Cebo similarly provided no details, expressing unfounded confidence that "*Of course*" there is alignment. All three teachers were unable to articulate intentional processes for constructing ILO- and activity-aligned assessments, indicating they may not actively develop assessments this way.

The findings suggest over-reliance on assumptions of pre-existing alignment, without transparent processes to deliberately design assessments measuring ILOs and activities. Yet research stresses that meaningful constructive alignment requires assessments to be consciously developed to reflect the specific ILOs driving instructional choices (Dolin et al., 2018). Failure to actively create alignment risks insignificant assessment. The evidence indicates a need to improve skills in transparently using ILOs and activities as the basis for assessment development, rather than presuming assessments provided or downloaded inherently align. Actively constructing alignment could enhance assessment meaning.

4.3.4.1 (d) Percentage of informal test or assessment linking to intended learning outcomes

The literature recommends teachers critically evaluate the percentage of assessment items that intentionally target ILO knowledge and skills, and make improvements when alignments are weak (Martone et al., 2009). Assessments should predominantly focus on measuring ILOs (Biggs, 2014).

However, the findings point to limited critical analysis of alignment in informal assessments since teachers does not design their own class activities by relied mostly on already made class activities. When asked to estimate the percentage of items linked to ILOs, Anele chose "*31% - 60%" but without explaining a process to determine or verify alignment.* Bhengu was most misaligned*, choosing "0% - 15%*" but with no strategy to analyze alignment. Cebo selected "16% - 30%" also without an articulated process, but performed slightly better. All three teachers were unable to describe a systematic approach to evaluating or confirming the constructively aligned percentage in their class activities.

The findings suggest these teachers may use assessments without clear analysis or confirmation of the ILO alignment percentage. Yet, research argues teachers should actively verify assessments that predominantly target key ILOs (Martone et al., 2009). Lack of critical analysis risks using misaligned assessments (from textbooks or outdated question papers). The evidence points to a need to build skills in analyzing assessments to determine and enhance the percentage deliberately targeting core ILOs of Electrostatics. This could provide data to improve assessments and strengthen alignment. Simply guessing percentages suggests possible overconfidence in assumed alignment. Developing analytical skills is key for constructive alignment.

4.3.4.1 (e) Reason for constructive alignment pedagogical practices

Literature indicates that teachers' underlying rationales for using instructional approaches provide insight into their curriculum and assessment choices (Pryor & Crossouard, 2008). Eliciting explicit reasoning is key to improving practice. Prompting clear direction of the learning process is important for the learner autonomy towards knowledge construction (Eley, 2006).

However, the findings reveal limited reflection on rationales for alignment approaches. All three teachers expressed vague, external motivations for alignment practices. Anele said he aligns,

"So that learners will be exposed to different questions and be able to answer them during the examination."

His reason focuses on exam preparation rather than constructing meaningful learning and attaining ILOs in Electrostatics. Bhengu explained "*I do it the way the subject advisor wants it to be*" emphasizing external accountability over internal purpose. Cebo said he aligns,

"So that learners will be familiar with the questions that may appear in the examination."

Like Anele, his reason prioritizes testing over broader ILOs. The findings point to insufficiently examined; externally motivated rationales focused on exams rather than meaningful learning. Yet the literature argues improving practice requires interrogating internal beliefs and values underlying choices (Pryor & Crossouard, 2008). Externally imposed accountability cannot drive meaningful improvements (Eley, 2006). Progress requires examining alignment motivations. The evidence suggests these teachers would benefit from guided self-reflection to uncover internal rationales, values and beliefs driving choices of CA. Developing self-awareness of purpose could enhance the meaningfulness of constructive practices beyond teaching to the test. Alignment may be strengthened by unpacking teacher thinking and priorities.

4.4 Discussion of findings

This study illuminated several key issues in physical Sciences teachers' experiences with constructive alignment that warrant further discussion.

4.4.1 Understanding Alignment in Principle Versus Practice

The findings revealed a disconnect between teachers' general understanding of alignment principles and their ability to apply those principles effectively in classroom practice when teaching Electrostatics and Electric Circuits. Anele demonstrated the strongest theoretical grasp of the need to align instruction with curriculum standards and assessments. However, in practice, his reliance on using past exams to dictate class activities indicated limitations in designing learning activities purposefully scaffolded to build skills based on standards. Similarly, Bhengu and Cebo could articulate broad notions of textbook activities supporting curriculum outcomes but failed to provide evidence of intentionally mapping activities to targeted skills and standards.

This theory-practice gap suggests teachers may benefit from professional development bridging specific alignment principles with concrete application in instructional planning and classroom teaching in Electrostatics. Knowing principles abstractly does not automatically translate into aligned practice (Penuel et al., 2009). Turning theory into constructive practice requires guided skill-building in areas like:

- Selecting discrete curriculum standards as the cornerstone for lesson planning rather than broadly covering textbook chapters.
- Using chosen standards to intentionally design learning activities focused on building the knowledge and skills embedded in those standards.
- Developing assessments deliberately focused on measuring the attainment of the standards-based learning goals.

With scaffolded support and modeling, teachers can move from superficial awareness to deeper, more intentional implementation of constructive alignment in day-to-day teaching of Electrostatics and other poorly performed topics. This evolution is critical, as research shows poor correspondence between principles, planning, and practice severely limits student learning (English, 2016). Using professional learning communities to collaboratively analyze standards, design aligned activities, and evaluate improvements over time could bridge the theory-practice gap in Electrostatics and Electric Circuits revealed in this study.

4.4.2 Lack of Transparency in Communicating Alignment in Electrostatics

The findings also indicated a frequent lack of transparency in communicating and explaining constructive alignments to learners when teaching electrostatics. Teachers did not consistently communicate the learning standards and outcomes underpinning Electrostatics and Electric Circuits as reflected on the Physical Sciences CAPS document. Assumptions were made that activity inherently supported outcomes without clearly explaining connections to learners. Assessments were presented without explicitly tying them to measurable intended learning outcomes. This contrasts with literature arguing that constructive alignment requires the learning path to be made highly visible and logical to learners (Jones & McLean, 2012).

Two issues may explain the lack of transparency observed. First, teachers themselves may not be actively designing crisp alignments, instead assuming textbook activities and past exam papers align “well enough” with standards. Without clarity, transparency for learners is impossible. Addressing this requires improving teacher skills in deliberate, standards-driven planning. Second, even when teachers intend alignment, making it explicit to students may require additional skill and comfort with transparently explaining pedagogical rationales. Professional development should focus on transparent communication of ILOs as a pivotal practice, including modeling language for explaining alignments in “- student-friendly” ways for second language speakers. Building both the intentional design and clear communication of constructed alignments in Electrostatics and Electric Circuits is critical for empowering learner learning and autonomy.

4.4.3 Assessment as an Underutilized Learning Tool

The findings also revealed formative assessment was under-leveraged as a means of deepening learning and improving alignment. Teachers often treated assessment merely as routine data collection rather than an opportunity to provide constructive feedback on progress toward learning standards in Electrostatics. Even summative assessments were portrayed as judging achievement rather than providing data to enhance outcomes attainment and inform future improvements in alignment. This represented missed chances to close learning loops, address misunderstandings presented on the DBE (2019; 2020; 2021 & 2022) diagnostic reports (refer to Figure 2.1 in Chapter 2) and strengthen alignment.

Research shows that in constructively aligned teaching, assessment becomes a powerful learning tool for both students and teachers rather than an endpoint (Dolin et al., 2018). For students, aligning assessment to clear standards provides ongoing feedback on growth toward goals while pinpointing areas needing work like those highlighted as misconceptions in the DBE (2018 – 2022) diagnostic reports. For teachers, analysis of patterns in assessment data reveals gaps in refining instructional and curriculum alignment. Developing teachers' assessment literacy skills could expand their view of assessment as a passive judgment to an active lever for learning enhancement. With support, teachers can learn to provide rich feedback tied to standards, collaborate with learners to analyze work, adjust activities based on emerging needs, and model how to use feedback for growth. Recognizing and leveraging assessment's full potential as a process rather than the product is integral to constructive alignment (Shepard, 2005).

4.4.4 Considering Teacher Beliefs and Values

Finally, the findings surfaced tensions between teachers' pedagogical beliefs and practices related to alignment. Although expressing commitment to learner-centered ideals, the reality of teaching often defaulted to transmission models fixated on content coverage and testing over meaningful, standards-driven learning. Literature suggests that competing beliefs often undermine changes in practice (Donnelly & Sadler, 2009). Moving to genuinely aligned teaching requires unearthing hidden teacher beliefs that may impede progress (Eley, 2006).

Constructive alignment implementation could be strengthened by including reflective components challenging unexamined teacher assumptions. Coaching teachers to bring to light discordant beliefs allows conscious examination and resolution. For example, facilitating collaborative analysis of curricular intentions compared to classroom realities could reveal gaps between student-centered ideals and didactic practices (Martone et al., 2009). Similarly, discussing motivations for pedagogical choices provides space for growth-oriented critique. Developing self-awareness and through self-reflection empowers teachers to intentionally shape practice consistent with ILOs.

Therefore, key issues warranting further discussion included differences between principle knowledge and application skill, lack of transparency in communicating alignment, under-leveraging assessment as a learning tool, and unexamined teacher beliefs potentially conflicting with alignment goals. Addressing these areas through reflective (self-reflection), collaborative skill-building represents an opportunity to strengthen constructive alignment implementation and enhance meaningful learning.

4.5 Conclusion

This study explored physical Sciences teachers' experiences with constructive alignment between intended learning outcomes, activities, and assessment when teaching Electrostatics and Electric Circuits. The findings reveal several conclusions about teachers' current understanding, enactment, and rationales related to alignment. First, teachers demonstrated gaps between general awareness of principles and effective application in practice. Second, transparency in communicating alignments to learners was lacking, missing chances to activate learners' autonomy. Third, formative assessment was under-leveraged as a tool for strengthening alignment and expanding learning. Finally, unexamined teacher beliefs appeared to constrain meaningful implementation. These results point to recommendations for greater skill-building to put alignment principles into action, increased transparency about rationale with learners, developing assessment literacy and prompting reflection on practice-beliefs coherence. Targeted professional development addressing gaps in understanding, rationale, design, communication, and leveraging of assessment could strengthen constructive alignment implementation. The result would be learning activities, curriculum materials, pedagogical strategies, and assessments better integrated to empower meaningful learner construction of knowledge and development of scientific skills. Constructive alignment holds the potential to enhance science learning, but teachers require support in evolving beliefs, knowledge, and skills to fulfil this potential. Ongoing analysis of alignment experiences provides a pathway for progress. Figure 4.5 below shows key findings illuminating from this study.

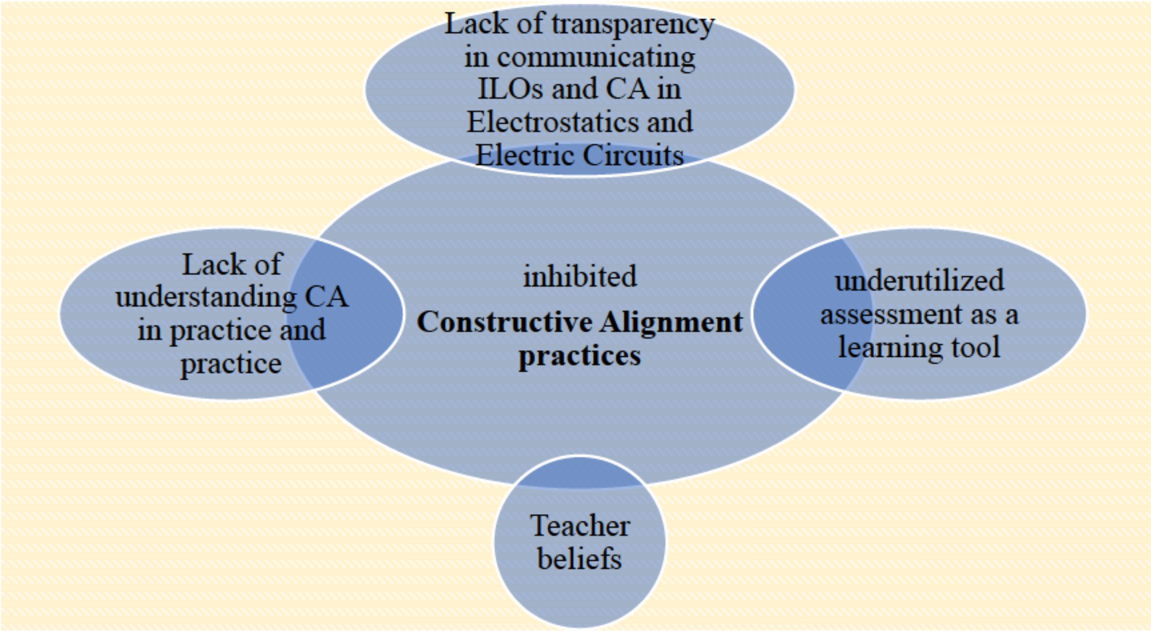


FIGURE 4.3: KEY FINDINGS ON TEACHERS' EXPERIENCES OF CONSTRUCTIVE ALIGNMENT

4.6 Chapter Four summary

Chapter four presented data generated in this study, appropriate analysis of data and discussion of findings in relation to literature. The first section is an introduction. The second section presents the biography of participants. The third section presents findings and analysis from: 1. Pre-observation interviews, 2. Observations, 3. Document analysis, 4. Post-observation interviews. The fourth section discusses four key findings of this study in relation to literature. The fifth section conclude by highlighting the most key findings and drawing from literature to consolidate the findings. The following chapter summarizes the findings and provide limitations as well as recommendations for future research.

Chapter five

Summary of Findings, Conclusions & Recommendations

5.1 Introduction

It has been helpful and crucial to conduct this study on Physical Sciences teachers' experiences with constructive alignment, particularly in the topics of Electrostatics and Electric Circuits included in the Grade 12 curriculum. Educational research has placed a great deal of emphasis on the need of constructive alignment in education, specifically concerning the coherence between intended learning outcomes (ILOs), teaching and learning activities (TLAs) and assessment methodologies. But little was known about the actual experiences' teachers have had navigating this complex phenomenon, particularly with regard to the Grade 12 Physical Sciences curriculum. The previous chapter presented, analysed, and discussed the findings on the data collected from the participants as well as that collected from the related teaching materials. The second section of this chapter seeks to summarise the key results of the research. The third section interprets the findings of this study in relation to the literature. The fourth section examines the implications of the study for practice, whereas the fifth section outlines some recommendations. Section six presents the limitations of this study, whereas the last section presents recommendations for future studies. This study provides a comprehensive understanding of the research's significance, its ground-breaking discoveries, and its exciting potential to transform Physical Sciences teaching at the Grade 12 level, Electrostatics and Electric Circuits in particular through a synthesis of the insights gathered.

5.2 Summary of Major Findings

5.2.1 Discrepancy between Understanding and Application of Constructive Alignment

The study found a significant gap between teachers' purported consciousness of constructive alignment principles and their implementation of these principles in their classrooms when teaching Electrostatics and Electric Circuits in grade 12. While teachers like Anele had a solid theoretical understanding of the importance of alignment in education, there was a clear gap between this understanding and its application in real-world educational situations. Indeed, this result is consistent with the findings of Penuel et al. (2009), who argued that theoretical comprehension does not always convert into practice. Similarly, English (2016) emphasized that a gap between principles and practice might significantly limit students' learning experiences. The use of professional learning communities, where educators may collectively critique standards, develop constructively aligned activities, and report on changes observed in their practices and learners' performance, may offer a viable approach to overcome this theory-practice gap in Electrostatics and Electric Circuits. Zhao (2016) alluded that aligning ILOs with learning activities and assessments presents an unbiased learning approach with more chances of attaining ILOs.

5.2.2 Transparency in Communication of Constructive Alignment (CA) and Intended Learning Outcomes (ILOs) to Learners

Another notable conclusion was the opaqueness with communicating ILOs as part of constructive alignment (CA) when teachers teach Electrostatics and Electric Circuits. There was a lack of clarity in directly trying to communicate ILOs in class activities and assessments. This opacity contradicts Jones and McLean's (2012) claim that for effective constructive alignment, the learning path should be clear and reasonable to learners. Dolin et al. (2018) reasoned that there should be clear and transparent communication of intended goals for the course in order to channel learners on the correct path to attaining those ILOs. This lack of transparency in communicating ILOs is likely due to two factors: educators' possible lack of clarity in aligning textbook exercises with exact standards, and the need for more refined abilities to explain these alignments to learners in understandable ways. Addressing these difficulties demands improving teachers' pedagogical skills and assessment literacies with a strong focus on open communication (Mellati, 2018). The value of such communication in developing learner autonomy and involvement cannot be overstated (Jones & McLean, 2012).

5.2.3 Assessment's Role beyond Just Measurement

The data also revealed a lack of use of assessment as a tool for supplementing learning. Assessments, rather than being just instruments for tracking academic accomplishment, maybe transforming agents for learning when used effectively (Dolin et al., 2018). According to Shepard (2005), in a constructively aligned instructional context, assessment should evolve from mere endpoints to instruments that actively alter the learning path. The importance of assessment during the teaching and learning process is further emphasized by (Magofe, 2016; Ali, 2018; Loughlin et al., 2021). As a result of this paradigm change, educators must rethink assessments in Electrostatics and Electric Circuits as active levers for modifying the learning experience rather than passive tools of judgment.

5.2.4 Impact of Teacher Beliefs and Values on Constructive Alignment

Finally, the study gave insight into the difficulties that arise between teachers' educational ideals and their alignment practices. According to Eley (2006), Peffer (2019), Soleimani (2020), and Wiley (2020), these underlying ideas can sometimes be strong barriers to the adoption of innovative teaching practices. Donnelly and Sadler (2009) agree, adding that overcoming cognitive conflict needs reflection tasks that help educators to do introspection and question established views. Such thoughtful involvement may help educators more genuinely identify with the goals of constructive alignment, ensuring that their practices are more in line with their educational beliefs. In chapter two, it was deeply discussed how epistemological beliefs can directly influence teacher pedagogical practices and their role in constructive alignment. In this last part of the summary of findings studies that suggest that implementation of constructive alignment is dependent on the epistemological beliefs of teachers are supported. However, the fifth section will provide recommendations for this hidden factor.

5.3 Interpretation of Findings in Relation to Literature

5.3.1 Theory-Practice Gap in Constructive Alignment

In educational contexts, the idea of a theory-practice gap is a recurring problem. The results of the study demonstrate that there is a discrepancy between the theoretical comprehension of constructive alignment held by Physical Sciences teachers and their actual use of this model in the classroom teaching Electrostatics. This aligns with the findings of Penuel et al. (2009), who highlighted that the possession of abstract information does not ensure its successful implementation in educational settings. Similarly, Korthagen (2007) observed that despite having a solid theoretical background, teachers frequently find it difficult to put this theory into practice for a variety of reasons, such as institutional constraints or personal beliefs. On the other hand, Cochran, Smith, and Lytle (1999) contend that the gap can be reduced when educators do systematic self-reflection on their own practices. Therefore, even though the theory-practice gap is noted in the literature, professional growth and reflective practice appear to be the main solutions to this issue.

5.3.2 The Need for Clear Communication in Constructive Alignment

Studies by Cain et al. (2017), Biggs and Tang (2011) and Little (2017) contended that constructive alignment and ILOs must be freely articulated for learning to be successful. According to the findings of this study, educators often fail to adequately communicate the relevance of classwork and homework to classroom objectives. This is comparable to the concerns voiced by Jones and McLean (2012), who state that for constructive alignment to be effective, students must be aware of the learning trajectory. Knight (2001) argues that in order for learners to take an active role in their education, teachers must make clear the expectations of the curriculum in terms of outcomes, assignments, and evaluations. Hattie (2009) believes that in order for instructors to become this precise, they need to know a lot about the curriculum and constructive alignment. This shows that knowing what the curriculum is supposed to accomplish is crucial to being an effective teacher rather than knowing the content of the subject only. The latter is supported by Darakhshan and Xie (2021), who argued that positive teacher communication behaviours are necessary for the attainment of intended learning outcomes in the learner-centred setting.

5.3.3 Maximising Assessment for Deeper Learning and Improved Alignment in Electrostatics and Electric Circuits

The findings also reveal that assessment is not being used effectively to improve student learning, especially formative assessment in Electrostatics and Electric Circuits. This is in contrast to Dolin et al. (2018), who claim that assessment is a learning tool rather than merely an endpoint in a constructively aligned context. Shepard (2005) also highlights the importance of tests and exams as critical feedback mechanisms that improve students' learning when they are connected to clear outcomes. Assessment should be utilized as a tool for learning, not only for learning, according to Black and William (1998). As a result, the study's underutilization of assessment in Electrostatics and Electric Circuits stands in sharp contrast to the body of existing research on the value of assessment and feedback in fostering deep learning and alignment. Black and William (2004) alluded that formative assessment consists of both interactive and planned components which should both be utilized by teachers to reinforce learners understanding throughout the learning process. Yan et al. (2023) alluded that maximising the impact of assessment through interactive practices increases opportunities for student learning and achievement. This coincided with the findings of this study as underutilisation of assessment is one of the key findings.

5.3.4 Re-evaluating Teacher Beliefs and Pedagogical Approaches

When thinking about putting constructive alignment into practice, it is important to uncover teachers' epistemological beliefs. According to the study, even while educators claim to support learner-centred practices, in reality, they could lean towards content-driven methods. According to Donnelly and Sadler (2009), deep-rooted ideas frequently prevent changes in educational practices while Eley (2006) contends that deeply ingrained beliefs can impede new practices. According to Pajares (1992), Peffer (2019), Soleimani (2020), and Wiley (2020) teachers' beliefs have an impact on their perceptions and judgments, which then have an impact on the way they teach. Epistemological beliefs shape how teachers plan their lesson and affect their teaching (Sengul et al. 2020). Thus, in order for teachers to truly adopt constructively aligned teaching, professional development programs must include reflective elements that enable them to consider and maybe adjust their views in light of best practices.

5.4 Implications for Practice

The study's findings shed light on a number of aspects of the experiences Physical Sciences teachers have had with constructive alignment, particularly in the areas of Electrostatics and Electric Circuits included in the Grade 12 Physical Sciences curriculum. These findings have significant and wide-ranging consequences for practice, especially in the teaching profession. The following section unpacks how the findings from this study can influence the practice within the teaching profession and teaching of Electrostatics and Electric Circuits.

5.4.1 Professional Development Emphasising Practical Application in Electrostatics and Electric Circuits teaching

It's alarming how differently teachers apply constructive alignment concepts in the classroom compared to how they conceptualize them (Penuel et al., 2009). This gap suggests that professional teacher development (PTD) which connects the comprehension of particular constructive alignment concepts with their practical use in instructional design and delivery needs to be given new priority (Biggs & Tang, 2011). It is not always the case that theoretical comprehension of constructive alignment translates into useful, successful teaching techniques (Krause, 2012). Offering an ongoing, structured professional teacher development (SPTD) opportunity is therefore essential in order to support teachers in choosing curricular standards as the foundation for lesson preparation and guarantee that activities and assessments are in line with these requirements.

5.4.2 Fostering Transparent Communication of CA and ILOs with Learners

According to Jones and McLean (2012), the learning route must be extremely obvious and rational to learners in order for constructive alignment to be effective. This study brought to light the common opacity in explaining to learners' constructive alignments and clear communication of ILOs. Two main areas need emphasis in the context of this transparency: instructors' ability to create clear alignments and their ability to communicate this to learners. As emphasized by Hattie (2009), it becomes essential that educators receive training in both creating classes with obvious alignments and effectively communicating these alignments as well as ILOs to learners. I lacked this in my teaching as well, the practice of synchronising all the ILOs in the TLAs and assessment was done effectively. However, I did not communicate these outcomes with learners as literature and the findings of this study suggest. Transparent communication of CA reinforces student autonomy and engagement by guaranteeing that intended learning outcomes (ILOs) are clear and that learners are empowered to take charge of their own learning. Martin et al. (2019) alluded that clear communication of ILOs through action verbs to learners can shift the lesson from a teacher-centred approach to more learners-centred approach. This coincides with the implication of this study for practice as it identifies a need for teachers to be offered training to create lessons with clear ILOs and detailed alignment of ILOs, TLAs and assessments.

5.4.3 Training in Assessment Literacy and Feedback Mechanisms

Assessment, which is sometimes devalued as a basic tool for measuring learning, has the potential to be a significant tool for improving constructive alignment (Dolin et al., 2018). This potential, however, is conditional on its correct use. According to Shepard (2005), assessments should be viewed as strong tools for furthering learning rather than simply measuring the ends. They should give feedback that is aligned with standards, allowing for modifications based on evolving needs and noting areas for improvement. This highlights the importance of assessment literacy training, which enables teachers to see tests as more than just evaluation instruments, but as feedback mechanisms that may push student improvement (Brookhart, 2011). A transformation in assessment perception and practice, based on high assessment literacy, has the potential to reshape assessment's function in the educational environment, especially in the teaching of Electrostatics and Electric Circuits in the Physical Sciences curriculum grade 12.

5.4.4 Reflective Teaching and Re-assessment of Pedagogical Beliefs

Aligning pedagogical practise with underlying attitudes is critical for obtaining desired educational results (Donnelly & Sadler, 2009). One congruence, however, is not often obvious in practice, as evidenced by one study, in which teachers frequently demonstrated a contradiction between their stated learner-centred principles and the actual transmission mechanisms they used. According to Eley (2006), critically assessing one's teaching principles alongside real-world classroom practices might result in a more harmonic alignment. According to Zahid and Khanam (2019), reflective teaching aligned with appropriate beliefs stimulates learners and teachers to develop necessary skills like decision making, and metacognition. As a result, incorporating reflective components into professional teacher development (PTD) becomes critical, allowing teachers to analyse, confront, and perhaps correct any misalignments between their beliefs and practices. Finally, the consequences of this study for the practice of teaching Physical Sciences, Electrostatics and Electric Circuits in particular are significant. Addressing the identified areas through intense, introspective, and collaborative professional teacher development can boost the effectiveness of constructive alignment in producing meaningful learning results.

5.5 Recommendations

Several recommendations may be made based on the study's findings to attempt to solve the primary challenges identified:

5.5.1 Enhance Teacher Training Modules for Practical Constructive Alignment Skills

Given the demonstrated theory-practice gap in teachers' comprehension and application of constructive alignment concepts, teacher training must be supplemented with targeted skill-building. According to Knight (2001), simple awareness of alignment concepts is inadequate. Teachers require systematic professional teacher development that teaches them how to translate theoretical knowledge of constructive alignment into effective classroom practices. Oliver (2011) suggests a scaffolded method in which teachers are guided step by step through the process of selecting particular curricular standards, designing activities matched to these standards, and framing assessment around the intended learning outcomes. Gynnild et al. (2021) maintained that teacher training in constructive alignment can increase the opportunities of learner satisfaction with pedagogical practices of their teachers. Such rigorous training can help teachers move from a superficial to a profound use of constructive alignment in their classroom teaching. According to Laurillard (2002), training for thorough grasp of alignment can dramatically improve student learning results.

5.5.2 Institutionalize Transparent Curriculum Communication Practices

The data revealed a persistent issue: a lack of clarity in communicating alignments and ILOs to learners. Kandlbinder and Peseta (2009) agree, emphasizing the importance of open communication in improving student knowledge and engagement. To take ownership of their learning, students must understand the underlying logic behind teaching and learning decisions (Hativa et al., 2001). Institutions must push for explicit communication of learning objectives and standards to address this challenge. Nurtanto et al. (2020) argues that if learning objectives are not communicated to learners, they are more likely to neglect them in their learning process. Therefore, training modules should provide techniques for teachers to express the relationship between teaching and learning activities and intended learning outcomes in the language that learners can understand. Furthermore, as Gibbs (2006) emphasizes, persistent practices of transparent communication of ILOs and Alignment can elucidate the learning process for learners, encouraging active participation and dedication.

5.5.3 Incorporate Continuous Assessment and Feedback as Key Pedagogical Tools

One major issue that has come to light is the underuse of assessment as a learning tool. Black and William (1996) advocate for the use of formative assessments as effective teaching instruments rather than just as a means of gathering data. Learners can identify areas for growth and fill in knowledge gaps with the use of constructive feedback comments (Hattie & Timperley, 2007). Teachers have to be prepared to approach assessments as continuous procedures that include learners' feedback continually. According to Schildkamp et al. (2020), assessment literate teachers can adapt their instruction to the needs of learners aligning them with the learning outcomes based on the information derived from assessment as a form of feedback. Schildkamp et al. (2020) further argued that teachers can use the information derived from assessment to modify teaching, provide feedback to learners that can be used to channel their learning towards achieving the intended learning outcomes. In order to support teachers in shifting from seeing assessment as a means of passing judgment to seeing its potential as a learning catalyst when teaching Electrostatics and Electric Circuits in Physical Sciences grade 12, schools must make investments in improving their assessment literacy through teacher professional development (TPD) sessions.

5.5.4 Establish Regular Teacher Reflective Sessions and Workshops

The results emphasized the significance of self-examination and inspection in reconciling educators' beliefs with pedagogical practices. Teachers can examine their teaching methods and beliefs by using reflective practices (Schön, 1983). Disparities can be revealed by regularly planned reflecting sessions when teachers examine how learning objectives and actual teaching practises coinciding (Brookfield, 1995). Collaboration between participants is encouraged, and best practices and ideas should be shared throughout these sessions. Additionally, workshops may be established to assist educators in critically analysing their reasons and decisions, enabling them to match their actions with their values (Korthagen, 2004). To put it simply, solving the problems associated with constructive alignment in the classroom calls for a multifaceted strategy. Stakeholders can create a cohesive, relevant, and enjoyable educational experience for both teachers and learners by investing in thorough teacher training (PTD), supporting reflective practices, utilizing the power of assessment, and promoting honest communication.

5.6 Limitations of the Study

All research projects have some inherent limits, which naturally influence the extent and meaning of the results. In addition to maintaining the integrity of the research process, acknowledging these limitations offers a framework for understanding and applying the findings (Maxwell, 2008). First, the study's regional emphasis-imposed limitations. Teachers of Physical Sciences in Umlazi township participated in the study. Because of this, the experiences that were recorded could not be entirely indicative of teachers from various sociocultural or educational backgrounds. Regionally particular perspectives are very helpful in comprehending localized practices and difficulties, but they also place restrictions on how broadly applicable the study's conclusions may be (Smith & Noble, 2014). It is important to exercise care when generalizing the results to larger settings due to the diversity of teaching experiences and educational environments that exist across areas. (Creswell & Creswell, 2017).

An additional constraint pertains to the approach utilised. Because the study is qualitative, depth is valued over breadth, and the emphasis is on capturing the richness of unique experiences rather than drawing broad conclusions from statistics (Patton, 2002). This methodological decision allows for a thorough knowledge of the subtleties of Physical Sciences teachers' experiences, but it also raises the possibility that the study may not fully represent the range of experiences that Physical Sciences teachers have. There are many (Creswell & Creswell, 2017; Betram & Christiansen, 2014) who contend that adding a quantitative component would have provided a broader perspective on the difficulties and achievements associated with constructive alignment (Bryman, 2012). A mixed method approach in this study could have been a great experience for both the researcher and the readers. It could have been a great experience if this study contained both qualitative and quantitative data, to report if constructively aligned teaching and learning does improve the results in the topics Electrostatics and Electric Circuits as the literature suggested. However, the depth of comprehension attained via qualitative inquiry continues to be its indisputable advantage.

The study included a restricted number of teachers involved in the participant selection process due to many data generation methods used. Those who are less confident or have different viewpoints may not have been represented since their selection may have been impacted by their readiness to share and reflect. The findings' comprehensiveness is limited by the problem of self-selection bias, which occurs when participants choose to share specific traits or experiences (Rosenbaum, 2005). Furthermore, the experiences pertaining to other topics or grades are not covered due to the study's concentration on Electrostatics and Electric Circuits within the Physical Sciences curriculum for grade 12. While instructors may have varying experiences with constructive alignment in other curriculum parts, this specialisation provides in-depth insights into these particular topics only although the data was generated on Electrostatics and Electric Circuits. According to researchers such as Johnson and Christensen (2012), changes in the content themes might occasionally have a major impact on pedagogical choices and alignment experiences.

Recognising the intrinsic limitations of researcher bias is also necessary. Researchers will always bring their own experiences, opinions, and prejudices to studies, even with their best attempts to preserve neutrality (Guba & Lincoln, 1994). These may somewhat affect how the study is conducted and how the findings are interpreted. Although this was mitigated by transparent documentation and introspective practises, readers should be conscious of this inherent subjectivity when evaluating the results. Finally, one drawback of the research is its time dimension. Constructive alignment experiences, beliefs, and practises among teachers are dynamic and might alter over time as a result of curricular modifications, professional teacher development (PTD) over time, or paradigm shifts in education as the current research investigates the use of Artificial Intelligence (AI) in Sciences education. Although the study provides a wealth of information on the current state of affairs, it only represents a single point in time, and these experiences might alter and evolve in the future (Merriam & Tisdell, 2015).

Although there are several limitations to this study, it provides insightful information on the experiences of Physical Sciences teachers who are constructively aligned. Acknowledging these limits guarantees a fair comprehension and utilisation of the results in suitable context.

5.7 Recommendations for Further Research

Even with the thorough approach this study took, there are still a lot of areas that need to be investigated further in order to further our understanding of constructive alignment in the context of teaching Physical Sciences, particularly Electrostatics and Electric Circuits in grade 12.

5.7.1 Diving Deeper into Teacher Beliefs and Constructive Alignment

Although the experiences of Physical Sciences teachers with constructive alignment were examined in the current study, it would be beneficial to probe further into the underlying ideas and values that influence these encounters. According to Pajares (1992), a teachers' beliefs affect their perceptions and judgments, which in turn determine how they behave in the classroom or explain their pedagogical practices. Moreover, Pajares (1992) further argued that teaching and learning decisions may be strongly predicted by the views of teachers. Thus, deep insights into the dynamics of scientific education may be gained by understanding the assumptions behind the alignment or lack thereof between assessments, learning activities, and intended learning outcomes. To explore these ideas further, future studies may use techniques such as reflective diaries, personal narratives, and in-depth interviews. Examining the complex interactions of individual beliefs, institutional expectations, and teaching strategies will surely deepen our understanding of the phenomenon (Fives & Buehl, 2012).

5.7.2 Investigating Student Perceptions of Constructive Alignment in Physical Sciences

While teachers' experiences of constructive alignment are important, knowing learners' viewpoints can provide a more complete picture of the effectiveness of alignment. As the primary beneficiaries of teaching, learners can give information about the success and appropriateness of their teachers' alignment practices (Biggs & Tang, 2007). According to Trigwell and Prosser (2004), learners' judgments of teaching quality are inextricably tied to their methods of learning. Investigating how learners perceive and experience constructive alignment in Electrostatics, for example, may show possible gaps or areas for improvement in teaching methodologies. Therefore, it can facilitate teachers to adjust their alignment practices using self-reflection. Surveys, focus groups, and even phenomenology studies might be useful in capturing these perspectives and assisting in the development of learner-centred learning contexts (Entwistle, 2009).

5.7.3 Comparative Studies on Different Sciences Subjects and Constructive Alignment

Beyond Electrostatics and Electric Circuits in grade 12 curriculum, Physical Sciences cover a wide range of disciplines. Comparing and contrasting teachers' experiences with constructive alignment in other disciplines, such as chemistry, or even Life Sciences, can reveal a variety of obstacles and techniques. Teachers may develop adaptable teaching tools and strategies by understanding how alignment is accomplished across various Sciences subjects or disciplines. According to Taber (2011), each Science subject has its own set of conceptual problems and misunderstandings. Furthermore, Lavonen et al. (2007) contend that the character of the subject matter might have a substantial impact on teaching tactics. As a result, comparative research might give complete guidance for successful and adaptive constructive alignment throughout the Sciences stream.

While this research provides a solid basic knowledge of constructive alignment in a specific setting, the wide realm of Sciences education remains disposed for additional investigation and explorations. Future studies can considerably improve our collective instructional knowledge by digging deeper into teacher views, including learners' viewpoints, and drawing analogies across disciplines.

5.8 Conclusion

The study of Physical Sciences teachers' experiences with constructive alignment in the topics of Electrostatics and Electric Circuits within the Grade 12 curriculum is extremely important. Understanding these experiences provides insights that can drive advances in teaching and learning tactics, curriculum design, and overall student results as the educational landscape evolves. Biggs (1996) proposed that the educational experience is optimized when desired learning goals, instructional techniques, and evaluation procedures are all coherently matched. This study investigated how this theory manifests itself in the lived experiences of Physical Sciences teachers, particularly within the limits of the Grade 12 curriculum.

According to Osborne and Dillon (2008), the topic of science, and specifically Physical Sciences, has frequently been the cornerstone of secondary education due to its capacity to build educated citizens and foster future scientists. As a result, optimizing the teaching and learning experiences in this sector is critical. The study's findings shed light on the obstacles and accomplishments that Physical Sciences teachers confront in their efforts to establish constructively aligned learning environments. Their stories shed insight into the institutional, pedagogical, and personal aspects that shape their teaching tactics and assessment decisions in Electrostatics and Electric Circuits. These findings relate to my experience as a physical sciences teacher, due to limited time for curriculum coverage I also find it difficult to use assessment beyond just measuring learners' achievement of ILOs. However, the literature and implications of this study provide a clear insight that will shape my teaching.

Several experts have stressed the significance of alignment in schooling. Biggs and Tang (2007), for example, emphasize the need for a well-aligned curriculum in promoting deep learning, whereas Hattie (2009) correlates constructive alignment with enhanced student results. The outcomes of this study corroborate these findings, revealing the critical role constructive alignment plays in moulding both teachers' and learners' educational experiences. According to the literature reviewed, when alignment was established, it not only facilitated easier teaching and learning approaches but also encouraged a deeper understanding of concepts among learners. Furthermore, the study's emphasis on the linked relationship between teachers' approaches, institutional expectations, and pedagogical options supports the points made by Pajares (1992) and Kagan (1992) concerning the interrelated nature of these factors.

However, it is critical to recognize that, as the literature implies, establishing perfect congruence in educational environments remains a difficult task and sometimes elusive (Mhlolo & Venkat, 2009). External demands, resource limits, and, in rare cases, personal views can all act as obstructions to a well-constructively aligned curriculum. This view highlights the need for ongoing professional teacher development and institutional support, a feeling shared by Avalos (2011) contends that teacher learning is a constant and continuous process formed and reshaped by practice.

When one considers the possibilities of this research, it is pivotal to imagine a ripple effect in the field of Physical Sciences teaching particularly in Electrostatics and Electric Circuits. If the findings of this study are implemented, Grade 12 Physical Sciences teaching may be transformed, paving the way for a more rich, aligned, and successful learning experience. The beneficiaries of this research and myself can utilise the findings of this study to adjust their teaching so that it is constructively aligned. The scope and complexity of this research highlight its significance not just as an academic exercise, but also as a lighthouse guiding the future of Grade 12 Physical Sciences teaching and learning. Its results, recommendations, and conclusions have the potential to shape educational policy, guide curriculum designers, inspire educators, and, most importantly, foster a new generation of Physical Sciences learners who are more equipped, more informed, and profoundly engaged. The merits of this study will also add to the studies conducted in high school Physical Sciences examining alignment, for example, the study by Edwards (2010). Moreover, it will contribute to the body of knowledge in constructive alignment (CA) with its focus on Physical Sciences teachers' "experiences" of constructive alignment as the literature shows the gap of knowledge in this area.

5.9 Chapter Five summary

The first section of this chapter provides the introduction and summary of the previous chapter and the introduction to chapter five. The second section of this chapter summarises the key findings of the research. The third section interpreted the findings of this study in relation to literature. The fourth section examined the implications of the study for practice, whereas the fifth section outlined some recommendations. Section six presented the limitations of this study, whereas the seventh section presented recommendations for future studies. The last part of this study is the conclusion which summarizes the whole chapter and outlines the possibilities of this study in shaping the Physical Sciences teaching and learning practices as well as its contributing ability to the body of knowledge in constructive alignment (CA).

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ANNEXURE A

PRE-INTERVIEW SCHEDULE

1. Please describe the process that you follow when you plan teaching, learning and assessment?

____

____

2. How do you align your class activities, assessment and intended learning outcomes (ILOs)? Explain.

____

____

3. Generally per assessment task, how many learning outcomes do you get to assess?

____

____

4. How do you make sure that the learners know exactly what the intended learning outcomes are?

____

____

5. Do you constantly refer to the learning outcome. And do they understand that those are outcomes.

____

____

6. Explain how you ensure that learners know exactly what they have to do to achieve the intended outcomes?

____

____

7. How often do you use assessment FOR learning as opposed to assessment OF learning? What informs your practice of assessment?

____

____

8. How do you decide WHAT to assess and what ASSESSMENT METHODS to use?

____

____

9. Do you give your learners informal test that is aligned to intended learning outcomes as well as activities done in class?

Yes /No

10. If yes how often do you give you learners informal/class tests?

Weekly	Per topic	Per term	Never

11. How do you use information from learners' scripts to improve the alignment of teaching, learning and assessment?

____

____

12. Is there anything else you would like to share with me with regard to the alignment of teaching, learning and assessment?

____

____

13. Do you think the alignment of teaching, learning and assessment is something that teachers are aware of?

____

____

Adapted from: Burger, M. 2008 (The alignment of teaching, learning and assessment

In English home language in grade 10 in district 9, Johannesburg)

ANNEXURE B

OBSERVATION SCHEDULE

Criteria	**Score**				
	0 – 1 Insufficient	**1.5** Below average.	**2** Acceptable	**2.5** Good	**3** Excellent
Communication of ILOs, made clear to learners before the lesson.					
Link between ILOs, assessment and activities.					
Depth of knowledge consistency compared to ILOs.					
Range of knowledge tested.					
Ability to link activities to the actual assessment (examination).					

Scoring table for determination of alignment of assessment with intended goals
(Adapted from Webb, 1997)

ANNEXURE C

DOCUMENT ANALYSIS TEMPLATE

Criteria	Score					
	0 Non-existent	**1** Poor/minimal detail	**1.5** Fair/covered in little detail/lacking quality	**2** Satisfactory/ adequate coverage	**2.5** Very good/ explicit instruction	**3** Excellent/ explicit, differentiated instruction
Are the ILOs of the curriculum addressed?						
What is the extent of teaching documents supporting the ILOs?						
Is there an identification and maintenance of action verbs used in activities and assessment as they are intended?						
Do the teaching activities address the same outcome as the test and (or) exam?						
Does the assessment given to learners match the standard of the final exam question paper?						
Does the teaching documents enforces meaningful learning by relating to assessment and activities?						

Scoring table for determination of alignment of teachng materials with intended Learning outcomes (ILOs) and assessment (Adapted from Kesidou & Roseman, 2002).

ANNEXURE D

POST-INTERVIEW SCHEDULE

1. Which documents best assisted you in preparing the lesson?

2. Was there any link between intended learning outcomes, activities, and assessment in your teaching and teaching documents? Explain.

3. Does the informal test (Assessment) given to learners' link to intended learning outcomes and activities thereof?

Yes /No

4. If yes how much percentage of your informal test (assessment) link to activities and intended learning outcomes thereof?

0% - 15%	16% - 30%	31% - 60%	<60%

5. Why do you constructively align the curriculum the way you do?

ANNEXURE E

GATE KEEPERS LETTER AND CONSNT FORM

School Principal (Gatekeeper) Consent Letter

Dear Sir / Madam

25 June 2022

My name is Phelelani Persival Maphalala (student number 213519668). I am a Master of education candidate studying at the University of KwaZulu-Natal, Edgewood Campus. I am studying under the department of Mathematics, Sciences and Technology Education. I am holder of Bachelor of Education (University of KwaZulu-Natal) and BEd Honors (University of KwaZulu Natal). My supervisor is Professor Nadaraj Govender who has a vast experience in teaching and research in the discipline of Mathematics, Sciences and Technology. He can be contacted be on email: Govendern37@ukzn.ac.za.

I am kindly requesting to conduct my study/research at your school. The study tile is: Exploring Teachers' Experiences of Constructive Alignment between Learning Outcomes, Activities and Assessment in Electrostatics and Electric Circuits in the Physical Sciences Curriculum. This research aims to explore teachers' experiences' and use of constructive alignment in Physical Sciences.

This study will involve three physical Sciences teachers in three different schools in KwaZulu-Natal province. Teachers participating will be high school teachers teaching grade 12 physical Sciences and the topics that the study focuses on is Electric Circuits and electrostatics. Since the study is on teachers' experiences of constructive alignment, teachers will be interviewed before they are observed in their teaching. Further to that post observation interviews will be conducted to find out teachers' reflections on their experiences of constructive alignment. All these activities will take place during the period for physical Sciences grade 12 and is expected to last for one week when the topics are expected to be finished. This is the duration a teacher or participant is expected to choose to enroll and remain in the study.

The participation will be voluntary and the participants can choose to opt out of the study at any time. Another risk is exposure to COVID-19 to the study participants. Hence COVID-

19 protocols will be observed during the study. Additional information on COVID-19 can be found on this link Safety in the workplace | South African Government (www.gov.za) as well as Education - Coronavirus COVID-19 | South African Government (www.gov.za).

This study is expected to have the following benefit, teachers will be able to reflect on their teaching and evaluating skills.

In the event of any problems or concerns, you may contact the researcher at email: [redacted] cell number 0[redacted]. Alternatively, the following contact details can be used: **Humanities & Social Sciences Research Ethics Administration**

Research Office, Westville Campus

Govan Mbeki Building

Private Bag X 54001
Durban
4000

KwaZulu-Natal, SOUTH AFRICA

Tel: 27 31 2604557- Fax: 27 31 2604609

Email: HSSREC@ukzn.ac.za

Please note that the information that you provide will be used for scholarly research only and that your participation is entirely voluntary. You have a choice to participate, not to participate or stop participating in the research at any time and no victimization or coercion will be used to make you participate. You will not be penalized for taking such an action. This project is designed not to give participants a cost. This is because data collection happens during normal school timetable.

Yours sincerely,

Maphalala P.P 25-06-2022

____________________ Date

School Principal Consent Form

I ____________________________have been informed about the study entitled: Exploring Teachers' Experiences of Constructive Alignment between Learning Outcomes, Activities and Assessment in Electrostatics and Electric Circuits in the Physical Sciences Curriculum. The researcher is Mr P.P Maphalala (213519668)

I understand the purpose and procedures of the study.

I have been given an opportunity to answer questions about the study and have had answers to my satisfaction.

I declare that participation by teachers in my school in this study is entirely voluntary and that they may withdraw at any time without affecting any of the benefits that they are entitled to.

I have been informed about any available compensation or medical treatment if injury occurs to participating teachers as a result of study-related procedures.

If I have any further questions/concerns or queries related to the study I understand that I may contact the researcher at Email: [redacted] and Cell: [redacted]

If I have any questions or concerns about rights of a teacher (participant), or if I am concerned about any aspect of the study as well as the researchers then I may contact:

Humanities & Social Sciences Research Ethics Administration
Research Office, Westville Campus
Govan Mbeki Building
Private Bag X 54001
Durban
4000
KwaZulu-Natal, SOUTH AFRICA
Tel: 27 31 2604557 Fax: 27 31 2604609
Email: HSSREC@ukzn.ac.za

______________________________ ________________

Principal's Signature Date

ANNEXURE F

PARENT CONSENT LETTER AND FORM

<u>Parent consent Letter</u>

Dear Sir or Madam

20 September 2022

My name is Phelelani Persival Maphalala (student number 213519668). I am a Master of education candidate studying at the University of KwaZulu-Natal, Edgewood Campus. I Am studying under the department of Mathematics, Sciences and Technology Education. I am holder of Bachelor of Education (University of KwaZulu-Natal) and BEd Honors (University of KwaZulu-Natal). My supervisor is Professor Nadaraj Govender in the discipline of Mathematics, Sciences and Technology. He can be contacted be on email: Govendern37@ukzn.ac.za.

I kindly request your permission to observe a lesson in the presence of your child in a study that titled: Exploring Teachers' Experiences of Constructive Alignment between Learning Outcomes, Activities and Assessment in Electrostatics and Electric Circuits in the Physical Sciences Curriculum. This research aims to explore teachers understanding and use of Constructive Alignment (CA) in the Physical Sciences curriculum.

Teachers will be interviewed before their teaching to find their understanding of CA, observed during teaching (while learners are present) and data recorded using observation schedule and later the post observation interviews will be conducted to find teachers' reflections on their experiences of CA.

The participation by your child is voluntary, and they can choose NOT to be observed or opt out of the lesson at any time. Another risk is exposure to COVID-19 to the researcher and all study participants. Hence COVID-19 protocol will be observed during the study. Additional information on COVID-19 can be found on this link Safety in the workplace | South African Government (www.gov.za) as well as Education - Coronavirus COVID-19 | South African Government (www.gov.za).

This study is expected to have the following benefit, teachers will be able to reflect on their teaching and evaluating skills. However, no direct benefit will be gained by learners.

In the event of any problems or concerns, you may contact the researcher at email: [redacted] cell number [redacted]. Alternatively, the following contact details can be used: **Humanities & Social Sciences Research Ethics Administration**

Research Office, Westville Campus

Govan Mbeki Building

Private Bag X 54001
Durban
4000

KwaZulu-Natal, SOUTH AFRICA

Tel: 27 31 2604557- Fax: 27 31 2604609

Email: HSSREC@ukzn.ac.za

Please note that the information from observations will be used only for scholarly purposes and not any other purpose. There will be no visuals or audio recordings used in this study, hence your child's identity will be highly protected.

Yours sincerely,

Maphalala P.P 20-09-2022

____________________ Date

Parent Consent Form

I ____________________________have been informed about the study entitled: Exploring Teachers' Experiences of Constructive Alignment between Learning Outcomes, Activities and Assessment in Electrostatics and Electric Circuits in the Physical Sciences Curriculum. The researcher is Mr P.P Maphalala (213519668).

I understand the purpose and procedures of the study.

I declare that my child' s participation in this study is entirely voluntary and that they may withdraw at any time.

I have been informed about any available compensation or medical treatment if injury occurs to my child as a result of study-related procedures.

If I have any further questions/concerns or queries related to the study I understand that I may contact the researcher at ([redacted]).

If I have any questions or concerns about my child' s rights, or if I am concerned about any aspect of the study or the researchers then I may contact:

Humanities & Social Sciences Research Ethics Administration
Research Office, Westville Campus
Govan Mbeki Building
Private Bag X 54001
Durban
4000
KwaZulu-Natal, SOUTH AFRICA
Tel: 27 31 2604557 Fax: 27 31 2604609
Email: HSSREC@ukzn.ac.za

I hereby provide consent to:

Observations conducted in the class with my child YES / NO

______________________________ ________________

Parent's/ Guardian Signature Date

ANNEXURE G

LEARNER ASSENT LETTER AND FORM

Learner assent Letter

Dear Grade 12 learner

22 September 2022

My name is Phelelani Persival Maphalala (student number 213519668). I am a Master of education candidate studying at the University of KwaZulu-Natal, Edgewood Campus. I Am studying under the department of Mathematics, Sciences and Technology Education. I am holder of Bachelor of Education (University of KwaZulu-Natal) and BEd Honors (University of KwaZulu-Natal). My supervisor is Professor Nadaraj Govender in the discipline of Mathematics, Sciences and Technology. He can be contacted be on email: Govendern37@ukzn.ac.za.

I kindly request your permission to observe a lesson in your presence for my study that is titled: Exploring Teachers' Experiences of Constructive Alignment between Learning Outcomes, Activities and Assessment in Electrostatics and Electric Circuits in the Physical Sciences Curriculum. This research aims to explore teachers understanding and use of Constructive Alignment (CA) in the Physical Sciences curriculum.

Teachers will be interviewed before their teaching to find their understanding of CA, observed during teaching (while learners are present) and data recorded using observation schedule and later the post observation interviews will be conducted to find teachers' reflections on their experiences of CA.

The participation by you is voluntary, and you can choose NOT to be observed or opt out of the lesson at any time. Another risk is exposure to COVID-19 to the researcher and all study participants. Hence COVID-19 protocol will be observed during the study. Additional information on COVID-19 can be found on this link Safety in the workplace | South African Government (www.gov.za) as well as Education - Coronavirus COVID-19 | South African Government (www.gov.za).

This study is expected to have the following benefit, teachers will be able to reflect on their teaching and evaluating skills. However, no direct benefit will be gained by learners.

In the event of any problems or concerns, you or your parent may contact the researcher at email: [redacted] cell number [redacted]. Alternatively, the following contact details can be used: **Humanities & Social Sciences Research Ethics Administration**

Research Office, Westville Campus

Govan Mbeki Building

Private Bag X 54001
Durban
4000

KwaZulu-Natal, SOUTH AFRICA

Tel: 27 31 2604557- Fax: 27 31 2604609

Email: HSSREC@ukzn.ac.za

Please note that the information from observations will be used only for scholarly purposes and not any other purpose. There will be no visuals or audio recordings used in this study, hence your identity will be highly protected.

Yours sincerely,

Maphalala P.P 22-09-2022

____________________ Date

Learner assent Form

I ____________________________have been informed about the study entitled: Exploring Teachers' Experiences of Constructive Alignment between Learning Outcomes, Activities and Assessment in Electrostatics and Electric Circuits in the Physical Sciences Curriculum. The researcher is Mr P.P Maphalala (213519668).

I understand the purpose and procedures of the study.

I declare that my participation in this study is entirely voluntary and that they may withdraw at any time.

I have been informed about any available compensation or medical treatment if injury occurs to me as a result of study-related procedures.

If I have any further questions/concerns or queries related to the study I understand that I may contact the researcher at ([redacted]).

If I have any questions or concerns about my rights, or if I am concerned about any aspect of the study or the researchers then I may contact:

Humanities & Social Sciences Research Ethics Administration
Research Office, Westville Campus
Govan Mbeki Building
Private Bag X 54001
Durban
4000
KwaZulu-Natal, SOUTH AFRICA
Tel: 27 31 2604557 Fax: 27 31 2604609
Email: HSSREC@ukzn.ac.za

I hereby provide assent to:

Observations conducted in my presence in class YES / NO

______________________________ ___________________

Learner's Name and Surname Date

______________________________ ___________________

Learner's Signature Date

ANNEXURE H

TEACHER CONSENT LETTER AND FORM

Teachers Consent Letter

Dear Sir / Madam

25 June 2022

My name is Phelelani Persival Maphalala (student number 213519668). I am a Master of education candidate studying at the University of KwaZulu-Natal, Edgewood Campus. Am studying under the department of Mathematics, Sciences and Technology Education. I am holder of Bachelor of Education (University of KwaZulu-Natal) and BEd Honors (University of KwaZulu-Natal). My supervisor is Professor Nadaraj Govender in the discipline of Mathematics, Sciences and Technology. He can be contacted be on email: Govendern37@ukzn.ac.za.

You are kindly invited to consider participating in a study that tiltled: Exploring Teachers' Experiences of Constructive Alignment between Learning Outcomes, Activities and Assessment in Electrostatics and Electric Circuits in the Physical Sciences Curriculum. This research aims to explore teachers and students understanding and use of Constructive Alignment (CA) in the Physical Sciences curriculum.

Teachers will be interviewed before their teaching to find their understanding of CA, observed during teaching and data recorded using observation schedule and later the post observation interviews will be conducted to find teachers' reflections on their experiences of CA.

The participation will be to be voluntary, and participants can choose to opt out of the study at any time. Another risk is exposure to COVID-19 to the researcher and study participants. Hence COVID-19 protocol will be observed during the study. Additional information on COVID-19 can be found on this link Safety in the workplace | South African Government (www.gov.za) as well as Education - Coronavirus COVID-19 | South African Government (www.gov.za).

This study is expected to have the following benefit, teachers will be able to reflect on their teaching and evaluating skills.

In the event of any problems or concerns, you may contact the researcher at email: [redacted]. cell number [redacted]. Alternatively, the following contact details can be used: **Humanities & Social Sciences Research Ethics Administration**

Research Office, Westville Campus

Govan Mbeki Building

Private Bag X 54001
Durban
4000

KwaZulu-Natal, SOUTH AFRICA

Tel: 27 31 2604557- Fax: 27 31 2604609

Email: HSSREC@ukzn.ac.za

Please note that the information that you provide will be used for scholarly research only and that your participation is entirely voluntary. You have a choice to participate, not to participate or stop participating in the research at any time and no victimization or coercion will be used to make you participate. You will not be penalized for taking such an action. This project is designed not to give participants a cost. This is because data collection happens during normal school timetable.

Yours sincerely,

Maphalala P.P 25-06-2022

____________________ Date

Teacher Consent Form

I ____________________________ have been informed about the study entitled: Exploring Teachers' Experiences of Constructive Alignment between Learning Outcomes, Activities and Assessment in Electrostatics and Electric Circuits in the Physical Sciences Curriculum. The researcher is Mr P.P Maphalala (213519668).

I understand the purpose and procedures of the study.

I have been given an opportunity to answer questions about the study and have had answers to my satisfaction.

I declare that my participation in this study is entirely voluntary and that I may withdraw at any time without affecting any of the benefits that I usually am entitled to.

I have been informed about any available compensation or medical treatment if injury occurs to me as a result of study-related procedures.

If I have any further questions/concerns or queries related to the study I understand that I may contact the researcher at (provide details).

If I have any questions or concerns about my rights as a study participant, or if I am concerned about an aspect of the study or the researchers then I may contact:

Humanities & Social Sciences Research Ethics Administration
Research Office, Westville Campus
Govan Mbeki Building
Private Bag X 54001
Durban
4000
KwaZulu-Natal, SOUTH AFRICA
Tel: 27 31 2604557 Fax: 27 31 2604609
Email: HSSREC@ukzn.ac.za

I hereby provide consent to:

Audio recording my pre-and post-interview	YES / NO
Analyze my teaching documents	YES / NO
Use of the observation schedule to observe my lessons	YES / NO

______________________________ ________________

Teacher's Signature Date

ANNEXURE I

ETHICAL CLEARANCE LETTER

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

27 September 2022

Phelelani Persival Maphalala (213519668)
School Of Education
Edgewood Campus

Dear PP Maphalala,

Protocol reference number: HSSREC/00004721/2022
Project title: Exploring teachers' experiences of constructive alignment between learning outcomes, activities and assessment in electrostatics and electric circuits in the Physical Sciences curriculum
Degree: Masters

Approval Notification – Expedited Application

This letter serves to notify you that your application received on 07 September 2022 in connection with the above, was reviewed by the Humanities and Social Sciences Research Ethics Committee (HSSREC) and the protocol has been granted **FULL APPROVAL**.

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number. PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

This approval is valid until 27 September 2023.
To ensure uninterrupted approval of this study beyond the approval expiry date, a progress report must be submitted to the Research Office on the appropriate form 2 - 3 months before the expiry date. A close-out report to be submitted when study is finished.

HSSREC is registered with the South African National Research Ethics Council (REC-040414-040).

Yours sincerely,

[redacted]

Professor Dipane Hlalele (Chair)

/dd

Humanities and Social Sciences Research Ethics Committee
Postal Address: Private Bag X54001, Durban, 4000, South Africa
Telephone: +27 (0)31 260 8350/4557/3587 **Email:** hssrec@ukzn.ac.za **Website:** http://research.ukzn.ac.za/Research-Ethics

Founding Campuses: Edgewood Howard College Medical School Pietermaritzburg Westville

INSPIRING GREATNESS