An investigation into the management of change in Design and Technology: a qualitative inquiry based on the implementation of a new curriculum for senior secondary schools in Botswana.

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An Investigation into the management of change in Design and Technology: A Qualitative Inquiry based on the Implementation of a New Curriculum for Senior Secondary Schools in Botswana.

By

Victor Thabang Ruele

Doctoral Thesis submitted in partial fulfilment of the requirements for the award of Doctor of Philosophy of Loughborough University

June 2015

Loughborough Design School
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Abstract

This thesis explored the management of change, from a British model of Design and Technology (D&T) curriculum to the Botswana model intended for senior secondary schools. There is little research on the management of change in D&T education especially at senior secondary school level. The study employs the ADKAR (Awareness, Desire, Knowledge, Ability, and Reinforcement) change model, originally designed for business and industry as the theoretical framework to assess the nature of change and use insights gained to identify gaps in the implementation and make proposals for more effective implementation.

The study employed a multi-phase case study as a data collection strategy, which was mainly qualitative and situated within a post-modernist inquiry paradigm. A multi-method approach was adopted for data collection, which included questionnaires, individual and group interviews as well as literature review. The data were collected from in-service officers and teachers because of their role as change managers and implementers respectively. Data analysis employed a thematic analysis approach for qualitative data while descriptive statistics were used for quantitative data.

The findings of the study revealed the following issues affecting the curriculum:

- limited implementation strategy.
- limited participation by key stakeholders.
- weak coalition for change.
- limited administrative support especially in terms of provision of resources.
- and a limited teacher support system as well as weak reinforcement mechanisms to sustain the change.

The findings showed that the existing D&T curriculum included new advanced technological content areas to align it with the country’s vision of moving away from the traditional agro-based economy to the industrial one. These findings suggest that the technology content areas were barely taught in secondary schools primarily due to limited teachers’ expertise and inadequate provision of equipment.

The study proposes a school-based continuous professional development (CPD) model, which recognises that teachers are change agents and a vital resource that
can be developed to build the necessary change capability. The premise of this framework is that the current regional management system was not effective considering the constraints of limited implementation capacity and resources, the vastness of some regions as well as the fact that schools operated under different contexts. The envisioned CPD recognises the uniqueness of school and teachers’ input into the design and development of CPD programmes. The proposed CPD model promotes also research-based evidence that ensures that it is not a mere skill upgrading exercise, but one that integrates teachers’ professional development needs, with those of the curriculum and students.

This thesis contributes to the field by providing some insights into some of the dynamics of implementing and coping with change within the context of Botswana. The ADKAR framework employed in this study is an original contribution in the field of D&T education. This framework will be of particular use to other countries undertaking D&T curriculum innovation in terms of guiding change management activities such as: readiness assessment; resource provision; developing communications strategies; identifying gaps in terms of training needs for teachers; creating enabling structures; resistance management and reinforcement strategies.
Personal Motivation

This study draws inspiration from the on-going revision of the Botswana General Certificate of Secondary Education (BGCSE) programme. The revision has been sanctioned by the Ministry of Education and Skills Development (MOESD - Botswana) through the Department of Curriculum Development and Evaluation (CD&E).

This research aligns well with the revision period of the BGCSE programme, which is due for implementation in 2016. Through this research, the researcher has gained invaluable lessons about educational change management that would help guide the on-going and future curriculum reforms in Botswana.

The researcher’s argument is premised on the notion that successful change at its core is rooted in individuals understanding the need for change and then making a personal decision to move from their current state, through a transition to the desired future. It is that cumulative effect of individual change that will ultimately lead to the whole organisational change (Hiatt, 2006; Hiatt and Creasey, 2012). Similarly, in Botswana, the author postulates that only when teachers, who are the implementers, accept change in the first place and get involved personally from the start that effective change will be achieved (Hargreaves, 2005; McBeath, 1997; Fullan, 2001). Hence, the bulk of the data collected were intended to provide insights into the nature of change from the perspective of teachers and in-service officers.
Acknowledgements

I would like to acknowledge everyone who has contributed to this thesis, both intellectually and through moral support. My writing of this report would not have been successful without the timely feedback and continued mentorship of my supervisors; Mr Nigel Zanker and Dr Carl Wilkinson. First, my special thanks go to Mr Nigel Zanker, my Principal supervisor, for his patience and unwavering support throughout my study. His vast experience and subject matter expertise are reflected in the results of this thesis and without whose guidance it would not be what it is. Second, though he retired before I completed my studies special thanks are required for Dr Howard Denton, for patience in teaching me the intricacies of educational research. Third, this thesis would never have been completed without the exceptional help I have received from him especially during the first two years of my study. I would also like to acknowledge the assistance and contribution of Dr Carl Wilkinson who joined my supervision team towards the end of my study. He has assisted me greatly during the write-up stage by endless hours of editing of initial drafts of this work. My special thanks also go to Professor Richard Moalosi of the University of Botswana and Mr Nick Ndaba, former senior officer for D&T education in Botswana, for their contribution and insights some of which I have incorporated into my work. Lastly, I wish to thank all the teachers and in-service officers for accepting to participate in this research project at a very difficult time after the industrial action. Despite their tight work schedules they were always willing to create time for me to complete the questionnaires and participate in both group and individual interviews respectively.

I salute you all.
Conference Paper Presentations from this Thesis


Publications from this Thesis

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## GLOSSARY OF TERMS

**BATSWANA:** Citizens of Botswana  
**GABORONE:** Capital city of Botswana  
**MOLEPOLOLE:** Name of Village  
**MOTSWANA:** Citizen of Botswana

## ACRONYMS AND ABBREVIATIONS

<table>
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<tr>
<th>Acronym</th>
<th>Description</th>
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<tr>
<td>ADKAR</td>
<td>Awareness, Desire, Knowledge, Ability, Reinforcement.</td>
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<tr>
<td>BEC</td>
<td>Botswana Examinations Council</td>
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<td>BGCSE</td>
<td>Botswana General Certificate of Secondary Education</td>
</tr>
<tr>
<td>CD&amp;E</td>
<td>Curriculum Development and Evaluation</td>
</tr>
<tr>
<td>CDT</td>
<td>Craft, Design and Technology</td>
</tr>
<tr>
<td>COSC</td>
<td>Cambridge Overseas School Certificate</td>
</tr>
<tr>
<td>D&amp;T</td>
<td>Design and Technology</td>
</tr>
<tr>
<td>DSE</td>
<td>Department of Secondary Education</td>
</tr>
<tr>
<td>ICT</td>
<td>Information and Communications Technology</td>
</tr>
<tr>
<td>IDT</td>
<td>Industrial Design and Technology</td>
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<td>INSET</td>
<td>In-Service Training</td>
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<tr>
<td>MCE</td>
<td>Molepolole College of Education</td>
</tr>
<tr>
<td>MOESD</td>
<td>Ministry of Education and Skills Development (Botswana)</td>
</tr>
<tr>
<td>NC</td>
<td>National Curriculum</td>
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<tr>
<td>NCE</td>
<td>National Commission on Education (1992)</td>
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<td>OECD</td>
<td>Organisation for Economic Cooperation and Development</td>
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<tr>
<td>PEO</td>
<td>Principal Education Officer</td>
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<tr>
<td>UB</td>
<td>University of Botswana</td>
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<tr>
<td>UCLES</td>
<td>University of Cambridge Local Examinations Syndicate</td>
</tr>
<tr>
<td>UK</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>TALIS</td>
<td>Teaching and Learning International Survey</td>
</tr>
<tr>
<td>TT&amp;D</td>
<td>Teacher Training and Development</td>
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<td>TPD</td>
<td>Teacher Professional Development</td>
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CHAPTER 1

INTRODUCTION & BACKGROUND
1 Introduction

1.1 Background

The year 2000 ushered a new era in the provision of the public education system for Botswana. This was when a locally developed programme was intended for senior secondary schools (17-19 year olds), termed the Botswana General Certificate of Secondary Education (BGCSE). The BGCSE programme itself was the product of the Revised National Policy on Education (RNPE, Government Paper No. 2 of 1994), which advocated the need to align the education system to the socio-economic needs of Botswana. The introduction of the BGCSE programme culminated three decades of a British education system, which schools had followed through collaboration between the government of Botswana and University of Cambridge Local Examinations Syndicate (UCLES).

Of relevance to this research was the introduction of the Design and Technology (D&T) curriculum into the BGCSE programme. The subject evolved from the Government’s desire to modernise a predominantly agro-based economy. The D&T curriculum was designed to provide students with a platform of prevocational knowledge and skills to enhance future career choices. Through the RNPE of 1994, the D&T education was identified as one of the key subjects which had the potential of contributing to the development of Botswana’s industrial and technological bases (Ministry of Education and Skills Development, 2000).

A decade since its inception the BGCSE programme has been reviewed once up to 2009. This was contrary to the provision of the Curriculum blueprint which advised that the curriculum should be reviewed every five years (Ministry of Education and Skills Development, Botswana, 1998). Studies on change management showed that change whether implemented in business or educational institutions, always has some element of uncertainty or surprise.

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1 BGCSE is the General Certificate in Secondary Education (GCSE) and equivalent to Higher International General Certificate in Secondary Education (HIGCSE).
(Kotter, 1996; Fullan, 2001). For example, studies have shown suggest that 70% of change initiatives failed to deliver, which they suggest was mainly due to inadequate attention paid to employee adoption and usage (Hiatt, 2006; Hiatt and Creasey, 2012; Kotter, 1996). In terms of the implementation of educational policies, this limitation was highlighted by the UNESCO report on Botswana. In the case of Botswana, the report acknowledged that although the country produced sound and timely educational policies, in terms of the capabilities and competencies required to drive such reforms it has been noted that:

“Without a supporting implementation strategy, implementation of policy has largely been reactive. In addition, public awareness on education policies has remained low. This is also true for the majority of those who are charged with the responsibility of implementing education policy in the different sub-sectors. These are some of the problems which need to be addressed aggressively” (UNESCO Education For All Study, 2000, Botswana).

The frequency and complexities of changes occurring in organisations require leaders and managers to understand change management and build capabilities and competencies which would enable them to be better prepared and equipped to manage these changes (PROSCI, 2014). Change management capability has been identified as a leverage which can help increase organisational capacity to handle new change (Hiatt and Creasey, 2012; Hiatt, 2006; PROSCI, 2014). Bourne and Bourne (2012) add to this that “most change effort fails because people revert to their old ways rather than get stuck in the new ways” (p.13). Likewise, Fullan (2001) notes that educational reform is a major undertaking and much more complex because: “the number and the dynamics of factors that interact and affect the process of educational change are too overwhelming” (p.50). This assertion points to the need by those responsible for initiating and implementing changes to have a sound theoretical knowledge and understanding of the inner workings of a change management process.

This thesis argues that teachers working in collaboration with in-service officers and a supportive school environment are a critical resource for initiating and
leading change in schools (Fullan, 2001; Morrison, 1998). The research employed the ADKAR change model as a supporting framework to help diagnose and assess how the change was being managed with the teachers as well as to inform an effective change management strategy. The model helps to identify both the stages and sequence required for an individual to experience successful change (Hiatt, 2006; Hiatt and Creasey, 2012).

A customised school-based in-service training and teacher professional development support system enables individual teachers’ situations to be assessed in terms of the stage they are at in the change process. It identifies their own personal barriers to change as opposed to the current one-size-fits-all system (Durrant and Holden, 2006; Hiatt and Creasey, 2012). The thesis proposes a paradigm shift from a modernist approach to change management which typifies the context in which the change was implemented to a post-modernist approach (Morrison, 1998; Scheurich, 1997). The post-modernist approach also aligns with the social constructivist research paradigm under which the study was situated and this view is also held by Cohen et al. (2011) who cited Suber-Skerritt (1996b) as saying that: “bringing about practical improvement, innovation, change or development of social practice and the practitioners’ understanding of their own practices” (p.344).

Bourne and Bourne (2012) found that: “one of the main reasons why change initiatives do not stick is because the support systems are not aligned with the change” (p.49). Given the amount and frequency of change occurring in organisations today, becoming better at implementing change is essential. It is against this background that a need was felt for the development of a framework to support the implementation of the D&T curriculum at senior secondary level (Republic of Botswana, 2009).

1.2 Aims and Objectives of the Research

This research investigated the nature and management of change from a British model aka the Cambridge Overseas model of the D&T curriculum to a locally developed one for senior secondary schools in Botswana. The primary research
question which drove this inquiry was: *What is the nature of change from the Cambridge D&T curriculum to the Botswana model and how are teachers being supported to implement the curriculum?*

To address the research question, the following objectives were established:

a) Gain insights into the nature and scope of change from the Cambridge curriculum to the locally developed D&T curriculum for senior secondary schools in Botswana.

b) Measure the level of awareness and support for the new D&T curriculum among the various stakeholders involved with the implementation of the curriculum in Botswana.

c) Identify and validate the key factors that facilitated or hindered the implementation of the BGCSE D&T curriculum in senior secondary school schools and consider how these might be overcome to ensure effective implementation;

d) Apply the findings of the study to make informed suggestions for appropriate change management capabilities and competencies needed for effective implementation of the BGCSE D&T curriculum.

1.3 Research questions

The objectives led to following formulation research questions:

a) What factors have necessitated change by the government of Botswana from the Cambridge D&T curriculum to a locally developed BGCSE D&T curriculum?

b) What change management capabilities and competencies were developed by the sponsor to facilitate effective implementation of the planned change?

c) What organisational factors have facilitated or inhibited effective implementation and management of change and transition in design and technology?
d) What change management capability needs to be developed to facilitate effective implementation of the BGCSE D&T curriculum?

1.4 Rationale for the Study

Since the transition to the BGCSE, little research has been conducted to assess how this new curriculum was being implemented in schools. This limited research activity has also been reported by Gaotlhobogwe (2010, p.4) who found that relatively few academics have carried out research in D&T in Botswana (Moalosi, 1999; Molwane, 1993; Molwane, Ruele and Mwendapole, 2008). So far, four doctoral studies (Dingalo, 2002; Molwane, 2003; Moalosi, 2007; Gaotlhobogwe, 2010) and key journal publications have been identified. The doctoral studies mentioned above focused on a range of issues related to the implementation of D&T at junior secondary school level. However, just one study by Ndaba (1994) attempted to address implementation issues at senior secondary level. In terms of publications the focus was found to be more on the historical perspective of the subject and implementation challenges (Molwane, 1993; Ndaba, 1994; Moalosi, 1999). Other studies by Moalosi, and Molwane, 2008 have looked at problems and challenges of the implementation of D&T in primary schools.

Within the context of Botswana, the researcher found that there were many publications focusing on public sector reforms, but none looked specifically at managing change in the education sector. With reference to technology education in Botswana, it was surprising, how over two decades since introduction into the education system; little research has been done in this area of study. Also, in terms of implementation there is little documentation available to teachers and in-service officers in the form of guidance materials.
1.5 Research Significance

Change is a constant feature in human lives. Organisations continuously introduce changes in response to internal and external stimuli (Newton, 2007; Stacey, 1993). Some of these changes focus on processes, technologies and others on the structure of the organisation. Research on change management showed that education as one of the drivers for socio-economic development has often been caught up at the receiving end of these changes (Fullan, 2001; Morrison, 1998; Stacey, 1993). It has been observed that change initiatives are often poorly managed, not well resourced and not seen through by the sponsor (Kotter, 2012; Harvard Business School Press, 2003; Hiatt and Creasey, 2012; Hiatt, 2006; Cameron and Green, 2012).

As indicated previously, this research investigated the management of change from the Cambridge model of D&T curriculum to the BGCSE one. Within this context, the researcher explored the nature of change, the organisational conditions under which the change took place and the capabilities that had been developed to facilitate successful implementation. In particular, the researcher explored how teachers as implementers were being supported through the transition period. The focus on teachers was deemed essential because educational reforms have been found to be problematic unless teachers become personally involved and accepting change in their own terms and constructs of reality (Hargreaves, 2005; McBeath, 1997; Fullan, 2001). Studies have shown that many problems arise during implementation, which often creates stress and confusion among those mandated to bring about these changes (Atkinson, 1990; Eggleston, 1996; Finger and Houguet, 2009; Jones, 2003; Jones et al., 2004; Bourne and Bourne, 2012; Fullan, 2001; Kotter, 2012; Sade, 2009).

Given the preceding background, change management was viewed as an essential organisational capability that those leading this curriculum needed to develop if the implementation was to become successful (Harvard Business School Press, 2003; Kotter, 1996; Fullan, 2001; PROSCI, 2014). For example, PROSCI (ibid) observed that successful change, at its core, occurs when employees who have to change how they do their jobs are adequately prepared,
supported, rewarded and sustained (Bourne and Bourne, 2012; Hiatt and Creasey, 2012; Kotter, 2007; Newton, 2007). Therefore, building change management capabilities would ensure that change initiatives proceed in an orderly manner and hopefully organisations will then enjoy greater success on critical projects and initiatives (Hiatt, 2006; Hiatt and Creasey, 2012; Kotter, 1996; Newton, 2007).

1.6 Methods used

The overall research design was a multi-level case study, which suited the evolving nature of this inquiry. The research was situated within a social constructivist research paradigm because most of the data collected were based on people’s views, experiences and perceptions in trying to implement a new D&T curriculum (Bryant, 2006; Bryson, 2000).

For purposes of gaining a holistic picture, as well as achieving triangulation, the study employed both quantitative and qualitative research instrumentation. The quantitative approach involved a questionnaire survey. The questionnaire survey consisted of both closed questions and open-ended questions. For the closed questions a Likert Scale was used to measure participants’ views and perceptions on the issues (Jameison, 2004; Bennett et al., 1992; Stensaker and Meyer, 2012). Open-ended questions were included in order to provide a rich body of evidence. The qualitative approach included semi-structured individual and group interviews with participants representing various levels of experience in order to provide a wide span of managers and stakeholders. Also used were insights gained from seminars, conferences and in-service training (INSET) workshops conducted for teachers.

In terms of assessing the nature and scope of change, the PROSCI’s ADKAR (1998) change management framework was used as a diagnostic tool to make sense of the change; diagnose gaps; develop corrective actions and propose strategies for driving forward the implementation of the BGCSE D&T curriculum. The ADKAR framework was chosen for the following reasons:
• Since introduction in 1998, the ADKAR framework has become widely used by over 2600 organisations around the world (Hiatt and Creasy, 2012).

• The framework offers a holistic analysis tool, which can help drive results at all levels of an organisation (ibid).

• The researcher had enrolled in PROSCI’s free online webinars on change management (http://www.change-management.com/webinars.htm). This is a forum where people involved in change management can learn from change management experts; share their experiences with peers or ask questions that are specific to change management issues in their daily operations. Also, there is some online tutorial support. In this manner the researcher familiarised himself with the ADKAR model.

• Most importantly, the researcher found that the model could be adapted easily to the context under investigation.

In this research, the ADKAR framework was used to guide the investigation on the management of the BGCSE D&T curriculum in three aspects namely:

1) As a diagnostic tool to assess the current state of affairs in terms of readiness, the general awareness of the need for change and the desire for change by various stakeholders as well as the capacity to implement.

2) Assess how teachers were being supported through the transition.

3) Identify gaps in the implementation and use insights gained to make recommend corrective actions for effective implementation in the future.
Chapter 1 – Introduction & Background

Figure 1.1 exemplifies how the ADKAR change management framework was applied to the investigation.

Figure 1.1: Application of the ADKAR change model as a diagnostic tool
Illustration by the researcher
1.7 Research Limitations

The qualitative approach being used for this inquiry inherently runs the risk of becoming biased (Cohen et al., 2011). Since the bulk of the data captured was principally qualitative in nature, this suggests that views expressed by those interviewed reflect their perceptions and attitudes, thus potentially biasing the results that may in some cases not reflect the true picture. Bearing this limitation in mind therefore requires the findings to be treated with caution (Cohen et al., 2011). Moreover, the pilot teacher survey managed to collect data from thirty-two (32) teachers and limited to two regions, the findings may not be applicable to other regions. Cohen et al. (2011) observed that very small samples tend to prohibit statistical analysis (Plowright, 2011). Similarly, inability to interview some of the prospective interviewees such as school heads has implications for the findings. However, keeping these limiting factors in mind, this study does not claim to provide all the definitive answers to the questions raised, rather it attempts to contribute to a greater understanding of the situation on the ground (Bell, 2005; Silverman, 2010; Cohen et al., 2011; Stake, 1995; Yin, 2009).

1.8 Contribution to Scholarship

One of the major contributions of this study is the adaption of the ADKAR framework to the management of educational change and the focus on the development of change capabilities at the level of teachers. The ADKAR model was developed with a focus for business and industry. Tim Creasey (cited in Hiatt and Creasey, 2012), the Co-founder of this model, appreciated (in an email correspondence, tcreasey@prosci.com) the effort made by the author to have trialled for the first time within an educational setting. This is deemed to be an original contribution by the author. The model has been found to be a useful diagnostic tool and a supporting framework which can be adapted easily for education. In this research, this framework was used to conduct readiness assessments, assess organisational change management capability and to identify gaps before a change is implemented on a large scale.
The output of this research feeds into a change management capability initiative by the researcher who is an educator, a curriculum developer and in-service training provider. The research collected primary data in an area where little research has been done before. As such the research is deemed to be an original contribution as far as the management of change in D&T at senior secondary school is concerned. The findings have validated and reinforced contemporary issues and debates about educational reforms which have been experienced in many countries (Addy, 2012; Atkinson, 1990; Barnes, 2005; Chikasanda, 2010; Hansen, 2010; Hargreaves, 2005; Jones, et al., 2004; Rasinen, 2003).

In terms of sharing Botswana’s experience on the global perspective the researcher contributed a book chapter (Ruele and Mwendapole, 2015) which shares the challenges of trying to transpose a model developed for a more developed country to the context of a developing country with limited implementation capacity. The research explored organisational conditions within this context and the capabilities which needed to be developed to facilitate successful implementation of a new D&T curriculum in Botswana. The findings of the study will be a great assistance not only to Botswana but to other developing countries operating under a similar context.

In terms of the management of change, the study adds to a growing body of literature which emphases: the importance of stakeholder participation especially the teachers in the change process; the need to understand the context for change; continuous administrative support and provision of resources; and the need for continuous professional development of the teachers as key change agents in schools.

A review of this curriculum is underway. Hopefully, the suggestions provided in this study will provide useful insights into the development of a change management competency framework for managing future changes in design and technology education.
1.9 Research Outputs

The study culminates with the following outputs:

- Use insights gained from the study to propose a conceptual framework of a change management framework that could be used to implement and manage a new curriculum effectively within the context of Botswana.

- Provide information that will sensitise those responsible for the provision of teacher professional development training in Botswana about the development of a more viable teacher support system.

- Recommendations arising from the thesis will help inform policy direction for future curriculum implementation.

- In terms of future research, the study contributes a more recent and validated literature on the management of the D&T education in Botswana especially at senior secondary level.

1.10 Thesis Structure

Figure 1.2 presents the basic structure of this research.
Figure 1.2, shows the research was implemented in three phases, the foci of which were informed by the findings at the end of each phase. The research was preceded with a small-scale pilot survey which was done in eight senior secondary schools. Four of the schools were based in and around Gaborone City whilst the other four were based in and around Francistown city. The findings of the pilot survey (case study one) were used to provide a focus for the next phase of the study. The findings of case study two were in turn used to inform the development of research questions for case study three.

1.11 Context of the Research

The literature review which establishes the context for this thesis is organised into two main sections. The first section provides an overview of the education system of Botswana. This is followed by an account of circumstances which led to the localisation of senior secondary education of Botswana. The second section provides a historical background to the development of the D&T curriculum in that country. The factors which led to the development of this curriculum are reported in chorological order. The chapter concludes with a summary of the reviewed literature and relates the findings to the wider context of the management of change.

Fullan (2005) defines context as: “the structure and cultures within which one works” p.16). In the case of an education system the context refers to all the governing structures under the ministry of education which include: various departments such as Curriculum Development and Evaluation, department of Secondary Education, regional structures, the schools, teachers, students and the community.

1.12 Country Profile

Botswana is a sparsely populated country with just over two million (2,024,787) people (Central Statistics Office, 2011). The country covers an area of 582,000 square kilometres, estimated to be the size of France. The citizens are referred to as Batswana (singular: Motswana). Batswana are the majority ethnic group in Botswana, making up 79% of the population. Formerly the
British protectorate of Bechuanaland, Botswana adopted its new name after becoming independent within the Commonwealth on 30 September 1966. Much of the country is flat, and the vast majority of land is covered by the Kalahari Desert. As seen on figure 1.3, the country is landlocked between South Africa to the South and Southeast, Namibia to the West and North, and Zimbabwe to the northeast. On the north the country shares the border with Zambia. On the northern part of Botswana is Kasane which acts as a gateway between Botswana and Zambia. Figure 1.3 shows the map of Botswana and its relative position in Southern Africa.

![Map of Botswana](http://wikitravel.org/upload/shared/1/1e/Botswana.png)

**Figure 1.3: Map of Botswana**

*Source: [http://wikitravel.org/upload/shared/1/1e/Botswana.png](http://wikitravel.org/upload/shared/1/1e/Botswana.png)*

Since gaining independence, Botswana's economy has grown exponentially scoring one of the world's highest growth rates. According to the World Bank
(2012) rating Botswana is classified as an ‘Upper middle income’ country with a GDP of $14.50 billion).

This progress is attributed primarily to prudent use and management of mineral resources and a stable democratic governance system, with regular free and fair general elections. The country’s largest exports are diamonds which account for more than one third of the GDP and for 70% to 80% in terms export earnings. Tourism, financial services, subsistence farming, and cattle rearing are other key sectors of the economy (World Bank, 2012).

However, the country continues to face development challenges such as high HIV prevalence rates, high unemployment especially among youth; vulnerability to external shocks due to lack of diversification of the economy beyond mineral exploitation (ibid).

To facilitate the discussions, a review of policies that guided the development of the education system are presented first. These discussions are then followed by a general overview of the system of education followed in Botswana.

Since independence, Botswana’s education system has undergone two major policy reviews (Republic of Botswana, 1992; Republic of Botswana, 1977; UNESCO, 2006). The first National Policy on Education (NPE) dates to 1977; and the second was launched in 1992 (Republic of Botswana, 1992). The next section provides the background to these two policy reviews. However, much of the discussion will be based on the second review because it reflects more or less the current context.

The provision of basic education was declared a basic human right by member states at the World Conference on Education for All (1990), held in Jomtien, Thailand. The Jomtien conference resulted in a declaration, which set specific targets against which progress towards provision of education for all could be appraised. When the Jomtien declaration came about Botswana had already drafted her own educational policy which had been derived from the National Commission on Education which was set up in 1976 (Republic of Botswana, 1977). The commission completed its task in 1977 and became known as the
National Commission on Education (NCE). Subsequent to the 1977 NCE, Botswana drafted her first educational policy known as the National Policy on Education (Republic of Botswana, 1977). This policy document outlined efforts towards the attainment of basic education. The NPE led to a production of an education policy document known as Education for Kagisano (Education for Social harmony), which set the direction and framework for planning, and for the provision of education. Education for Kagisano was seen as a significant milestone in the history of Botswana’s education systems as it “closed a chapter on one of the legacies of Botswana’s colonial history that of restricting access to quality education to only a few privileged individuals” (World Education Forum, 2000).

As a response to the Jomtien conference, in 1991 the government of Botswana, through the MOESD held a national conference whose primary objective was to engage all the relevant stakeholders in a dialogue on the problems faced by the country. These problems included: meeting the basic learning needs of the child, youth and adult and sought their opinions, support and active participation towards the government’s efforts of achieving the Jomtien educational objectives. Subsequent to that national conference, a second National Commission on Education was appointed in 1992 to revise the 1977 education policy (Republic of Botswana, 1992; Republic of Botswana, 1993). The reason for this was that the socio-economic context, within which the 1976 review took place, had changed considerably in that the country faced a new challenge of preparing the workforce that would need to take up challenges of the ever changing global economy (Republic of Botswana, 1992; Republic of Botswana, 1994).

The 1992 commission reviewed the whole education system of Botswana (Republic of Botswana, 1992; Republic of Botswana, 1993). One of its terms of reference was that the country faced a challenge of preparing children to contribute to the workforce. This would need to take up the challenges of an ever changing global economy. Therefore, the mandate of this commission was to investigate and recommend to the government an education system that is relevant and responsive to the socio-economic needs of the country. The
commission led to the production of the second educational policy document known as the *Revised National Policy on Education (RNPE)* (Republic of Botswana, 1994).

The RNPE identified seven key strategy issues for the provision of education in Botswana as follows:

1. Access and equity;
2. Effective Preparation of Learners for Life, Citizenship and world of work;
3. Development of training responsive and relevant to the needs of economic development;
4. Improvement and Maintenance of Quality of the Education System;
5. Enhancement of the performance and status of the teaching profession;
6. Effective management of the education system;

In addition to the RNPE of 1994, a number of national policy documents and international protocols and conventions to which Botswana is a member had profound impact in the development and provision of education in Botswana. The following documents guided the design and development of the curriculum:

- *National Development (NDP 9);*
- *Dakar Framework for Action;*
- *Millennium Development Goals (MDGs);*
- *Multi-lateral agreements (World Declaration of Education for All (EFA);*
- *New Economic Partnerships for African Development (NEDPAD);*
- *Other national policies (National Population Policy; National Policy on Culture).*
For the purpose of the development of the BGCSE programme, the RNPE and Vision 2016 remain the main reference documents which have guided on-going curriculum reform implementation and provision of education and training (Republic of Botswana, 1994). Vision 2016 is a policy through which the Botswana government articulates one of the seven pillars, the need to have “an educated and informed nation” (Botswana Vision 2016 Council, 2010). Therefore, both of these documents outline “Botswana’s strategy to propel its socio-economic and political development into a competitive, winning and prosperous nation” (ibid).

1.12.1 **The Structure of the Education System**

This section presents a summary of the education system of Botswana because this information is already in the public domain (Republic of Botswana, 1992; Republic of Botswana, 1994; Republic of Botswana, 2000; Tabulawa, 2009; UNESCO, 2006). The Botswana education system comprises seven years of Primary schooling (ages 6-13), three years of Junior secondary schooling (ages 14-16) and two years of Senior secondary schooling (ages 17-19). Each year at primary school is known as Standard, and at secondary school is known as Form. Owing to the government’s commitment to the 10-Year Basic Education Policy, this makes provision for access to education from primary to junior secondary education, to be free but not compulsory.

Figure 1.4 attempts to show the various levels of the education system of Botswana and possible career paths for further education and training or possible employment within the public sector.
1.12.2 Aims of the BGCSE Programme

On completion of the 2 year senior secondary programme learners should have:

- acquired knowledge, developed confidence and ability to assess their personal strengths and weaknesses and be realistic in choosing appropriate career/employment opportunities and/or further education and training;

- developed skills to assist them in solving technical and technological problems as they relate to day-to-day life situations;

- developed desirable attitudes and behavioural patterns in interacting with the environment in a manner that is protective, preserving and nurturing;

- acquired attitudes and values, developed basic skills and understanding to allow for execution of rights and responsibilities as good citizens of Botswana and the world;

- developed information technology skills as well as an understanding and appreciation of their influence in the day-to-day activities;
• acquired knowledge, attitudes and practices that will ensure good family and health practices including awareness and management of epidemics (such as HIV/AIDS) that prepare them for productive life;

• developed pre-vocational knowledge and manipulative skills that will enable them to apply content learnt, and attitudes and values developed, to practical life situations in the world of work;

• developed an understanding of, and acquired basic skills in business, everyday commercial transactions and entrepreneurship;

• developed foundation skills such as problem solving, critical thinking, communication, inquiring, team work/interpersonal, to help them to be productive and adaptive to survive in a changing environment;

• developed study skills required for further study and training (Ministry of Education and Skills Development, Botswana, 1998).

1.12.3 The Management of the Education System

The MOESD is the custodian and presides over various departments which include: Department of Secondary Education (DSE), the Department of Human Resource Development (HRD) formerly known as Teacher Training and Development (TT&D) and the Department of Curriculum Development and Evaluation (CD&E).

• DSE is the supervisory department for primary, junior and senior secondary schools. Their mandate includes planning, formulating programmes, implementing, monitoring and evaluating the national secondary education system.

• CD&E designs, develops and evaluates the national curriculum different curricula through collaboration with other stakeholders. The mandate of the department of CD&E also includes implementation of educational policies as well as to facilitate the delivery of curriculum and support services to students at all levels.
- Examinations are now run by the Botswana Examinations Council (BEC), which took over from UCLES. BEC is a government agency which was enacted by Parliament in 2002: "to conduct schools examinations and any other examinations for the Ministry and issue certificates in respect of such examinations" (Botswana Examinations Council, 2010).

The management of schools is done according to the districts. Botswana is divided into 15 administrative districts: 9 rural districts and 6 urban districts. These are administered by 15 local authorities (district councils, city councils or town councils). Figure 1.5 shows these districts.

![Districts of Botswana](http://en.wikipedia.org/wiki/Districts_of_Botswana#)

**Figure 1.5: Districts of Botswana**


### 1.12.4 Curriculum Development Processes followed in Botswana

The next section describes the curriculum development process followed in Botswana. The process consists of four major phases as shown in figure 1.6.
1.3 The Design Phase

The main objective of this phase is to determine the broader parameters of the particular programme. This starts with a needs assessment which may emanate from new technology, job market (local & overseas), industrial/societal demands, change in government’s policy, entrepreneurship, scientific developments and so on.

1.4 The Development Phase

This involves the development of the subject specific content necessary for achieving the educational objectives outlined in the Curriculum Blueprint (Ministry of Education and Skills Development, Botswana, 1998). The tasks involved at this phase include among others:

- sequencing the various subject/courses;
- selecting the content in each subject; and
- sequencing the units and topics.
1.15 The Implementation Phase

It is the stage when the programme is rolled out to schools or the actual implementation of the curriculum in the identified institutions. It includes effecting organisational changes like work distribution, role clarification, provision of support services and streamlining procedures and communication channels. The processes involved at this stage include among other;

- Implementation workshops;
- Teaching/classroom instruction takes place;
- Provision of instructional materials, teachers’ guides and teaching aids;
- Resource mobilisation;
- Infrastructure development;
- Teacher development – training and in-service.

1.16 The Evaluation Phase

Curriculum evaluation can be defined as the collection and provision of evidence, on the basis of which decisions can be taken about the feasibility, effectiveness and educational value of curricula. The evaluation may be carried out at various levels such as the:

- whole curriculum of the programme
- curriculum of a single course
- specific components like the objectives, course content, teachers’ guide, textbook, audio-visual aids, teaching methods and evaluation procedures.

The evaluation may be formative or summative. The formative evaluation is carried out during the process of curriculum development. The results of this evaluation provide information to curriculum developers which enable them to correct flaws detected in the curriculum. On the other hand the summative evaluation is carried out after offering the curriculum once or twice. This evaluation is used to summarise the merits as well as the weaknesses of the
programme. The next section will explore and discuss the development of a teacher training and development support system currently used in Botswana. Implications of this system are also highlighted.

### 1.17 Teacher Training and Development Support System

This section presents and discusses a teacher support system used in Botswana. It begins by updating the reader on the developments regarding the on-going restructuring exercise by the MOESD (Botswana) on human resource training and development. Implications of these developments on teacher training and continuous professional developments are highlighted. This is followed by the support system used in D&T at both regional and school levels. It describes how the system is implemented and managed and concludes by highlighting challenges at each level.

Training and professional development has now been mandated to the newly established Human Resources Development Council (HRDC). This council replaces the department of Teacher Training and Development (TT&D) which was initially created to offer leadership and direction in the provision of training and support to teachers at both pre-service and in-service levels (UNESCO World Data on Education, Botswana, 2006). However, due to the restructuring of the functions of the MOESD the establishment of HRDC suggests that its mandate has been broadened to cater not only for the training and professional development needs of teachers, but for all members of staff in the regions (Directorate of Public Service Management, 2006). The overall mandate of the HRDC is to implement, monitor and evaluate in-service programmes for the regional staff and teachers. Other functions of this council are outlined as follows:

- Promote continued improvement of teacher education after formal training;
- Assess training needs and priorities of teachers in the field;
- Deliver training programmes through workshops, seminars, and conferences;
• Coordinate in-service training of teachers in the regions;

• Upgrade the professional qualifications of teachers through short term training courses;

• Identify and select teachers for internal and external training;

• Promote teachers’ participation in tours and exchange programmes in and around the country; and

• Manage and supervise in-service training in the region (Directorate of Public Service Management, 2006).

The formation of the HRDC is a welcome development because it will provide policy direction towards achieving human resource development in Botswana. However, in the researcher’s view, if not well managed it may jeopardise teachers’ professional development because the arrangement tends to put teachers’ needs in the same basket with the other non-teaching professionals. This is even a more compelling case for D&T because there is already shortage of in-service officers. This suggests that in those regions where the subject is not represented, teachers will find their chances for professional development becoming increasingly limited.

In terms of teacher training and development in D&T education, it dates back to the early 1990s when the Cambridge D&T curriculum was introduced in the Botswana education system. Ndaba\(^2\) (1994) notes that at inception locally trained teachers D&T education were in shortage. As a result a number of serving teachers initially trained to teach traditional craft subjects were sent to some colleges and universities in the United Kingdom during the late 1980s and early 1990s, with the aim of preparing them to teach D&T education (Ndaba, 1994). So given this situation, initial training was done through collaboration with some institutions in England (Fox, 1988). Because of this working relationship, some of the institutions where the teachers had been trained were

\(^2\) Mr Nick Ndaba is one of the pioneers of D&T education in Botswana and the first local to be appointed to the position of a senior education officer.
often called upon to provide training to those teachers in the field to prepare them for the implementation of the (Fox, 1988; Ndaba, 1994).

Nationally, support for teacher training and professional development is offered through a network of ten regions. Education centres have been located strategically at various points in the country to ensure that the service is brought closer to the schools. Each centre is equipped with facilities to cater for residential courses especially for teachers coming from distant schools. The centres are staffed with In-Service Education Officers for the various subjects whose responsibility is to provide teachers with the necessary expertise and professional background for effective implementation of the curriculum in schools. The basic functions of the education centres are outlined below:

- Provide an effective and coherent in-service education programme and to support the implementation of government policies and recommendations by liaising with all stakeholders;
- Identify the needs of schools and to be responsive to their requirements and difficulties through provision of support services;
- Develop training programmes that will foster the professional development of all teachers in order to make them effective classroom practitioners;
- Promote autonomous school based staff development;
- Sensitise schools on new developments in education and to systematically monitor and support them;
- Provide opportunities for in-service officers to update and upgrade their professional skills and qualifications (UNESCO World Data on Education, Botswana, 2006).

Provision of support for teacher training and professional development in Botswana is managed at three levels namely: nationally, regionally and at school level. At national level, it is managed through the HRDC already mentioned in the preceding paragraph. At regional level, the regions are organised into
clusters, each cluster has a coordinator aka cluster coordinator who liaises with schools and the in-service (INSET) officer in terms of teachers’ training needs.

The regional teacher support system is cascaded to schools through Staff Development Committees (SDCs) which act as coordinating organs for professional development of teachers in schools. The SDCs are headed by a staff development officer (SDO). The SDO is a member of the school senior management team who coordinates all staff development activities in the school. The various departments headed by senior teacher 1 develop their long and short term staff development plans. This is an annual process which involves a discussion between individual teachers and their immediate supervisors and once approved the plans are submitted to the SDO’s office for consideration.

In terms of collaboration with schools, in-service officers liaise with the SDO and senior teacher 1 to discuss training teachers’ needs. Once a need has been identified a department can make their request through the SDO for school based training. However, for training that involves other schools, a request is made through the regional office in collaboration with in-service officer and a cluster coordinator. The next section introduces and discusses the development of a new programme for senior secondary schools which included a new D&T curriculum for Botswana.

1.18 Localisation of the Botswana Senior Secondary Education

The background to the introduction of the BGCSE programme was offered in section 1.1. As mentioned, this programme is a prevocational level of schooling which seeks to prepare students for the world of work, further education and lifelong learning (Ministry of Education and Skills Development, Botswana, 1998; Republic of Botswana, 1994).

The next section provides further insights into the localisation of the BGCSE programme. As already noted in section 1.1 that prior to 2000, senior secondary schools in Botswana had followed the Cambridge Overseas School Certificate (COSC) programme. During this period which spans over three decades the
Ordinary Level Examinations for the COSC programme were set and marked by UCLES. Collaboration with UCLES was seen as a way of maintaining a high standard of qualifications with international recognition (Ndaba, 1994). Consequently, many Batswana students who sat for the COSC examinations have been able to study abroad without a need for supplementary tests (Ndaba, 1994). Moreover, this arrangement was necessary because prior to this period, Botswana did not have sufficient capacity to enable her to localise senior secondary school examinations (ibid).

However, in the years since the adoption of the Cambridge curriculum, there has been a realisation that it was not fully relevant to the socio-economic needs of the country (Republic of Botswana, 1992; Republic of Botswana, 1994). Moreover, some of the content in the Cambridge syllabus and examinations was found to be culturally irrelevant (Republic of Botswana, 1994). Hence, the decision to localise the curriculum was to “make it more relevant to Botswana’s contemporary and future political, socio-economic challenges and needs” (Ministry of Education and Skills Development, Botswana, 1998). Ndaba (1994) holds the same view by arguing that a philosophy developed for one country cannot be transposed unchanged to meet a different context. Similarly, Williams (2007) observes that adoption of Western education systems “provided little reference to the local social, economic or cultural context” (p.47). Additionally the service offered by Cambridge in terms of the administration of examinations was becoming too costly for the government of Botswana (Republic of Botswana, 1993; Ndaba, 1994). Because of these aspects, there was an increasing pressure on the government to localise senior secondary school examinations. Ndaba (1994) notes that: “the first move towards localisation came in 1993 when local marking of some subjects took place, with guidance from UCLES” (p.83). The endorsement of the Botswana Examinations Council (BEC) in 2002 was part of the localisation process. However, for ensuring that the BGCSE programme meets international standards, UCLES remains the accrediting body.

Having looked at the localisation of the national education system of Botswana, the next section focuses on the introduction of a new D&T curriculum which
replaced the Cambridge Overseas one. To differentiate it from the Cambridge, this Botswana model is referred to as the BGCSE D&T curriculum.

### 1.19 The Introduction of the D&T Education in Botswana

The subject was piloted between 1988 and 1989 in five senior secondary schools (n = 23) and sixteen junior secondary schools (n = 140). As already mentioned in section 2.6, the actual implementation in the rest of the senior secondary schools was done in 1990 (Ndaba, 1994; Molwane, 1993; Moalosi, 1999; Gaotlhobogwe, 2010). Ndaba (1994) explains that the idea of piloting was to allow for time to build the required capacity before widespread implementation. At inception many schools did not have the right facilities because the workshop facilities had been built to cater for the traditional craft subjects like Woodwork, Metalwork and Technical Drawing. Whereas, the BGCSE’s D&T curriculum introduced new content areas such as electronics, pneumatics and computer aided design and manufacture. These new content areas required the schools to be upgraded by creating new workshop layouts to cater for specialised equipment which is associated with these content areas.

In Botswana D&T education is offered at junior and senior secondary school levels. It is classified as a practical subject and offered as an elective to both male and female students under the Creative, Technical and Vocational subjects. A typical senior secondary school has about five D&T teachers including a senior teacher who acts as a head of department. Generally a D&T department has an enrolment of between 100-200 students per stream. The author observes a higher number of boys studying the subject whereas girls tend to opt for other subjects particularly Food and Nutrition or Fashion and Fabrics. The rest of the students go into other optional subjects such as Art and Design, Agriculture and Computer studies. This poses D&T to competition from other subjects in as far as enrolment of students into practical subjects is concerned. In terms of delivery in the classroom, teachers do not specialise in any

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3 Year groups (Form 4 = 17 year olds; Form 5 = 18 year olds).
particular content area and likewise, students are required to study all the content areas. Figure 1.7 presents the composition and organisation of the BGCSE programme.

<table>
<thead>
<tr>
<th>Core Group</th>
<th>Optional Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humanities and Social Sciences</td>
<td>Sciences</td>
</tr>
<tr>
<td></td>
<td>Single Science</td>
</tr>
<tr>
<td></td>
<td>Double Science</td>
</tr>
<tr>
<td></td>
<td>Chemistry</td>
</tr>
<tr>
<td></td>
<td>Physics</td>
</tr>
<tr>
<td></td>
<td>Biology</td>
</tr>
<tr>
<td></td>
<td>Human and Social Biology (Only for Private Candidates)</td>
</tr>
<tr>
<td></td>
<td>Design and Technology</td>
</tr>
<tr>
<td></td>
<td>Agriculture</td>
</tr>
<tr>
<td></td>
<td>Art and Design</td>
</tr>
<tr>
<td></td>
<td>Food and Nutrition</td>
</tr>
<tr>
<td></td>
<td>Computer Studies</td>
</tr>
<tr>
<td></td>
<td>Fashion and Fabrics</td>
</tr>
<tr>
<td></td>
<td>Business Studies</td>
</tr>
<tr>
<td></td>
<td>Home Management</td>
</tr>
<tr>
<td>Third Language</td>
<td></td>
</tr>
<tr>
<td>Physical Education</td>
<td></td>
</tr>
<tr>
<td>Music</td>
<td></td>
</tr>
<tr>
<td>Religious Education</td>
<td></td>
</tr>
<tr>
<td>Moral Education</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 1.7: Subjects offered under the BGCSE programme**  
Source: Ministry of Education and Skills Development (2009)

### 1.19.1 The Structure and Content of the BGCSE D&T Curriculum

Figure 1.8 presents the basic structure and content of the BGCSE D&T curriculum.

<table>
<thead>
<tr>
<th>Syllabus Component</th>
<th>Content Area(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Health and safety</strong></td>
<td>Safety Precautions and First Aid.</td>
</tr>
<tr>
<td><strong>3. Communication</strong></td>
<td>Graphics and Information Technology</td>
</tr>
</tbody>
</table>

**Figure 1.8: The Content of the BGCSE D&T Curriculum**  
Figure 1.9 presents the content of the Cambridge Overseas D&T curriculum which was being followed prior to the introduction of the BGCSE one.

<table>
<thead>
<tr>
<th>Syllabus Component</th>
<th>Content Area (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Design</td>
<td>Design is concerned with problem-centred situations calling for solutions that can be realised through manufactured artefacts.</td>
</tr>
<tr>
<td>1.1 Design method</td>
<td>Solutions may be arrived at through diverse methods, but each will include the statement of a Brief; Analysis; Synthesis and Evaluation.</td>
</tr>
<tr>
<td>1.2 Design content</td>
<td>Aesthetics; Anthropometrics and Ergonomics; Information gathering; and awareness of basic understanding of common mathematical shapes in product design.</td>
</tr>
<tr>
<td>1.3 Graphics</td>
<td>The ability to show ideas and constructions by pictorial drawing, exploded and sectional views by recognised methods.</td>
</tr>
<tr>
<td>2. Technology</td>
<td>A broad understanding with practical experience; rather than an in-depth knowledge of any particular material, technology or media.</td>
</tr>
<tr>
<td>3. Materials</td>
<td>General physical and working properties and applications of common constructional materials, especially plastics, wood and metal.</td>
</tr>
</tbody>
</table>
| 3.1 Theoretical knowledge| A knowledge of different and appropriate properties and uses of the following;  
|                           |  - Plastics  
|                           |  - Wood  
|                           |  - Metals                                                                                                                                                                                                                                                                 |
| 3.2 Practical processes  | Experience in the use of hand and machine tools, operations and processes covering major materials namely metal, plastic and wood.                                                                                                                                                                                                     |
| 4. Developing Technologies| Developing technologies of structures, mechanisms, electronics, materials processing and micro-computing are increasingly being used in Design and Technology Department, as aids in graphics, design, control and realisation. Candidates should wherever possible, be given the opportunity to keep abreast of developments in these areas. |

Figure 1.9: The Cambridge Overseas D&T Syllabus (2012, pp.9-13).

In comparison to the Cambridge curriculum the BGCSE D&T curriculum is organised into six major content areas as opposed two. Unlike, its predecessor, this curriculum includes a range of new technological content areas namely:
electronics, pneumatics, computer control, desktop publishing (DTP), computer aided design and computer aided manufacture (CAD/CAM). These new content areas were intended to enhance knowledge and skills as well as to keep up with the pace of technological development (Ministry of Education and Skills Development, 2000). Ruele and Mwendapole (2015) observed that the content of the BGCSE D&T curriculum is oversubscribed in materials, tools and processes. This situation results in a curriculum which is predominantly craft based. Also, the Design and ICT content areas of the curriculum are undersubscribed. In terms of the Design content, the authors observed that “design is fast becoming a key component of how countries, individuals and organisations compete on the global market” (p.121). To redress this imbalance, the authors suggest:

“a need for curriculum audit that addresses the contribution of the different strands to the innovation process possibly with the end result of developing strategies that engender creativity, innovation and technical proficiency” (ibid).

Another observation worth noting is the focus of the technology content between the two curricula. For example, under the BGCSE D&T curriculum, Technology covers Energy, Structures, Mechanisms, Electronics and Pneumatics (Figure 1.18); whilst under Cambridge is to do with “Experience in the use of hand and machine tools, operations and processes covering major materials namely metal, plastic and wood” (Figure 1.9). In the Cambridge curriculum there is a section on developing technologies which is similar to what is covered under technology in Botswana. The perception of what constitutes technology within the context of Botswana is a matter that needs to be established.

In section 1.18 of this document, it was mentioned that prior to the development of the BGCSE D&T curriculum schools had followed the Cambridge D&T model (Syllabus code 6043). At inception the Cambridge model was still in the transition from the Craft, Design and Technology (CDT) model described by Eggleston (1996). According to Eggleston the CDT model originated from England where it was: “seen largely as prevocational training for the growing
ranks of manual industrial and domestic workers” (p.14). Similarly, Atkinson (1990) describes this model as a merger of the traditional crafts with some element of designing. In fact the BGCSE’s D&T model also resembles the Technical Studies in Scotland (Canavan and Doherty, 2007). As seen in figure 1.8, the BGCSE D&T curriculum is still deeply rooted in the CDT model. The issue of curriculum content is pertinent to debates about how education systems should be used as driving forces for the production of the workforce for ‘new’ economies (Lewis, 2000). It has to be borne in mind that the BGCSE D&T curriculum was developed to enable Botswana to realise her vision of: “a move away from the traditional agro-based economy to the more broadly based industrial economy the country which the country was aspiring for” (Republic of Botswana, 1994).

1.20 The Transition from Cambridge to the BGCSE D&T Model

This section presents an overview of the model for the D&T curriculum adopted by Botswana and how it has evolved to its current state. Moreover, the section offers some insight into how the subject is implemented in schools.

The author notes differences in titles, emphases and perceptions about the meaning and purpose of Design and Technology education (Atkinson, 1990; Banks, 1994; Eggleston, 1994; 1996; Rasinen, 2003). In this study the titles “Design and Technology (D&T)” or “Technology Education (TE)” are used synonymously. D&T describes a programme of study that: “helps to prepare students to become technologically literate” (Rasinen, 2003, p.31; also see Canavan and Doherty, 2007, p.292). Eggleston (1996) defines D&T as a subject that involves: “the creative application of knowledge, skills and understanding to design and make good quality products” (p.24). These two definitions were deemed sufficient for the purpose of this study.

The exact definition of Technology education is problematic because of the variations among countries in terms of their philosophies and perceptions of technology (Atkinson, 1990; Rasinen, 2003; De Vries, 1995; Eggleston, 1996; Lewis, 2000). For instance, Rasinen noted in his study of technology education
curricular of six countries that, although those countries shared a common understanding of the purpose of technology education, however, there were some differences in terms of emphasis, organisation of content as well as the approaches used to implement the curriculum. Despite these differences, Rasinen found a shared vision regarding the need to respond to current and emerging socio-economic needs of those nations (De Vries, 1995; Eggleston, 1996; McCormick, 1993; Raizen, 1995). Also found as a common feature espoused in the curricular of those countries was the need to provide skills which would enable children to thrive in the ever changing technological world (Rasinen, 2003; Williams, 2007).

In terms of Botswana, the origin of the D&T education would be better understood from the context in which the subject evolved. The movement towards the introduction of the D&T into the education system of Botswana dates to 1987 (Ndaba, 1994; Fox, 1988; Moalosi, 1999). In senior secondary schools, D&T education was formally introduced in 1990 (Ndaba, 1994; Fox, 1988; Moalosi, 1999). Ndaba (1994) reports that the subject was recommended after: “consultative work undertaken by R. Fox, the Principal Lecturer and Head of Department at the College of St Mark and St John, Plymouth in the United Kingdom” (p.149). According to Ndaba the Fox consultancy had been commissioned by the MOESD (Botswana) to: “explore the provision of a technical and vocational education in the British system for educational innovations” (p.110). Subsequent to this consultancy, D&T recommended as a suitable replacement for the traditional craft subjects which included: woodwork, metalwork and technical drawing (Ndaba, 1994; Fox, 1988; Moalosi, 1999). As a consequence of the Fox consultancy, when the RNPE was approved by parliament in March 1994, D&T was recommended for both junior and senior secondary schools. However, for junior secondary schools (14-16 year olds), the subject was set to become a core subject in January 1996 (Government Paper No. 2 of 1994, REC. 32, para. 5.5.13 c). Therefore, it is fair to mention that the Fox report became the reference document which served as a milestone for the development of technology education in Botswana (Ndaba, 1994).
Many countries perceive technology as the driving force for innovation and economic development (Atkinson, 1990; Lewis, 2000; Rasinen, 2003). Lewis (2000) affirms this perception by stating that technology as a school subject can clearly be a vehicle for social transformation in the third world. Moreover, the development of this curriculum was perceived by the government as a ‘vehicle’ by which to prepare her future workforce for participation in an increasingly inter-dependent global economy (Ministry of Education and Skills Development, 2000). Therefore, Botswana’s view of technology education is consistent with developments around the world (Canavan and Doherty, 2009; Chikasanda, 2010; Jader, 2011; Jones, 2003; Jones et al., 2004; Rasinen, 2003; Eggleston, 1994; 1996; Hargreaves, 1994; Sade, 2009; Williams, 2007).

Similarly, the BGCSE D&T curriculum is designed to build on knowledge and skills acquired in the Junior Secondary education in order to prepare young male and female Batswana for the demands of the technological world of the 21st century (Ministry of Education and Skills Development, 2000). The subject was introduced to meet the technological needs of the country as well as to prepare students for future careers and further training (Ndaba, 1994). It is intended to equip children with a variety of knowledge, skills and attitudes that not only prepare them for further training and employment but for life in general (ibid).

In view of the time when the D&T education was introduced in Botswana one notes that it was a significant period during which many countries around the world were experiencing a widespread and rapid technological change (Eggleston, 1996). Referring to this phenomenon, Ndaba notes that: “the need for technological ‘know how’ had become paramount and reforming technical education was one way of achieving the desired effect” (p.110). Eggleston (1996) concurs that:

“...the development of new technology curricula under state leadership is a world phenomenon. Active and remarkably similar programmes are, for example, currently running in
Botswana, Ministry of Education, in New South Wales, Australia, and in British Columbia (Canada) under state authorities” (p.39).
CHAPTER 2

LITERATURE REVIEW
2 Literature Review

2.1 Introduction

This section establishes the theoretical framework in order to understand the nature of change and its management processes. It also considers how change impacts on the organisation as a whole as well as the individuals in that organisation. The section explores further exemplar change management models which have been used as diagnostic tools to help organisations to mitigate some of the common problems that impede success.

Change management is viewed as an essential organisational capability and individual competency for employees (Kotter, 1996; Hiatt and Creasey, 2012, Newton, 2007). The issue of change management is pertinent because it aligns with the purpose of this study which sought to explore how to manage change and support teachers through a transition in a new design and technology curriculum in Botswana. The study explored organisational conditions within this context and the capabilities which needed to be developed to facilitate successful implementation of this government initiative. This is a topic where little research has been done within the context of Botswana (Ndaba, 1994; Gaotlhobogwe, 2010). Because of the many issues which arose from the literature review; a thematic approach was deemed appropriate to facilitate the discussions (Gomm et al., 2004; Gibson and Brown, 2009). This section is organised into the following headings:

- Definition of Terms;
- Change Management Process;
- Key Drivers or Sources of Change;
- Examples Change Management Models;
- Change Management Principles;
- The Nature of Educational Change;
- Change Management in Education.
2.1.1 Definition of Terms

The purpose of this section is to develop a working definition of change management and its associated terms as used in this research. Moving through change is a process that needs to be understood to enable organisations to deliver sustainable results through the change (Kotter, 1996; Hiatt and Creasey, 2012).

According to PROSCI (2014) change is a movement out of a current state (where you are today), through a transition state and to a future state (where you want to be). There is usually a time factor between the current state and the future state because it takes time for people or the organisation to transition between the two states. Figure 2.1 presents a graphical illustration of a change process.

![Figure 2.1: An illustration of change](image)

Adopted from: Hiatt and Creasey, 2012, p.34)

Oxford University Press (2012) defines change as: “an act or process through which something becomes different”. Fullan (2001) defines change as: “a shift in the external situation it is about the events or circumstances which impact on and affect the organisation” (p.31). Morrison (1998) offers another definition as:

“a dynamic and continuous process of development and growth that involves a reorganisation in response to ‘felt needs’. It is a
process of transformation, a flow from one state to another, either initiated by internal factors or external forces, involving individuals, groups or institutions leading to a realignment of existing values and practices” (p.13).

Others like Kotter (1996) have used the term ‘transformation’ to draw a distinction between large-scale changes as opposed to smaller changes. In the view of the author, regardless of the term used change describes as a deviation from a currently established baseline or ‘burning platform’ or comfort zone by an organisation or an individual. Others like Fullan (2001, p.39) have used terms such as ‘innovation’ and ‘reform’ interchangeably to denote change. In this study, these terms will be used interchangeably.

The foregoing section has established our understanding of the process of change. It has underscored the notion that although change is constant feature of our lives. For instance, changes can be internally motivated or externally motivated. However, regardless of its nature and scope, change has been found to be complex and difficult to manage (Bourne and Bourne, 2012; Kotter, 1996). The change can be a dramatic departure from the norm or it can be minor. Changes can be anticipated or unexpected. But in all cases, the fundamental nature of change is a movement from the current state through a transition state to a future state (Cameron and Green, 2012; Hiatt and Creasey, 2012; Hiatt, 2006; Kotter, 2007; Newton, 2007).

This next section explains and discusses the difference between change and transition. A distinction between these two concepts is necessary to provide a working conceptual framework. Moreover, the two terms have been found to be problematic in the sense that conceptually the two are closely related which often tempts people to use them interchangeably (Bridges, 2009). As a consequence, the next section is devoted to providing working definitions of these two terms as used within the context of this study. For instance, Bridges (2009) asserts that these terms are not just a matter of semantics, but differ significantly (Cameron and Green, 2012). To illustrate this point: change is situational. In simple terms, change can be likened to physically moving office,
or installing new equipment, or re-structuring. In contrast, transition refers to the psychological effects of change that people go through as they internalise and come to terms with the realities of the new situation brought about by the change (ibid, p.67). Like Cameron and Green (2012) found, transition is about letting go of the past and taking up new behaviours or ways of thinking. Bridges (2009) argues that change can be planned while transition is less easy to manage. Because of lack of an understanding of the distinction between the two terms in as far as change management is concerned, Bridges (2009) found that transition often: “lags behind planned change because it is more complex and harder to achieve” (cited in Cameron and Green, 2012, p.135). Figure 2.2 illustrates the distinction between change and transition.

Using figure 2.1 for illustration, change can be thought of as a physical movement out of one’s current state to the future state. In contrast, the transition stage lies between the current and the future state. It is a stage which prepares an individual psychologically to internalise effects of change and supports him/her out of the current state through to the ultimate future state. It is deemed the most difficult for individuals to get through because the individual concerned can only make a successful transition if he/she has the desire and commitment to move out of the current state (Hiatt and Creasey, 2012). Another challenge might be the nature of change in terms of how it impacts the individual concerned in an organisation (Bridges, 2009; Hiatt, 2006). For instance, Hiatt and Creasey (2012) assert that each individual’s situation is unique as such the speed at which they are able to transition from the current to the future state will be different (Bridges, 2009; Hiatt, 2006). Moreover, awareness and desire for change in particular have been cited as
some of the major sources of resistance to change (Hiatt, 2006; Kotter, 1996). Hiatt (2006, p.40) found that reinforcement can be used to sustain the change and to prevent the individuals from slipping back into the old behaviours or old ways of doing things (Bourne and Bourne, 2012). Hence, it is important that once an individual has reached the future state, some form of reinforcement is instituted to sustain their interest in the new state (Bridges, 2009). For instance, as a token of acknowledgement and appreciation for success some form of reward can be awarded to those individuals who have reached certain milestones set by the organisation (Bourne and Bourne, 2012; Hiatt, 2006; Kotter, 1996). Indeed, Bourne and Bourne (2012) also found that an incentive system is: “often a forgotten step and a major source of change failure” (p.50).

From the understanding established between change and transition, it then makes it imperative that before a change can be introduced, an assessment and analysis of how the change will impact on the organisation as a whole as well as individuals within that organisation must take place. Hiatt and Creasey (2012) have underscored the notion that successful change, at its core, occurs when employees who have to change how they do their jobs are adequately prepared, supported, rewarded and sustained (Harvard Business School Press, 2003; Kotter, 1996).

### 2.1.2 Change Management Process

The foregoing sections have focussed on trying to establish a working definition of change and its associated terminology. There has been little discussion of change management. This section explores some of the basic concepts underlying the change management. It starts by defining the change management process and uses a graphical illustration of this process so as to illustrate the link between change and transition. In addition the section will give examples of types of change.

Building on the previous section, Newton (2007) defines change management (CM) as: “the name given for a disparate set of processes, tools, techniques, methods and approaches to achieve a desired end state through change” (p.7). Hiatt and Creasey (2012) define CM as: “the application of processes and tools to
manage the people side of change from a current state to a new future state so that the desired results of the change are achieved” (p.9). Likewise, Kotter (1996) defines CM as: “a set of basic tools or structures intended to keep any change effort under control” (p.25). Elsewhere, Newton (2007) defines CM as: “a disparate set of processes, tools, techniques, methods and approaches to achieve a desired state through change” (p.7). Kotter (1996) adds to this point by asserting that change management is a way of making a big change and keeping it under control and also ensuring that it proceeds in an orderly manner. The above definitions were deemed sufficient for the purpose of laying the theoretical framework for subsequent discussions on this topic. Kotter identifies the following activities associated with CM:

- Defining and instilling new values, attitudes, norms, and behaviours within an organisation that support new ways of doing work including overcoming resistance to change;
- Building consensus among customers and stakeholders on specific changes designed to better meet their needs; and
- Planning, testing, and implementing all aspects of the transition from one organisational structure or business process to another (ibid, p.25).

To sum up, the foregoing section sought to establish a working relationship between change and change management. Hiatt and Creasey (2012) have underscored the notion that if we are to effectively position change management in our organisations, we need to start the conversation about the current state, transition state and future state for the organisation. And then continue the conversation to focus on individual current states, transition states and future states. Hence, change management is about supporting individual employees impacted by the change through their own transitions; from their own current state to their own future state that has been created by the project or initiative. Hiatt and Creasey (2012) argue that it is only when employees embrace, adopt and use the change that results are achieved (Graetz, 2005; Hayes, 2010; Hiatt, 2006; Kotter, 1996).
2.2 Key Drivers or Sources for Change

Having looked at the nature of change and then defined the change management process, this section focuses on major aspects of change:

- Sources of change;
- Types of change;
- Examples of change management models; and
- The practical applications of change management.

Pressure for change is defined as the need or driving force (Stacey, 1993). According to Fullan (2001) change may be imposed on people by natural events or deliberate reforms. In some instances it is the people themselves who may voluntarily initiate and participate in the change. Kotter (1996) cited in Harvard Business Review (2007, p.3) notes that: “most successful change efforts begin when some individuals or some groups start to look hard at a company’s competitive situation, market position, technological trends, and financial performance”. Stacey (1993) observes that the need for change within organisations is driven largely by external factors such as the economic, technological, social, political and cultural environment. However, not all change is directly externally driven. Change may also happen due to internal organisational factors such as; employee demands, organisational politics and top management changes (Bennett et al., 1992; Fullan, 1993; 2001; Morrison, 1998; Murray, 1990; Kotter, 1996). Morrison (1998) noted that technological developments in the workplace have been the major driving forces behind transformations in education. Figure 2.3 summaries some of the key drivers of organisational change.
2.3 Types of Change

Figure 2.4 summarises three types of change identified by Ackerman (1997).

- **Developmental**
  - May be either planned or emergent; it is first order, or incremental. It is change that enhances or corrects existing aspects of an organisation, often focusing on the improvement of a skill or process.

- **Transitional**
  - Seeks to achieve a known desired state that is different from the existing one. It is periodic, planned and second order, or radical. Much of the organisational change literature is based on this type (Fullan, 1993; Fullan, 2001; Bridges, 2009; Kotter, 1996; Morrison, 1998; Whitaker, 1993).

- **Transformational**
  - Is radical or second order in nature. It requires a shift in assumptions made by the organisation and its members. Transformation can result in an organisation that differs significantly in terms of structure, processes, culture and strategy (Blake and Bush, 2009). It may, therefore result in the creation of an organisation that operates in developmental mode – one that continuously learns, adapts and improves.
2.4 **Examples of Change Management Models**

This section presents and discusses some business and industrial literature on management of change initiatives which have served as impetus for educational reforms. The insights gained are used to inform the development of a framework that can be used to support the management of change within the context of the BGCSE D&T curriculum.

2.4.1 *Kotter’s (1996) Model*

According to Kotter (1996) 70% of all major change efforts in organisations fail because they do not take a holistic approach required to see the change through. Research identifies ten factors have been found to contribute to the demise of many change efforts. Figure 2.5 presents these contributing factors.

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**Figure 2.5: Factors contributing to change failure**

*Illustration by the researcher based on Kotter’s 8-Step change model*
Figure 2.6 summarises Kotter’s 8-step change model.

Figure 2.6: Kotter’s 8-Step Change Model
Adapted from: Kotter (2012)
2.4.2 Blake and Bush (2009) Model

The Eight Lenses of the Change Prism developed by Blake and Bush (2009) is a planning aid and diagnostic tool that is used to provide a ‘reality check’ before embarking on a change initiative. The planning aid is designed to help anticipate problems that are likely to arise and take necessary steps to ensure that change activities are not underestimated. Blake and Bush’s (2009) model is premised on the organisational ability to address the following guiding questions:

a) **Strategy and future use**: what do we want to achieve and what will it look like when we get there?

b) **Planning and management**: what needs to be done and what benefits do we want or expect?

c) **Leadership and capability**: who will need to make the change happen and what will be required of them?

d) **Stakeholders and communication**: who needs to be involved or kept informed and how will we communicate them?

e) **Resilience and capacity**: how ready, willing and able are we to absorb the changes?

f) **Organisation alignment**: how will we need to be organised to make changes work?

g) **Culture and behaviours**: what values and attitudes do we want employees to embody and what behaviours will we need them to adopt?

h) **Employee motivation and skills**: what motivators, processes and skills need to be in place to enable employees to do their jobs effectively and achieve the future state? (p.80).
2.4.3 PROSCI’S ADKAR Change Management Model (1998)

The PROSCI Inc, founded in 1994, is the world leader in benchmarking research and change management products. PROSCI’s tools and methodology are based on best practices research with over 3400 international organisations and are used by more than three quarters of Fortune 100 companies (http://www.prosci.com/). As such the PROSCI methodology has become one of the most widely used approaches to managing the people side of change in business and government (Hiatt and Creasey, 2012). The name "ADKAR" is an acronym based on the five building blocks:

- **Awareness** of the need for change
- **Desire** to participate and support the change
- **Knowledge** on how to change
- **Ability** to implement required skills and behaviours
- **Reinforcement** to sustain the change (Hiatt and Creasey, 2012, p.46).

The ADKAR change management model was developed to provide guiding framework through which organisations or change leaders could build change management capability and enable them to implement change effectively. Unlike other models (Blake and Bush, 2009; Kotter, 1996) which tend to focus on the management of change throughout the entire organisation, the ADKAR is an individual-focused change management model that has been designed to support individuals through a transition (Hiatt, 2006). It takes cognisance of the uniqueness of individuals’ circumstances and because of this when change is implemented; individuals in an organisation rarely progress at the same speed.

The premise of the PROSCI’s ADKAR change model is that to move out of the current state, an individual needs **Awareness** of the need for change and **Desire** to participate and support the change. Successfully moving through the transition state requires **Knowledge** on how to change and the **Ability** to implement the required skills and behaviours. In the future state, that **Ability** is
utilised and Reinforcement is required to sustain the change (Hiatt, 2006; Hiatt and Creasey, 2012). In this manner, ADKAR provides a lens through which an organisation can diagnose the barrier point in change management. Figure 2.7 summaries how the ADKAR change model works.

**Figure 2.7: PROSCI’s ADKAR change management model**
*(Illustration by the researcher)*

PROSCI (2014) highlighted that organisations often focus more on the technical aspects of change such as implementing a new system or creating a communication plan. Moreover, they argue that for organisational change to be successful, individual employees must make a successful personal transition and adopt a new way of doing their jobs.
The PROSCI’s change model integrates individual change management and organisational change management and can be implemented in a number of ways including:

1) Making sense of change;
2) Guiding change management plans;
3) Measuring progress;
4) Diagnosing gaps;
5) Developing corrective actions; and
6) Enabling managers and supervisors.

Essentially this model emphasizes the “people side” of change and targets leadership within all levels of an organisation including executives, senior leaders, middle managers and line supervisors. In addition, this model provides the guidance and tools through which change leaders would need to apply at the project or initiative level. Hiatt and Creasey (2012) observed that the envisaged change can only be effective if the individual employees impacted by the change embrace it (Bourne and Bourne, 2012). Figure 2.8 exemplifies how the change process is integrated within the ADKAR change model.

![Figure 2.8: The PROSCI ADKAR model and the states of change](Source: PROSCI (2014))
2.4.4 Three Broad Phases of Change

Because change is difficult and complex to understand, many in the field have provided techniques for breaking it down into phases so as to help analyse the change (Hiatt and Creasy, 2012; Fullan, 2001). For example, Hiatt and Creasey (2012) observed that the most effective change management process consists of three phases namely: Phase 1 - Preparing for change; Phase 2 – Managing change; Phase 3 – Reinforcing the change. Figure 2.9 presents these three phases and the activities at each phase.

**Figure 2.9: PROSCI’S 3-Phase Change management Process**
Adopted from: Hiatt and Creasey (2012, p.63)
Fullan (2001) echoes this sentiment, noting that: “most researchers now see three broad phases to the change process” (p.50). The one-way arrow denotes a linear flow of activities between the stages. However, Fullan cautions of the many interacting variables at each phase which may affect activities in the subsequent phases. Figure 2.10 exemplifies this generic mode and also explains the processes involved at each phase.

![Diagram of 3-Phase Change Model](image)

**Figure 2.10 An example of a 3-Phase Change Model**

(Adopted from: Fullan, 2001)
2.5 Change Management Concepts

This section presents and discusses the key issues which arose from the change management literature. These issues are considered to be the key ones because they have been consistently reported as the most influential in determining organisational capacity to implement and sustain change (Kotter, 1996; Harvard Business School Press, 2003; Fullan, 2001). The list presented in this section is not claimed to be an exhaustive one, but serves as guiding principles which need to be established before proceeding with any proposed change initiative. Table 2.1 lists some of the critical issues which arose from change management literature (Bourne and Bourne, 2012; Cameron et al., 2009; Harvard Business School Press, 2003; Kotter, 1996; Newton, 2007; Stensaker and Meyer, 2012; Hiatt and Creasey, 2012).

Table 2.1: Concepts associated with Change Management (1 of 4)

<table>
<thead>
<tr>
<th>Literature on change management</th>
<th>A list of key concepts/issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>“None of the change programs are easy nor is success ever assured” (Harvard Business School Press, 2003).</td>
<td>1. Change is a complex and unpredictable phenomenon</td>
</tr>
<tr>
<td>“Change for both the initiator and those affected, is rather like a journey of the unknown. You cannot predict accurately how people will react or how new processes and procedures will work” (Bourne and Bourne, 2012).</td>
<td></td>
</tr>
<tr>
<td>“Unfreezing or creating the motivation for change” (Lewin, 1951).</td>
<td>2. Creation of awareness of the need for change and sharing the vision</td>
</tr>
<tr>
<td>“Establishing a sense of urgency” (Kotter, 2012).</td>
<td></td>
</tr>
<tr>
<td>“Creating a burning platform” or “a compelling case for change” (Bourne and Bourne, 2012).</td>
<td></td>
</tr>
<tr>
<td>“Awareness of the need for change” (Hiatt, 2006; Hiatt and Creasey, 2012; Hiatt, 2013; PROSCI, 2014).</td>
<td></td>
</tr>
<tr>
<td>“Building a business case” (Newton, 2007).</td>
<td></td>
</tr>
<tr>
<td>“Establishing the need for change” (Cameron and Green, 2012).</td>
<td></td>
</tr>
<tr>
<td>“Strategy and future use” (Blake and Bush, 2009).</td>
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</tbody>
</table>
### Table 2.2: Concepts associated with Change Management (2 of 4)

<table>
<thead>
<tr>
<th>Literature on change management (Cont’d)</th>
<th>A list of key concepts/issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Developing vision and strategy” (Kotter, 2012).</td>
<td>3. <strong>Planning</strong> for change and developing a change management <strong>strategy</strong></td>
</tr>
<tr>
<td>“Planning and management” (Blake and Bush, 2009).</td>
<td></td>
</tr>
<tr>
<td>“Developing a means of achieving the vision” (Bourne and Bourne, 2012).</td>
<td></td>
</tr>
<tr>
<td>“To achieve a purpose in competition with other organisations, there needs to be a strategy” (Stacey, 1993).</td>
<td></td>
</tr>
<tr>
<td>“Forming a powerful coalition” (Kotter, 2012).</td>
<td>4. Formation of a strong and credible change <strong>leadership</strong></td>
</tr>
<tr>
<td>“Leadership and capability” (Blake and Bush, 2009).</td>
<td></td>
</tr>
<tr>
<td>“Build the change team and create a steering committee” (Newton, 2007).</td>
<td></td>
</tr>
<tr>
<td>“Good communication plays an important part in making sure that the management team presents a strong and united front” (Bourne and Bourne, 2012).</td>
<td>5. <strong>Effective communication</strong> is critical</td>
</tr>
<tr>
<td>“Effective communication can set the tone for a change program and is critical to the implementation from the very start” (Harvard Business School Press, 2003).</td>
<td></td>
</tr>
<tr>
<td>“Without credible communication, and a lot of it, employees’ hearts and minds are never captured” (Kotter, 2012).</td>
<td></td>
</tr>
<tr>
<td>“Communication needs to be well planned, and these plans need to be clear about how to get the right information to the right people at the right time through the right medium” (Cameron and Green, 2012).</td>
<td></td>
</tr>
<tr>
<td>“Enlist the support and involvement of key people” (Harvard Business School Press, 2003).</td>
<td>6. <strong>Stakeholder involvement</strong> and <strong>ownership</strong> in the change process</td>
</tr>
<tr>
<td>“Major change is usually impossible unless most employees are willing to help, often to the point of making short-term sacrifices” (Kotter, 2012).</td>
<td></td>
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</tbody>
</table>
### Table 2.3: Concepts associated with Change Management (3 of 4)

<table>
<thead>
<tr>
<th>Literature on change management (Cont’d)</th>
<th>A list of key concepts/issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Empower a broad base of people to take action by removing as many barriers to the implementation of the change vision as possible” (Kotter, 2012).</td>
<td>7. <strong>Changing systems or structures</strong> that impede the change effort or vision</td>
</tr>
<tr>
<td>“To really drive the change forward, the systems should be aligned to the change” (Bourne and Bourne, 2012).</td>
<td></td>
</tr>
<tr>
<td>“Create enabling structures... such structures include pilot programs, training, and reward systems” (Harvard Business School Press, 2003).</td>
<td></td>
</tr>
<tr>
<td>“Providing whatever support and action is appropriate to ensure the change initiative achieves its objective” (Newton, 2007).</td>
<td>8. <strong>Continuous and visible support</strong> by the <strong>sponsor</strong> or <strong>administrator</strong> is critical not just at the beginning, but throughout the entire life of the project.</td>
</tr>
<tr>
<td>“Major change is often said to be impossible unless the head of the organisation is an active supporter” (Kotter, 2012).</td>
<td></td>
</tr>
<tr>
<td>“Sponsors actively and visibly participate in the change” (PROSCI, 2014).</td>
<td></td>
</tr>
<tr>
<td>“Visible managerial support” (Cameron and Green, 2012).</td>
<td></td>
</tr>
<tr>
<td>“Providing information and support to those who need it” (Bourne and Bourne, 2012).</td>
<td>9. People need to be <strong>empowered</strong> with <strong>knowledge</strong> of how to implement change through <strong>training</strong> and <strong>adequate resources</strong>.</td>
</tr>
<tr>
<td>“Resources available for education and training” (Hiatt, 2006).</td>
<td></td>
</tr>
<tr>
<td>“Providing appropriate incentives to continue working through the change period” (Newton, 2007).</td>
<td></td>
</tr>
<tr>
<td>“Empowering people to effect change... without the right skills and attitudes, people feel disempowered” (Kotter, 2012).</td>
<td></td>
</tr>
<tr>
<td>“A number of supporting mechanisms need to be in place” (Cameron and Green, 2012).</td>
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</tbody>
</table>
Table 2.4: Concepts associated with Change Management (4 of 4)

<table>
<thead>
<tr>
<th>Literature on change management (Cont’d)</th>
<th>A list of key concepts/issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Ensure sustainability, have follow-through” (Cameron and Green, 2012).</td>
<td>10. For change to stick, it needs to be anchored into the organisational culture.</td>
</tr>
<tr>
<td>“Consolidate improvements and produce still more change” (Kotter, 2012).</td>
<td></td>
</tr>
<tr>
<td>“Resistance from employees and managers is normal” (Hiatt and Creasey, 2012).</td>
<td>11. Change is often met with resistance. Anticipate that there will be resistance to change and develop a resistance management plan</td>
</tr>
<tr>
<td>“There are nearly always people who will not accept change and it is important to manage these people-not to ignore them and leave them so that they become a continuing source of discomfort” (Bourne and Bourne, 2012).</td>
<td></td>
</tr>
<tr>
<td>“Some may see change as a reflection on their success, while others perceive change as a statement of failure...As a result, resistance from some mid-level managers is very common” (Hiatt, 2006).</td>
<td></td>
</tr>
<tr>
<td>“There are bound to be negatives, and people should anticipate them” (Harvard Business School Press, 2003).</td>
<td></td>
</tr>
<tr>
<td>“It is often asserted that people within organisations generally resist change” (Stacey, 1993).</td>
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</table>

From the initial literature review on change management, a number of issues arose which necessitated further understanding. Figure 2.11 a list of these issues.
Chapter 2 – Literature review

2.5.1 Complexity and Unpredictability of Change

Change is a non-linear and complex phenomenon and often full of surprises (Fullan, 1993; Kotter, 1996). Fullan (1993) describes change as “a journey of unknown destination” (p. viii). Fullan makes the following observation about the complexity of change:

“it is a world where one should never trust a change agent, or never assume that others, especially leaders, know what they are doing, - not because the change agents and leaders are duplicitous or incompetent – but because the change process is so complex and so fraught with unknowns that all of us must be on guard and apply ourselves to investigating and solving problems” (ibid, p.viii).

Bourne and Bourne (2012) drove this point home that: “change for both the initiator and those affected, is rather a journey of the unknown; you cannot predict accurately how people will react or how new processes and procedures will work” (p.20). Even the most carefully planned and executed change
programme will have some emergent issues (Kotter, 1996). Additionally, as Stensaker and Meyer (2012) observed another challenge is the: “ability to predict and handle different responses to change among employees” (p.106). However, the literature asserts that in order to determine an appropriate strategy, it is important to understand the nature of change one wishes to effect and the context in which they are working in (Blake and Bush, 2009; Hiatt and Creasey, 2012; Kotter, 1996; Fullan, 1993; Stacey, 1993).

2.5.2 Creation of Awareness about the Need for Change

Bourne and Bourne (2012) identified creating a burning platform as the first step in managing change. Creating a burning platform refers to building awareness around the need for change as well as creating a desire among employees (Kotter, 1996; Hiatt and Creasey, 2012). Kotter (1996) argues that not “creating enough sense of urgency” at the outset is the most common mistake in trying to implement change. Moreover, he suggests that the need for change and the downside of the required change not occurring must be explained to every member of the organisation. It is emphasised that organisation wide discussion must take place and be encouraged (ibid). For this to occur would necessitate talking to other co-workers about the situation (Kotter, 1996).

Additionally, outside consultants or collaborators can be brought in to add mirror to the discussion and highlight the necessity for change to occur. This will establish a sense of urgency within the organisation and create a consensus. To achieve a high sense of urgency, it is recommended that at least 75% of the organisation needs to agree that the change is needed (Kotter, 1996; Harvard Business School Press, 2003). Once this has been accomplished, the organisation can move to the next step of the change model.

2.5.3 The role of Leaders and Managers in Change Management

This section examines the role of leadership in change management. Particular attention is given to the leader’s role in terms of creating a vision, aligning relationships around the vision and inspiring others to achieve the vision. Leadership is considered as a collective process and also discusses pertinent
issues around maintaining coherence between the leading coalition and the various stakeholders. The objectives of this section are to:

- explore the different roles expected of them and their colleagues in a change process;
- explore the range of skills and qualities that leaders need to ensure success;
- identify how leaders of change can adapt their style and focus to the different phases of change;
- underscore the importance of self-knowledge and inner resources in any leadership role.

For the purpose of clarifying roles played by leaders and managers in change management a distinction between these two concepts is critical. Helping managers to be effective sponsors of change have been identified as the most critical success factor in dealing with the people dimension of change (Hiatt and Creasey, 2012; Newton, 2007; Cameron and Green, 2012). This is even a more compelling case because of the bureaucratic nature of our systems which were designed to keep those establishments functioning a lot of emphasis was focused on many companies and universities developed management programs and many companies encouraged their employees to take up management courses. But little was taught about leadership. Kotter (2012) argues that management was emphasised because it was easier to teach than leadership. Kotter (2012) notes that: “unfortunately for us today, this emphasis on management has often been institutionalised in corporate cultures that discourage employees from learning to lead” (p.30). With a strong emphasis on management and less on leadership, bureaucracy and an inward focus can take over. Figure 2.12 summarises the roles played by leaders and managers in the change management process.
One of the key success factors in the management of change is the leadership commitment to build an organisational change management capability (Havard Business School Press, 2011; Hiatt and Creasey, 2012). The issue of change leadership was cited as problematic in the management of change because nobody is good at it (Kotter, 1996; Munroe, 2014). According to Kotter (1996), change by nature requires creating a new system, which in turn always demands leadership. He argues that central to successful implementation is the key role the ‘magic’ leader plays. Kotter argues that the vision of the organisation hinges on the leader’s ability to articulate it to others in ways that make the benefits of change clear. Similarly, Harvard Business School Press (2003) identify a leader as someone: “who owns and leads the change initiative”

Figure 2.12: Comparing leadership and management roles

Illustration by the researcher adapted from: Kotter (2012, p.29)
(p.38). Essentially the leadership must act as champion, assemble the resources needed for the project and take responsibility for the success or failure (Kotter, 1996; Harvard Business School Press, 2003). Elsewhere, Cameron and Green (2012) identified a wide range of styles and skills required of leaders as follows:

- Goal setting;
- Monitoring and controlling;
- Coaching and supporting;
- Building vision;
- Communicating vision;
- Building coalitions;
- Networking;
- Negotiating;
- Facilitating;
- Dealing with conflict (pp.155-56).

Fullan (2001) shares the same view that: “the enemy of improvement is inertia” (p.175). Hence, to initiate, implement and sustain the change process requires certain conditions to be created (Kotter, 1996; Fullan, 2001). The first condition requires the presence of strong and visionary leadership. Lachive and Tardif (2002) describe this leadership as people who have the capacity to: “attract individuals to a rallying objective defined by a mission, an educational vision, and guiding principles, backed by the establishment and maintenance of a climate of confidence that drives the determination to succeed” (ibid, p.7). Kotter (1996) develops this point further by arguing that change leadership is concerned with the driving forces, visions and processes that fuel large-scale transformation. Essentially change leadership is about seeing the whole picture, the ability to motivate others and explaining how to get it done. Figure 2.13 shows the strategic roles played by a leader in an organisation.
2.5.4 Creation of Shared Vision and Strategy for Change

Although it is believed that creating a burning platform makes the need for change a reality (Kotter, 1996). Some like Bourne and Bourne (2012) argue that this effort alone is not sufficient to create change. They argue that a vision of the future and knowledge of how to take the first few steps to get there should be developed. Fullan (1993) highlights personal building vision as a foundation for building greater change capacity because: "it connects with the moral purpose of contending with the forces of change" (p.13). Fullan contends further that shared vision is important in the long run; however for it to be effective one has to have something to share (ibid, p.13).

PROSCI (2014) illustrate this point that if you do not know where you are going, any road will lead you there. This underlies the importance of defining the future state (Blake and Bush, 2009). PROSCI assert that defining the future state provides direction and a way to evaluate your progress. It also creates stability when the excitement around change management ebbs and flows. In contrast, Kotter (1996) observed that many practitioners begin pursuing change capability without defining what the situation would look like if they were successful (Hiatt and Creasey, 2012).
Once the needs have been identified, some form of strategy needs to be developed. Fullan (2001) describes this stage as implementation and defines it as "the means to achieving certain outcomes" (p.52). Harvard Business School Press (2003) echoes this sentiment, noting that implementation involves planning the change and operationalising the strategy. As part of the implementation plan change leaders need to be appointed including their training and that of the rest of the staff. Moreover, the implementation plan may involve organisational restructuring. Harvard Business School Press (2003) cautions that: "an overly complex plan may confuse and frustrate participants in the change effort" (p.54). From this understanding, it is therefore advised that a good implementation plan should be flexible and open to revision (ibid).

2.5.5  Communicating Change and Motivating Others

This section considers the role of communication in the management of change. The section addresses issues associated with change managers perceiving, interpreting and using information communicated to them by others. The premise of the section is to demonstrate how the quality of communication can facilitate or hinder change in an organisation.

Once the need for change has been identified and the decision to adopt it has been taken, it needs to be communicated throughout the organisation. For success, it is recommended that the need for change must be clearly articulated at all levels and embedded in the culture of the organisation (Fullan, 2001; Kotter, 1996; Harvard Business School Press, 2003). Fullan (2001) drives this message home that: "the more the horizontal and vertical two-way communication that exists, the more knowledge there will be about the status of change" (p.181). The foregoing statement highlights the need for effective communication from the outset of the implementation effort. For example, Morrison (1998, p.16) notes that people may require further information about the envisaged change and how the changes will affect them personally. Equally important for people to know might be how the envisaged changes will take place and be managed and the possible consequences of the changes on the
employees. This highlights the need to have a clear vision to establish the nature and direction of change (Kotter, 1996).

The issue of communication is particularly problematic when one considers that most organisational structures, particularly those in education, tend to operate within a pyramidal management system (Tabulawa, 2009). For example, Bush and Middlewood (2005, p.66) observed that this management style can hinder effective communication. In a similar way, Fullan (2001) notes that often such pyramidal structures act as impediments to change. Hence, Fullan argues that if change is built on a weak infrastructure it is doomed to fail. Moreover, he identified another limitation of pyramidal structures as that of lack of cohesion among various stakeholders in terms of purpose (ibid). Therefore, it is important that: “the information gathering system to assess and address problems of implementation be institutionalised” (Fullan, 2001, p.181).

2.5.6 Stakeholder Participation

Kotter (2012) notes that: “the implementation of any kind of major change requires action from a large number of people” (p.10). This leads to a discussion about stakeholder participation in the change process. Similarly, the Harvard Business School Press (2003) also argued that: “effective change demands collaboration between willing and motivated partners” (p.25). Schmeer (1999) defines stakeholders as “actors (persons or organisations) who have a vested interest in the policy that is being promoted” (p.3). Fullan (2001) argues that: “real change... whether desired or not represents a serious personal and collective experience” (p.32). Stakeholder participation is a pertinent issue in change management because it has been observed stakeholders are likely to resist change if they do not understand the implications it may have on them (Newton, 2007). The foregoing statements underscore the notion that strategies for change must build on ownership and involvement of all the key players (Morrison, 1998). Harvard Business School Press (2003) shares this notion that people closest to a situation can address the issues better than those in the management. Morrison suggests that one way of ensuring stakeholder participation is by adopting a bottom-up strategy rather than a top-down model.
Morrison believes that the bottom-up approach would help to: “build ownership, engagement and involvement of all participants actively rather than passive recipients of prefigured decisions” (ibid, p.16). Similarly in education Fullan (2001) has argued that change needs to be analysed from the perspective of the roles played by various stakeholders and their organisational relationships (Morrison, 1998; Murray, 1990; Schutt, 2006).

Elsewhere, Cameron and Green (2012) have argued that whatever the level or degree of organisational change, the people on the receiving end are the individual human beings. Because of this people need to know the reasons behind the change as well as the intended effect on them and their working practices (Hiatt and Creasey, 2012; Newton, 2007). Success of the change vision hinges on its ability to be communicated to all members of the organisation and other key stakeholders (Kotter, 1996). A shared vision and the collective acceptance to change are considered to be the second most essential condition (Lachiver and Tardif, 2002; Kotter, 1996). The change vision should be presented and discussed openly to allow organisational members to express their concerns and fears about the looming change process. Kotter suggests that outside consultants or collaborators can be brought in to add more credibility to the discussion and highlight the necessity for change to occur. Similarly, Dalin et al. (1993), cited in Morrison (1998, p.16), assert that the strategies of change must build on ownership and involvement of participants. This will help allay any misunderstandings about the process which may hinder the change as it is being implemented. Therefore, to enhance participation by all key stakeholders requires an organisation to develop mechanisms that facilitate collective consultation and decision making (Schmeer, 1999).

### 2.5.7 Administrative Commitment and Support

Stacey (1993) argues that sustainable change in organisations requires administrative support. For success, however, regardless of where the original pressure came from, senior management commitment and drive for change is essential if momentum is to be maintained for effective implementation (Bourne and Bourne, 2012; Graetz, 2005). Hiatt and Creasey (2012) underscore this
point that: “the sponsor’s role in change must be to be active and visible in all phases of the change process” (p.34). Likewise, Fullan (2001) and Kotter (1996) support this notion that senior management should show more commitment to change. They suggest that commitment to change is demonstrated by provision of resources such as the human capacity, finance and time.

Harvard Business School Press (2003) defines capacity as the resources that the organisation needs to implement the change effectively. The organisation’s capability in terms of human and physical resources will need to be assessed beforehand. In addition to the above considerations, it is advised that an organisation will need to develop enabling structures (Harvard Business School Press, 2003). Kotter (2012) identifies four main barriers to change in organisations:

a) **Structures:** Formal structures make it difficult to act;

b) **Skills:** Lack of need skills undermines action;

c) **Systems:** Personal and information systems make it difficult to act; and

d) **Supervisors:** Bosses discourage actions aimed at implementing the new vision (p.106).

### 2.5.8 Empowering Employees and Providing Incentives

Kotter (1996) argues that addressing the concerns and fears of organisational members is not enough; organisational members must be empowered to act with additional information about the vision. By including members in the development of ideas about how the vision should be achieved, organisational leaders will give them a sense of empowerment.

Leaders should try to remove any barriers which hinder the vision’s success and implementation by identifying those members who have embraced the vision and begun to work on the change process (Hiatt and Creasey, 2012). Those individuals should be rewarded and encouraged as they can as conduit of the vision by allaying remaining scepticism and fear within other organisational
members. When short-term milestones have been achieved, these successes can be celebrated to acknowledge a sense of accomplishment. This will ensure that the morale remains high within the organisation that change direction is maintained.

**2.5.9 Institutionalising and Consolidating Change**

Without reinforcement, employees may revert back to the old way of doing things, and the project may not deliver the intended results (Kotter, 1996; Hiatt and Creasey, 2012; PROSCI, 2014). Kotter asserts that generating short-term wins generates a great launching pad for organisations to continue change initiatives. Initial change successes can be used as a foundation for expanded and greater change for the organisation.

Kotter (2012) maintains that lessons learnt from short-term wins and the change morphologies adopted by the organisation must become institutionalised to increase its ability to a changing environment. Once the benefits of short-term wins have been consolidated, organisational leaders and members seek to continuously improve on new skills and enhance their ability to successfully attain the goals set out in the organisational change vision. Kotter (2012) recommends that to encourage continued improvement and to prevent stagnation, new change agents and leaders should be regularly added to organisation's change coalition (Cameron and Green, 2012). The next section discusses mechanisms that can be used to ensure that change is sustained.

**2.5.10 Continuous Improvement, Monitoring and Reflection**

Change initiatives should not be perceived by organisational members as a passing trend within an organisation (Kotter, 1996). The changing demands and technology constantly require organisations to adapt and remain flexible (Stacey, 1993). In a sense the urgency for change that was explained and developed in step one, is something the organisation should never seek to lose (Kotter, 1996). This will enhance organisation's members to learn how to implement the change quickly and constructively in the future and lead a culture that embraces innovation rather than fearing it.
2.5.11 Supporting Employees through Change

Cameron and Green (2012) note that:

“individual change is the heart of everything that is achieved in organisations... once individuals have the motivation to do something different, the whole world can begin to change” (p.11).

One way of ensuring that change is sustained in an organisation is by empowering employees through training and provision of resources. Bridges (2009) notes that in many organisations when change is envisioned it is usually the top executives who go through their own transition first. The middle management and the rest of the employees are usually considered last. Consequently, the organisational leaders tend to get past their own transition whilst the rest of the organisation is still grappling with their own. This oversight is also noted by Fullan (2001) who argues: “it is easier to adopt structural changes than to engage in the hard-work of cultural changes in relationships, capacity and motivation” (p.221). Indeed Bridges recommends that if an organisation wants to take its people on board with a change initiative, it needs to consider its own transition alongside with that of its employees who may be on different stages.

2.5.12 Resistance Management

Any time people perceive themselves as losers in a change initiative, expect resistance. Resistance may be passive, in the form of non-commitment to the goals and the process for reaching them (Harvard Business School Press, 2003).

Studies have shown that change initiatives are often met with resistance (Hiatt and Creasey, 2012; Kotter, 2012; Morrison, 1998; Oskamp (1977). Hiatt (2006) asserts this point that that resistance does not occur in a vacuum. For instance, Kotter (2012) notes that: “occasionally the roadblocks are only in people’s heads and the challenge is to convince them that not external barriers exist.” (p.10). To illustrate this point Kotter observes that if members of an
organisation feel that they have not been duly consulted they may resist change. Kotter attributes this resistance to change to following:

a) people having to learn new skills;
b) loss of status or standing;
c) devaluation of their knowledge or skills; and
d) lack of understanding of the change.

Similarly, in education Fullan (2001) noted this resistance by the teachers. He attributes this resistance to several factors. He identifies the main ones as follows:

- inertia (the lack of desire to change);
- status quo (people are satisfied with what they already have in place);
- rapidity of change (always the next new thing);
- teacher’s lack of research knowledge or lack of time to read;
- no financial or time support.

Elsewhere, Hiatt and Creasey (2012) identify two contexts in which resistance may occur namely: personal and organisational. For instance, an employee’s personal and family situation may affect how they react to change. Employees may also have concerns about how the change might affect their professional career and plans. In some cases resistance to change may be due to concerns about the degree to which the envisaged change may affect a particular employee personally. Hence, these authors suggest three strategies for managing resistance as follows:

1) Resistance prevention;
2) Proactive resistance management;
3) Reactive resistance management.

However, Harvard Business School Press (2003) noted that if people are sufficiently dissatisfied with the status quo, they are more likely to make the effort and accept the risks with doing something new. Similarly, Bridges (2009)
observed that though many people eventually internalise the change and make the needed adaptations, however he maintains that they would cope better if they are being supported through various psychological stages (Harvard Business School Press, 2003). Figure 2.14 illustrates some of the possible causes of resistance at various levels of the change process.

Figure 2.14: Possible causes of resistance in an organisation

Source: PROSCI (2014)

Morrison (1998) asserts that people respond to change in a variety of ways. He argues that people will respond to the way in which they perceive the change. However, in order to minimise people’s resistance to change, Morrison asserts that those leading the change need to demonstrate that the new ‘zone’ is even more comfortable and secure (Bridges, 2009).

2.5.13 Managing people’s negative attitude to change

The foregoing section discussed issues associated with resistance to change. Specifically, the section focused on how people develop negative attitudes toward a given situation and processes can be used to help them develop more positive attitudes. This section explores causes of resistance to change and strategies that can be used to change people’s negative attitudes to change.

Oskamp (1977) defines an attitude as: “the cause of a person’s behaviour toward another or an object” (p.5). In social science, the term refers to, “a posture of the
mind” (ibid, p.7). Katz (1960) cited by Oskamp (1977, p.50) suggests four major functions which attitudes perform. Figure 2.15 presents these attitudes.

![Diagram of Functions of Attitudes]

**Figure 2.15: Four major functions of attitudes**

Illustration by the researcher based on Oskamp (1977, p.50)

a) **Understanding**: Oskamp (1997) explains that many attitudes help us to understand our world and to make sense of occurrences around us. They provide consistency and clarity in our interpretation of events. These do not imply that they provide a factually truthful picture of the world but merely the one that is meaningful and understandable to the particular individual who holds it (ibid, p.50).

b) **Need satisfaction**: Many attitudes are formed as a result of our past rewards and punishments for saying or doing particular things. Once formed these attitudes usually continue to be useful in helping us to satisfy our needs or reach our goals (ibid, p.50). These attitudes have also been termed ‘adjustive’ in the sense of helping us to adjust to life situations in the sense that they are useful in reaching our goals. For example, a pupil may choose to do D&T because he has done well in the past and have been rewarded by the teacher’s praise and his own feeling of competence (ibid, p.50).

c) **Ego-defence attitudes**: Can also help to enhance our self-esteem and to defend us against the failings of life (thousand slings and arrows). Oskamp notes that all people use these as a defence mechanism to some extent, but argues that they are used much more by individuals who are insecure or feel inferior or have deep internal conflicts.
d) *Value expressive attitudes:* Are usually difficult to change because people’s values are apt to be very important central parts of one’s cognitive structure.

Oskamp (1977) emphasises that it takes different forces and pressures to change attitudes that are serving different situations. The conditions that may lead to changing a person’s understanding-oriented attitude may be quite different than the conditions necessary for changing an ego-defensive attitude. Understanding-oriented attitudes are most likely to change in situations which have become ambiguous for the attitude holder due to new information or a changed environment (ibid, p.53). On the other hand, ego-defensive attitudes are unlikely to be changed by procedures which work with other types of attitudes, such as providing new information or offering incentives for change. Since ego defences are erected to protect the person from threats and conflicts, it is necessary first to remove the threat or conflict before attitude change can occur. He suggests that this can be done by establishing a supportive atmosphere.

In summing up, in order to address people’s resistance to change it is essential to establish the driving forces behind that negative attitude. Katz (1960) cited in Oskamp (1977, p.50) asserts that understanding people’s attitudes can help to explain the types of situations in which different attitudes can be aroused and types of influences which will be effective in changing different attitudes.

### 2.6 Summary


The management of change whether it is implemented in corporations or educational institutions can be analysed in two broad dimensions, namely: the technically and socially (Hall, 1997; Kotter, 1996). The technical dimension deals with developing a vision for change and its implementation strategy. While the social dimension deals with the human factors associated with the
change. The latter has been found to be the most challenging and often overlooked aspect of the change process (Bridges, 2009; Hiatt and Creasey, 2012; Fullan, 2001; Hargreaves, 2005; Hiatt, 2006; Kotter, 1996).

When an organisation implements a change, no matter the size or nature or type, the bottom line is to improve the performance of the organization in some meaningful way. The change may be to fix a problem or to seize an opportunity. It may result from customer, competitive or internal pressures (Stacey, 1993). It may be incremental in nature or it may be a radical new way of operating. It may impact a few individuals or impact the entire organisation (Hiatt, 2006; Hiatt and Creasey, 2012). It may impact behaviours, processes, tools, technology, organisational structures or job roles. But, regardless of the nature of the change, organisations launch projects and initiatives to improve performance; to reach a future state that is better than the current state (Hiatt, 2006).

Fullan (2001) notes that one of the major difficulties about change lies in planning and coordinating such a multi-level social process because of the fact that change many people in an organisation. This view has also been echoed by Stensaker and Meyer (2012) who remarked that the biggest challenge faced by those responsible for initiating and managing change is: “their ability to predict and handle different responses to change among employees” (p.106). Essentially, change management is viewed as a leverage which can offer organisations a holistic process for developing the strategies and plans to support impacted individuals through their own transitions.

The literature identified a number of popular and frequently used change models like Kotter’s (1996) "8 Step Change Model" and the PROSCI "ADKAR Change Model". A number of studies have found that many of these models are simply variations to suit a particular context (Fullan, 2001; Kotter, 1996; Stacey, 1993). Each model has its own merits and limitations. Kotter (1996) concurs with this notion that there is no perfect model. However, Fullan (2001) argues that: “the uniqueness of the individual setting is a critical factor” (ibid, p.49). He elaborates this point further by contending that “what works in one situation
Indeed as Bourne and Bourne (2012) have also asserted that there is no magic formula. This leads to the conclusion that the reason people would prefer a particular model is because they feel is most appropriate to their own circumstances. Therefore, the underlying message is that for any change initiative to succeed, the context and the organisational conditions in which it is carried out must be considered (Fullan, 2001; Kotter, 1996).

In contrast, Warrilow (2009) suggests that the main limitation observed with most models is that they are not sufficiently holistic and broad in scope to fully address the human factors which have been identified as the commonest causes of failure. As Fullan (2001) points out that: “research findings on the change process should be used less as instruments of ‘application’ and more as means of helping practitioners and planners ‘make sense’ of planning, implementation strategies and monitoring” (p.49).

Many of the change management principles discussed in the preceding section focused mainly on approaches used in the corporate world. The next explores change management within an educational context.

### 2.7 The Driving Forces behind Educational Change

The foregoing sections highlighted key change concepts and how they relate to managing change especially in business and industry. These theories and principles are essential for managing change in accordance with individual circumstances and then making the necessary adjustments (Hiatt and Creasey, 2012; Kotter, 1996). To bring these concepts closer to education, the next section will focus on how some of the principles used in industry and business have shaped educational reforms.

The management of change in education has become a topical issue of perennial interest in the field mainly because of the following key drivers: developments in science, technology, politics, economies and educational practices (Morrison, 1998; Stacey, 1993). It has been observed that these developments have often been accompanied by unintended tensions between the business community
and the education one (Fullan, 2001; Morrison, 1998; Stacey, 1993). For example, Morrison (1998) highlights these tensions between these two ‘storms’ in terms of the management of change. For example, he notes that the business community often accuses the educational community for declining standards, for their failure to prepare students for the demands of work, by producing illiterate, innumerate and work shy employees. In turn, the educational community has accused the world of work as being the graveyard of aspirations, creativity, flexibility, adaptability, breadth and problem solving capabilities that schools have taken painstaking care to develop in their students (Entwistle (1981) as cited in Morrison, 1998, p.8). The business community argue that change in the business community is driven largely by the need to gain a competitive advantage whilst the education fraternity argue that competition is not an attribute that schools wish to encourage.

Morrison (1998) argues that: “regardless of how one views society, education as a significant component in socio-cultural and economic renewal and development is caught up in change” (p.3). Consequently, Fullan (1993) highlights this point that: “teachers’ jobs are more complex than ever before. They must respond to the needs of a diverse and changing student population, a rapidly changing technology in the workplace, and demands for excellence from all segments of society” (p.5).

Furthermore, Fullan (2001) observed that politically educational reforms are introduced because those in power deem them desirable according to certain educational values. Whitaker (1993) asserts this point that: “it is naive to hope for a day when education will be freed of political intervention” (p.8). Likewise Kotter (1996) acknowledges that change process is a long and challenging experience that many organisations must endure to guarantee success. However, Fullan (1993) argues that educators cannot do the task alone because already too much is expected of them. He explains that: “the market place raises the stakes ever higher in its performance demands of schools” (ibid, p.5). This asserts the view held by Morrison (1998, p.1) that the practices for the management of change in business and industry have a lot to offer to the world of education in terms of the management of change.
In summing up, it has been noted that education as a social service is often caught up in change mainly due to external pressures such as politics or changing demands in business and industry (Morrison, 1998; Fullan, 1993). These driving forces often require educators and teachers to adapt by updating their knowledge and skills to ensure that the education is relevant to the changing demands in the workplace. Therefore, human resource development and management are deemed the critical success factors in human services like education (Morrison, 1998). In terms of educational reforms, it has been argued that the critical site of change is the classroom and the teacher (Durrant and Holden, 2006; Morrison, 1998).

This leads to a discussion about how teacher professional development can be used to build teachers’ capacity to initiate and lead change. The premise of the next section is that teachers as the main force to implement a new curriculum are an essential part of the implementation strategy (Morrison, 1998; Whitaker, 1993; Fullan, 2001; Durrant and Holden, 2006).

### 2.8 Fostering Change and Managing Curriculum Change

This section highlights and discusses some important issues in fostering curriculum change, conditions for managing curriculum change and innovation and ideas for supporting teachers’ professional development in design and technology. The section concludes by offering some guidelines for the development of a more viable framework which could be used to support the implementation effort in Botswana.

Managing curriculum change is a complex issue (Fullan, 1993, 2001; Lachiver and Tardif, 2002). Once the motivation and the necessary conditions for change have been established, Lachiver and Tardif (2002) identify two frameworks which need to be considered to support implementation effort. The first is a learning framework which focuses on how students learn; the second is a conceptual framework which enables the detailed design of learning activities, and this necessitates a change in teachers’ attitudes toward teaching. This section is organised into the following headings:
• Conditions for curriculum change;
• Learning framework;
• Conceptual framework;
• Managing curriculum change;
• Conclusion.

Lachiver and Tardif (2002) assert that: “to engage and lead educators in a curriculum change process is not done easily; the road is difficult, sinuous, and sometimes chaotic” (p.7). Likewise Kotter (1996) acknowledges that the change process is a long and challenging experience that many organisations must endure to guarantee success. Hence, to initiate, implement and sustain the change process requires certain conditions must be created (Kotter, 1996; Fullan, 2001). The first condition requires the presence of strong and visionary leadership. Lachiver and Tardif (2002) describe this leadership as people who have the capacity to: “attract individuals to a rallying objective defined by a mission, an educational vision, and guiding principles, backed by the establishment and maintenance of a climate of confidence that drives the determination to succeed” (ibid, p.7). Kotter (1996) develops this point further by arguing that change leadership is concerned with the driving forces, visions and processes that fuel large-scale transformation. Essentially change leadership is about seeing the whole picture, the ability to motivate others and explaining how to get it done. Kotter emphasises that change leadership is a problematic issue in the management of change because nobody is good at it.
2.9 Managing Curriculum Change

This section highlights and discusses some important issues to consider in fostering curriculum change and some ideas for supporting teachers’ professional development. The remainder of this section will present and discuss principles that emerge from the professional development literature as a key strategy for curriculum change management.

In England, Hughes (2005) noted that D&T was one subject that: “experienced more changes than any other subject” (p.107). He observed that these changes often affected the school system as a whole. The changes have been attributed mainly to rapid technological changes that are taking place in society at large. Consequently, D&T teachers are constantly planning and implementing change as a strategy to meet the demands of an increasingly technological world.

Similarly, Banks (1994) noted that the implementation of changes in D&T education often require both the novice and experienced teachers needing to update their own understanding of the subject specific knowledge necessary for the content of the new curriculum (Atkinson, 1990).

Fullan (1993, p.12) argues that the individual educator is a critical starting point because the leverage for change can be greater through the efforts of individuals. He asserts that teachers are: “in one of the most ‘natural’ occupations for working on purpose and vision, because underneath that is what teaching is all about” (p.13). Fullan highlights this point, that: “we need a dual approach; working simultaneously on individual and institutional development” (ibid, p.12). Once the motivation and the necessary conditions for change have been established, Lachiver and Tardif (2002) identify two frameworks which need to be instituted to support implementation effort. The first is a learning framework which focuses on how students learn; the second is a conceptual framework which enables the detailed design of learning activities, which necessitates a change in teachers’ attitudes toward teaching.

Fullan (2001) identifies three dimensions which are significant in implementing any new educational program or policy. These are:
1) The possible use of new or revised *materials* which may be in the form of instructional resources such as curriculum materials or technologies;

2) The possible use of *new teaching approaches* such as teaching strategies or activities; and

3) The possible alteration of *beliefs*, for example pedagogical assumptions and theories underlying particular new policies or programs (*ibid*, p.39).

Figure 2.16 captures the three dimensions of change identified by Fullan (2001).

![Dimensions of change in education](image)

**Figure 2.16: Dimensions of change in education**

*Illustration by the Researcher based on Fullan (2001, p.39)*

Using the above scenario as an example, Fullan explains that a teacher could use *new curriculum materials or technologies* without altering the *teaching approach*. Or use the *materials* and alter some teaching *behaviours* without coming to grips with the conceptions of *beliefs* underlying the change. What Fullan has demonstrated is that accomplishing changes in practice will involve the interrelationship of the three dimensions outlined above: “*because together they represent the means of achieving a particular educational goal or set of goals*” (*ibid*, p.39). Figure 2.16 shows all the three dimensions intertwined to signify that the change has to occur in practice along the three dimensions in order for it to have any desired effect on the outcome.
2.10 Experiences of Managing Change in D&T Education

This section provides some case studies of the experiences by some countries on an international level in their attempt to implement the design and technology curriculum. The analysis and conclusions drawn from the review provide useful lessons for developing countries such as Botswana for future curriculum development and implementation process.

2.10.1 England’s Experience

The implementation of the D&T education into the National Curriculum in England and Wales in 1990 required that both the novice and experienced teachers needed to update their own understanding of the subject specific knowledge necessary for the content of the new curriculum (Atkinson, 1990; Banks, 1994; Eggleston, 1996).

- Many teachers found themselves under immense pressure to comply with new procedures in terms of the new curriculum (Eggleston, 1996; Atkinson, 1990). Eggleston notes that: “it became clear the new order was only being incompletely delivered in schools mainly due to the heavy burden of record keeping, testing and reporting associated with the National Curriculum” (p.40).

- There was also a widespread lack of resources both in terms of in-service training and the teaching and learning resources. One of the challenges was to bring together teachers from different backgrounds. For example, in England Atkinson (1990) observed tensions between the old and the new teachers which resulted in the subject being polarised between those who wanted: “to protect what they perceive to be their individual boundaries and those who believe in the need for hard technology and a sound knowledge base” (p.10).

- A widespread dissatisfaction and unrest among teachers was reported. Ultimately the government stepped in to save their major educational initiative (Eggleston, 1996).
2.10.2 New Zealand Experience

The New Zealand new technology curriculum was introduced in 2007; following a lengthy period of trialling and consultation, which included the publication of a draft version in 2006. Jones, Harlow and Cowie (2004) conducted a study on teachers’ experiences trying to implement this curriculum. Specifically their study sought: “feedback from teachers about the effectiveness of the curriculum in practice” (p.102). The key aspects which informed data collection for this investigation included: “background and experience of teachers, general issues related to implementation, practice, support, the curriculum documents, impact and compliance issues” (ibid, p.102).

Jones et al. (2004) report that prior to the implementation of this curriculum a draft statement of the curriculum was trialled in schools to accord teachers and other stakeholders such as business and community groups a chance to air their views. The responses obtained from teachers indicated that a positive response in terms of the general structure and philosophy of the curriculum.

In terms of the confidence to deliver the curriculum, the results showed that: “across all school types two thirds of teachers expressed a medium level of confidence in teaching technology and one-fifth a high level of confidence” (ibid, p.104). Jones et al. noted that in terms of support and professional development: “... an extensive programme of professional development was offered to teachers” (ibid, p.108). While many teachers found professional development beneficial to them, however, a number of them, expressed the need for more support in the form of ‘practical ideas’ which would help them to implement the curriculum such as “… videos and software, student resources, and teacher guidebooks” (ibid, p.109). Some teachers felt that the facilities they taught in hindered their implementation (ibid, p.113).

Overall, the major issues which were raised by the teachers concerning the implementation of the curriculum included:

- The difficulty of resourcing the equipment needed to implement the technology curriculum (50%);
• a ‘crowded curriculum’ was found to be a major challenge for 32% of all teachers, in particular the primary teachers;

• Teachers expressed the need for up-skilling or professional development in technology education and in particular a specific technological area (22%);

• Understanding the curriculum was one of the major challenges for 22% of all teachers (ibid, p.115).

2.11 Building Change Management Capability

The purpose of this section is to establish an understanding of how teacher professional development can be used to build the necessary change management capabilities and competencies. To lay the theoretical framework, the section starts by providing a working definition of teacher professional development. This is followed by a discussion about the nature of professional development in education as well as the role of teachers as change agents. The section concludes by exploring with key features of an effective professional development.

The researcher noted several terms in literature such as: teacher development, in-service education and training, staff development, career development, human resource development, professional development, continuing education, and lifelong learning (De Vries et al., 2013). Because of this variation in use and interpretation, the researcher deemed it necessary to provide a working definition which will guide the discussions on this topic. Researcher adopts the following working definition proposed by Day (1999, p.4):

“Professional development consists of all natural learning experiences and those conscious and planned activities which are intended to be of direct benefit to the individual, group or school and which contribute, through these, to the quality of education in the classroom. It is the process by which, alone and with others, teachers review, renew and extend their commitment as change agents to the moral purposes of teaching; and by which they acquire and develop
critically the knowledge, skills and emotional intelligence essential to good professional thinking, planning and practice with children, young people and colleagues through each phase of their teaching lives” (Cited in De Vries et al., 2013, p.79).

Scheerens (2010) defines teacher professional development (TPD) as: “activities that develop an individual’s skills, knowledge, expertise and other characteristics as a teacher” (p.19). Similarly, Villegas-Reimers (2003) cited Glatthorn’s (1995) definition of TPD as: “the growth that occurs as the teacher moves through the professional career” (p.11). Indeed Fishman et al. (2003) maintain that:

“professional development should fundamentally be about teacher learning: changes in the knowledge, beliefs, and attitudes of teachers that lead to the acquisition of new skills, new concepts, and new processes related to the work of teaching” (p.645).

Essentially, the ultimate goal of TPD is to prepare teachers to enact the curriculum appropriately for its design in their classrooms (ibid).

2.11.1 The Nature of Professional Development in Education

“Training is the cornerstone for building knowledge about the change and the required skills” (Hiatt and Creasey, 2012, p.70).

In order to bring about the desired changes in the classroom teachers’ effectiveness needs to be enhanced through professional development (PD). In education, PD activities are designed to enable teachers to update their knowledge, skills, and if necessary to implement the change (De Vries et al., 2013; PROSCI, 2014). Therefore, teacher training and professional development can be used as leverage to deliver knowledge about the change and the required skills (Morrison, 1998; Whitaker, 1993).

Many countries use TPD programmes to serve multiple objectives which include induction and mentoring especially for new teachers in their first years in schools (Villegas-Reimers, 2003). Moreover, these programmes are used to address teachers’ effectiveness especially in terms of addressing short-comings
in their initial training (Ben et al., 2012). For example, Ben et al.’s (2012) study identified a number of professional development activities which teachers participated in. Some of these activities included:

- Courses and workshops;
- Education conferences and seminars;
- Qualification programmes;
- Observation visits to other schools;
- Professional development network;
- Individual and collaborative research;
- Mentoring and peer observation;
- Reading professional literature;
- Informal dialogue to improve teaching (pp. 58-59).

Welch and Mueller (2003) note the existence of many forms of professional development (PD) for classroom teachers within the context of the design and technology education. PD activities range in duration, intensity and focus. For example, in some cases the duration may be a daylong session up to up a weeklong (ibid, p.91). These activities may be delivered as ‘one-shot workshops’ or on continuous basis. Welch and Mueller observed that facilitators of such training often: “present ideas, give tips, provide hand-outs, project a certainty about the topic and assume that the giving and receiving of public knowledge will lead to behavioural change” (ibid, p.91).

Jones (2003) cited in Canavan and Doherty (2007, p.292) observed in many countries that the general approach to in-service training has been on the development of skills and knowledge. Jones argues that there is a need to consider training that would encompass both academic rigour and practical skills development. The next sections discuss the essential features for an effective professional development.

### 2.11.2 Supporting Teachers through Change

As was experienced in other countries, for example England (Atkinson, 1990; Banks, 1994; Jones, 2003; Cavanan and Daughery, 2007; Chiksanda, et al.,
2011), the implementation of a new curriculum often causes a lot of anxiety among the teachers because everyone is learning at the same time (Fullan, 2001). One way of overcoming these challenges is to pilot the curriculum before full implementation (Kotter, 1996; Newton, 2007; Cameroon and Green, 2012). For piloting the curriculum, teachers may be engaged through in-service training in the development of instructional materials for them to trial and experiment with (Fullan, 2001).

2.11.3 Features of an Effective Teacher Professional Development

Fullan (1993) identifies two reasons why educational reforms are failing. One is that the problems are complex and intractable. He argues that: “workable, powerful solutions are hard to conceive and even harder to put into practice” (p.46). The second reason highlighted by Fullan is that the strategies that are used do not focus on things that will really make a difference (ibid, p.46). He attributes failure to an inability to: “address the fundamental instructional reform and associated development of new collaborative cultures among educators” (ibid, p46). In a similar view, Welch and Mueller (2003) have identified four elements which they consider would lead to positive change in the classroom. These are:

a) **PD must provide a challenge to teachers’ frame of reference.** They argue that the introduction of a new curriculum often requires teachers to meet certain professional standards; consequently teachers are faced with a challenge of adjusting to new understanding and practices.

b) **PD must be situated in relevant contexts if teachers are to learn and apply new knowledge.** The argument here is that PD would not be beneficial to the teachers if they are not able to situate that new knowledge and understanding in the specific context of classrooms.

c) **Collaborative support from other teachers greatly increases the likelihood that changes in practice will be sustained.** Welch and Mueller (2003) argue that a collaborative approach provides an
opportune moment for teachers to engage one another in tackling issues pertaining to new subject matter and to engage in innovative work aimed at curriculum reform. Likewise Fullan (2001) argues that “good ideas come from talented people working together” (p. 175). Moreover, Fullan affirms that shared expertise is the driver of instructional change (ibid, p.175).

**d)** *PD must provide opportunities for teachers to form ‘communities of practice’ that encourage them to reflect on the content and contexts of their pedagogy.* Moreover, the collaborative approach would enable teachers to reflection-in-action and reflection-on-action for the development of professional practice (Schwille and Dembele, 2007; Stein et al., 2007). Figure 2.17 exemplifies a more comprehensive PD model for education.

![Figure 2.17: Essential features for PD](https://via.placeholder.com/150)

**Figure 2.17: Essential features for PD**

*Illustration by the researcher based on Welch and Mueller (2003)*

Durrant and Holden (2006) hold the view that teachers as leaders of learning can be supported and scaffolded more by engaging them in research. They argue that: “*engagement in research and its evidence enables teachers to link their own learning with student-learning*” (ibid, p.33). Similarly, Welch and Mueller argue that: “*PD must encourage teachers to use an enquiry and problem-solving paradigm that results in their producing new knowledge, rather than a training paradigm that results in their consuming knowledge*” (ibid, p.91).
Hiebert et al. (2002) observed further that: “there is a growing consensus that professional development yields the best results when it is long-term, school-based, collaborative, focused on students’ learning, and linked to curricula” (p.3). OECD (2005) concur that effective professional development: “is on-going, includes training, practice and feedback, and provides adequate time and follow-up support” (p.49). Hiebert et al. (2002) highlight this point that: although special programs have demonstrated that, with carefully designed support, teachers can use specific research information for improving their practice.

Timperley et al. (2007) propose another PD model which is premised on the notion that unless teachers are supported with professional learning opportunities: “they will act in isolation of the wider knowledge that research is making available and which could enhance their effectiveness” (p.x). Figure 2.18 presents a conceptual model of a research-based PD.

![Figure 2.18: Evidence based PD model](image)

*Adopted from: Timperley et al. (2007)*

Timperley et al.’s (2007) model recognises the use of evidence gathered through research and the teacher’s own experience and working context as preconditions for doing things differently. The writers show how specific student needs, identified from local data, can be used to challenge existing theories and open the way for new teacher practice that is underpinned by research pedagogy. This model provides a platform for a professional development support system which can be used to help teachers complete the
loop by showing them how to effectively access and use new pedagogical understandings in their daily practice (ibid).

Elsewhere, Fullan (2001) suggests the use of professional development framework which consists of the following:

- a set of organising principles about the process of systemic change and the role of professional development in that process; and
- a set of specific activities, or models of staff development that focus on system wide improvement of instruction (ibid, p.175).

Within this framework Fullan (2001) suggests the following organising principles of the reform strategy:

- It is about instruction and instruction only;
- Instructional improvement is a long, multi-stage process involving awareness, planning, implementation and reflection;
- The focus is on system-wide improvement;
- Set clear expectations, then decentralise;
- Collegiality, caring and respect (p.175).

From the different PD models already explored, Hiebert et al. (2002) cite National Educational Research Policies and Priorities Board (1999) as reporting that: “there is a persistent concern that educational research has too little influence on improving classroom teaching and learning” (p.3). Similarly, Welch and Mueller (2003) argue that: “while professional development for teachers exists in many forms, no particular one emerges as the best way to facilitate change in classroom practices” (p.91). Durrant and Holden (2006) assert this point that: “we are still a long way from understanding the dimensions of teacher professionalism and school improvement processes that link professional learning, leadership and student learning” (p.33). Elsewhere, Timperley et al. (2007) recognise that: “a major frustration for teachers is when they do not have the knowledge, the tools, or the support to engage effectively with their students” (p.xiii).
The principles discussed in the foregoing section reflect a paradigm shift to teacher professional development which takes cognisance of students’ experiences and learning outcomes, teachers’ classroom practice, and school-wide structures and cultures. The remainder of this section presents and discusses principles that emerge from the professional development literature as a key strategy for curriculum change management.

2.11.4  **Reculturing the teaching profession**

Fullan (2001) defines the reculturing of the teaching profession as: “the process of creating and fostering purposeful learning communities” (p.136). Fullan argues that: “the development of professional learning communities does have depth, and the beauty is that these communities integrate development and accountability seamlessly in new cultures of improvement” (ibid, p.136). Unfortunately he notes that learning communities are hard to get and harder to sustain. Timperley et al. (2007) argue that for a culture of professional development to continue to grow in schools leaders and teachers need to: “understand ‘what works’ and for whom, and how to support their teachers to develop practices that benefit all learners” (p.xiii). Therefore, all the concerned parties, individually and collectively need to work on this agenda. Fullan adds to this by highlighting that the infrastructure around teachers is critical in helping to foster powerful learning communities. However, he cautions that a school principal can act as a source of help or hindrance in this effort.

Figure 2.19 illustrates how professional learning can be integrated into assessment of learning and pedagogical practice.

![Figure 2.19: The Nature of Professional Learning Communities](Adapted from Louis & Kruse, 1995; Newmann & Wehlage, 1995)
2.11.5  **Professional Knowledge Base for Teaching**

The PD model (figure 2.17) advocated for by Welch and Mueller (2003) has laid a useful framework for D&T. However, this model is limited in scope because it focuses on three areas of teacher professional knowledge namely: subject knowledge, pedagogical knowledge and knowledge of educational contexts.

Shulman (1986; 1987) identifies seven categories of knowledge bases which are essential to teacher training and professional development. Figure 2.20 presents these seven categories of knowledge.

![Figure 2.20: Categories of teacher knowledge (Shulman (1987)).](image)

With reference to teachers’ knowledge of educational ends, Fullan (1993) remarked that: "managing moral purpose and change agentry\(^4\) is at the heart of productive educational change" (p.8). Goodlad (1990a) cited in Fullan (1993, pp.8-9) identifies four moral imperatives which are essential to understanding the basic rationale for teaching in post-modernist society.

a)  **Facilitating critical enculturation**: Goodlad (1990a) explains the notion that schools as major players in developing educated persons have moral responsibility to inculcate in the young the desired values

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\(^4\) Fullan (1993) defines change agentry as being self-conscious about the nature of change and the change process (p.12).
and attitudes which mirror society’s virtues and moral principles (cited in Fullan, 1993, p.8).

b) Providing access to knowledge: Fullan argues that the school is the only institution in society that offers the young a more formalised opportunity to encounter with all the subject matter of human conversation in many forms. As such: “teachers must be diligent in ensuring that no attitudes, beliefs or practices bar students from access to the necessary knowledge” (ibid, p.9).

c) Building an effective teacher-student connection: The moral responsibility of educators is more compelling where the lives of teachers and students intersect. Hence, Fullan’s argument that the epistemology of teaching must encompass pedagogy that goes far beyond the ‘mechanics’ of teaching. He argues that this epistemology: “must combine generalisable principles of teaching, subject-specific instruction, sensitivity to the pervasive human qualities and potentials always involved” (ibid, p.9).

d) Practising good stewardship: This is a moral requirement that emphasises that if schools are to become the responsive, renewing institutions as is expected of them, would require that teachers be purposefully engaged in the renewal process (ibid, p.9). In his words Goodlad argues that: “the implications of moral commitments to inquiry, knowledge, competence, caring, and social justice go farther than curriculum and classroom practices” (ibid, p.9).

Welch and Mueller (2003) argue however, that: “while such PD may be useful for introducing ideas, it does not facilitate change or noticeable improvements in classroom and professional practices” (p.91).
2.12 Gaps in the Literature

This study was directed by the research question: *What is the nature of change from the Cambridge D&T curriculum to the Botswana model and how are teachers being supported to implement the curriculum?*

This question sought to explore issues pertaining to the management of change to a locally designed D&T curriculum in Botswana. The research was being conducted against the backdrop of issues and concerns which was highlighted in the Final BGCSE Evaluation Report (Ministry of Education and Skills Development, 2009). Contributing to the challenge of implementing the D&T curriculum was limited research into this area especially at senior secondary level.

To date, research published in Botswana has focussed on the junior secondary school level and addressed issues pertaining to the historical perspective of the subject, teachers’ and students’ perceptions and classroom experiences regarding the teaching and learning of the D&T education (Ndaba, 1994; Moalosi, 1999; Fox, 1988; Molwane, 2003; Moalosi, 2007; Gaotlhobogwe, 2010). There is more research into this area in more developed countries, especially England, Australia, New Zealand and the United States (Atkinson, 1990; Rasinen, 2003; Williams, 2007). The contexts of these countries differ significantly to that of a developing country like Botswana (Ndaba, 1994; Lewis, 2000; Williams, 2007). Studies in these contexts provided insight have helped to lay the theoretical framework for this inquiry.

Because of the critical role played by teachers and in-service officers as implementers and change managers respectively, it was deemed necessary to focus much of the data collection effort on them (Fullan, 1993; Morrison, 1998; Whitaker, 1993). This is a more compelling issue because studies have shown that in trying to implement educational policies implementers often face unforeseen challenges (Fullan; 2001; Kotter, 1996). Fullan (1993) in particular attributes the demise of educational reforms on a number of factors to mention but a few: the organisational structure within which changes take place, the way teachers are trained and political dimension in terms of the exercise of
power and authority. Equally important are leadership and management capabilities of those charged with the role of leading change in their organisations (Kotter, 1996). For example, at school level, Bennett et al. (1992) notes that the principal has a strong influence in terms of: "whether a change is to be taken seriously by supporting teachers both psychologically and with the resources" (p.117).

In summing up, the author notes a consensus in the literature which points to the fact that when change is introduced in many organisations, they tend to focus more of their time and energy on straightforward, technical aspects of the change process (Fullan, 2001; Kotter, 1996; Bridges, 1998; Harvard Business School Press, 2003). These technical aspects include: planning change, provision of physical infrastructure and defining roles and responsibilities (PROSCI, 2014). However, it has been observed that organisations or those who initiate change tend to overlook the more complex and unpredictable concerns of people affected by the change (Hiatt and Creasey, 2012; Hiatt, 2006; Kotter, 1996; Bridges, 2009). Ignoring the human side of change is deemed shortsighted and a symptom of ineffective management (Bridges, 2009; Harvard Business School Press, 2003). It is against this background that the researcher deemed necessary to assess the level of participation by teachers in the vision and decision-making processes relating to this curriculum. Moreover, it was deemed necessary to assess how the teachers were being supported through the transition to the new curriculum. Bridges (2009) argues that getting people through the transition is essential if the change is to work as planned (Hargreaves, 1997). Likewise, Hiatt and Creasey (2012) noted that individual change management is often overlooked by many change management models. According to Hiatt and Creasey (2012) individual change management includes the tools and processes that supervisors use with their employees to manage individual transitions through change (ibid, p.41). Hence, the employee-oriented component of change management is deemed the critical ingredient that enables organisations to create a robust, closed-loop process to manage the people side of change (Hiatt and Creasey, 2012; Bridges, 2009). Therefore,
effective change management requires that organisations both the technical and people side of change to proceed simultaneously.

### 2.13 Chapter Summary

Socio-economic factors and technological advancements have dramatically accelerated the speed of change in many countries. New technology, the ever-changing socio-economic needs of a country and political pressures all contribute to the need for education systems to continually review their practices. The pace of change shows no sign of slowing. Indeed, Botswana is no exception to these global developments.

Until now, little national research evidence has been published on the management of change from the Cambridge to the BGCSE D&T curriculum, especially on how the new curriculum was being implemented and how that has impacted on the teaching and learning. The introduction of the BGCSE D&T curriculum ushered a new era in the provision of secondary education in Botswana. Change management was central to this effort.

For developing countries such as Botswana, it has been observed that such countries often try to transpose into their systems education models which have been developed for their more developed donor countries (Chikasanda, 2011; Ndaba, 1994; Williams, 2007). The greatest challenge in trying to implement a ‘foreign curriculum’ lies in the context and the stage of development the country is at (Lewis, 2000). Other challenges include: the will and capacity of the people charged with the responsibility of implementing (Hiatt and Creasy, 2012; Fullan, 2012). Also contributing are the governance system and the organisational arrangements in which such change initiatives operate (Kotter, 1996; Fullan, 1993, 2001; Morrison, 1998).

In conclusion, Fullan (1993) notes that the main reason educational reforms of any scale fail is because:

> "We have an educational system which is fundamentally conservative. The way teachers are trained, the way that schools are organised, the way the educational hierarchy operates and the
way that education is treated by political decision-makers results in a system that is more likely to retain the status quo than to change” (p.3).
CHAPTER 3

METHODS AND METHODOLOGY
3 Methodology and Research methods

3.1 Introduction

This chapter presents and discusses the theoretical framework which informed the design and methodology employed in this inquiry. The chapter then explains and justifies the rationale behind the design, the methods used for data collection and the techniques used for the analysis. The ethical procedures followed to conduct this research are explained and the limitations of the data collecting methods are also highlighted.

3.2 Restatement of the research question

In order to focus the discussion, the research questions are restated. The main research question is: What is the nature of change from the Cambridge D&T curriculum to the Botswana model and how are teachers being supported to implement the curriculum? Fullan (2001) highlights that change management is a complex phenomenon because it is often accompanied by many interacting variables such as: uncertainty, poor communication, power-plays and chaos. This makes it imperative for those who initiate and implement change to develop a sound theoretical knowledge and understanding of the inner workings of educational change processes. To explore and contextualise these issues, an initial literature review was conducted. The researcher used concepts derived from the literature as theoretical framework for the research. This literature review was in three parts:

1) Part one aimed to develop a general understanding of the research topic. This was achieved by a review of similar work previously done in this field in terms of the scope; relevance and limitations.

2) Secondly, it is recognised that are some fundamental principles which need to be understood before engaging in organisational change (Kotter, 1996; Fullan, 2001; Stacey, 1993), which necessitated the researcher to familiarise himself with the principles of change and its management strategies. In this research, the ADKAR change management strategy...
explained in figure 1.1 was used as diagnostic tool to assess the nature of transition within the context of Botswana.

3) Familiarised the researcher with the principles and procedures of conducting educational research. It is essential to get a good grasp of the methodologies used in educational research (Barbour, 2008; Bell, 2005; Berg, 2007; Cassell and Symon, 2004; Charles, 1995; Craig, 2009; Cohen et al., 2011; Denzin and Lincoln, 1998; De Vaus, 2001). This is to enable the researcher to identify the strengths and limitations of these methodologies and to identify the most appropriate for the study. Moreover, this literature helped to develop the most suitable research instruments for data collection. Figure 3.1 explains the theoretical framework which guided the development of research questions.

<table>
<thead>
<tr>
<th>Literature findings</th>
<th>Development of research questions as a result of the literature findings</th>
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<tbody>
<tr>
<td><strong>Change drivers</strong></td>
<td><strong>RQ1. What factors have necessitated change from the Cambridge to the BGCSE model of D&amp;T?</strong></td>
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<td>What motivated the government of Botswana to move away from the Cambridge curriculum?</td>
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<td></td>
<td>Was the change necessary?</td>
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<tr>
<td><strong>Stakeholder participation</strong></td>
<td><strong>RQ2. What views and perceptions are held by various stakeholders regarding the change and transition?</strong></td>
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<td></td>
<td>How was the decision about curriculum change communicated to various stakeholders?</td>
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<td></td>
<td>How effective was this communication?</td>
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<td></td>
<td>What roles did the various stakeholders play in decisions about curriculum change?</td>
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<tr>
<td></td>
<td>The desire to support the change and the attitude towards the change by the various stakeholders especially the teachers?</td>
</tr>
</tbody>
</table>

Continued →
A clear vision is essential to establish the nature and direction of change (Bush and Middlewood, 2005; Kotter, 1996).

Managing curriculum change and its implementation is both a technical and social process (Fullan, 2001).

Fullan (2001) argues that "educational change is technically simple but socially complex" (p.69).

Educational change is a dynamic process and involves interacting variables (Fullan, 2001; Schutt, 2006)

Successful leaders channel their efforts more towards motivating and developing people rather than maintaining systems and structures (Bush and Middlewood, 2005).

Change management is: “the application of processes and tools to manage the people-side of change from a current state to a new future state so that the desired results of the change (and return on investment) are achieved” (Hiatt and Creasey, 2012, p.9).

Fullan (2001) highlighted that in order to set the stage for change, there is a need for visionary leadership; shared vision; continuous monitoring and professional development of all those involved in the change process (Barnes, 2005; Bush and Middlewood, 2005; Kotter, 1996; Warrilow, 2009).

What strategy was developed to implement the curriculum?

How effective was this strategy?

What capacity was developed to prepare for the change?

RQ3. What organisational factors have facilitated or inhibited effective implementation and management of change and transition in design and technology in Botswana?

What leadership and management capabilities are required to effect and manage change in design and technology in Botswana?

How have teachers been affected by the change?

How are the teachers being supported to cope with the change?

RQ4. How can we develop a more effective strategy for the implementation and management of change and transition in the design and technology curriculum in Botswana?

Figure 3.1: The development of research questions
Source: Researcher’s conceptual framework based on initial literature review
The themes or concepts which arose from the literature were used in conjunction with educational research concepts and procedures to guide the development of the researchers’ conceptual framework for the study. Subsequent to the literature review, the following research questions were established:

- *What factors have necessitated change by the government of Botswana from the Cambridge D&T curriculum to a locally developed BGCSE D&T curriculum in Botswana?*
- *What organisational factors have facilitated or inhibited effective implementation and management of change and transition in design and technology?*
- *How can we develop a more effective strategy for the implementation and management of change and transition in the design and technology curriculum in Botswana?*

To address the research questions a conceptual framework (see figure 4.3) was developed to inform the decisions pertaining to: how the phenomenon in question was researched, and how this knowledge could be attained. The framework chosen was intended to deepen understanding and facilitate a reflective dialogue with the various stakeholders involved with the development and implementation of the new D&T curriculum in Botswana.

### 3.3 The Theoretical Framework

In this study the “theoretical framework” is the term being used for a “conceptual framework”; as such the two terms are often used interchangeably. A study conceptual framework, in the view of Merriam (1998) is the structure or the scaffolding upon which the study was conducted (Denzin and Lincoln, 1998; Miles and Huberman, 1994; Anfra Jr and Mertz, 2006). Plowright (2011) explains that “frameworks structure our thinking about research” (p.3). Bryman (2008) describes it as a logical sequence in which the study is to be carried out as well as the elements of the study. Plowright (2011) explains that the theoretical framework is: “based on a search and review of relevant and appropriate literature that is focused
on the substantive topic of research” (p.12). Essentially the theoretical framework describes and justifies the particular academic discourse within which the study is framed.

Robson (2011) explains that the researcher’s ontological and epistemological assumptions largely influence the study’s orientation in terms of whether to adopt a qualitative or quantitative approach. Ontology refers to: “a branch of philosophy which deals with the nature and organisation of reality” (Mars, 1995, p.26). Similarly, Cohen et al. (2011) define ontology as: “the nature of reality or phenomenon” (p.33). Ontology is usually contrasted with epistemology which according to Cohen et al. (2011): “deals with nature and sources of our knowledge” (p.33). Silverman (2010) expands this further by explaining that “when one employs a particular method one is drawing upon and consolidating ideas about how the world works, what people are like, and so on” (p.332). Furthermore, Silverman notes that the choice of how to investigate a topic is intimately connected to the epistemological and ontological issues relating to the very nature of that topic (ibid, p.332). Cohen et al. (2011) found that researcher’s ontological position and methodological framework are intimately related. The former involves the philosophy of how we come to know the world and the latter involves the practice (Hargreaves, 1994). Robson (2011) emphasises that in order to reduce possible bias the data collection methods used by the researcher and conclusions drawn need to be examined carefully.

This research inquiry into change management is grounded on a social constructivist paradigm, where knowledge about the phenomenon under investigation is socially constructed and situated. Punch (2000) defines paradigms as: “a set of assumptions about the social world, and about what constitutes proper techniques and topics for inquiring into that world” (p.35). Similarly Cuba and Lincoln (1994), explain that paradigms represent: “a world view that defines, for its holder, the nature of ‘the world’ and the individual’s place in it” (cited in Punch, 2000, p.48). With this theory, change and the context in which it takes place cannot be separated (Fullan, 2001).
The paradigms can be thought of as the ‘lenses’ through which people can view the world under investigation (Punch, 2000). Cohen et al. (2011) argue that politics and interests shape multiple beliefs and values, as these beliefs and values are socially constructed. As such, paradigms have some influence on the researchers’ philosophical stance in terms of how they conduct their research (Thomas, 2009; Robson, 2011). Consequently, a stance adopted by the researcher whether consciously or otherwise, has wider implications for the validity of the study in terms of the methods used to collect data, techniques used to analyse them and the truthfulness of interpretations of the findings (Robson, 2011). In essence, the methodological issues cannot be separated from theoretical assumptions (Silverman, 2010; Robson, 2011).

Examples of general paradigms within social research are positivism, post-positivism, critical theory and constructivism. Shaver (1992) defines constructivism as: “the belief that ‘individuals learn as they wrestle cognitively with problems of concern to them” (cited in Brownlee et al., 2001, p.250). According to Shaver the researchers who subscribe to the constructivist paradigm hold the belief that understanding exists only for the individual who actively creates such beliefs (ibid). Robson (2011) defines social constructivism as: “a view that social properties are constructed through interactions between people rather than having a separate existence” (p.24). Constructivist approaches are sometimes referred to as interpretivism. Working within the social constructivist paradigm would enable the researcher to capture and present wide-ranging perspectives of the various stakeholders involved with the implementation of the curriculum.

In terms of the ontological position, a post-positivist approach was adopted in recognition of the fact that the introduction of the BGCSE D&T curriculum was a political decision which typifies a reform driven change as such its intervention would require a much broader mandate (Ndaba, 1994; Republic of Botswana, 1994). In support of the researcher’s ontological position, Scheurich (1997) explains that the post-positivist researchers: “subscribe to an improvement view; a liberal, emancipatory world view in which, through research; they fix what is wrong with the system or social order, without fundamentally challenging the nature of the social order itself” (p.137). Robson (2011, p.23) adds to this by explaining that a
post-positivist researcher aims to find the truth about something, by using
evidence from other related studies to add mirror to their findings or conclusions
they reach the issues under investigation. According to Robson post-positivists
believe that: “evidence in research is always imperfect and fallible” (p.22). As such,
they argue that methods and conclusions used in any investigation: “should be
examined to reduce bias and establish reliability and validity” (ibid).

Regarding the research paradigms adopted in this research, the researcher
acknowledged tensions which exist between qualitative and quantitative
approaches (Robson, 2011). Liu and Liu (1997) observed that these tensions are:
“more than a debate over epistemology but rather a struggle over ideology and
values as well” (p. 14). In this research these approaches are not seen essentially as
incompatible rather they would enable the researcher to harness the strengths of
each approach. As argued by Silverman (2010) that: “rather than one methodology
being intrinsically superior to another, it might be wise to think of quantitative and
qualitative approaches as complementary parts of the systematic, empirical search
of knowledge” (p.8). Therefore, combining the two approaches would enable the
research to go beyond being a predominantly qualitative, but would use a mix of
qualitative and quantitative evidence (Yin, 2009). Also, in terms of the reporting
the findings, it would ensure some measure of objectivity and minimise researcher
bias (Robson, 2011).

3.4 Research Strategy and Justification

Robson (2011) defines strategy as: “the general broad orientation taken in seeking
answers to the research questions - the style” (p.43). Silverman (2010) defines
methodology as: “a general approach to studying research topics” (p.121).
According to Silverman, the strategy shapes which methods are used and how each
method is used. Silverman explains that features that attract researchers to this
methodology are many, which include the following four issues that the researcher
should consider when deciding on a research strategy:

a) Making an early decision about which methods to use;
b) Understanding the link between methods, methodologies and society;
Chapter 3 – Methodology and Research Methods

3.4 Methodology and Research Methods

3.4.1 Qualitative research design in this context

The study investigated the experiences of the implementation of a new design and technology curriculum in Botswana; the capacity for change and the kinds of support needed to cope with the change. The goals were to identify and evaluate the necessary steps and strategies for managing the change and transition to ensure effective implementation in schools. Consequently, the study adopted a principally qualitative descriptive form of inquiry because most of the data collected were in non-numerical form. Such data were used to help describe the participants’ views and experiences regarding the implementation of this curriculum.

Silverman (2010) explains that: “most qualitative researchers believe that they can provide a ‘deeper’ understanding of the social phenomenon that would be obtained from purely quantitative data” (pp.124-125). However, due to the complexity and political nature of educational reforms (Fullan, 2001), this kind of inquiry necessitated the use of both quantitative and qualitative methods. The former was employed for the purpose of representativeness of the views expressed, and the latter for the purposes of more in-depth probing and the verification of the quantitative data (Cohen et al., 2011). Moreover, this strategy provided a platform for the participants to air their views and allowed the researcher to probe issues to deepen understanding (Arksey and Knight, 1999). Qualitative methods included individual and group interviews and the use of diaries.

3.4.2 Quantitative design

Quantitative research traditions in social research fall into traditions namely the positivists and post-positivists. The positivists adopt a natural science approach and subscribes to the notion that knowledge about a phenomenon under investigation can be gained through direct experience or observation (Robson,
2011). The positivists claim that: “all scientific propositions are founded on facts. All hypotheses are tested against these facts” (Robson, 2011, p.21). Robson argues that positivists rely heavily on quantitative methods which employ the general laws and theories through which people can understand the social world (ibid).

However, Yin (2009) argues that combining the research methods used in the two traditions can enable the researcher to achieve some degree of analytical generalisation to a larger population. Also, employing multiple sources of data helps to enhance interpretation as well as the level of confidence in the findings.

Silverman (2010) explains that some researchers prefer the quantitative research purely because of the serious attention it usually pays to issues of reliability and validity. Validity refers to: “the truth: as interpreted and the extent to which an account accurately represents the social phenomenon to which it refers” (p.275). Reliability refers to: “the degree of consistency with which instances are assigned to the same category by different observers or by the same observer on different occasions” (ibid, p.275).

One quantitative method used was a survey questionnaire, which was administered to the teachers because they represented a larger population of the sample. The questionnaire captured both quantitative and qualitative data. The quantitative data were captured in two forms: the first was nominal in the sense that it captured teachers’ demographic information. The second was ordinal because it employed Likert scales to measure teachers’ perceptions on a number of issues. To analyse these data, descriptive statistics techniques were used. Then charts were used to display and to help interpret such data. For qualitative data, the questionnaire included some open-ended questions which enabled the participants to elaborate their answers and/or offer additional personal views and suggestions.
3.5 Case study research in this context

Precise definition of case study is problematic because of the variation in use (Simons, 2009; Gomm et al., 2004; Merriam, 1988; Stake, 1995). Simon (2009) observed that the term has: “different meanings for different people in different disciplines” (p.19). The following operational definition by Yin (2009) is adopted: “a strategy for doing research which involves an empirical investigation of a contemporary phenomenon within its real life context using multiple sources of evidence” (cited in Robson, 2011, p.136). Case study research can be implemented as a single or multiple case studies (Yin, 2009). In this study, case study is being viewed as a research design in its own right. Yin elaborates that case study research design serves as a ‘blue-print’ which sets out the research boundaries in terms of: “what questions to study, what data are relevant, what data to collect, and how to analyse the results” (p.26).

Yin (2009) explains further that a case study is appropriate to use: “especially when the boundaries between phenomenon and context are not clearly defined” (p.13). Stake (1995) also notes that case study inquiry enables the research to explore many issues of interest in real life contexts using multiple sources of evidence. Yin (2009) explains further that if the researcher wants to address the ‘how’ and ‘why’ questions, the researcher would lean more toward the case study.

The case study design aligns well with the exploratory nature of this inquiry in the sense that very little was known about issues affecting the implementation of the D&T curriculum (Yin, 2009). Much of the literature about change highlights that those involved with the change process need to understand the context and the organisational conditions within which it takes place (Fullan, 1993, 2001; Kotter, 1996; Stacey, 1993; Stensaker and Meyer, 2012; Whitaker, 1993). Therefore, the case study framework enabled the researcher to collect baseline data, and use findings to illuminate the situation in terms of how the D&T curriculum was being implemented in schools (Simons, 2009; Robson, 2011). Moreover, this research strategy was deemed appropriate because it enabled the researcher to collect data in their natural setting (Yin, 2009). A multi case study approach was adopted such
that the findings at the end of each phase were used to set the direction for the subsequent studies.

Figure 3.2 exemplifies the multi-phase case study approach used in this research.

Figure 3.2: Example of multiple case study approach
Illustration by the Researcher

Plowright (2011, p.25) highlights a number of practical issues which should be considered when planning and designing case study research. These are: a) methodological issues, b) logistical issues and c) the degree of control. Methodological issues include the amount of in-depth detail that can be collected from the cases and the degree of generalisability that can be made about inferences from the data collection. Logistical issues relate to the location of participants whilst the degree of control relates to how much control the researcher has over which cases are allocated to a group or groups in his/her research (ibid, p.25). Figure 3.3 summaries these issues.
Figure 3.3: Issues to consider when planning case study research
(Source: Adapted from Plowright, 2011, p.25)

Figure 3.3 illustrates that, as part of planning a study, the researcher needs to strike a balance act between what can be achieved against practical constraints of researcher’s capability, the amount of data to collect and other logistical issues (Plowright, 2011; Robson, 2011; Yin, 2009). Cohen et al. (2011) note that many novice researchers approach their research with assumptions that access to participants is easy, so access to the participants was one of the first considerations made in this study. Since the study is based in Botswana, the challenge was to consider how to synchronise field work with school calendars there. The researcher had to check the situation in schools before embarking on a fully worked out plan. Access to the school calendar was done through the Ministry of Education website, but that had to be verified with the teachers. In addition, enquiry about the research permit was done to determine if it would be needed including associated procedures.

Other organisational issues involved email correspondence with prospective participants to determine if they would be able to participate in the research and when that would be possible. This was an important consideration with regard to the duration for data collection; financial implications and resources needed. This planning ensured optimum use of available resources to minimise travelling costs between England and Botswana for the implementation of fieldwork.
3.5.1 Limitations of case studies

One of the criticisms of a case study research is the degree to which the findings can be generalised. Robson (2011) uses the term “generalisability” to describe: “the extent to which the findings of the inquiry are more generally applicable outside the specifics of the situation studied” (cited in Plowright, 2011, p.31). Plowright concurs that because case study research by nature involves a small number of cases; this affects the extent to which the researcher may generalise the findings outside the study of the participants.

Generalisability is associated with quantitative research whose aim is to make broader inferences about the whole population. This gives rise to questions such as: “how do we know... how representative case study findings are all members of the population from which the case was selected?” (cited Ryman, 1998, in Silverman, 2010, p.139). However, Silverman (2010) maintains that generalisability can be achieved by statistical procedures provided the sample is selected randomly to ensure that it is truly representative of the whole population. Plowright (2009, p.26) also notes the uniqueness of the situation under investigations as another criticism of case study research because the researcher has limited control over the case allocation. The choice is determined and limited by the potential case or cases that make up the group that will be studied (ibid, p.26). Elsewhere, Yin (2009) highlights concerns over the lack of rigour in the use case studies. Yin cited some instances where: “the case study researcher has either not followed systematic procedures or has allowed equivocal evidence or biased views to influence the direction of his findings and conclusions” (p.14).

3.6 Multi Methods Approach

Research methodology is sometimes referred to as the research design. Thomas (2009) defines methodology as: “the study of methods” (p.70). He explains that methodology deals with a discussion of the methods the researcher will be using, the rationale for using them and the plan of how the study will be designed and implemented. Cohen et al. (2011) define methodology as: “how we research complex, multiple-realities” influenced by communities of practice who define what
counts as acceptable ways of researching” (p.33). Essentially, methodology refers to the choice and use of particular strategies and tools for data gathering and analysis. Seale (1999) asserts that: “methodological awareness involves a commitment to showing as much as possible to the audience of research studies... the procedures and evidence that have led to particular conclusions, always open to the possibility that conclusions may need to be revisited in the light of new evidence” (cited in Silverman, 2010, p.274). In terms of the methodological framework, Thomas (2009) observes that a common approach by many social researchers is that of being eclectic; using a variety of methods; taking the best of many methods; not following one tradition but using complementary insights.

Research methods in this context refer to the research tools or: “techniques and instruments for data collection” (Swetnam and Swetnam, 2009, p.56). As already explained in sections 3.4.1 and 3.4.2 the instruments used for qualitative data collection included interview schedules and dairies. While for quantitative data collection, questionnaires were used. Silverman (2010) maintains that: “the research methods should be chosen based on the specific task at hand” (p.9).

As already mentioned multiple methods approach recommended by Creswell and Clark (2011) was used for data collection (also see Bryman, 2008; Simons, 2009). In the context of this study, multiple methods refer to the integration of qualitative with quantitative methods as well as working with different types of data (Silverman, 2010; Creswell, 2009; Creswell and Clark, 2011; Simons, 2009). In justifying the use of the multiple method approach, Creswell (2009) argues that audiences such as policy makers, practitioners, and other stakeholders need multiple forms of evidence to document and inform the research problems. Likewise, Fielding (2010) highlighted that sometimes it is useful to: “use a combination of quantitative and qualitative methods to get a broad overview and insight into what the data mean” (cited in Wiles et al., 2008, p.14).

Punch (2000) advises that if the researcher combines the two approaches, it should be clear on which research questions will involve quantitative methods and data or vice versa and which will combine both. Silverman (2010) elaborates this
point by advising that before using multiple methods one should consider these fundamental questions:

- *Have you time and resources to gather and to analyse multiple datasets? Isn’t there a danger that one or two of your data sources will be under-analysed?*

- *Have you thought through the issues involved in trying to establish the ‘true’ state of affairs by comparing data from different sources?* (p.134).

Robson (2011) explains that a social constructivist approach is flexible in the sense that it does not prescribe any particular way of doing research or methods of data collection. Mason (2002) holds the same view that: “most qualitative researchers operate from the perspective that knowledge is situated and contextual” (p.62). Therefore, working within this approach necessitated the researcher to combine different methods in the same study to ensure that the data captured represented a broad and balanced view of various actors involved with the curriculum. Within the context of this study, the use of multiple forms of evidence was employed to document and inform the research problems so that it would add more credibility to the study (Bryman, 2008; Creswell and Clark, 2011). This is especially important because the findings are to be shared with a wider audience such as policy makers, practitioners, and other stakeholders. Overall the choice of research methods reflects both the research topic and the overall strategy.

In summing up this section, Silverman (2010) notes that research instruments like interviews, focus group interviews and questionnaires, which ask the respondents to provide facts, attitudes or experiences, have an important part to play in fields like education. Silverman alludes to the fact that the findings of such instruments can give policy makers a reasonable sense of how, at one point in time their clients are responding to a particular service. Moreover, unlike observational studies, interview studies can be completed relatively quickly and in this sense, give immediate answers. However, some qualitative interview studies may lack the analytical imagination to provide anything more than anecdotal insights (Plowright, 2011; Silverman, 2010; Yin, 2009). Moreover, Silverman highlights that when there are doubts about the rigour of the data analysis, policy makers
and practitioners may doubt the quality of the answers such research provides. Figure 3.4 exemplifies a multi method approach as used in the pilot survey. The details of each method are explained in the case studies chapters.

![Multi method approach used in the pilot survey](chart)

Figure 3.4: Multi method approach used in the pilot survey

### 3.7 Researcher's Conceptual Framework

This section outlines the concepts which underpin the development of the framework for the study. Conceptualisation here denotes a semantic structure which reflects a particular conceptual system (Mars, 1995).

The need for careful planning prior to undertaking any research cannot be over-emphasised (Plowright, 2011; Cohen et al., 2011; Robson, 2011). Robson (2011) identifies five important elements which must be considered when trying to conceptualise a study framework. These elements are:

1. Purpose;
2. Conceptual framework;
3. Research questions;
4. Methods and;
5. Sampling frame.
These elements are summarised in table 3.1 below.

<table>
<thead>
<tr>
<th>Research design elements</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Purpose (s)</strong></td>
<td>What this study is trying to achieve? Why it is being done? Are you seeking to address the effectiveness of something? Is it in response to some problem or issue for which solutions are sought? Is it hoped to change something as a result of the study?</td>
</tr>
<tr>
<td><strong>Conceptual framework</strong></td>
<td>Your theory about what is going on, of what is happening and why. What are the various aspects or features involved, and how might they be related to each other?</td>
</tr>
<tr>
<td><strong>Research questions</strong></td>
<td>To what questions is the research geared to providing answers? What do you need to know to achieve the purpose (s) of the study? What is it feasible to ask given the time and resources that you have available?</td>
</tr>
<tr>
<td><strong>Methods</strong></td>
<td>What specific techniques (e.g., semi structured interviews, participant observation) will you use to collect data? How will the data be analysed? How do you show that the data are trustworthy?</td>
</tr>
<tr>
<td><strong>Sampling procedures</strong></td>
<td>Who will you seek data from? Where and when? How do you balance the need to be selective with that of collecting the data needed?</td>
</tr>
</tbody>
</table>

*(Adopted from Robson, 2011, p.72)*

The essence of having a clear framework prior to the actual research enables the researcher to work coherently, keeping true to the research focus (Cohen et al., 2011). Even so, Robson (2011) advises that a framework should be used in a flexible manner to allow it to be revisited and modified as the study progresses (Mason, 2002). Equally, Silverman (2010) argues that: “*while the examiners will look for evidence of a logical structure to your research, they will also want to see that you have been prepared to be flexible and to change direction when appropriate*” (p.74).
3.8 Rationale for the adoption of the ADKAR model

This section provides the justification for the adoption of the ADKAR model over several other change management models which were presented in section 2.4 of the literature review. As already discussed in section 2.4.3, the ADKAR change model (1998) was developed by Hiatt (2006) of PROSCI research to assist in determining if change management activities were having the desired results during organisational change (Hiatt and Creasey, 2012).

Initial literature review was done to inform decisions about the most appropriate framework to use for this inquiry. The researcher noted the existence of a number of change models, many of which are simply variations to suit a particular context (Fullan, 2001; Kotter, 1996; Blake and Bush, 2009; Newton, 2007; Stacey, 1993). For example, both Fullan (2001) and Bourne and Bourne (2012) concur that there is no magic formula; the choice of a particular model depends on the uniqueness one’s situation. As such no conclusion could be reached in terms of the best model to use because each model has its own merits and limitations. However, in terms of their application, the researcher noted that some of those models emphasised a step by step approach which in his view made them too prescriptive and rigid because one cannot miss the recommended steps (Newton, 2007; Kotter, 1996). In the context of this study, the criteria used to determine the appropriateness of the change model to use were based on the overall aim, objectives and the research questions of the study already stated in sections 1.2 and 1.3. The researcher investigated the nature of change from the Cambridge D&T curriculum to the BGCSE one with the objective of determining the extent to which the desired results of the change had been achieved.

The ADKAR change management model is a bottom-up method of business improvement as such it aligned well with the nature of the study which identified the teachers and in-service at the lower levels of the hierarchy as key players in change process. Studies have shown that the probability of change being successful is enhanced if employees have the knowledge and ability to implement the change (Hiatt, 2006; Hiatt and Creasey, 2012; Newton, 2007). From this perspective, the model provided the right diagnostic tool to help identify the key factors impeding
the change effort and sought ways to support them. Compared to top-down models which tend to communicate the change and implement programs for all the employees, the ADKAR has the advantage that it works its way upwards from the individual level. Thus it ensures that each individual is well equipped to make a successful transition at a reasonable pace. This approach was helpful in measuring the effectiveness of change at the individual level through case study 2. For example, through the instruments which were developed using the ADKAR framework, the researcher was able to identify gaps in implementation which were related to teachers’ knowledge and ability to implement the curriculum (Chart 4.9). Subsequently, a school-based in-service training was deemed a necessary intervention to achieve the desired results.

In summary, the author adopted the ADKAR model for this inquiry because it helped with the development of the conceptual framework (figure 3.5) which enabled the researcher to develop data collection instruments for diagnosing the nature of change from Cambridge to the BGCSE D&T curriculum. The building block nature of the ADKAR model provides a diagnostic framework that is simple and adaptable to apply (Hiatt, 2006). The framework can be used to assess the strengths and weaknesses of the change management plan, and target his/her effort at the barrier points to change. Besides being used as an assessment tool for diagnosing change underway, the framework can also be used as a coaching tool for change managers and supervisors. Also, the building block nature of model allows change to be broken down into parts; identify the specific processes of that breakdown, and take remedial measures. Furthermore, PROSCI developed bookstore products which include a list of reference materials, books and leadership packages for managing change (http://www.change-management.com/bookstore.htm). These products are available in Australia, Canada and the United Kingdom and through their other affiliates. The books can also be purchased online through Ebay or Amazon, which helps to reach out to customers worldwide. The author purchased some of their books on Amazon.
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Figure 3.5 presents the researcher’s modified framework based on Robson’ (2011) research design framework. The framework integrates the various elements of the study namely: the main research question which was central to the inquiry; the research questions to be addressed and the sampling strategy which referred to the population upon which the inquiry would be focused (Cohen et al., 2011; Plowright, 2011).

![Diagram of research design framework]

**Figure 3.5: Framework for research design framework**  
Adapted from: Robson (2011, p.71)

The elements shown in dashed lines were added to Robson’s original framework. This is because the researcher used an initial literature review to determine the scope and direction of the study. A working title was developed and the keywords derived from the title were used to guide initial literature search. The questions were in turn used to guide research methods, which were then used to identify participants. Figure 3.6 exemplifies how this framework was used in the pilot study. The themes or concepts (shown in **bold** in figure 3.6) that arose from the initial literature review were used to guide the development of research questions. Figure 3.6 exemplifies the final conceptual framework developed to guide the inquiry.
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Keywords and concepts about change management which arose from the literature review

- Motivation for change
- Stakeholder participation
- Capacity to manage change
- Type of leadership required
- Psychological state of teachers
- Authorities capacity
- Provision of resources
- Professional development
- Practicalities and Complexity of change
- Organisational culture
- Organisational situation and context
- Time to implement
- Change management plan/strategy

Using the ADKAR change model as the guiding framework

Change drivers and Vision
Awareness and Desire
Knowledge and Ability
Reinforcement

Pilot Survey Objectives

- To gain insights into the nature of the transition from the Cambridge D&T curriculum to the BGCSE D&T curriculum and its implementation process.
- To identify and validate the key factors in implementing and managing a D&T curriculum in Botswana.

Primary Research Questions (RQs)

| RQ1 | What factors have necessitated change from the Cambridge to the BGCSE model of D&T? |
| RQ2 | What views and perceptions are held by the various stakeholders regarding the change and transition? |
| RQ3 | What organisational factors have facilitated or inhibited effective implementation and management of change and transition in design and technology? |
| RQ4 | How can we develop a more effective strategy for the implementation and management of change and transition in the design and technology curriculum in Botswana? |

Figure 3.6: The researcher’s own conceptual framework for the pilot study
(Adapted from research design frameworks by: Yin, 2009; Robson, 2011; Silverman, 2010)

Please note:
- It was felt that RQ1 would be answered by Directors because it deals with policy matters or decision making at a much higher level.
- RQ2 and RQ3 are designed for those respondents who are directly involved with the actual implementation exercise.
- RQ4 was answered by all the respondents.

RQ1. What factors have necessitated change from the Cambridge to the BGCSE model of D&T?
RQ2. What views and perceptions are held by the various stakeholders regarding the change and transition?
RQ3. What organisational factors have facilitated or inhibited effective implementation and management of change and transition in design and technology?
RQ4. How can we develop a more effective strategy for the implementation and management of change and transition in the design and technology curriculum in Botswana?
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Themes or Concepts identified through Initial Literature review

1. Vision and Strategy
2. Administrative support
3. Leadership
4. Communication
5. Awareness and Desire
6. Stakeholder Involvement
7. Enabling Structures
8. Empowering employees
9. Resistance Management
10. Reinforcement Mechanisms

Laid the theoretical framework for the study

To contextualise initial literature findings to the management of the BGCSE D&T curriculum, a small-scale pilot survey was conducted.

What is the nature of change from the Cambridge D&T curriculum to the Botswana model and how are teachers being supported to implement the curriculum?

The ADKAR change model was used as a diagnostic tool to assess the nature of change.

Figure 3.7: Application of the ADKAR framework to the inquiry
3.8.1 **Sampling and Conduct of Research Instruments**

This section explains the procedures which were used to identify and select the participants. Participant selection was informed primarily by the research questions to be answered. The selection was done after developing the conceptual framework for the study. A matrix (see Appendix 3.4) was developed to assist aligning the research questions with prospective respondents.

Mason (2002) describes sampling as principles and procedures a researcher uses to choose and gain access to relevant data sources. Mason (2002) underscores the notion that sampling and selection of participants are the strategic elements of qualitative research. The study employed two sampling techniques namely: snowball and purposive. Snowball sampling describes: “*a multistage technique which begins with one or a few people and spreads out based on links to the initial people*” (Neuman, 2011, p.269). Snowball sampling was used to invite teachers to participate in the online questionnaire survey. The technique was found useful in the pilot survey because at the time the researcher did not have contact details of potential participating teachers. Teachers were invited because it was determined that as implementers their views and suggestions could help illuminate the situation on the ground (Bush, 2003; Fullan, 2001). They also represented a larger population of the respondents. Participation in the study provided a platform for them to share their views and experiences.

Purposive sampling was used to select participants for the individual interviews. These participants included: senior officers in the Ministry of Education, in-service officers, heads of departments and senior teachers. Gibson and Brown (2009) describe purposive sampling technique as: “*the process of selecting research participants on the basis of their relevance to the research*” (p.56). Ball (1990) recommends the use of this sampling technique for accessing: “*knowledgeable people; those who have in-depth knowledge about particular issues by virtue of their professional role, power, access to networks, expertise or experience*” (as cited in Cohen et al., 2011, p.157; also Schutt, 2006, p.156).
This technique aligns well with case study research principles; whose aim is to understand or gain insight into the case (Simons, 2009). Likewise, Creswell (2009) explains that in qualitative research the researcher: “purposefully selects participants that will best help understand the research problem and question” (p.178). However, Neuman (2011) noted that in purposive sampling, cases need not necessarily represent the entire population but the technique is used to gain a deeper understanding of the phenomenon being investigated (Neuman, 2011; Thomas, 2009; Schutt, 2006). This sample was chosen because it was accessible and the participants were willing to take part in the study. The participants were chosen to allow data responses from a wide range of professional categories within the Ministry of Education. The intent was to give a broad and balanced view of opinions and attitudes across all the levels (Hughes, 2005; Schutt, 2006).

Silverman (2010) explains that purposive sampling: “allows us to choose a case because it illustrates some feature or process in which we are interested” (p.141). However, he notes that: “this does not provide a simple approval to any case we happen to choose” (ibid). He maintains that rather, purposive sampling demands that one has to think critically about the parameters of the population they are studying and to choose their sample case carefully on this basis (ibid). Elsewhere, Schutt (2006) argues that purpose sampling may not necessarily produce a sample that represents some larger population: “but targets individuals who are particularly knowledgeable about the issues under investigation” (p.155).

3.8.1.1 Individual interviews

The interviews were chosen for this study because they allow a variety of issues to be explored in depth than would be possible with a questionnaire. Miller and Salkind (2002, p.300) found that interviews (if targeted appropriately) can yield almost a perfect sample of the general population because practically everyone can be reached. The language can be adapted to the ability or educational level of the person being interviewed. Similarly, Neuman (2007) found that: “well trained interviewers can ask all types of questions and can use extensive probes” (p.339). In this study interviews were chosen because the researcher knew the participants very well and the participants as such scheduling easier would be easier. The
qualitative methods such as observations, individual and group interviews are
deemed ideal for answering ‘why?’ and ‘how?’ questions (Miller and Salkind, 2002;
Neuman, 2007). Such methods would enable the researcher to gain in-depth
understanding of the perspectives, experiences and practices of the key
stakeholders involved in the curriculum.

All interviews were semi structured to offer the flexibility to change direction to
pursue emergent issues, to probe a topic or deepen response (Neuman, 2007;
Miller and Salkind, 2002). This technique allowed an informal relationship with
respondents and also helped the researcher to elicit such information in an open
and relaxed manner (Creswell, 1998). Furthermore, the interviewer can collect
additional data about the informant for subsequent follow-ups especially during
data analysis (Miller and Salkind, 2002). As recommended by Bell (2005), planning
and conducting an interview requires the researcher to develop an interview
schedule similar to the one shown in Appendix 4.2. The interview schedule
contained a list of questions and the order in which they would be asked (Bell,
2005; Creswell, 2009). This allowed responses to be compared across the data
sets. The questions collected information about attitudes, perceptions and
experiences regarding the curriculum. So, personal interviews enabled the
researcher to probe issues that lie beneath the meanings and perspectives of
participants (Cohen et al., 2011). Figure 3.8 summarises procedures which were
followed to conduct the individual interview.
Individual interviews

Procedures followed | How the data were recorded
--- | ---
- Purposeful sampling procedures recommended by Miles and Huberman (1994) were used to identify key informants. Initial contact with the Senior officers was made by phone through the Enquiry Desk. | - The interview was tape recorded to minimise too much writing during the interview. However, the author jotted a few notes. This was found useful in noting supplementary questions.
- The purpose of the study was explained and dates for the interview were proposed. Once the request was accepted, a formal letter was written which included: Informed consent form and the interview schedule. | - In designing the interview schedule, procedures recommended by Bell (2005) were followed. Bell (2005) suggests that prior to conducting an interview, the researcher needs to design an interview schedule which should include: questions to be asked, the order in which they will be asked and methods of analysis. Bell also recommends that the interview should be piloted (Creswell, 1998).
- The interview schedule contained questions to be asked in the interview. The documents were sent by email month before the data collection exercise. | - An interview schedule was prepared with a list of questions and their order in which they will be asked (Creswell, 1998). The interviewees were asked the same questions. However, as already mentioned, there was provision for asking additional questions which were had not been anticipated. The form was also found useful for transferring interview transcriptions.
- The same interview schedule was used across to make it easier to validate the responses against the respondents. | - After the interview, the researcher verified that the device used to record the interview had worked throughout the interview. Reflection on the interview was done whilst issues were still fresh in the mind.
- Upon arrival in Botswana, a courtesy visit was made to the Senior officers’ offices to formalise the appointments and make all the necessary arrangements including the venue for the interview. | - As already mentioned in figure 3.8 the interviews were semi-structured with questions that enabled information to be gained about specific issues and which also allowed the respondents to discuss topics openly within the set parameters.

**Figure 3. 8: Procedures for individual interviews**

Adapted from: (Miles and Huberman, 1994; Bell, 2005; Creswell, 1998)

In terms of the duration of interviews, Miller and Salkind (2002) advised that: “interviews should be kept within a 45-minute time span” (p.310). Beyond this, they reported that respondents might feel tired and show less interest in the interview. The interviews took between 45 and 60 minutes, with the average being approximately 45 minutes in duration. However, in some cases the interview went beyond the maximum time limit especially with in-service officers because they had many other issues to share. For the senior officers, in-service officers and senior teachers the interviews were conducted in their offices and audio taped for later transcription. The audiotapes were transcribed verbatim by the researcher.

As already mentioned in figure 3.8 the interviews were semi-structured with questions that enabled information to be gained about specific issues and which also allowed the respondents to discuss topics openly within the set parameters.

Limitations with interviews were also noted, for example, Neuman (2007, p.190) cautions against interviewer bias which might skew the data. He explained since the interviewer has control over which person answers the questions, he/she may influence the respondent to answer in a particular way. Moreover, Silverman
(2010) cautions that the researcher needs to give thought to how his/her relationship with the people in his study might affect the findings.

Kvale and Brinkmann (2009) adds to the above by cautioning that recorded interviews pose other challenges such as poor audio quality due to technical defects or background noises. This might necessitate playing the recording several times to avoid mishearing and misinterpretations of hardly audible passages.

Elsewhere, Simons (2009) highlights concerns regarding personal involvement and/or subjectivity of the researcher and the way inferences are drawn from the data. Thomas (2009) drives this point home by arguing that the researcher has an undeniable position about the nature of the observations and interpretations that they make. As a consequence, both Simons and Thomas advise that the researcher needs to declare his/her ontological position on the issues being investigated. This is to guard against personal biases which might influence the choice of methods and procedures used to collect and analyse the data, which helped to reduce his bias.

Personal biases were addressed in the following ways: by showing sensitivity to researcher's own views and prior assumptions; by asking neutral questions; by reporting objectively and sharing the findings with participants. Furthermore, the researcher was closely monitored by his supervisors.

3.8.1.2 Group interviews

Liamputtong (2011) explains that group interview is: "useful in exploring and examining what people think, how they think, and why they think the way they do about the issues of importance to them without pressuring them into making decisions or reaching a consensus" (p.5). In this kind of interview, the researcher introduces the topic and assists the participants to discuss it, by encouraging interaction and guiding the conversation (ibid). The group interview enabled the researcher to follow-up on issues which arose from the questionnaire. Berg (2007) notes that when administered carefully, group interviews are extremely dynamic and: "a far larger number of ideas, issues, topics and even solutions to a problem can be generated than through individual conversations" (p.146). Simons (2009) also
finds group interviews to be: “economical; they enable the researcher to get a sense of the degree of agreement on the issues; and can provide a cross-check on the consistency of perspectives and statements of certain individuals” (p.49). However, Liamputtong (2011, p.3) emphasises that group interviews do not always aim to reach consensus on the issues, but rather to provide a greater understanding of why participants hold certain views on the issues under discussion. On the basis of the foregoing, the group interview provided a reflective forum for both the researcher and the teachers. This enabled them to share their experiences and interactions in the practising environment. Furthermore, these interviews allowed data to be compared and validated against other data sources.

3.8.1.3 Group size and composition

The researcher noted that the literature provides mixed opinion on a suitable number of participants for a group interview. For instance, Robson (2011) concurs that: “opinion varies on the optimum size of the group” (p.295), for example, Robson (2011) cited Steward and Shamdasani (1990) as suggesting a group size of 8 to 12. Likewise, Houlston (2010, p.41), also noted frequent recommendations in the literature suggesting 8-10 members for group interviews. Houlston (2010) even suggested smaller groups of 4-6 with the rationale that they may work better for some topics. In contrast, Morgan (1998) opted for 6 to 10 (cited in Robson, 2011, p.295) and elsewhere, Liamputtong (2011, p.3) suggested a group of 6-8 people.

Besides the group size, another important consideration for the researcher is to determine its composition. Robson (2011) has suggested two approaches to dealing with group dynamics. One needs to determine whether he/she is going to use a homogeneous or heterogeneous group. The former refers to a group of people with a common background, position or experience and the latter, refers to a group of people which differ in the aspects mentioned above. The homogenous group have been found to:

- Facilitate communication;
- Promote an exchange of ideas and experiences;
- Give a sense of safety in expressing conflicts or concerns; and
The researcher also noted the disadvantages associated with using the homogeneous group mentioned above. For example, Krueger and Casey (2000) cautioned against using groups of people who know and work closely with each other. They argued that their relationships and hierarchies may influence contributions (cited in Robson, 2011, p.295).

By contrast, the heterogeneous group was found to have the advantages that it can stimulate and enrich discussion; and may inspire other group members to look at the topic in a different light (ibid). However, one disadvantage is: the risk of power imbalances; which can lead to lack of respect for opinions expressed by some members. If not handled properly this situation may lead to a dominant participant destroying the group process (Houlston, 2010). Moreover, Simons (2009) notes that group interviews may be difficult to control with different people trying to have their say. Also, hearing different voices might present difficulties in transcribing the data.

Given that group interviews involve many people, Houlston (2010) highlights: “the complexity of arranging meetings with multiple people (p.42). For example, it might not be possible to find a common time for all the participants. He advises that the researcher could invite more people in case some participants are unable to turn up. Furthermore, he suggests that when conducting research in institutional or workplace settings, scheduling may be made easier by co-opting members of such institutions to help facilitate the meetings. Also, he suggests that if meetings are scheduled at meal times, the researcher might provide drinks, snacks or meals for participants (ibid, p.42).

As shown in figure 3.4 the teachers participated in the questionnaire and the group interviews, but participation in the group interview was voluntary. The questionnaire contained a section at the end which asked them to provide their contact details if they wished to participate in the group interviews. The researcher used their mobile numbers to invite them to the interviews. The sizes and composition of the sample for the group interviews varied between eight and ten. The interviews were scheduled for the afternoons because it was convenient for the teachers to attend as they did not have lessons at this time. The venue was
one of the classrooms organised by the head of department. For the pilot study, a teacher training college was chosen because it was in a central location, which meant the teachers would not have to travel a long distance. Also some of the participants came from the college, who were lecturers that had moved from senior secondary schools and who had been teaching design and technology.

### 3.8.1.4 Procedures and management techniques

The researcher had familiarised himself with the disadvantages associated with conducting a group interview, as such he was always alert and acted appropriately to such situations. For example, the researcher noted that the group was cross sectional; it consisted of lecturers and teachers with different teaching experiences at various levels. So during the interview he paid attention to dominant participants who could skew the data; conflicts and power struggles which could arise among participants. To overcome some of the difficulties explained above, some ground rules were established prior to the conduct of the interview. Figure 3.9 presents these ground rules.

- Before the start of the interview participants were kindly asked to switch off their mobile phones.
- Participants were reminded that the session would be audio recorded to ensure that what they said was captured correctly.
- They were assured that no names would be identified in reporting the findings.
- Everyone was encouraged to talk; but not at the same time and were assured that everyone’s opinion was welcome.
- In order to create a friendly and relaxed atmosphere the researcher suggested that he would address them by their first names.
- Everyone was asked to listen respectfully and not interrupt when others were responding.
- They were assured that everyone would be accorded equal chance to participate in the discussions.

**Figure 3.9: Ground rules used for the group interview**

Adapted from: (Kvale and Brinsmann, 2009; Robson, 2011)
At the end of the interview, a report was prepared reflecting the discussion using the participants’ own words, listing the key statements, ideas, and attitudes expressed for each topic in readiness for transcription and analysis.

### 3.8.2 Participants and Sources of data in this context

Stringer (2007) highlighted that the primary data in this kind of research are usually derived from interviews with key stakeholders. However, he noted that as the scope and issues to be addressed become clearer, other sources of data may become relevant. The primary data were collected from the questionnaires, individual and group interviews and diaries. Secondary data were collected through a review of official documents and the literature. For the literature, the data collected were used to gain insight into the topic and to guide the design of the research questions. The sources of data were driven by; the research questions, the practicalities of the research context and the need to provide as complete a picture as possible.

### 3.8.3 Teacher questionnaire survey

This section discusses the design and administering of the questionnaires. As already mentioned the quantitative approach involved a questionnaire survey. The questionnaire was administered to the teachers for two main reasons: firstly teachers as curriculum implementers, their views were needed to help illuminate the nature of existing conditions in schools; and secondly, they represented a larger population. The use of a questionnaire was found more appropriate because the teachers from which the data were collected were geographically widely dispersed. Questionnaires enabled the data to be collected quickly and conveniently from several schools simultaneously. Since the researcher was working within a time constraint, this approach enabled the data to be gathered on one-shot basis and hence was economical (Robson, 2011). Also, the questionnaire approach offered the flexibility that it could be emailed or administered directly to respondents. Emailing was considered for those teachers who had Internet access. Other advantages of the use of a questionnaire are absence of interviewer effect; since there is no interviewer present when a self-completion questionnaire is being completed, there is little interviewer bias. Convenience for respondents to
complete the questionnaire at a time convenient to them and the speed they want to go (Bryman, 2008).

A research assistant was engaged to help with the distribution of the questionnaires around schools and collection of them at a later date. This was found to be more effective and efficient than the postal method. The postal method was deemed too expensive to run and was also found to have a lower response rate (Bryman, 2008). For the hard to reach schools, it was considered to use an online questionnaire, however this method was not effective because many of the teachers did not have access to the Internet.

Despite the advantages mentioned above, the researcher also noted some disadvantages associated with the use of questionnaires. For example, Robson (2011) cautions about the difficulty in following up issues which individuals may have raised in a questionnaire. Moreover, Cohen et al. (2011) advise that since the data collected represent a wider population; the use of questionnaires requires careful planning. Other disadvantages found with the use of questionnaires are given below:

- Since a self-completion questionnaire was used, it meant that the respondents could only answer to the best of their ability, if some questions are unclear; the researcher would not be there to consult for clarification. Because of this lack of supervision during the completion of the questionnaire, there is a greater risk by respondents of missing data out or partially answering questions. This challenge was overcome by ensuring that the questions asked were clear and easy to complete. The questionnaires were piloted with some teachers in the field before administering them to the rest of the participants.

- Questionnaires do not usually offer the opportunity to probe participants to elaborate their answers as in face-to-face interviews. Bryman (2008) proposes that this problem could be overcome by the use of open ended questions. However, Bryman cautions that open ended questions should be used sparingly and that the researcher should also avoid asking too many questions.
Another challenge highlighted is that because of issues of maintaining anonymity it is difficult for the researcher to follow up on some responses.

Due to time constraint, one can only ask a limited number of questions. Moreover, it has been noted there is a tendency by the respondents to under-report the issues which they perceive to be sensitive (Bryman, 2008).

The next section discusses the procedures used to administer the questionnaires for case studies as the researcher used different approaches for logistical reasons. For example, in the pilot study the researcher administered the questionnaire whilst based in England. So he engaged the services of his colleagues at the University of Botswana (UB) and some teachers in schools. The colleagues at UB distributed and collected questionnaires for schools based in the south central region, whilst for those in the northern region, the researcher approached one of the teachers, who had participated in the piloting of the instruments to assist with the distribution and collection. This teacher had been briefed on ethical procedures to observe in approaching participants. Regarding the colleagues at UB, they both had doctoral degrees; as such they had the necessary credentials to help with the data collection exercise. However, the researcher still impressed upon them the procedures to be observed such as: to approach people politely; not to force anyone to participate; to encourage participants to answer to the best of their ability and not to discuss their answers. The same set of instructions was given to other teachers who volunteered to assist with the distribution and collection of the questionnaires.

For returning the questionnaires, the researcher made an arrangement with a fellow research student who had travelled to Botswana to bring them to England. This refers to the questionnaires which came from schools in the south central region. For the schools in the northern region, the researcher sent money (£20) to the teacher mentioned above to post them through a courier company. The questionnaires arrived within three days. In case study 2, the researcher administered the questionnaires during fieldwork in Botswana.
3.8.3.1 The design of the questionnaire

Two types of questionnaires were used: the paper based and the online one. The paper based was administered directly to the participants while for the online one a web link was sent by email to the participants. Miller and Salkind (2002) noted that questionnaires: "take a great deal of time and energy to develop, but when designed and administered correctly, they can provide a significant and accurate assessment" (p.301). Neuman (2007) advises that the design of a questionnaire should take into consideration the following:

- **Organisation**: questions should be organised into common topics or themes to facilitate a smooth and logical flow;

- **Question order or sequence**: it is advised to make opening questions pleasant interesting and easy to answer;

- **The wording**: should be made simple to avoid confusion or to influence the respondent to answer in a particular way. Neuman (2007) noted that certain words may trigger some emotional reaction;

- **Length of the questionnaire**: it has been noted that the length depends on the survey format. It is advised that the questionnaire should be of reasonable length to make the respondent feel comfortable about completing it.

The questionnaire comprised closed questions and open-ended questions. For the closed questions a six-point, rating scale was used to measure teachers' views and perceptions relating to the following issues:

- the motivation for curriculum change;

- the clarity of communication regarding the change;

- their level of satisfaction regarding their participation in the change process;

- their level of satisfaction regarding the support offered to them by the authorities and in-service support providers during the transition period; and
• a range of other issues affecting the implementation of the curriculum.

The open-ended questions were included to enable teachers to justify their answers, provide additional personal perspectives and suggestions. Figure 3.10 presents the structure and composition of the questionnaire used.

<table>
<thead>
<tr>
<th>Part</th>
<th>Explanations</th>
<th>Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part A</td>
<td>Introduction and instructions</td>
<td>• To facilitate clarity of instructions and to ensure that the participants appreciated the need to participate in the study.</td>
</tr>
<tr>
<td>Part B</td>
<td>Personal details</td>
<td>• To capture teachers’ demographic data.</td>
</tr>
<tr>
<td>Part C</td>
<td>General questions</td>
<td>• To capture additional information.</td>
</tr>
<tr>
<td>Part D</td>
<td>A measure of teachers’ perceptions regarding the change; and the degree of their participation in the change process.</td>
<td>• To provide insights into their thoughts and opinions regarding the change; • To assess awareness; the level of participation and satisfaction with the roles played in the change processes.</td>
</tr>
<tr>
<td>Part E</td>
<td>A measure of the effects of change on practice.</td>
<td>• To assess the level of satisfaction. • To identify needs.</td>
</tr>
<tr>
<td>Part F</td>
<td>The capacity for change; organisational conditions affecting change.</td>
<td>• To identify facilitating and hindering factors needs; to assess the implementation capacity.</td>
</tr>
<tr>
<td>Part G</td>
<td>A measure of the state of the BGCSE D&amp;T curriculum.</td>
<td>• To gain further insights; generate contextual understanding.</td>
</tr>
<tr>
<td>Part H</td>
<td>Change management strategies</td>
<td>• To generate ideas; assess and identify appropriate intervention strategies.</td>
</tr>
</tbody>
</table>

Figure 3.10: The structure and composition of a questionnaire for teachers

3.8.3.2 The piloting of the questionnaire

Piloting refers to “giving the questionnaire to a small set of respondents who are similar to those in the final survey” (Neuman, 2011, p.312). The objectives of piloting were to: a) trial-test on a few practising teachers to help identify errors before the actual implementation, b) collect baseline data which would be used to measure the level of understanding and interpretation of the questions by the respondents, c) revise based on the analysis of the try-out data, and d) to measure the validity and reliability of the instruments used. The researcher used feedback obtained to modify and/or make appropriate revisions to the instruments before administering them to the rest of the participants. The participants who took part in the pilot exercise were not involved in the final questionnaire. This was done to
avoid them from influencing others. Guidance on evaluating the questionnaire was based on the points already discussed in section 3.8.3.1.

### 3.8.3.3 The administration of the questionnaire

Snow balling sampling technique was used to identify and invite participants for the online questionnaire. Once the participants had accepted; a request letter and the questionnaire were emailed to some participants who had provided their email addresses. For those who did not have email addresses, the documents were emailed to two colleagues at the University of Botswana (UB), who had direct contact with them. Both the letter and the questionnaire had sections which outlined the purpose of the study including ethical issues to be observed. The colleagues at the UB printed copies of the letters and administered the questionnaire on behalf of the researcher. The completed questionnaires were brought back by a colleague who had travelled to Botswana. The findings of this study helped to illuminate the situation on the ground in terms how the curriculum was being implemented.

### 3.8.4 Recording and compiling the data

Microsoft Excel application software was used for recording responses to all questions in the teacher questionnaire. To make it easier to analyse the data at a later stage, an Excel spread sheet was created for each question. Figure 3.11 presents a typical form used to record participants’ responses.

![Figure 3.11: A form used to record participants’ responses](image)
3.9 Qualitative Data Analysis

This section presents and describes techniques used to analyse and interpret qualitative data. The qualitative data described here refers to verbal information captured through interviews or written statements as in the teacher questionnaire; where respondents were given the opportunity to elaborate their answers. Unless otherwise stated, such data are difficult to analyse because the respondents are at liberty to give as many different answers or solutions to a particular issue as they deem fit. In this manner, it is not easy to identify common themes or patterns in the data. Hence, the researcher deemed necessary to develop a strategy to analyse them. For this purpose, thematic coding technique recommended by Robson (2011) and Miles and Huberman (1994) was used for analysing the qualitative data already described above (also see Ibrahim, 2012).

As a preamble to this section, the researcher deemed necessary to provide a working definition of data analysis. This is followed by examples of recommended techniques that can be used to aid analysis and interpretation of qualitative data. The section concludes by exemplifying a coding system which was used in this study.

Neuman (2011) defines data analysis as: “a search for patterns recurrent phrases or ideas in the data” (p.517). A generic way of analysing qualitative data is to apply some codes to the data known as thematic coding (Robson, 2011). Codes are tags or labels “for assigning units of meaning to the descriptive or inferential information compiled during a study” (Neuman, 2011, p.510). Kvale and Brinkmann (2009, p.202) explain that “coding can be either concept driven or data driven”. Concept-driven coding uses codes that have been developed in advance by the researcher, sometimes referred to as a priori codes. A priori codes are formed by either looking at some material or by consulting existing literature. Whereas data-driven coding implies that the researcher starts out without codes, and develops them through reading through the transcripts. Neuman explains that coding allows the researcher to move from the particular description of a phenomenon or social setting to a more general interpretation (ibid). He maintains that in all data analysis, the specific raw data is placed into broader categories and these
categories examined to identify patterns or themes. The next section describes a technique that was used to analyse and interpret qualitative data.

Figure 3.12 summarises a thematic coding method which the researcher used as guidance for qualitative data analysis.

![Thematic Coding Method Diagram](image)

**Stages of thematic coding analysis**
(Adapted from: Robson, 2011, p.476; Miles and Huberman, 1994)

Thematic analysis was used to identify patterns of meaning across a dataset which in turn helped to answer the research questions asked. Patterns were identified through a rigorous process of data familiarisation, data coding, and theme development and revision. This thematic coding was used to make sense of the data captured through the interviews and some sections of the questionnaire where participants were asked to provide reasons for their answers or make suggestions on particular issues.
3.9.1 **Coding of the data and challenges**

This section exemplifies a coding system used in the study. It also highlights some challenges encountered in applying codes to the data. To help with the analysis of data, the researcher developed a coding system based on major issues which arose from the data. A list of codes used is presented in figure 3.13.

<table>
<thead>
<tr>
<th>Major themes which arose from the data and coding</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Initial teacher training</td>
<td>ITT</td>
</tr>
<tr>
<td>2. In-service training/Continuous professional development</td>
<td>INSET</td>
</tr>
<tr>
<td>3. Expertise/Resource persons in the field</td>
<td>EXP</td>
</tr>
<tr>
<td>4. Practical experience/exposure</td>
<td>PRAC</td>
</tr>
<tr>
<td>5. Teaching and learning resources</td>
<td>RES</td>
</tr>
<tr>
<td>6. Laboratory equipment/machinery</td>
<td>EQU</td>
</tr>
<tr>
<td>7. Assessment procedures</td>
<td>ASS</td>
</tr>
<tr>
<td>8. Teacher welfare issues</td>
<td>TWEL</td>
</tr>
<tr>
<td>9. Other kinds of support</td>
<td>SUP</td>
</tr>
</tbody>
</table>

**Figure 3.13: Codes used in data analysis**

The coding system shown in figure 3.13 arose from data analysis in case study 2. So for consistency, this coding was applied across the data sets which included: a teacher questionnaire, individual and group interviews. The codes were assigned as the researcher read through the text.

One of the challenges encountered with analysing narrative data was with identifying themes or patterns especially where the respondents had divergent viewpoints on the issues. It was difficult to organise the major themes into coherent categories using the framework given in figure 3.12. Organising the themes into coherent categories was a labour intensive process because it involved reading and re-reading the text.
3.9.2 **Application of Codes to the Data**

Figure 3.14 exemplifies how the coding system presented in figure 3.13 was employed to aid the analysis of responses to open ended questions in the teacher questionnaire. Possible codes are designated in parentheses.

```
Lack of support; lack of training; Inadequate resources for personal development” (T5).
“Studied CAD but lacked practice due to lack of equipment” (T7).
“Lack of exposure and continuous in-service development programs” (T14).
“I did not have extensive training in CAD/CAM applications as well as Desktop publishing” (T21).
“CAD was and has never been taught at most schools and often the equipment would not be in a good condition” (T23).
“CAD/CAM has not been taught to many teachers and even resource persons cannot teach it with confidence” (T32).
“Covered the course at tertiary level and since then I haven’t had any practice on this course” (T39).
“I never practised what I learnt at university because of lack of equipment or machinery of CAD/CAM in schools”(T48).
```

![Figure 3.14: Thematic coding technique used in case study 2](image)

**Source:** Field data - Case Study 2
Figure 3.15 illustrates a technique used to record and organise the data which were captured through individual interviews.

![Diagram of data analysis process](image)

**Figure 3.15: Data analysis for individual interviews**  
*Illustration by the researcher based on Miles and Huberman (1994)*

### 3.10 Quantitative Data Analysis

Quantitative data analysis is helpful in evaluation because it provides quantifiable and easy to understand results. Quantitative data were captured in some sections of the questionnaire. The first set of data was nominal in nature because it captured teachers’ demographic information and the rest were qualitative. Some sections of the questionnaire measured respondents’ opinions on particular issues and for this purpose a rating scale was used. Such data were analysed using descriptive statistics which yielded charts for further analysis.
Chapter 3 – Methodology and Research Methods

3.11 Use of Likert type self-rating scales

Likert (1932) type self-rating scales were used in the survey questionnaire to measure individual teacher’s rating of their ability to deliver various content areas of the curriculum. The same scales were used to measure teachers’ feeling or beliefs towards particular issues. The respondents were asked to rate their ability and confidence to teach all the content areas of the curriculum. A six-point scale was used to aid respondents’ own scoring or ranking.

The use of scales has been criticised for not being accurate because of the margin of error (confidence level) particularly when a small sample is used (Kidder, 1981; Neuman, 2011; Cohen et al., 2011). For example, Kidder cautioned about a common systematic error known as the halo effect. The halo effect describes a situation where more than one characteristic of a person is to be judged. He cites a tendency by a rater to: “carry over a generalised impression of the person from one rating to the next, or they try to make their ratings consistent” (p.206). Furthermore, Kidder cautioned of another error which he termed the generosity error. The generosity error is characterised by overestimating the desirable qualities. Here the rater tends to avoid extreme judgements and tends to settle for the more moderate categories. Likewise, Neuman (2011) argued that instead of giving respondents a list of items and force them to rank-order, it would be better to ask them to: “choose among alternatives instead of rating items along an imaginary continuum” (p.181). In this manner respondents: “can rate several items equally high, but will place them in a hierarchy if asked to rank them” (ibid). Conversely, Kidder (1981) argued that “individuals are often in a better position to observe and report their own beliefs, feelings and fears than anyone else” (p.205). However, Kidder noted that even though individuals are capable of reporting their feelings or beliefs objectively, the challenge lies in that: “their concept of what constitutes a moderate or an extreme position may be quite different from those of others making comparable ratings” (p.205). Therefore, this argument would seem to corroborate with Cohen et al., and Neuman’s arguments. For example, some respondents may due to fatigue or lack of interest opt for neutrals without even reading the question. Despite the limitations already discussed, Kidder (1981) maintained that: “self-ratings have proved useful in measurement of social attitudes” (p.205).
### 3.12 The rationale for using a 6-point Likert scale in the study

This section explains the rationale for applying a 6-point Likert-scale in this study as opposed to the 5-point and 7-point ones which are commonly used in many survey questionnaires (Chomeya, 2010; Johns, 2010). Also highlighted are some of the debates about the number of point to use on a scale. As a preamble, the author wishes to underscore the primary goals of this research which were: 1) to gain insights into the factors which led to the introduction of a new D&T curriculum in Botswana; 2) to assess how the change was perceived by the various stakeholders involved with the implementation effort; and 3) to measure how the change was being implemented and the transition managed.

The researcher deemed it necessary to develop some instruments which would enable him to measure participants’ views, perceptions and attitudes towards the government’s decision to change the curriculum. For this purpose, it was determined that rating scales would serve as a useful tool to measure the perceptions of the teachers as the key stakeholders because of their role as curriculum implementers. Ultimately, the researcher aimed to use insights gained to identify problems or gaps with the implementation and recommend corrective actions.

Initial literature was done to lay the theoretical framework which informed the researcher’s decision regarding the rationale for using Likert scales; the optimum number of scale points to use and how to administer them. Generally, in terms of the use of Likert scales, Preston and Colman (2000) found that many researchers prefer to use Likert scales for the following reasons:

- a) ease of rating;
- b) time required to select an answer; and
- c) participants’ satisfaction with their ability to express their feelings (Cited in Wakita et al., 2012, p.535).

In search for the optimum number of points to use on a scale, the researcher noted that the Likert type scale of five and seven points were the most commonly used (Chomeya, 2010; Johns, 2010). However, research has not provided sufficient grounds for preferring odd number of points over even ones (Kidder, 1981; Chang,
1994; Chomeya, 2010; Jameison, 2004). For instance, Wakita et al., (2012) found that an odd number of options is used when researchers need a neutral anchor, such as “neither agree nor disagree,” whereas an even number of options is used when researchers intend to elicit participants’ opinions or attitudes through answers such as “Agree” or “Disagree”. Likewise, Johns (2010) has argued that the reason why five has become the norm is because it attempts to strike a compromise between the conflicting goals of offering enough choice (since only two or three options mean measuring only direction rather than also strength of opinion) and making things manageable for respondents (since few people will have a clear idea of the difference between, say, the eighth and ninth point on an eleven-point agree disagree scale). Elsewhere, Matell and Jacoby (1972) found that: “as the number of scale steps is increased, respondents’ use of mid-point category decreased” (cited in Garland, 1991, p.1).

In terms of the 6-point rating scale, Chomeya (2010) observed that it was preferred because it tends to give the discrimination and reliability values which are higher than 5 points. He argued that the 6 points scale offers the following advantages:

- it reduces the deviation to be the least or reduce the risks which might occur due to the deviation of personal decision making;
- an even number of ratings in the scale commit respondents to either the positive or negative end of the scale.
- Chomeya also argued that neutral answers are rare anyway because in the majority of the cases, only those who had a positive or negative opinion will want to participate in a research study.

Based on the theoretical framework and the objectives of the study already presented, a 6-point Likert rating scale was deemed appropriate for this study because the researcher wanted the respondents to provide more precise answers about the situation on the ground. For example, in the pilot survey, self-rating scales were deemed appropriate to collect data which would enable the researcher to measure teachers’ perceptions or beliefs towards particular issues relating to how the BGCSE D&T curriculum was being implemented. Given this situation, the
researcher felt that neutral answers would not help address the specific research questions relating to identifying the key factors affecting the implementation. Also, since the respondents had willingly accepted to participate in the study, the researcher trusted that they would be willing to commit themselves by offering their honest opinions on the range of issues which affected the implementation of the BGCSE D&T curriculum. Similarly, in case study two used a 6-point scale to aid teachers in the scoring of their capability and confidence in the various content areas of the curriculum. Furthermore, there were questions which asked respondents to indicate their level of satisfaction with the support they received from school heads and in-service officers. The follow-on questions enabled the researcher to collect the specific data on the contributing factors.

To conclude this section, the author wishes to acknowledge the debates surrounding the number of scale points on a rating scale (Chang, 1994; Kidder, 1981; Garland, 1991; Jameison, 2004; Johns, 2010; Chomeya, 2010). Garland (1991) concurs that the widespread use of rating scales in market and social research has generated considerable debate over the optimal number of points to use. For example, the researcher observed that those researchers preferring the 6-point scale cited the following reasons: they prefer to have an even number of ratings in the scale to have respondents commit to either the positive or negative end of the scale (Chomeya, 2010; Johns, 2010). Researchers who subscribe to this view disagree with giving the respondent a neutral or indecisive answer choice. They also argue that neutral answers are rare anyways because in the majority of the cases, only those who had a positive or negative experience/opinion will want to participate in a research study. In terms of the use of odd number of points on a scale, some like Wakita et al. (2012) have argued that respondents might truly feel neutral about a given topic, and presenting to these respondents a scale without a neutral midpoint can introduce respondent bias as respondents are forced to choose a more positive or negative response. They argue that neutral is a legitimate opinion that exists among respondents. Therefore, if a researcher wants to solicit every opinion of the people that are surveyed, the neutral rating needs to be included in the scale.
However, studies have shown that there is no theoretical reason to rule out different lengths of response scale (Johns, 2010). After all, as Johns (2010) noted the options are supposed to reflect an underlying continuum rather than a finite number of possible attitudes. This suggests the number points used on a scale remains a contentious issue (Garland, 1991; Johns, 2010; Cohen et al., 2011). As summed by Cohen et al. (2011) it is ultimately the responsibility of the survey questionnaire designer to decide upon the scale that best fits their needs.

### 3.13 Correlation Analysis

Robson (2011) defines a correlation as: “the co-relationships between two variables” (p.433). Correlation studies make use of statistical measures known as correlation coefficients (Lippa, 1994). According to Lippa correlation coefficient indicates: “how much two variables ‘go together’” (p.46). Similarly, Robson explains that correlation coefficients give: “an indication of both strength and the direction of the relationship between the variables” (p.433).

Commonly used correlation coefficients include Pearson’s correlation coefficient (R) and Spearman rank correlation coefficient (Robson, 2011). The Spearman’s rank correlation coefficient was used to discover the strength of a link between two variables namely: teacher capability and confidence. Spearman’s correlation technique was chosen because of its simplicity and adaptability to the study. The researcher was interested in testing and assessing whether there was any relationship between teachers’ ability and confidence to deliver all the content areas of the curriculum. It enabled the researcher to measure the strength and direction (negative or positive) of a relationship between these two variables. A scatter plot of the data was used to test for significance.

The coefficient of correlation ranges from -1 to +1 (Lippa, 1994). Lippa states that if the correlation is computed to be positive value, then as the value of one variable increases (or decreases), the value of the other also increases (or decreases). According to Lippa: “positive correlations range from any value greater than zero to a maximum of +1, which indicates a prefect straight-line relationship between the two variables” (ibid, p.46). To illustrate, in this study the researcher was trying to
establish if there was any correlation between teacher capability and confidence. A coefficient of -1 means that the two variables are perfectly negatively correlated: If a teacher’s ability and confidence are correlated at $r = -1$, each unit of increase in ability will be associated with a decrease in confidence. A coefficient of +1 means that the two variables are perfectly positively correlated: If ability and confidence are correlated at $r = 1$, each unit of increase in teachers’ ability will be associated in an increase in confidence. A coefficient of 0 means that the two variables are not correlated at all.

Robson (2011) cautions that: “it is difficult to assess the strength of this relationship (real significance or importance rather than statistical significance) from the correlation coefficient” (p.436). Because the measurements used were based on respondents own judgement, such measures are subject to error which would prevent them from showing a perfect correlation. Lippa (1994) drives the point home that: “correlations need not be perfect to provide useful information” (p.48). In this research, correlations reported were deemed significant in the sense just described.

### 3.14 Application of Spearman’s Rank Correlation to the findings

This section exemplifies how Spearman’s rank correlation was applied to the findings in case study 2. The Spearman's rank correlation coefficient used to establish if there was any link between teacher capability and the level of confidence to teach a particular content area. For the analysis, Microsoft Excel application software was used to calculate and illustrate by means of a scatter graph the degree of correlation between these two variables. Moreover, this process was done to validate the findings.

---

$r = \text{denotes correlation coefficient}$
Figure 3.16 illustrates a scale used to aid in judging the degree of correlation in this study.

<table>
<thead>
<tr>
<th>Correlation (R)</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00 – 0.19</td>
<td>Very weak</td>
</tr>
<tr>
<td>0.20 – 0.39</td>
<td>Weak</td>
</tr>
<tr>
<td>0.40 – 0.59</td>
<td>Moderate</td>
</tr>
<tr>
<td>0.60 – 0.79</td>
<td>Strong</td>
</tr>
<tr>
<td>0.80 – 1.0</td>
<td>Very strong</td>
</tr>
</tbody>
</table>

**Figure 3. 16: A scale used to measure the degree of correlation**

Illustration by the researcher based on: (Lippa, 1994; Robson, 2011)

Table 3.2 presents the findings in terms of the degree of correlation between teachers’ ability and confidence across all the content areas.

**Table 3.2: Correlation analysis of teachers’ ability and confidence**

<table>
<thead>
<tr>
<th>Ability and confidence in various content areas</th>
<th>Correlation (R)</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electronics</td>
<td>0.63</td>
<td>Strong positive correlation</td>
</tr>
<tr>
<td>Pneumatics</td>
<td>0.78</td>
<td>Strong positive correlation</td>
</tr>
<tr>
<td>Mechanisms</td>
<td>0.83</td>
<td>Very strong positive correlation</td>
</tr>
<tr>
<td>Structures</td>
<td>0.87</td>
<td>Very strong positive correlation</td>
</tr>
<tr>
<td>CAD/CAM</td>
<td>0.32</td>
<td>Weak correlation</td>
</tr>
<tr>
<td>DTP</td>
<td>0.72</td>
<td>Strong positive correlation</td>
</tr>
<tr>
<td>Wood technology</td>
<td>0.50</td>
<td>Moderate correlation</td>
</tr>
<tr>
<td>Metal technology</td>
<td>0.39</td>
<td>Weak correlation</td>
</tr>
<tr>
<td>Plastic technology</td>
<td>0.69</td>
<td>Strong positive correlation</td>
</tr>
<tr>
<td>Graphics</td>
<td>0.78</td>
<td>Strong positive correlation</td>
</tr>
<tr>
<td>Product design</td>
<td>0.92</td>
<td>Very strong positive correlation</td>
</tr>
</tbody>
</table>

Source: Field data – Case study 2
Kerr, Hall and Kozub (2002) recommend that: “a correlation of 0.62 or greater must be observed before one can be 95% confident that the observed relationship was not by change” (p.171). Overall the results show that in eight (8) out of eleven (11) subjects, there is a strong correlation between teachers’ ability and confidence to deliver those content areas. The remainder observed either a moderate (wood) or a weak correlation (metal technology and CAD/CAM). The most surprising results were for wood and metal especially since their rating has been consistently high.

A further analysis of the relationship between teacher ability and confidence was done based on the mean values across all the content areas. Chart 3.1 presents these findings.

### Chart 3.1: Mean values - Ability and Confidence

<table>
<thead>
<tr>
<th>Source</th>
<th>Wood</th>
<th>Metal</th>
<th>Plast</th>
<th>Mech</th>
<th>Struc</th>
<th>Elec</th>
<th>Pneu</th>
<th>CAD</th>
<th>DTP</th>
<th>Gra</th>
<th>Des</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ability</strong></td>
<td>5.5</td>
<td>5.2</td>
<td>5.1</td>
<td>5</td>
<td>5.2</td>
<td>3.9</td>
<td>2.8</td>
<td>2.1</td>
<td>2.8</td>
<td>4.8</td>
<td>4.6</td>
</tr>
<tr>
<td><strong>Confidence</strong></td>
<td>5.3</td>
<td>5.1</td>
<td>5.2</td>
<td>5.1</td>
<td>5.2</td>
<td>3.8</td>
<td>2.7</td>
<td>1.9</td>
<td>2.7</td>
<td>4.6</td>
<td>4.6</td>
</tr>
</tbody>
</table>

**Source: Field data – Case study 2**

As can be observed in chart 3.2, the mean values for teacher ability and confidence are consistent across all the content areas. The results are also consistent with the deficiencies identified among the teachers. For example, CAD/CAM and pneumatics have been consistently low. Therefore, the results have demonstrated satisfactorily a valid measure of teacher capability. However, the results must be treated with caution because of inaccuracies associated with judgements based on Likert scales which have already been discussed in section 3.11 (Cohen et al., 2011; Lippa, 1994; Kidder, 1981; Neuman, 2011; Robson, 2011).
3.15 Triangulation

Houlston (2010) explains that methodological triangulation is often used by researchers to avoid relying solely on a particular data set to generate assertions. Besides achieving triangulation, different methods were used to complement each other because each has its own deficiencies and biases (Cohen et al., 2011). Combining methods enabled the researcher to achieve triangulation and increased validity (Gray, 2004; Hakim, 2000; Thomas, 2009; Simons, 2009). Silverman (2010) suggests ways of enhancing the validity of interview findings.

Silverman (2010) argues that: “many theoretical perspectives in sociology and elsewhere suggest that we cannot simply aggregate data to arrive at an overall ‘truth’” (p.134). Similarly, Hammersley and Atkinson (1983) caution that: “one should not adopt a naively “optimistic” view that the aggregation of data from different sources will unproblematically add up to produce a complete picture” (cited in Silverman, 2010, p.134).

Given the situation described above, the researcher made every attempt to evaluate carefully the various forms of evidence and checked them for consistency. In addition to verbatim description of evidence, other data sets were used to achieve triangulation. The data have been displayed in various forms such as charts, graphs and tables and the files are available for others to see. It was anticipated that questionnaire data would be triangulated with the written statement data, thereby offering a way to validate the analysis of written statements. Silverman (2010) also highlights that research should be conducted so as to: “ensure the professional integrity of its design, the generation and analysis of data, and the publication of the results” (p.156). Furthermore, the direct and indirect contributions of colleagues, collaborators and others should be acknowledged (ibid).
3.16 Ethical considerations

This section discusses ethical principles which should be observed when carrying out research which includes how these principles were addressed in this study as well as some of the challenges encountered.

Any research in a social context should be based on sound ethical principles which the researcher must uphold in order to establish and maintain trust with participants (Neuman, 2011; Simons, 2009). Neuman (2011) defines a code of ethics as: “the principles and guidelines developed for professional organisations to guide research practice and the clarity line between ethical and unethical behaviour” (p.155). The research was carried out in accordance with Loughborough University Ethical Advisory Committee code of ethics. Permission was sought to undertake the research, and to ensure compliance, the researcher completed an ethical clearance form provided in Appendix 3.1. The code of ethics outlines principles and rights of human participants. Simons advises that the first way of establishing an ethical approach to research is through institutional procedures. Neuman (2011) stresses that ethical responsibility for any research rests with the individual researcher. He also emphasised the ethical requirement concerning the privacy and confidentiality of using the information one gathers. Moreover, Neuman maintains that adherence to ethical procedures: “helps to protect social research from charges of insensitivity or abusing people” (p.154).

De Vaus (2001) identifies four broad ethical principles which social research should conform to. These are:

- Voluntary participation;
- Informed consent;
- No harm to participants;
- Anonymity and confidentiality (Gibson and Brown, 2009).
3.16.1 Voluntary participation

The principle of voluntary participation is that people should never be forced into helping with research (Denscombe, 2010; Silverman, 2010). For example, Silverman advises that: “researchers should inform subjects of their right to refuse to participate or withdraw from the investigation whenever and for whatever reason they wish” (p.155). Silverman emphasises that there should be no coercion of research subjects to participate in the research (ibid). These are the basic principles of ‘informed consent’ to be observed in this study. However, De Vaus (2001) noted that voluntary participation can pose a number of problems. For example, it can produce biased samples and can lead to high dropout rates thus leading to few cases for meaningful analysis.

3.16.2 Informed consent

Silverman (2010) explains that: “the principle which underpins informed consent entails giving as much information as possible about the research without so that prospective participants can make informed decisions on their possible involvement” (p.155). Silverman explains further that the primary objective is to conduct research openly and without deception (ibid). Informed consent is closely related to voluntary participation. De Vaus (2001) outlines three basic characteristics of informed consent forms as follows:

- The purpose of the study and its basic procedures;
- The identity of the researcher and the sponsor;
- The use to which the data might be put (p.85).

Both De Vaus (2001) and Denscombe (2010) have highlighted the need for the researcher to provide sufficient detail for the participant to understand the aims, methods and anticipated outcomes of the research. However, they advise that such information must be brief since the participants will not have time to spend to read if presented on more than one page (Denscombe, 2010). Silverman (2010) cautions that: “consent is not simply resolved through the formal signing of a consent document at the start of the research; instead, it is continually open to revision and questioning” (p.155).
3.16.3 Anonymity and confidentiality

De Vaus (2001) and Silverman (2010) highlight the importance of assuring participants of confidentiality for methodological as well as ethical reasons. De Vaus noted that if participants are assured that their responses are truly confidential; they are more likely to participate in the study. He also noted that the participants are: “more likely to provide frank and honest answers” (p.87).

Anonymity was observed by using pseudonyms to: “mask particular biographical features of participants or other identifiers” (Gibson and Brown, 2009). Each participant was assigned a unique identification code as follows:

- Teacher (T);
- Senior teachers (STs); and
- Principal Education Officers (PEOs). These are in-service officers based in the regions and are responsible for providing in-service training to teachers.

The coding also enabled the researcher to verify the responses against the individual participants. However, Gibson and Brown (2009) cautioned that it can be difficult for researchers to determine which features of the data would be recognisable by others. They argue that: “it is easy to promise anonymity, but in practice it can be much harder to safeguard” (p.61). This requires that researchers take steps to ensure that research data and its sources remain confidential unless participants have consented to their disclosure (Silverman, 2010). Silverman advises that if participants consent to the disclosure of their names in reporting the findings, the researcher should ensure that plans have been made for storage for such data and access to them.

Several measures were taken prior to data collection. Before the start of the interviews all respondents were given informed consent forms to read through and afforded the opportunity to questions before they signed. The Participant Informed Consent form used is provided in Appendix 3.2. The researcher also used the opportunity to assure the participants that the data collected would be used only for academic purpose. The data were recorded accurately and the researcher avoided asking embarrassing questions and allowed the participants to express
themselves freely. Lastly, confidentiality was observed by ensuring anonymity in reporting.

### 3.17 Limitations of the study

Cohen et al. (2011) highlight that for qualitative study to be valid; it requires that all the checks and balances should be put in place. This is to avoid the risk of becoming biased. Bearing this limitation in mind required for a more truthful, objective and open minded approach. The fact that data captured was principally qualitative implies that views expressed by those interviewed may be a reflection of their own perceptions and attitudes, and not necessarily portraying the true picture. This may potentially bias the results in some ways. On the basis of this, the findings should not be generalised or assumed applicable to other regions.

The sample size used in the pilot survey for the teacher questionnaire was thirty. The recommended sample size for the questionnaire survey is 25% of the population (Plowright, 2011). There are thirty-two (32) senior secondary schools in Botswana with an average of five (5) teachers per school. This gives a total number of 160 teachers. It was intended to capture data from at least forty teachers. Unfortunately, the pilot managed to capture data from thirty-two (32) teachers. This means that the pilot was eight (8) teachers short. However, this limitation was counter-balanced by increasing the sample size in case study two. For example, in case study two the data were captured from 66 teachers which accounts for over 40% of the population and thereby making the study valid. Concerning small samples, Cohen et al. (2011) observed that they tend to prohibit statistical analysis. Likewise, Plowright (2011) notes that the fewer the cases, the more restricted the researcher’s opportunity to generalise or relate the findings to a wider population. He also highlights that generalisation, does not only depend on the number of cases, but also relies on the technicalities of different types of sampling (p.26). Therefore, one could argue that although the data captured through the questionnaire especially in the pilot were based on a small sample, however, such data provided some useful insights for the subsequent case studies.
Another limitation noted relates to the use of interviews. With reference to this, Silverman (2010) advises that the researcher needs to think carefully before generating data through research instrument like interviews and focus group. Although he acknowledges that sometimes such methods may indeed be appropriate to the topic in question. He maintains, however, that sometimes, the researcher may be neglecting to study illuminating, naturally occurring data (ibid, p.9). In terms of this study, the inability to interview some of the prospective interviewees has implications for the findings. The researcher notes that such data need to be treated with caution. However, keeping these limiting factors in mind, the process of analysing these types of data has provided the researcher with some valuable experience at each phase of the study.

As already mentioned, this research was situated within the post-positivist research paradigm which adopts a more subjective approach to the phenomenon under investigation (Robson, 2011). Researching within the post-positivist paradigm acknowledges that knowledge deemed to be ‘truthful’ is not universally generalizable to all cases and situations. Rather, findings are viewed as contextually related and could be inductively applied elsewhere provided that context is closer to the one being investigated (Yin, 2009; Plowright, 2011). Moreover, the methodological approach employed in this research, was chosen because they were deemed relevant to the specific demands and constraints of the research topic and to enable the researcher to elicit the optimum data and insight from the available sources. Most importantly, the findings have contributed to a greater understanding of the situation on the ground.
CHAPTER 4

CASE STUDY 1 – PILOT SURVEY
Chapter 4 - Pilot survey

An exploration of the management of change from Cambridge to the BGCSE D&T curriculum: Insights gained from views and perceptions of the various stakeholders

4.1 Introduction

This chapter describes the design and implementation of a pilot survey which was carried out at the start of this research project. The aims and objectives of this survey are outlined. This is followed by the theoretical basis and the justification for the study. The methods employed are explained. A summary of the findings are presented in a discursive manner. The conclusions drawn from these findings were used to inform the development of new research questions for the next case study.

The aim of this study was to help gain some insights into the nature and scope of change from the perspective of the sponsor and the implementers. The primary research question addressed was: What is the nature of change and transition from the Cambridge model of design and technology curriculum to the Botswana one? This study followed an initial literature review which was done to identify studies which had examined the issues of curriculum change within the context of Botswana. This literature review was done to help familiarise the researcher with the processes and challenges of implementing change initiatives. The literature about change management highlights that change is a complex phenomenon and has many interacting variables (Fullan, 2001; Kotter, 1996). In terms of educational change, Fullan underscored the need to understand the context and the organisational conditions within which change takes place. Elsewhere, Hargreaves (2005) has argued that change within educational settings may not be successful unless the potential implementers become personally involved and accept the change in their own terms (McBeath, 1997; Fullan, 2001). The foregoing statement asserts the importance of stakeholder participation at all levels of the change process (Kotter, 1996).
4.2 Justification for the study

The preliminary literature review was limited in addressing curriculum change within the context of Botswana. Therefore, it was considered that a pilot study could be used in conjunction with the literature to clarify the direction and focus the study. The pilot study was exploratory in nature because little was known about the area of research being investigated (Neuman, 2011). It was intended to use the findings to inform the direction and scope of a subsequent study. Initial literature findings were used to guide the formulation and focus questions for this initial research.

For this purpose, a small-scale pilot survey was designed to capture baseline data from various stakeholders involved with the development and implementation of the curriculum. Figure 4.1 exemplifies research activities which have been done in Botswana.

<table>
<thead>
<tr>
<th>Researcher</th>
<th>Focus of the study</th>
<th>Level of school</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gaotlhobogwe (PhD, 2010)</td>
<td>Attitudes to and perceptions of design and technology students towards the subject: A case of five junior secondary schools in Botswana.</td>
<td>• Junior secondary school</td>
</tr>
<tr>
<td>Moalosi (PhD, 2007)</td>
<td>The impact of socio-cultural factors upon human-centred design in Botswana.</td>
<td>• Junior secondary school</td>
</tr>
<tr>
<td>Molwane (PhD, 2003)</td>
<td>Assessing students’ capability in design and technology education in junior secondary schools in Botswana.</td>
<td>• Junior secondary school</td>
</tr>
<tr>
<td>Dingalo (PhD, 2002)</td>
<td>Factors associated with gender differences in enrolment for science and technology subjects in Botswana.</td>
<td>• Junior secondary school</td>
</tr>
<tr>
<td>Ndaba (MPhil, 1994)</td>
<td>The effects of the shift from the traditional craft subjects to design and technology: The Botswana experience.</td>
<td>• Senior secondary school</td>
</tr>
</tbody>
</table>

**Figure 4.1: Research activities in D&T education in Botswana**

A summary by the Researcher based on literature review

As shown in figure 4.1, four doctoral studies (Dingalo, 2002; Molwane, 2003; Moalosi, 2007; Gaotlhobogwe, 2010) and a few journal publications have been identified (Ndaba, 1994; Molwane, 2003; Moalosi and Molwane, 2008). These studies have focused on a wide range of issues related to D&T education in Botswana mainly at junior secondary school level. Other studies (Moalosi and
Molwane, 2008) have looked at problems and challenges of the implementation of D&T in primary schools. In terms of publications the focus has been more on the historical perspective of the subject at inception (Molwane, 1993; Ndaba, 1994; Moalosi, 1999). Only one study by Ndaba (1994) attempted to highlight issues of the implementation the D&T curriculum at senior secondary level. Although it has some relevant information, Ndaba’s study was based on the experiences of the transition from the traditional crafts to the Cambridge D&T curriculum. This was in the early 1990s prior to the introduction of the BGCSE curriculum. The context in which the study was conducted was different. The BGCSE curriculum was introduced in 2000 and since inception it has been evaluated once in 2009 (Ministry of Education and Skills Development, 2009). Generally, it was observed that relatively few academics have published on senior secondary school level (Gaotlhobogwe, 2010; Molwane, Ruele and Mwendapole, 2008; Moalosi, 1999; Ndaba, 1994; Molwane, 1993). Based on the evidence already presented in figure 4.1, it was deemed necessary to explore the issues of change management and implementation at senior secondary level. The senior secondary level of schooling was deemed a key stage for Botswana because it was a prevocational level which was designed to equip children with skills for further education and training as well as possible employment (Republic of Botswana, 1994).

4.3 Aims and Objectives

This pilot survey aimed to gain insights into the challenges and opportunities faced by curriculum implementers during the transition period from the Cambridge D&T curriculum to the BGCSE one. Therefore, the specific objectives of the pilot were to:

a) Gain insights into the nature and scope of change regarding the implementation of the BGCSE D&T curriculum;

b) Measure the level of awareness and support for the BGCSE D&T curriculum by the stakeholders involved in its development, adoption and implementation;

c) Provide a diagnosis of why the change may not be as effective as planned and propose corrective actions to support the management of change;
d) Apply findings of the pilot study as inputs to the design of a response action for a subsequent study.

### 4.4 Research questions

As was shown in section 2.5, initial literature on change management identified many factors which affect change. A summary of these key factors is provided in figure 4.2. From this, it was deemed necessary to design a pilot survey and use its findings to determine the most critical issues to focus on for the subsequent study.

**Figure 4.2: A summary of key change management concepts**

Illustration by the research based on initial literature reading

Based on the change management concepts already discussed in section 2.5 the following research questions were formulated:

1) What factors have necessitated change from the Cambridge to the BGCSE model of D&T curriculum?

2) What views and perceptions are held by various stakeholders regarding the change and transition?

3) What organisational factors have facilitated or inhibited change?
4) How can we plan and manage change in a new D&T curriculum in Botswana?

4.5 Study conceptual framework

Figure 4.3 presents the conceptual framework which guided the design of the pilot survey. Literature review was done to support the development of the conceptual framework for the study as well as to validate the findings. As seen in figure 4.3 the research questions were developed around key issues or themes (shown **bolded**) which arose from the literature.

**Figure 4.3: Pilot survey conceptual framework**

*Illustration by the Researcher based on change management concepts*

The inductive nature of the enquiry meant there was no finite starting point but evolved from the findings at the end of each phase (Mason, 2002).
4.6 Participants and Selection

Participant selection was driven primarily by the research questions and the kinds of data required. Snowball sampling technique similar to Neuman (2011, p.269) was used to recruit teacher participants for the questionnaire while for the individual interviews purposive sampling procedures were used (as in Miller and Huberman, 1994; Creswell, 2009; Gibson and Brown, 2009). Participation in the group interviews was voluntary. The questionnaire had a section at the end which asked the participants to provide their contact details if they wished to participate in the group interviews.

In order to ensure that the questions asked were relevant to the participants, the framework shown in figure 4.4 was used to map out the research questions against prospective participants or other sources. The final version of this matrix is shown Appendix 3.4.

![Figure 4.4: A matrix used to align research questions with data sources](Illustration by the Researcher)
4.7 Methods and Study Sample

The design of this study derives from the main study methodological framework which has already been outlined in chapter 3. A qualitative strategy was used because most of the data collected were based on people’s views and experiences with the new curriculum. Since the area being studied had not been explored before in Botswana, a case study approach outlined by Yin (2009) and Stakes (1995) was found appropriate. The aim was to generate in-depth understanding of the nature of transition rather than to generalise to a whole population (Simons, 2009).

This survey employed a multi-methods approach described in section 3.4 of the methodology chapter because of the fact that the data were from the various stakeholders each trying to put their perspectives and experiences across. As such it became necessary to: “combine techniques to triangulate perspectives” (Denton, 1992, p.6). Also continuing along the same argument as Denton that: “if methods differ and yet give significantly similar results then confidence in the reliability grows as distortions and ‘blind spots’ of one method should be covered by another” (p.6). As shown in figure 4.4, the methods used included a questionnaire, individual interviews and a group interview.

The design was iterative in the sense that insights gained in the initial study were used to focus the subsequent study, both in terms of the questions that were asked and potential participants. The focus, methodologies and a sampling frame are shown in figure 4.5.
Methods & sample size

Context of the study

Regions from which baseline data were collected

South central

North

Questionnaire

Group interview

Individual interviews

Data set 1 (n = 32)

Data set 2 (x = 8)

Data sets 3, 4 & 5 (n = 3)

Data set 6 (n = 2)

Data set 7 (n = 2)

Issues addressed

Motivation for change

Vision and strategy for change

Level of Communication

Administrative support

Stakeholder participation

Capacity to implement

Level of support to teachers

Organisational factors

These issues arose from initial literature review

Figure 4.5: Multi method approach used in the pilot survey
Source: Illustration by the Researcher

4.7.1 Teacher questionnaire

It was determined that some research questions would be better answered by teachers through a self-completion questionnaire (Appendix 4.1). The reasons for using a questionnaire have already been explained in section 3.8.3. The questionnaire was found appropriate for teachers for two main reasons:

i. Teachers as curriculum implementers were deemed key success factors in the implementation of any new curriculum (Fullan, 2001). Consequently, their views were found helpful in illuminating the nature of existing conditions in schools.

ii. They represented a larger population. The questionnaire enabled the data to be gathered on one-shot basis and hence economical (Schutt, 2006). Furthermore, the questionnaire offered the flexibility that it could be either emailed or administered directly to respondents.
The design of the questionnaire took into consideration the research questions to be answered and strategies for recording, organising and analysing data. The design followed guidelines provided by Neuman (2007) in section 3.8.3.1. The questionnaire consisted of both open and closed questions. To enhance clarity each question was preceded with an opening statement which helped to clarify the questions. The questionnaire was designed and piloted on ten teachers on the field and appropriate revisions were made. To avoid influencing others, these teachers were not involved in the final questionnaire. Both qualitative and quantitative data were collected and analysed. The forms used to record teachers’ responses are shown in appendix 3.3.

4.7.2 Individual interviews

The purpose of interview was to enable the researcher to compare the data with those obtained through the teacher questionnaire. The interviews were organised around conceptual issues which had emerged from the literature.

4.7.3 Group interview

A group interview was conducted in the South Eastern region. The groups were heterogeneous, in the sense it was composed of teachers and lecturers of a teacher training college. In the group were people of different experiences, with some having taught both the Cambridge and the BGCSE D&T curriculum. Others had only taught the BGCSE one. For the purpose of this study, this group was deemed appropriate because it comprised people who had experienced teaching the curriculum. Some had been involved in its development and as such were well informed about the issues being discussed. The group had eight members. The participants were the teachers who had previously participated in the questionnaire. The questionnaire had a provision for participants to provide their contact details if they wished to participate in the interview. The researcher used the contact details provided to invite them. The group interview provided a reflective forum for both the researcher and teachers to share their experiences in the practising environment. Ultimately this kind of mutual exchange was found useful in helping to generate solutions and plans for improvement.
4.8 Ethical procedures

In terms of ethical procedures, several measures were taken prior to data collection. For the questionnaire, an introductory statement was included which outlined the purpose of the study and the participants’ rights to withdraw from the study. For the interviews, a letter was sent in advance to the participants to request their participation. This gave enough time for them to organise themselves and re-schedule their important duties in advance. The correspondence included an interview schedule, informed participant form and an ethical clearance form. Confidentiality was observed by anonymity in reporting.

4.9 Description of the context

Due to financial and time constraints, the pilot survey was limited to two regions (n=10), the Northern and South central. Geographically the regions are 400km apart. The regions were chosen for three reasons as follows:

1. First, the researcher was familiar with the setting, school heads and teachers, which made access easier.

2. Second, schools in those towns were closer; this was particularly helpful for arranging group interviews. Teachers would not have to travel long distances.

3. Third, because schools operated under almost similar contexts, administratively, staffing and student in-take. This enabled the data collected to be compared and contrasted along similar criteria thus increasing the external validity of the findings.

The regions were chosen based on availability of transport and decent accommodation for lodging in duration field work. All the schools are funded by the government.
4.10 Findings

This section presents findings of this pilot study. Because of the small samples used in the study, the findings will be presented in a discursive manner. Findings presented are for: the teacher questionnaire (Set 1); group interviews (Set 2); Individual interviews (Sets, 3, 4, 5, 6, & 7).

4.10.1 Age distribution of teachers

Chart 4.1 presents the age profile of the teachers who participated in the pilot survey. The data on the age distribution of teachers was deemed useful in helping to anticipate potential changes in the composition of the teaching force.

As observed in chart 4.1, the teachers with the highest teaching experience ranged between 16-20 years, followed by those 11-15 years. A combined total of these is 20 out of 30 (66.7%). This number represents the majority. The least experienced were 5 years and below. In terms of teaching qualifications, it was observed that in the sample (n=30) four teachers had a Master’s degree in Education whilst the remainder held Bachelor's degrees.
4.10.2 Institutions of Training

In the sample, it was observed that four institutions have been involved in the training of D&T teachers in Botswana. These are: the University of Botswana, University of Exeter (England), University of Newcastle (Australia) and Edith Cowan University (Australia). Chart 4.2 presents findings in respect of institutions where teachers in the sample had been trained.

Chart 4.2: Universities involved in the training of D&T teachers

Key:

- ECU – Edith Cowan University
- EXE – University of Exeter
- UB – University of Botswana
- UNW – University of Newcastle

The findings show that the majority (20 out 30) of the teachers in the sample studied at University of Botswana. The rest are shared almost equally by three institutions (ECU, EXE, and UNW). These data can be useful in helping to identify the strengths and weaknesses of programmes offered by these institutions.

4.10.3 Awareness about the need for change

This part asked the participants to share their views regarding their awareness about the change; the level of communication by the authorities; and their role in decision-making related to the change process. The questions related to this part
were addressed by a questionnaire for teachers, a group interview and individual interviews with senior officers. Document review was also done to validate the findings.

Teachers’ attitudes to change were measured using the following question:

**Q10: Do you think the change from Cambridge to the BGCSE D&T curriculum was necessary?**

This question required a “**Yes** or **No**” response. However, it had a provision for respondents to justify their answers. Those who answered with a “**No**” moved to the next question. Chart 4.3 presents a measure of teachers’ perceptions about the whether or not they felt the decision to change the curriculum was the right one.

*Key: NR (No Response)*

In the sample, fifteen (50%) welcomed the move away from Cambridge, whilst eight (27%) did not see the need for change. The remainder did not respond to the question. The researcher could not establish why did not answer the question.

Those teachers who answered “**Yes**” provided the following reasons:

“**To align it with the specific needs of the country**” (T001).

“**So that the locals can have a say in the running of the examination**” (T007).

“**To provide local relevance to the syllabus**” (T013).
“Living in a competitive global world...we need to embrace changes in the education world” (T017).

“We needed a localised curriculum which acknowledge our cultural technology and also adopts the globalisation” (T027).

Key: T = Teacher, followed by an identification code.

For those who answered “No” did not provide their reasons. However, three respondents could not answer the question because they did not have the experience of teaching the Cambridge curriculum (T003; T004; T026). For example, one respondent indicated that: “I was not at senior when it was changed” (T026). One respondent indicated that he did not know the reason why the curriculum was changed (T002). So overall these findings suggest that the majority of teachers in the sample appreciated the need for curriculum change.

To validate the responses from the questionnaire, the same question was addressed to other participants in the individual and group interviews. Table 4.1 presents some of the views expressed across the data sets.

Table 4.1: Participants perception of the level of communication

<table>
<thead>
<tr>
<th>Data sets</th>
<th>Participants’ views on the level of communication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set 2</td>
<td>“I wouldn't say it was communicated; I would give it a zero”</td>
</tr>
<tr>
<td>Set 3</td>
<td>“Unfortunately I cannot ascertain the level of communication...may be there wasn’t enough consultation”</td>
</tr>
<tr>
<td>Set 4</td>
<td>“That is interesting....don’t know why, because the process starts with the teachers, of course you can’t involve everybody”</td>
</tr>
<tr>
<td>Set 5</td>
<td>“I wouldn't know because I was not in the office”</td>
</tr>
<tr>
<td>Set 6</td>
<td>“At JC (junior certificate) that information never reached us”</td>
</tr>
<tr>
<td>Set 7</td>
<td>“At MCE and UB the invitation was extended”</td>
</tr>
</tbody>
</table>

Source: Field data – Case study 1

NB: The codes for different datasets have been explained in figure 4.4.
Regarding the senior officers (Data sets 3, 4 and 5) some of them reported that they were new in their positions as such they could not ascertain the level of communication. Also they could not provide records of such communication. Therefore, based on this evidence it was concluded that communication was not clear.

4.10.4 Communication about the change and stakeholder participation

This question sought to measure perceptions of the various stakeholders in terms of how whether or not the decision by the government of Botswana to move away from Cambridge curriculum was a good one. A follow up question asked the participants to justify their answers.

The question was asked through the interviews and the teacher questionnaire (n=30). Findings in respect of this question are presented in the following sequence: questionnaire data, followed by individual interviews and then the group interviews.

The next question required participants to share their views regarding the level of communication regarding the change.

Q11. Was the need for change clearly communicated to the D&T teachers?

The teachers were asked to offer their ratings on a scale of 0-5 in terms of their perceptions of how well the authorities communicated the decisions about the change.

To measure the effectiveness of communication regarding the change, a rating scale shown in Figure 4.6.

![Figure 4.6: The scale used to measure effectiveness of communication](Illustration by the Researcher)
Chart 4.4 summarises the teachers’ perceptions in terms of the level of communication regarding the change.

**Chart 4.4: Teachers’ perceptions about the level of communication**

Three (3) rated the level of communication 3 on a scale of 5, suggesting that the communication was somewhat clear and fairly communicated; eleven (11) rated between 0-2, suggesting that it was unclear and poorly communicated; eight (8) left it blank.

In the questionnaire, a follow-up question asked the respondents to justify their answers in terms of the scores they had awarded for the level of communication. The following statements capture the level of awareness by some teachers regarding the change:

“I was not around at the time” (T020)

“I was not at senior when it was changed” (T026)

“Heard over the media about the transition” (T028)

“Never informed; I was never consulted; Never took part in any” (T029).

“About communication, I do not have information because I was still schooling” (T030).

From the above statements, one notes that communication from the authorities regarding the change not effective.
4.10.5  Stakeholder participation in the change process

The question of stakeholder participation was also raised with the teachers in the questionnaire and a group interview. Teachers are considered the major stakeholders in the curriculum development process (Directorate of Public Service Management, 2006). In terms of teacher participation in curriculum development, a typical question posed to senior education officers was:

Q3: At what level in the development processes were schools and teachers consulted and involved in decisions about the new curriculum?

In response to this question one officer commented that: “Schools were advised to set up committees to consult and establish the needs of the schools. May be there wasn’t enough consultation” (Case study 1 Field data - Data set 3). It was also reported by the department of Curriculum Development and Evaluation that the teachers participated through subject panels and task forces. However, it was surprising to note that the CD&E office could not establish the level of participation especially by key stakeholders such as teachers. This is because the CD&E office is the one responsible for inviting the various stakeholders. The following statement highlights this point: “of course you can’t involve everybody” (ibid, Field data). The researcher noted that CD&E seemed not have mechanisms in place to ensure that the people invited into the panels have the experience and expertise needed. This statement explains the current situation: “we do rely on the curriculum development officer to identify and then we write them letters” (ibid). Relying solely on the curriculum development officer without some quality assurance mechanisms is susceptible to abuse of this privilege.

4.10.6  Changes brought about the new curriculum

The next question asked respondents to share their experiences regarding any changes in practice and new requirements that were brought about the new curriculum.

Q14. What new content areas do you teach as a result of the introduction of the BGCSE D&T curriculum?
Figure 4.7 provides a summary of the main categories of content areas identified in the data upon analysing the responses to question 14.

The BGCSE D&T curriculum introduced new content areas such as electronics; pneumatics and computer aided design and manufacture (CAD/CAM).

In order to determine the most critical training needs for the teachers, a further analysis was done using descriptive statistics technique. Chart 4.5 summaries teachers’ preferences in terms of their training needs.

Electronics was ranked the highest (11), followed by pneumatics (7); CAD/CAM and CNC (6) and computer graphics (2). The findings were also validated by the data obtained from the group and individual interviews.
4.10.7 Capacity for change

The capacity for change was assessed in terms of the leadership at all levels, provision of resources (physical and funding) and teachers’ professional development. This part required participants to comment on the kinds of support they had received to prepare them for the change. It was focused mainly on the teachers by as the implementers. Teachers’ perception on the capacity for change was assessed through administrative support. A typical question asked was:

Q18. How would you rate the level of support you have received from the providers?

Chart 4.6 presents the findings in respect of teachers’ perceptions on the level of resources in their respective schools.

![Chart 4.6: Teachers' perception of the level of teaching resources](chart)

A scale of 0-5 was used to record the answer that best described their perceptions.

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Level of satisfaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Very high</td>
</tr>
<tr>
<td>4</td>
<td>High</td>
</tr>
<tr>
<td>5</td>
<td>Fairly low</td>
</tr>
<tr>
<td>6</td>
<td>Average</td>
</tr>
<tr>
<td>4</td>
<td>Low</td>
</tr>
<tr>
<td>1</td>
<td>Very low</td>
</tr>
</tbody>
</table>

From these findings, we notice that the skew is more towards the negative end (from average to low), which suggests that teachers are not satisfied with the level of resources.

A follow up question measured teachers’ perception of administrative support. Chart 4.7 present these findings.
Similarly in terms of administrative, we note that fifteen out thirty (50%) of the respondents suggest that administrative support rates from low to very low. None of the respondents rated it as high.

4.11 Discussion of the findings across the data sets

This section reports the findings of a small-scale pilot study which was designed to collect baseline data from various key stakeholders involved with the implementation of the BGCSE D&T curriculum. The data collected were used to provide insights into how the change was managed and inform a response action.

This discussion is based on selected findings of both the questionnaire and the interviews. Since this was a small sample, the author cautions that the findings limited reliability as they may not be representative of the views of many teachers in the field. However, the information obtained was found useful to illuminate these discussions. The pilot identified many issues affecting the implementation of the BGCSE D&T curriculum. The discussions will focus on the following:

- Communication regarding the change;
- Stakeholder participation;
- Implementation strategy;
- Capacity to implement change;
- Teachers’ professional development.
The ADKAR framework described in section 2.4.3 was used as a diagnostic tool to help assess nature and scope of this change. Figure 4.8 illustrates how the ADKAR change model was used in the teacher questionnaire.

<table>
<thead>
<tr>
<th>Parts</th>
<th>Questions</th>
<th>Explanation</th>
<th>Reference to the ADKAR model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part A</td>
<td>Q1 - 7</td>
<td>• Demographic data</td>
<td>• Not applicable</td>
</tr>
<tr>
<td>Part B</td>
<td>Q8 - 9</td>
<td>• General questions</td>
<td>• Not applicable</td>
</tr>
<tr>
<td>Part C</td>
<td>Q10 - 13</td>
<td>• An assessment of the respondents’ awareness of the reasons for change and their perception about the change; their perception about the level of communication and the role they played in the change process.</td>
<td>Awareness of the need to change</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Desire to participate in and support the change</td>
</tr>
<tr>
<td>Part D</td>
<td>Q14 - 15</td>
<td>• Identification of new knowledge included in the new curriculum and the resources to enable teachers to deliver the curriculum.</td>
<td>Knowledge about how to change</td>
</tr>
<tr>
<td>Part E</td>
<td>Q16 - 18</td>
<td>• An assessment of administrative support and how teachers were being supported to implement the new skills, knowledge and behaviours.</td>
<td>Ability to implement new skills and behaviours</td>
</tr>
<tr>
<td>Part F</td>
<td>Q19 - 20</td>
<td>• An assessment of the effectiveness of change management activities.</td>
<td>Reinforcement to keep the change in place</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Identification of organisational barriers to change and mechanisms to reinforce the change.</td>
<td></td>
</tr>
<tr>
<td>Part G</td>
<td>Q21 - 22</td>
<td>• Collection of feedback and the determination of corrective actions based on the suggestions offered.</td>
<td></td>
</tr>
</tbody>
</table>

Figure 4.8: Application of the ADKAR to the Pilot survey
Illustration by the Researcher based on the ADKAR model (Hiatt, 2006)

4.11.1 Age distribution of teachers in the sample

Age distribution was deemed critical in helping to assess the level of teaching experience of the current teaching force in Botswana. Due to rapid technological developments which affect the content of D&T education (Kohler and Mishra, 2009), one would expect that young teachers entering the profession to bring new
knowledge or expertise which their older and more experienced counterparts may not have. For instance, in the sample, there were those teachers who trained in the early 1990s, when the subject was still in transition from the Cambridge curriculum which was predominantly craft based. Such teachers might need support in coping with the more advanced technologies like pneumatics, computer aided design and manufacture. Teacher age provides a proxy for the overall ‘experience’ of a teaching force, based on the assumption that older teachers have accrued greater years of service. An older profile may be a reflection of more experience, while a younger age profile can indicate a higher level of pre-service training. This finding is significant in the sense that it would help identify the strengths and weakness among the teachers.

In terms of teaching qualifications for senior secondary education, the data showed that the teachers have been trained at different institutions. This represents a fair distribution though a large number of teachers were trained at the University of Botswana. The advantage of training teachers in different countries could beneficial to the country in terms of cross fertilisation of ideas. On the other hand, attempting to manage people with different training backgrounds and philosophies might present a challenge (Ndaba, 1994). As was observed in England, if this situation is not well managed it might lead to polarisation among the teachers (Atkinson, 1990; Canavan and Doherty, 2007).

The data on teachers’ credentials would be particularly useful for purposes of maintaining standards as well as to inform continuous professional development programmes. This information may be used in the future as a justification for a skills audit to assess teachers’ in-service training needs.

4.11.2 Awareness of the need for curriculum change

"Successful change management starts by understanding why you want to change in terms of the objective you want to achieve" (Newton, 2007, p.19).

The questions relating to this section had asked the various stakeholders to share their views regarding their awareness about the change; the level of
Hiatt and Creasey (2012) suggest that the first step in managing change is to build awareness around the need for change and create a desire among employees (Bourne and Bourne, 2012; Kotter, 1996). It has been observed that once people understand the reasons why change is necessary, they can use that knowledge or information to determine what needs to change to achieve this objective (Newton, 2007). Therefore, initial communications are typically designed to create awareness around the business reasons for change and the risk of not changing (Kotter, 1996). Likewise Bourne and Bourne (2012) note that effective communication is important at each step in the change process, but it is particularly important at the beginning. They assert that communications should be designed to share the right messages at the right time (Hiatt and Creasey, 2012).

With reference to the development of the BGCSE D&T curriculum, the government of Botswana had a vision of moving away from the traditional agro-based economy to the more broadly based industrial one (Republic of Botswana, 1994; Ministry of Education and Skills Development, 2000). Hence, a question was designed to assess the level of awareness among the respondents about the reasons for changing the curriculum. The question comprised three parts.

1. The first part asked the participants to share their views in terms of their awareness about the government’s decision to change the curriculum.

2. The second part asked the participants to comment on how those decisions were communicated to them by the authorities.

3. The last part assessed the role played by the various stakeholders in decisions about the change. The questions related to this part were open-ended even for the questionnaire to allow the respondents to provide reasons and justify their answers.

Document review was also done to validate the responses. For the validation, the main reference documents used were the report of the National Commission on

The decision by the government of Botswana to move away from Cambridge was a policy matter, which stemmed from the recommendation of the NCE. The commission was set up to identify an education system that is relevant and responsive to the socio-economic needs of the country. This commission led the production of an education policy document known as the RNPE, 1994. Following the recommendation of the RNPE, D&T was identified as one of the key subjects needed for the country “to move away from the traditional agro-based economy to the more broadly based industrial economy the country” (Permanent Secretary, cited in the Ministry of Education and Skills Development, 2000, p.ii). It was recommended for all students from Junior to senior secondary school level (Government Paper No.2 of 1994, REC. 32, para. 5.5.13, c). The implementation date for junior secondary schools was 1996 whilst for senior secondary schools was 2000. The above documents are available in the public domain. The remarks by the Permanent Secretary in the MOESD suggested that production of the BGCSE D&T curriculum was: “the outcome of a great deal of professional consultation and collaboration” (as cited in the BGCSE D&T Teaching Syllabus, 2000, p.ii). However, the responses from the senior officers suggested that the communication regarding the change was not effective (see table 4.1). Kotter (2012) asserts that: “the real power of a vision is unleashed only when most of those in an enterprise or activity have a common understanding of its goals and direction” (p.87).

4.11.3 Stakeholders’ level of participation in the change process

Managing change is not like a one way street. It is argued that implementation will go more smoothly if it has the backing of key people (Harvard Business School Press, 2003). In many change management models, it is emphasised that employee involvement is a necessary and integral part of managing change (Blake and Bush, 2009; Harvard Business School Press, 2003; Kotter, 1996; PROSCI ADKAR, 2014). For instance, Kotter (2012) asserts that shared sense of a desirable future can help motivate and coordinate the kinds of actions that create transformations. Bourne and Bourne (2012) expressed the same sentiment that: “it is one thing to
understand the need for change yourself but quite another to persuade others that is needed” (p.19). This underscores the importance of stakeholder involvement in the change process in terms of their desire to participate and support the change. For example, Bourne and Bourne (2012) cited collaboration with various stakeholders as having the following advantages:

- It enables an understanding of why the change is needed;
- It enables individuals with different experience and skills to become involved in the key change decisions;
- It builds a commitment to implementing change;
- It creates a critical mass of people to help push the change through (p.37).

The design and implementation of a curriculum is a collaborative exercise because it involves various stakeholders. Policies should be put in place to inform mechanisms on how best to engage the various stakeholders, each of whom have a part to play in the design and implementation of the BGCSE D&T curriculum.

Hence, it was deemed necessary to obtain feedback from key stakeholders who were involved in the change management process. The department of Curriculum Development and Evaluation (CD&E) helped the researcher to establish who the key stakeholders were. In terms of the functions of the various departments of the MOESD, CD&E has the overall responsibility to: “formulate policy; provide coordination; direction and leadership on curriculum reform and revision for basic education” (Directorate of Public Service Management, 2006, p.93). Moreover, their mandate includes: “links with key stakeholders such as teachers, educationists, employers, the community and international bodies to enrich the curriculum development and evaluation process” (ibid, p.95). The following statement confirms this role with respect to the participation of: “teachers, private sector and other organs of the government” (Case study 1, Field data). On the basis of this evidence CD&E was considered to be the main respondent to address the issue of stakeholder participation.
Participation of teachers in curriculum development is critical because of the role they play as implementers (Fullan, 2001). At school level, Bennett et al. (1992) notes that the principal has a strong influence in terms of: “whether a change is to be taken seriously by supporting teachers both psychologically and with the resources” (p.117). Equally important are leadership and management capabilities of those who are charged with the role of leading change in their organisations (Kotter, 1996). Management skills would ensure that the change proceeds as planned and in an orderly manner. Leadership skills would provide direction, inspiration and the necessary mentoring of others through change. Change managers require both sets of skills. Bush and Middlewood (2005) elaborate on this point by arguing that if schools are to operate effectively to achieve their objectives leadership and management need to be given equal prominence (Whitaker, 1993).

Effective change management requires the speed that the employee (human side of change) navigates the change process is matched with the speed of the business change or technical side of change (Hiatt and Creasey, 2012). Figure 4.9 illustrates how to maintain the right balance between the speed at which the organisation moves and that of employees.

![Figure 4.9: Balancing the speed of change with that of employees](Image)

*Source: (Hiatt and Creasey, 2012. p.37)*
When put into the context of the development of the BGCSE D&T curriculum took place between 1998 and 1999 whilst actual implementation took place in 2000 (Ministry of Education and Skills Development, 1998). During this period, schools were also being upgraded to accommodate new workshops for technology content areas. Hiatt and Creasey (2012) assert that: “*effective changes progress along these two axes*” (p.38). In view of the date for D&T curriculum it is noted that the curriculum was implemented when teachers’ awareness of the need for change was established.

It has been observed that at the beginning of projects, people sometimes have only limited information about why change is undertaken (Fullan, 2001; Kotter, 1996). Although it was reported that the production of the RNPE was a result of a broader consultative process, however, from the findings one gets a sense that many of the problems with the design and implementation of the D&T curriculum emanate from limited communication and consultation with the various stakeholders.

Overall in terms of the level of communication at various levels of an organisation, Kotter (2012) noted that gaining understanding and commitment to a new vision is never an easy task especially in large organisations. Therefore, to enhance the level of communication and to create that sense of urgency about the need for change, Kotter (2012) identified the following guiding questions that need to be asked:

- What do we want to achieve with this change and why?
- How will we know that the change has been achieved?
- Who is affected by this change, and how will they react to it?
- How much of this change can we achieve ourselves? and
- What parts of the change do we need help with?

However, Kotter (2012) cautions that: “*even smart people make mistakes here all the time, outright failure is not uncommon, even in well-known firms*” (p.87).
4.11.4 Administrative support to change

Administrative support aka refers to sponsor is defined as: “the individual or group that has the power to sanction or legitimise change” (Hiatt and Creasey, 2012, p.23). Active and visible participation by senior management is essential throughout the change project (Bourne and Bourne, 2012; Hiatt and Creasey, 2012). Also in terms of communication regarding change, Bourne and Bourne (2012) observed that employees tend to listen to sponsors for messages about why a change is happening. Administrative support is therefore deemed an important consideration in terms of building awareness of the need for change and the desire to participate (Hiatt, 2006; Hiatt and Creasey, 2012). It has been observed that when a change is initiated, employees often look to sponsors for direction, commitment and vision (Kotter, 1996). Hiatt and Creasey (2012) identify three roles that define sponsorship during change:

a) Sponsors actively and visibly participate in the change;
b) Sponsors build a coalition of sponsorship between key business leaders;
c) Sponsors communicate directly with employees about why the change is necessary (cited in, p.23).

Hiatt and Creasey (2012) observed that if the roles outlined above are performed effectively by the leader of the change. They outline the following steps which should be taken as part of the implementation process:

- Sufficient resources and funding will be made available;
- Priorities will be established between competing initiatives;
- Any impediments to change will be removed and the sponsor stays active throughout the entire project;
- Other senior leaders sponsor the change and manage resistance as necessary;
- A coalition of sponsorship is formed to lead and support the change;
- Employees understand why the change is being made and how the change aligns with the vision of the organisation;
Moreover, if employees have any concerns about the change, they are accorded a platform through which they can resolve their concerns (ibid, pp.23-24).

This question relating to administrative support was addressed across the data sets; however, the main respondent was the department of secondary education. This is because one on its mandates includes the procurement of equipment and infrastructural development. In order to implement the new curriculum, curriculum development, staff training, new equipment and materials were needed in all schools. In terms of the physical infrastructure, it was reported that in 1999 the MOESD undertook a major upgrade of all senior secondary schools to prepare for the BGCSE programme (Case study 1 - Field data: Set 3). This upgrade involved building new workshops for specialist content areas such as electronics, pneumatics and computer aided design and manufacture. The following statement highlights these developments: “There has been a lot of investment in the infrastructure within D&T. But sadly teachers don’t have enough knowledge of the use of the new equipment to handle electronics” (Case study 1 - Field data: Set 3). Unfortunately, it was reported that some schools had the equipment whilst others were not fully equipped (Case study 1 - Field data: Set 1; Set 2; Set 6). Considering that the curriculum was to be implemented the following year, in view of the researcher, this time was not sufficient. As experienced in England and New Zealand, change becomes problematic if it is not supported by appropriate provision for staff development or support from senior management teams (Atkinson, 1990; Canavan and Doherty, 2007; Jones, 2003).

4.11.5 Leadership and Resources

*Managing change is important. Without competent management, the transformation process can get out of control. But for most organisations, the much bigger challenge is leading change* (Kotter, 2012).

The term leadership refers to guiding authority that determines and enables change to occur (Fullan, 2005; Hiatt and Creasey, 2012; Harding and Pooley, 2007; Harris and Wilson, 2004). The notion of leadership in change management is to set
direction, solve problems, create a vision and lead people in an organisation to a better future (Barnes, 2005; Fullan, 1993; Hiatt, 2006; Kotter, 1996, 2012).

This part assessed organisational capacity to implement change. This capacity was assessed in terms of the human, physical infrastructure, funding as well as the time to implement. In this study, leadership and administrative support were identified as being critical in helping to mobilise resources, deployment of personnel as well as directing the change effort. The participants were asked to comment on the kinds of support they had received from their leaders to support them through the change process. Within the context of Botswana, those involved in leading this curriculum were: Directors (at national and regional levels); curriculum development officers; in-service officers; school heads; senior teachers and subject leaders. The data were obtained across all these levels. For the teacher questionnaire participants’ level of satisfaction with the kinds of support offered was measured on a rating scale which was provided in the questionnaire.

In terms of administrative support it was reported that some departments in the ministry were still undergoing restructuring (Case study 1 Field data: Set 5). This has been evidenced by lack of education officers in some regions. This development puts into question the capability of the leadership required to lead the change. Also reported was staff turnover at CD&E office which in the author’s view seriously undermines the capacity to deliver the new curriculum.

Barnes (2005) observed that: “active leadership in school curriculum is an important component of a systemic educational change strategy” (p.12). Leadership must set the tone for the vision and walk the talk of embracing the change by rewarding innovative and creative employees for their efforts in implementing successful change initiative (Kotter, 1996; Fullan, 2005).

In summing up, the author would argue that leadership and management skills in D&T are crucial to provide authoritative support to strengthen the curriculum (Barnes, 2005). Kotter (1996) asserts this point that management of change requires strong leadership. Warrilow (2009) elaborates this point further that challenge the leader faces is getting the staff to deliver the new idea and achieve organisational goals. He argues that managing change is not enough; those
responsible for initiating it must also lead it. The author would add that this needs to operate at all levels of leadership.

4.11.6 Changes to the new curriculum D&T curriculum

The aim of this question was to assess whether the new curriculum had included any new content areas and how the teachers were being supported to cope with new content. It was addressed to the curriculum developers, teachers and in-service officers. Unlike its predecessor which was found to be predominantly craft based (Ruele and Mwendapole, 2015), the BGCSE D&T curriculum includes new content areas namely electronics, pneumatics and computer aided design and manufacture. The inclusion of these content areas was to align the curriculum with the country’s vision of moving away from the traditional agro-based economy to the industrial one (Republic of Botswana, 1994).

Some expressed the view that there has not been much change in approach to the way the subject used to be taught under Cambridge. The following statement drives this point home: “The BGCSE programme is fairly new people want to stick to the old system...we’re still in a transition” (Case study 1 - Field data: Set 4). Still on the same issue one officer suggests that: “teachers continued to work along traditional lines” (Case study 1 - Field data: Set 3).

From the foregoing statement, it seems like there was an oversight in the initial training of D&T teachers because many of them trained between 1990 and 1999 when schools were still offering the Cambridge curriculum (Ndaba, 1994). As a consequence, there seems to be a mismatch between the skills possessed by many of the teachers in the field and the needs of this new curriculum. This raises the question of professional adequacy of the current teaching profession in terms of their capability to deliver this government initiative.

4.11.7 The level of support to the teachers

This question was addressed to all the participants. The participants were asked to list content areas of the BGCSE D&T curriculum which they needed support in. Chart 4.8 presents what teachers perceived to be new content areas.
Since there were many subject areas which the teacher felt that they were new, the researcher tried to organise them into three main categories. Figure 4.10 summaries content areas which were reported in the questionnaire.

**Field data – Case study 1**

According to the categories developed by the researcher, computer aided design and the use of related machines appeared nineteen times in the data. These are followed by electronics and then pneumatics.

### 4.11.8 The organisational structure

“To really drive the change forward, the systems should be aligned to the change”

(Bourne and Bourne, 2012).
According to Hiatt (2006) the organisational or environmental context represents: “how a person or group views the environment that is subjected to the change” (p.19). The environmental context in which change occurs is a pertinent issue because each person’s experience within a given organisation is unique. One of the enablers in managing change is to modify or remove systems or structures that impede the change effort (Bourne and Bourne, 2012).

In terms of the organisational context in which the change occurred, one notes that the BGCSE programme was implemented within a centralised governing structure. This pyramidal management structure has often been criticised for: “being insensitive to the local context, to local school culture, and to the capacities of particular school staff and organisational structures” (Hall, 1997, p.353). Similarly, Bush and Middlewood (2005) observed that concentrating decision-making on a central authority leaves only tightly programmed routine implementation to lower levels in the organisation. Equally, the “bottom-up” approach has also been criticised for being too narrowly focused, for lowering quality, and for being limited by the abilities of local change agents (ibid. p.353). Contrary to this, Hall (1997) suggests that implementing a national curriculum with some degree of autonomy and government support in a capacity-building manner might be a productive way of resolving tensions between these diametrically opposing forces. This is particularly relevant to Botswana especially since education is funded fully by the state. The use of central command by the government would ensure that educational policies are adhered to as well as to ensure that limited resources are used in a prudent manner.

Furthermore, there are dynamics at both regional and school levels as well as at individual teacher level which would necessitate some degree of autonomy in terms of meeting both the technical and social obligations of the implementation. This empowerment can be made possible by removing any structural barriers which impede the implementation effort by giving greater autonomy to the schools. Newton (2007) asserts that: “the best change plans combine knowledge from people at different levels in the organisational hierarchy and strike the correct balance between top-down and bottom-up thinking” (p.20).
4.11.9  **Sustaining the momentum for change**

Kotter (2012) suggests that one way of ensuring that change is sustained is by developing a succession plan such that change agents and leaders would be regularly added to organisation’s change coalition (Morrison, 1998). Periodic reviews would help to identify problems in the change process as they occur (Kotter, 1996). Moreover, when embarking on a major change initiative it is recommended that the change should be broken down into smaller sets of successive activities before implementing on a larger scale (Fullan, 2001; Kotter, 1996).

Kotter asserts that the vision which was developed for change in the first place is something that the organisation should never seek to lose. Kotter’s assertion provides important lessons for those involved with the implementation of the BGCSE D&T curriculum. For instance, the author noted that the curriculum was implemented against the Cambridge framework which was perceived to be a successful undertaking especially during its inception. Ndaba (1994) asserts this point that: “the implementation of design and technology was, by and large, a great success” (p.111). However, it seems success was either declared prematurely by those in authority or they became too complacent. Kotter (1996) concurs that one of the major reasons why change efforts in organisations fail is because some try to make bigger leaps at a fast speed. Kotter suggests that this situation is like driving a big engine at high speed which would require a very skilful driver. In terms of the capacity to implement, Lewis (2000) cautions that: “it is one thing to leapfrog into modernity; it is another to sustain viable programs” (p.164). Ironically this is the main issue that the current system is grappling with and one of the terms of reference for undertaking this study.

4.12  **Conclusions**

This pilot study explored a range of issues relating to the processes and challenges of implementation curriculum change in the BGCSE D&T curriculum. In particular, the researcher was interested in examining how the new curriculum was being implemented through the experience of teachers as change agents.
Previous literature indicated that many organisations tend to place more emphasis on the straightforward, technical aspects of the change process (Kotter, 1996; Newton, 2007). However, they have been found to ignore the more complex and unpredictable concerns of people affected by the change (Fullan, 2001; Kotter, 1996; Bridges, 1998, Harvard Business School Press, 2003). Ignoring the human side of change is deemed short-sighted and a symptom of ineffective management (Harvard Business School Press, 2003). Bridges (2009) argues that getting people through the transition is essential if the change is to work as planned.

Research leading to this study shows that since inception the BGCSE D&T curriculum has only been reviewed once in 2009 which means when this study commenced (2011) it had already entered a second phase without being reviewed. It is against this background that this study was undertaken to explore the organisational conditions under which the change took place, the capacity to implement the change, the teachers’ knowledge and skills and the support system and other issues related to its implementation. Hence, the primary research question which drove this inquiry was: What is the nature of change from the Cambridge D&T curriculum to the Botswana model and how are teachers being supported to implement the curriculum?

Change management is viewed as an essential organisational capability that change leadership need to develop if organisations are to remain competitive and successful (Hiatt, 2006; Hiatt and Creasey, 2012; Kotter, 1996). Equally important is the need to build individual competency because individual change leads to organisational change (Bourne and Bourne, 2012; Hiatt and Creasey, 2012). Building individual change competency includes training for managers and supervisors to equip them with the tools they need to assist their employees through the change process. It is the cumulative effect of individual change that leads to organisational change (Bourne and Bourne, 2012).

The key findings in respect of this pilot study are: (a) the localisation of the curriculum was widely hailed as a move in the right direction; (b) it has been noted that some progress has been made in terms of the training of the D&T teachers. Many of them possess the relevant qualifications and seem to be quite
experienced. However, it seems that their training was limited especially in ICT, CAD/CAM and the technology content areas; (c) in terms of administrative support and commitment, the general observation is that the government as the main sponsor did not commit fully to the project. For instance, there remains the unfinished business on the part of the government in terms of provision of equipment for ICT, CAD/CAM and control technologies particularly pneumatics. It was noted that the government provided mainly the physical infrastructure but did not provide the necessary equipment to support the teaching and learning of the content areas mentioned above.

The localisation of the senior secondary school programme was intended to address some of the deficiencies of the Cambridge curriculum especially that of relevance. However, the data suggest that the content of the BGCSE D&T curriculum suggest that it is still deeply rooted in the traditional crafts as such it does not differ much from its predecessor.

Another major concern which arose from the data was that of limited participation by teachers and teacher training institutions in the design of this curriculum. This is a cause for concern because the teachers as implementers should be at the forefront of curriculum design and implementation (Fullan, 2001). Teacher training institutions, by virtue of being involved with initial teacher training and professional development, should provide direction and academic leadership. In fact, Boser and Daugherty (1994) advanced a similar argument that lecturers from teacher training institutions can be actively involved as resource persons in the provision of in-service training and continuous professional development to the teachers (Day, 1999).

In terms of implementation, it was found that unlike its predecessor the BGCSE D&T curriculum was not piloted before full implementation. Pilot programs are necessary because they give people the opportunities to grapple with implementation and its problems on a smaller, more manageable scale. Harvard Business School Press (2003) also advise the same and assert that: “pilot programs are test beds in which implementers can experiment with and debug change initiatives before rolling them out more broadly” (pp.57-58).
In terms of the content of the curriculum itself, it has been noted that it is predominantly craft based. In view of the researcher, it does not differ much from its predecessor and may suggest that the teaching continued along the traditional lines. Furthermore, the manner in which the curriculum is organised and implemented has many practical implications in terms of: teacher capability; the amount of content to cover; teaching methods; resources and the time to implement.

These findings necessitated a more in-depth study with the purpose of exploring how teachers could be supported to deliver this curriculum. The following statement validates this point that: “Everybody is realising that when you introduce something new you need to go back to the teachers because they are the ones who are going to teach” (Case study 1 Field data: Set 1; Set 3; Set 4: Set 5; Set 6). One officer echoed the same sentiment that: “I think when people went for training, nobody thought the curriculum was going to change” (Case study 1 Field data: Set 6). The foregoing statements validate and reinforce the realisation that the teachers are integral to the change process (Fullan, 2001; Morrison, 1998, Whitaker, 1993). The author concludes by echoing Ruele and Mwendapole’s (2015) sentiments that:

“curriculum development is reciprocal; therefore the change agents and relevant stakeholders should be involved in designing and developing a vibrant and appropriate D&T curriculum at senior secondary level” (p.121).
4.13 Recommendations for the next phase

As already highlighted in the preceding section the pilot identified many issues affecting the BGCSE curriculum. It would be impractical to try and address all of them. Therefore, some criteria were developed to help prioritise on the most pressing needs. A SWOT analysis (Maxi-Pedia, 2012) technique shown in figures 4.11 and 4.12 below was used in conjunction with the ADKAR framework (Chart 4.5) to help identify the areas of focus.

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
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<tbody>
<tr>
<td>Teacher Issues</td>
<td>Teacher Issues</td>
</tr>
<tr>
<td>• Adequate supply of teachers across the schools.</td>
<td>• Many teachers were trained during the offering of the Cambridge D&amp;T. Unfortunately their Initial training did not prepare them adequately for the BGCSE especially in the new content areas such as electronics and others.</td>
</tr>
<tr>
<td>• Many teachers possess relevant professional qualifications and teaching experience.</td>
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<table>
<thead>
<tr>
<th>Implementation Issues</th>
<th>Implementation Issues</th>
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<tbody>
<tr>
<td>• A locally developed curriculum with improved relevance to the socio-economic needs of the country.</td>
<td>• The curriculum is predominantly craft based; it needs to be diversified to include some electives so as to cater for a wider clientele as well as to align it to the country's vision for economic diversification. Also the product design component is seriously under-subscribed.</td>
</tr>
<tr>
<td>• The localization of the curriculum offers Botswana the liberty to set her own standards.</td>
<td>• Limited participation by some key stakeholders like the UB and MCE was noted. Also communication regarding the change was not clearly articulated especially to the teachers. This limited their participation in decision making about the content of the curriculum.</td>
</tr>
<tr>
<td>• Various stakeholders have participated in the development of the curriculum. Some degree of participation by teachers in subject and national panels was reported.</td>
<td>• The senior officers were new in their posts as such they could not establish whether there was an implementation strategy. The review of the curriculum was overdue. The time allocation for D&amp;T is not adequate considering that the curriculum is congested.</td>
</tr>
<tr>
<td>• A phased-in implementation strategy has been adopted. This strategy allows for some periodic reviews. The Curriculum Blue Print (2000) recommends that the curriculum should be reviewed after every five years.</td>
<td></td>
</tr>
<tr>
<td>• On-going revision will provide the opportunity to address issues of content and a congested curriculum.</td>
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<table>
<thead>
<tr>
<th>Subject management Issues</th>
<th>Subject management Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>• The restructuring of the functions of the MOESD has ensured that the roles of various departments are clearly defined.</td>
<td>• Managing change which involves many stakeholders operating under the current hierarchical structure presents many challenges. For example, lack of a coordinated approach between various departments was noted. The restructuring created a leadership vacuum at national level; currently there is no officer for D&amp;T to represent the subject and provide overall guidance.</td>
</tr>
<tr>
<td>• Many services have been decentralised to the regions. The regions have in-service officers to provide support to teachers. The regions have education centres equipped with facilities to support in-service training.</td>
<td>• Some regions are vast; they cannot be managed by one officer. Some regions (e.g. northern) did not have facilities for in-service training. Also due to limited funding, these centres are not well resourced and hence not fully utilised. Links between schools were found to be weak because they operated under different situations.</td>
</tr>
<tr>
<td>• To make their management easier schools have organised into clusters. This arrangement enables limited resources and expertise to be shared. It also allows opportunities for collaboration and networking.</td>
<td>• In-service officers perform many duties because they combine D&amp;T with other practical subjects; this renders them ineffective. Also these officers have not been trained professionally as such their capability is limited.</td>
</tr>
<tr>
<td>• In-service officers have a broader mandate which includes school inspection. This gives them the opportunity to meet teacher and discuss needs.</td>
<td></td>
</tr>
</tbody>
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Figure 4.11: The BGCSE D&T curriculum – Strengths and Weaknesses

A summary by the Researcher
### Opportunities

- A strands approach is being suggested for the on-going revision. This will provide the opportunity for teachers to be deployed according to their strengths.
- The strands approach may call for team teaching which will not only be enriching for students but will make the curriculum more manageable. This approach also lends itself well to curriculum integration and project based learning which will give students a wide range of skills.

- The envisaged strands approach may lead to compartmentalisation of the curriculum. The reorganisation of the curriculum may require some teachers to be retrained. Retraining of teachers may not be possible under the current economic climate.
- There may be a need to reshuffle teachers across schools, this might cause disgruntlement among others.
- Team teaching may be difficult to organise especially in an environment where teachers do not have a good working relationship.
- The BGSE curriculum has been designed around the behaviourist model. This model has been criticised for being counter-productive to the constructivist learner-centred pedagogy (Tabulawa, 2009). This model also limits teachers’ creativity. Time is another limiting factor.

### Threats

- D&T is perceived to be a failing subject; this is not a good advertisement for the subject.
- Achieving a higher enrolment in D&T can longer be guaranteed because of competition from allied subjects.
- Owing to the recent announcement by the Minister for Education that D&T and other practical subjects will in the future be offered only in schools of excellence; the future offering of the subject remains in the balance.
- D&T is an expensive subject. Limited funding hampers its potential for future expansion.
- The major stumbling block is teachers’ low morale which emanated from unsatisfactory working conditions adversely affects the subject. This statement explains the situation: “I'm sorry to say our teachers have been tied to 8 hrs. They do the bare minimum. The sacrifice, the passion have been taken away by the industrial action” (Case study 2 - Field data, PED4).

### Enabling factors

- The strands approach offers the opportunity to incorporate new technologies might help raise the image of the subject and hopefully attract more students.

### Restraining factors

- The BGCSE curriculum has been designed around the behaviourist model. This model has been criticised for being counter-productive to the constructivist learner-centred pedagogy (Tabulawa, 2009). This model also limits teachers’ creativity. Time is another limiting factor.

---

**Figure 4.12: The BGCSE D&T curriculum – Opportunities and threats**

A summary by the Researcher

As seen in figures 4.11 and 4.12, many of the issues had more to do with the management of the whole education system. The researcher felt that these issues can be dealt with at a much higher level. The purpose of this research, the next focus will be more on teacher issues at school level. Hiatt and Creasey (2012) underscored the notion that the success of a change effort in an organisation is judged by its people because they are the ones who produce results. Similarly, in terms of educational reforms, the teachers as implementers are deemed as a key factor in the delivery of this curriculum (Durrant and Holden, 2006; Fullan, 2001; Hargreaves, 1994; Lachiver and Tardif, 2002; Morrison, 1998; Whitaker, 1993).

The SWOT analysis framework already described above was not effective in helping to identify gaps and determine the focus for a follow-up study. As a consequence, the researcher considered using the five elements of the ADKAR...
The ADKAR Model has been found to be an effective instrument for understanding why a change is not occurring (Hiatt, 2006; Hiatt and Creasey, 2012; PROSCI, 2014). According to Hiatt (2006) the premise of this framework is that the objectives of the change are achieved: “when change management activities create awareness, desire, knowledge and ability to succeed at the change, and when those activities reinforce the change to retain the benefits” (p.47). Chart 4.9 was used to map out the issues which arose from the data against the five elements of the ADKAR model. The responses were entered into Microsoft Excel and each ADKAR element was assigned a unique code. Words or statements in the data were then classified according to the element they were associated with. Then to produce a chart as shown below, a COUNTIF function was used.

**Chart 4.9: Gaps in the implementation of the BGCSE D&T curriculum**

As seen in chart 4.9 many of the implementation gaps identified had to do with teacher knowledge and ability. In terms of the ADKAR framework which was used to diagnose the gaps in the change management process, these findings suggest that the impact of the change on the teachers in terms of their knowledge and ability to implement the curriculum was underestimated prior to implementation.
4.14 Summary

Both the pilot study findings and those of the BGCSE evaluation study of 2009 (Republic of Botswana, 2009) have provided sufficient grounds for further study with the aim of collecting data which would address the following objectives:

- Conduct a skills audit in respect of the teachers with the ultimate goal of helping to identify gaps in knowledge and skills among the teachers and assess how those disparities impact on the implementation of the curriculum;

- Assess how teachers are being supported to cope with some new content areas of the curriculum;

- Determine the priority aspects of the curriculum where attention should be focused;

- Identify other inhibiting factors and recommend corrective actions.
CHAPTER 5

CASE STUDY 2
Chapter 5 – Case study 2

**An assessment of teachers’ capability to implement the BGCSE D&T curriculum and other related issues:** Insights based on the experiences of teachers and in-service officers.

### 5.1 Introduction

This study was a follow-up on some major issues arising from the pilot study. These issues have already been summarised in figures 4.9 and 4.10. As mentioned in chapter 4, section 4.13, a combination of SWOT analysis and the ADKAR diagnostic tool were used to identify gaps in the implementation as well as to help prioritise on the most pressing issues. Chart 4.5 shows many of the implementation issues identified were related to knowledge and ability elements of the ADKAR change model.

According to the ADKAR model, if knowledge was the area identified as a barrier to change, then education and training were recommended to help develop the skills and behaviours needed by the change (Hiatt, 2006; Hiatt and Creasey, 2012). Likewise, if the area identified is ability, it was recommended that on-going coaching and support would be needed as well as time to develop new abilities (ibid). It was against this background that it was deemed necessary to design another study that focused on the implementers namely; teachers, senior teachers and in-service officers. In this regard, a new research question was established: *To what extent are teachers capable and supported to implement the new D&T curriculum in senior secondary schools in Botswana?*

### 5.2 Aims and Objectives

The primary goals of this study were to:

a) assess how the teachers were coping with the new curriculum;

b) measure the level of support they received to enable them to implement the curriculum; and
c) use insights gained to determine how they could be supported to implement the curriculum more effectively.

To address these aims, the following objectives were established:

- Identify and validate gaps in knowledge and skills among the teachers which hinder effective delivery of the BGCSE D&T curriculum;
- Apply knowledge gained from the findings to identify priority areas where attention should be focused;
- Assess and evaluate the effectiveness of the current system used to support teachers’ professional development in the D&T education in Botswana; and
- Use insights gained to propose a more viable professional development support system for the context of Botswana.

5.3 Research questions

In order to address the above objectives the following research questions were formulated:

1. What knowledge and skills do the D&T teachers in Botswana have which would enable them to deliver the BGCSE D&T curriculum more effectively?
2. What is the teachers’ level of confidence in delivering this curriculum?
3. Which content areas of the BGCSE D&T curriculum do teachers need more support in?
4. What is the nature of an in-service training support system used for D&T teachers in Botswana?
5. What views and perceptions are held by teachers and INSET officers regarding the provision in-service training and professional development in D&T in Botswana?
6. How can we design and implement a more effective support system for teachers’ professional development needs in D&T education in Botswana?
As was done in the previous study, it was deemed necessary to design another conceptual framework (as in section 3.3) that would help to inform decisions on how to integrate the various elements of this study. The next section presents and describes this conceptual framework.

5.4 Design and conceptual framework

Figure 5.1 shows the conceptual framework which informed the design of this study. The framework summarises all the various elements of this study, including: the primary research question; the objectives of this study; the research questions which addressed those objectives; the methods which were used to answer the research questions and the participants from whom the data were collected.

![Diagram showing the conceptual framework](attachment:researcher_conceptual_framework_diagram.png)

Figure 5.1: Researcher’s own study conceptual framework
Illustration by the Researcher
As shown in figure 5.1 the research questions were addressed through a teacher questionnaire \((n=66)\) followed up with a group interview with some teachers \((n=3)\); individual interviews with senior teachers \((n=8)\) and in-service officers \((n=4)\). Literature review was used to validate the findings. This sample size was deemed adequate to enable the researcher to get as complete a picture as possible.

### 5.5 Context and Participants

The study was conducted in six regions \((n=10)\) of Botswana namely the Northern, Central, South Central, Kweneng, Kgalagadi and the Southern regions. Compared to the pilot study, this was an increase by three more regions. The rationale for increasing the number of regions was to increase reliability of the findings and to enable comparisons to be made. Figure 5.2 shows the relative sizes of study samples for the pilot study and case study 2.

![Figure 5.2: Comparison of study sample for the pilot study and case study 2](image)

In terms of the number of participants, case study 2 shows 50% increase.
Table 5.1 shows a summary of the regions, schools and at total number of participants in the study.

<table>
<thead>
<tr>
<th>Region</th>
<th>School</th>
<th>No</th>
</tr>
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<tbody>
<tr>
<td>South East</td>
<td>Ledumang senior</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Naledi Sec</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Gaborone Sec</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>St Josephs</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Kagiso Sec</td>
<td>5</td>
</tr>
<tr>
<td>Southern</td>
<td>Moeding College</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Lobatse Sec</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Goodhope Sec</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Seepapitso Sec</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Moshupa Sec</td>
<td>2</td>
</tr>
<tr>
<td>Kgatleng</td>
<td>Molefi Sec</td>
<td>3</td>
</tr>
<tr>
<td>Kweneng</td>
<td>Mogoditshane Sec</td>
<td>6</td>
</tr>
<tr>
<td>Central</td>
<td>Madiba Sec</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Lotsane Sec</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Swaneng Sec</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Lethakane Sec</td>
<td>3</td>
</tr>
<tr>
<td>North East</td>
<td>Francistown Sec</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Mater Spei</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td><strong>Total = 66</strong></td>
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</tr>
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</table>

5.6 Data collection methods

The study collected both qualitative and quantitative data. As indicated in the conceptual framework (figure 5.1) the methods used for collecting data comprised: a teacher questionnaire, individual and group interviews. Collectively these methods were used in complimentary fashion to enhance interpretability as well as to address different but complementary questions within the study.

5.6.1 Teacher questionnaire

A questionnaire (see Appendix 5.1) with a self-report was developed to capture data from teachers. The questionnaire comprised three sections.
1) The first section incorporated a self-report which was used to measure teachers’ capability and confidence to deliver all the content areas of the curriculum.

2) The second section assessed how teachers were being supported to deliver the curriculum.

3) The third section focused on identifying the priority areas in which teachers would need support and propose some kind of intervention.

Table 5.2 summarises the design of the questionnaire and the issues which were being addressed. The design took into consideration the research objectives; research questions to be answered and strategies for recording, organising and analysing data. Since this was a self-completion questionnaire, it required the design and layout of the questionnaire to be made simple and easy to follow. Each question was preceded with an opening sentence which helped to clarify the questions. The questionnaire comprised four (4) parts, and had a total of nine (9) questions. The details of each question can be found in Appendix 5.1.

**Table 5.2: The Design and Structure of the Questionnaire**

<table>
<thead>
<tr>
<th>Objectives</th>
<th>RQs</th>
<th>Questions</th>
<th>Issues addressed</th>
</tr>
</thead>
<tbody>
<tr>
<td>OBJ.1</td>
<td>RQ1</td>
<td>Part A: Q1 – Q4</td>
<td>• Assessment of teachers’ ability to deliver various content areas of the curriculum</td>
</tr>
<tr>
<td>OBJ.1</td>
<td>RQ2</td>
<td>Part B: Q5 – Q6</td>
<td>• Teachers’ level of confidence in various components of the curriculum</td>
</tr>
<tr>
<td>OBJ.1</td>
<td></td>
<td>Part C: Q5 &amp; Q6</td>
<td>• Identification of priority areas for in-service training</td>
</tr>
<tr>
<td>OBJ.2</td>
<td>RQ3</td>
<td>Part C: Q7 - Q8</td>
<td>• Assessment of practical issues relating to the delivery of the curriculum and other hindering factors.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Identification and validation of main hindering factors.</td>
</tr>
<tr>
<td>OBJ. 3 &amp; OBJ. 4</td>
<td>RQ5</td>
<td>Part D: Q9</td>
<td>• Recommendations on an appropriate framework to support teachers’ in-service training needs in Botswana.</td>
</tr>
</tbody>
</table>
The questionnaire was designed and piloted on a few teachers in the field and appropriate revisions were made. To avoid influencing others, these teachers were not involved in the final questionnaire. Both qualitative and quantitative data were collected and analysed.

The questionnaires were delivered directly to the schools. This helped to increase the response rate because the researcher had the opportunity to meet teachers in their respective schools. This accorded him the opportunity to explain the purpose of the study and the importance of attempting the questions to the best of their abilities.

5.6.2 Individual Interviews

Semi-structured interviews were used to collect data from senior teacher grade 1s and in-service officers. Interview schedules for these interviews are provided in appendices 5.2 and 5.3 respectively. Purposive sampling technique already described in section 3.8.1 was used to identify participants for the interviews (Neuman, 2011; Schutt, 2006). This technique was premised on the notion that these participants were implementers and managers of the subject at regional and school levels respectively.

An interview schedule (see Appendices 5.2 and 5.3) was designed with a list of topics which the researcher wanted to get the responses. All the participants answered the same questions to enable their responses to be compared and validated against each other. However, the schedule was used in a flexible manner to enable the focus of the interviews to be adjusted as new insights emerged. The interview schedule included the following:

- Introductory comments;
- List of topic heading and possibly key questions to ask under these headings;
- Set of associated prompts;
- Closing comments.
The details of procedures followed in designing and administering the instruments for data collection have been explained in section 3.7.1. The interviews were captured with a digital audio recorder and transcribed verbatim. As a precaution against equipment failure, two audio recording devices were used.

### 5.6.3 Group Interviews

Besides the questionnaire and individual interviews, other data were collected through semi-structured group interviews. The group interview involved teachers who had participated in the questionnaire; however, their participation was voluntary. The interviews were used as an extension to the questionnaire to help reach a consensus on the most pressing issues affecting the delivery of the curriculum. Figure 5.3 summarises methods employed in this study.

![Data collection methods](image)

**Figure 5.3: Data collection methods used**

The length of individual and group interviews varied between 45 minutes and 60 minutes respectively. In both cases, interview schedules were designed following the procedures outlined in figure 3.8. For the group interviews, the researcher developed some ground rules shown in figure 3.9 which were read out to the participants at the beginning of the interview.
5.6.4 Ethical issues

Ethical issues were addressed in the same manner as already outlined in section 4.8.

5.7 Findings

This section reports the key findings of this study that assessed teachers' capability and the kinds of support needed to enable them to deliver the curriculum more effectively.

The results are divided into three sections. The first section presents the findings arising from the teacher questionnaire (for the closed and open-ended questions). The second section deals with views and perceptions of senior teachers and in-service education officers on the same issues. The third section presents a summary of the results. Figure 5.4 presents a matrix which was developed to align research questions with prospective participants and the issues being addressed.

<table>
<thead>
<tr>
<th>Research Questions addressed</th>
<th>Data Sets</th>
<th>Issues addressed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TQ Set 1</td>
<td>G1 Set 2</td>
</tr>
<tr>
<td>1. What knowledge and skills do D&amp;T teachers in Botswana possess which are essential to the delivery of the D&amp;T curriculum?</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>2. What is the teachers' level of confidence in delivering this curriculum?</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>3. Which content areas of the BGCSE D&amp;T curriculum do teachers need more support in?</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>4. What range of issues affect effective delivery of the BGCSE D&amp;T curriculum?</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>5. How can the teachers be supported to acquire essential knowledge and skills in D&amp;T in Botswana?</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

Figure 5.4: Matrix for collecting data
Figure 5.5 presents the format that will be followed to report and analyse the findings.

![Diagram](image)

**Figure 5.5: Presentation format**

To ensure anonymity in reporting the following coding system is used:

- **T** - Teachers → Set 1
- **GI** - Group interviews → Set 2
- **ST** - Senior teachers → Set 3
- **PEO** - Principal education officers → Set 4

### 5.8 Teacher Capability and Confidence to deliver the curriculum

This section presents results for Q1 and Q2 which assessed teachers’ capability and confidence to deliver all the content areas of the curriculum. In this study capability refers to “the integrated knowledge, skills, judgment, and attributes that people need to perform a job effectively” (Mind Tools, 2012). The conclusions drawn from these findings will help answer RQ3. The results presented are for the following content areas of the BGCSE D&T curriculum:

- Resistant materials;
- Graphics and Product design;
Chapter 5 – Case Study 2 Report

- Control technologies namely, electronics and pneumatics; and
- Computer aided design and manufacture (CAD/CAM).

The results for the resistant materials namely: wood, metal and plastics technologies are not discussed in detail here because the respondents had reported themselves positively in them as such the findings did not yield any new insights.

Teacher questionnaire responses were measured using a self-rating scale shown below.

![Self-Rating Scale]

Chart 5.1 presents the results for resistant materials or sometimes referred to as the traditional crafts.

![Chart 5.1: Teachers’ self-report on resistant materials]

Teacher questionnaire \( n = 66 \) in all the cases

As seen in chart 5.1 the results show that majority (wood = 93%; metal = 88%; plastics = 86%) of teachers reported themselves positively (very good to exceptional) in all the three content areas. However, these results did not reveal
much in terms of providing any new insights because the traditional crafts subjects had been part of the Cambridge curriculum.

Chart 5.2: Teachers’ self-report on Product Design and Graphics

A similar trend is observed for graphics and product design shown in figure 5.2 which suggests an acceptable level of capability in these two areas. The skew is more towards the high end.

Chart 5.3 presents a self-report of teachers’ ability and confidence to teach electronics technology.

Chart 5.3: Teachers’ self-report on Electronics

Referring to chart 5.3 it is observed that a majority (55%) rated themselves positively from “good to very good”. Almost half (24%) of the majority rated
themselves as “average”. Only a minority (8%) rated themselves as “exceptional”. The remainder (12%) can be classified as “low to no background”. These findings suggest a majority of teachers surveyed consider themselves as quite capable to teach electronics. Overall these results showed encouraging signs as far as the capability in electronics is concerned and provide a platform to build on for the future.

In terms of the confidence to teach electronics, we observe almost similar trend with some minor variations. The data suggest that teachers’ confidence level is nearly as high as their ability to teach electronics. This was an interesting correlation that needs to be established across all the content areas.

A similar self-report was done for pneumatics. Chart 5.4 presents the results for pneumatics.

**Chart 5.4: Teachers’ self-report on Pneumatics**

A comparison of the results for these two content areas reveals that more than half (55%) of respondents reported themselves as capable of teaching electronics. Conversely, for pneumatics 26% of the respondents rated their ability in the subject as good to very good. 29% rated their ability in the subject as average. Compared to electronics, it was noted that the skew was more towards the low ability end. There was a noticeably higher number (17%) of respondents with no background in pneumatics. This number when combined with those who rated themselves from low to very low (23%). A similar trend was observed even for the
level of confidence to teach subject. These findings suggest that teachers are not as equally capable to teach pneumatics.

5.8.1 Reasons for teachers’ low self-rating in pneumatics

This section presents responses for Q2 of the questionnaire (see Appendix 5.1) which asked teachers to explain the reasons for awarding themselves low scores (0-3) in some content areas. The findings reported here are for pneumatics because the rating for electronics was quite high. Teachers gave varied reasons to this part of the question. To analyse and identify key words, the coding system already discussed in section 3.9.1 was applied to the data.

Figure 5.6 exemplifies some of the responses and how they were coded. The coding system used has already been explained in section 3.9.1.

| T3 - Never did pneumatics. Also there was no equipment in schools (ITT; EQUI). |
| T16 - I was only introduced to pneumatics years back at the university (ITT; PRAC). |
| T17 - I have knowledge in pneumatics but skills in executing practical not yet explored as currently pneumatics lab is not equipped (PRAC; EQUI). |
| T28 - Pneumatics is a topic that I was not taught initially and I still find it difficult (ITT). |
| T34 - I have never done pneumatics at my tertiary schooling institutions (ITT). |
| T53 - Have never done it except in the BGCSE syllabus (ITT). |
| T56 - Lack of equipment to practice and teach the topic in my school (EQUI; PRAC). |
| T59 - I never trained on it (ITT). |
| T60 - have no competence at all (CAP). |
| T62 - I learnt about it whilst in the field, was never covered during training (ITT). |
| T63 - I never trained on it (ITT). |

Figure 5.6: Teachers’ reasons for low capability in pneumatics

Source: Field data - Case study 2

Figure 5.6, shows (denoted with red stars) that the most cited words were in the text were those associated with initial training (8 counts). The data suggest that some teachers did not study pneumatics during their initial training (T3; T16; T28; T34; T53; T59; T62; T63). Some reported that there was no equipment in schools to enable them to gain practical experience (T3; T17; T56).
To corroborate teachers’ responses, a similar question was addressed to the senior teachers. For the senior teachers, they were asked to indicate areas in the curriculum which they felt teachers needed support in. The following statements by senior teachers explain the situation in some schools:

“Infrastructure is there, but it’s not well equipped” (ST2).

“We don’t have pneumatics equipment; it is just a lab” (ST5).

“We are poorly equipped; we have been borrowing some equipment from the region. Pneumatics is bits and pieces; some components such as valves are missing. Labs have not been fully set up since 2002” (ST6).

“I would say about a month ago, we had a pneumatics workshop. However, the components were provided by the resource person” (ST7).

“We have only one pneumatics kit” (ST8).

ST1’s perceptions on the level of resources for pneumatics

Interview transcripts: Field data - Case study 2

Based on senior teachers’ comments, the state of pneumatics in schools can be summarised as follows:

- The school had been provided with just the physical infrastructure (labs), but the necessary equipment has not been supplied (ST2; ST5; ST7). One senior teacher reported that at his school they had in-service but the training kits used had been brought in by the resource person (T8). This suggests that they could not continue practising after the training because they do not have their own kits;

- It appears that some schools had been supplied with some pneumatic kits though the number was limited. Worst still some components were missing (ST6; ST8). At another school one senior teacher reported that they had to borrow some kits from other schools because they did not have sufficient number of kits for teaching purposes;

- Another challenge cited was that control labs in schools have not been set up (ST6).
Overall, these findings suggest that teachers are not as equally competent in pneumatics as they are in electronics.

The next section presents results for the CAD/CAM content area of the curriculum. Chart 5.5 presents teachers’ self-rating for this content area.

**Chart 5.5: Teachers’ self-rating for CAD/CAM**

As can be seen in chart 5.5, a combined total of twelve out of sixty-six (18%) respondents reported themselves as being “good to very good”. This is a very low number. A slightly lower number (12%) to this rated themselves as “average”. While a majority (59%) of respondents reported a “low to very low” ability in CAD/CAM. The remainder (9%) reported themselves as having “no background”. What is missing in the results is that no respondents reported themselves as “exceptional” in this area. Overall these findings suggest that teachers’ capability in this area is below average.

In terms of teachers’ confidence in CAD/CAM, the skew is more towards the negative end. Combined total for “very low” to “moderately low” add up to forty-two (64%). This constitutes a majority. The number of those who responded “no confidence” is eleven (17%). The combined total for those who answered “moderately high” to “high” is nine (14%). The remainder (5%) rated themselves as “neutral”. Overall the data suggest that teachers’ level of confidence in CAD/CAM is “very low” according to the scale used.
5.8.2 Reasons for teachers’ low self-rating in CAD/CAM

As was done in pneumatics, a follow up question asked participants to explain the reasons for low capability and confidence in CAD/CAM. Teachers gave varied reasons for this part of the question. Table 5.3 presents teachers’ responses to this question.

Table 5.3: Reasons for low capability in CAD/CAM – Teachers’ perceptions

<table>
<thead>
<tr>
<th>ID</th>
<th>Reasons for low capability in CAD/CAM</th>
<th>Codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>T3</td>
<td>Studied CAD but lacked practice due to lack of equipment</td>
<td>PRAC EQUI</td>
</tr>
<tr>
<td>T5</td>
<td>Lack of support; lack of training; Inadequate resources for personal development</td>
<td>INSET RES</td>
</tr>
<tr>
<td>T17</td>
<td>I did not have extensive training in CAD/CAM applications as well as Desktop publishing</td>
<td>ITT -</td>
</tr>
<tr>
<td>T19</td>
<td>CAD was and has never been taught at most schools and often the equipment would not be in a good condition</td>
<td>EXP EQUI</td>
</tr>
<tr>
<td>T21</td>
<td>I did not have extensive training in CAD/CAM applications as well as Desktop publishing</td>
<td>ITT -</td>
</tr>
<tr>
<td>T23</td>
<td>CAD was and has never been taught at most schools and often the equipment would not be in a good condition</td>
<td>PRAC EQUI</td>
</tr>
<tr>
<td>T24</td>
<td>Whilst studying did not get to master the practical aspects much</td>
<td>ITT PRAC</td>
</tr>
<tr>
<td>T28</td>
<td>CAD/CAM has not been taught to many teachers and even resource persons cannot teach it with confidence</td>
<td>ITT EXP</td>
</tr>
<tr>
<td>T35</td>
<td>Covered the course at tertiary level and since then I haven’t had any practice on this course.</td>
<td>ITT PRAC</td>
</tr>
<tr>
<td>T39</td>
<td>Since I completed my studies, I have never taught CAD/CAM.</td>
<td>PRAC -</td>
</tr>
<tr>
<td>T54</td>
<td>Covered it in my BEd programme and had never practiced it again</td>
<td>PRAC -</td>
</tr>
<tr>
<td>T55</td>
<td>Because there are no prescribed softwares to aid teach such (sic)</td>
<td>RES -</td>
</tr>
<tr>
<td>T56</td>
<td>Lack of practice and softwares in schools to teach the topic</td>
<td>PRAC RES</td>
</tr>
<tr>
<td>T57</td>
<td>Lack of practice and end up forgetting to use the tools on the software</td>
<td>PRAC -</td>
</tr>
<tr>
<td>T58</td>
<td>There hasn’t been any intensive formal training on this one to capacitate me (sic)</td>
<td>ITT -</td>
</tr>
<tr>
<td>T62</td>
<td>Not taught in schools, training was also basic at initial training</td>
<td>PRAC ITT</td>
</tr>
</tbody>
</table>

**NB:** The coding system already provided in section 3.9.1 was used to help identify major issues which arose from the data as they were being analysed.
The next level of analysis involved using descriptive statistics to identify the most prominent factors which might have contributed to low capability and confidence in CAD/CAM. Chart 5.6 presents these findings.

Chart 5.6: Factors contributing to low capability in CAD/CAM

Chart 5.6 shows that the most frequently cited factors in the data were *limited of practical experience* (16 counts), followed by *initial teacher training* (9 counts). These were followed by *lack of equipment and lack of teaching and learning resources* (5 counts each). Another factor reported even though on this aspect of the curriculum appears less significant was that of limited opportunities for in-service training. These findings showed the opposite of those observed in pneumatics (chart 5.6) where initial teacher training was cited as the highest factor followed by lack of equipment and limited practical experience (3 counts each). These findings may be a reflection of the disparities that exist across schools in terms of their needs.

To validate teachers' responses on their capability to deliver the curriculum, a follow-up interview was done with senior teachers. For their part the senior teachers responded as follows:
“The teachers are different in terms of their abilities” (ST1).

“Most of them are not bad; I think we need to bridge the gaps in control technology” (ST2).

“I would say that we’re making an attempt in electronics, pneumatics we have discarded because we do not have supportive materials” (ST3).

“Our teachers don’t have the practical skills, and most of them lack technology skills. The greatest challenge is imparting the knowledge” (ST4).

“In my view, the majority of the staff went to university when some of these topics were not covered” (ST5).

“The teachers are lacking in some areas. There are some shortfalls in some skills in areas of electronics and pneumatics” (ST6).

“We are rich in wood and metal, even plastics. When it comes to practical, or hands-on, teachers are really lacking, they prefer theory. “The content areas most affected are pneumatics, followed by electronics” (ST7).

Insights gained from senior teachers’ assessment of gaps in teacher knowledge and skills suggest the following:

- Although no definite conclusion could be reached because each individual teacher’s circumstance is different and situations differ from school to school in terms of deficiencies in the subject, however, the impression one gets is that many teachers possess just basic level of knowledge and skills of the subject. The general concern is that many teachers are limited in practical skills. Some expressed suspicion that it may be that teachers are not sufficiently prepared from initial training to handle the practical aspect of the subject. The finding suggests that teachers either have limited teaching skills or use inappropriate teaching methods (ST4; ST7);

- There is a consensus among the senior teachers that there are deficiencies in control technology especially electronics and pneumatics (ST2; ST3; ST4; ST5; ST6; ST7). Again the situation differs from school to school. However,
the general perception is that as was observed with the teachers’ own self-report in the two content areas (electronics (55%); pneumatics (26%), teachers are not as capable to teach pneumatics.

Figure 5.7 summarises the main factors which according to both sets of respondents (teachers and senior teachers) were perceived to have contributed to low capability in control technologies.

**Figure 5.7: Factors contributing to low capability in advanced technologies**

**Illustration by the Researcher**

A further validation was done on both teachers and senior teachers’ assessment of teacher capability. This was done by analysing in-service officers’ responses on the same issue.

The next section presents the officers’ views on teacher capability.
“In terms of skills, teachers are not well rounded even with resistant materials. They lack all the basic skills. Teachers are not adequately prepared from initial training” (PEO1).

“I think we have teachers who I don’t know whether to say they are not well trained. Their subject knowledge is lacking” (PEO2).

“They are not exposed to practical skills” (PEO3).

“I’m worried when you talk about competencies; our teachers are lacking very much in practical skills. In-depth knowledge of the subject; I refer to theory and practice. They lack confidence in the subject; technical know-how; the ability to demonstrate practical skills to students step by step” (PEO4).

INSET officers’ perceptions on teacher capability
Interview transcripts: Field data - Case Study 2

A summary of insights gained from the officers’ comments is presented below.

- The findings show a contrast to the teachers’ positive rating reported in many content areas of the curriculum especially resistant materials, product design and graphical communication. For the officers they reported that teachers lacked in-depth knowledge across all content areas.

- As was observed by senior teachers, the officers also reported widespread limited practical and teaching skills (classroom practice).

5.8.3 Assessment of Current Teacher Support System

The next section presents the findings in respect of RQ5 which assessed the effectiveness of the current teacher support system. The question was addressed to all the participants with some slight alterations to suit their context (see appendices 5.2 and 5.3). For teachers, a rating scale shown below was used to measure their opinion.
Chart 5.7 summaries teachers’ perception regarding the current in-service support system.

**Chart 5.7: Level of satisfaction with provision of INSET support**

According to the scale used the results that forty-two (64%) of respondents were very dissatisfied with the current teacher support system. A combined total of somewhat dissatisfied and dissatisfied is nineteen (19), this represent 29%. The remainder (6%) reported somewhat satisfied and very satisfied with the system respectively. Missing in the data are those completely satisfied. An overall the majority of respondents (93%) are very dissatisfied with the current teacher support system.

A follow up question asked teachers to rate the level of support received from their in-service officers. Chart 5.8 presents their perceptions.
Chart 5.8, shows when asked how satisfied they were with the level of support received from INSET officers, the majority (82%) which represents a combined total of fifty-four out of sixty-six respondents reported somewhat dissatisfied to very dissatisfied, while ten (15%) reported somewhat satisfied. Just one respondent reported very satisfied with the service provided. Missing in the data were those completely satisfied. So, overall the results suggest that teachers were dissatisfied with the support offered by in-service officers.

To validate teachers’ responses, follow-up interviews were conducted with their senior teachers and in-service officers (Appendices 5.2 and 5.3). A typical question asked the respondents to describe the support system used to help teachers deliver the curriculum in schools. The criteria used to guide respondents to judge the effectiveness of the support offered were provided in the interview schedules (Appendices 5.2 and 5.3).
Presented below are senior teachers’ perceptions of the current in-service support system.

“I don’t think there is anything of that nature; only when there is a workshop organised by TT&D” (ST1).

“At departmental level we sometimes have mini workshops. I don’t remember attending some training except from Botswana Examinations Council to sensitise us on assessment procedures for paper 2” (ST2).

“We rely on teacher training to help us train teachers” (ST3).

“Support systems are not very clear or they are not there. Here we don’t have it. We have something similar to a Performance Management System” (ST4).

“There is no such a thing; that is why I was talking about in-service training. There is basically no in-service training” (ST5).

“That one is not publicised. It’s us who go to TT&D. There is a staff development officer; we put our request for training through his office. It’s there but not effective” (ST6).

“We used to have Education officers (EOs). In our region we don’t have any officer who specialises in D&T. We have two who are Home economics specialists. They have don’t know anything about D&T” (ST7).

“I want to be honest with you, our region, I don’t see it, I don’t feel it, I don’t think they are supporting us” (ST8).

A similar question was addressed to in-service officers. The following extracts illustrate their perceptions.
“We try to support teachers, unfortunately when they get back to schools, they don’t have materials try with and engage students. I also do research on how we can simplify things for them. I’m not competent in all the areas” (PEO1).

“I’m sorry to say for the 3 years that I have been in the office, we have carried out school inspection, we have recommended such things as in-service training, but that has not happened. In our schedule, there isn’t much time to find a slot to conduct a workshop. We have had a workshop, but we haven’t had any follow-up. I think that is the part that is lacking” (PEO2).

“It is not that effective, looking at the area, the size. The region is wide and the schools are far apart. Some schools are not easy to reach” (PEO3).

“Schools are playing a minor role in staff development. We should be getting support from staff development officers, but of late focusing more on PMS. There are follow-ups, though we are hampered by lack of transport. We haven’t conducted a workshop that goes into 2 weeks. One week is not enough because it forces me to run through issues” (PEO4).

**INSET officers’ perceptions on in-service training**

**Interview transcripts: Field data Case Study 2**

### 5.8.4 Administrative support

This question measured participants’ perception on the level of support received from the school administration. In this context, administrative support refers to any kind of support offered by the school senior management team (SMT). The SMT comprises the school head, head of department (HOD) and senior teacher grade 1 (ST1). In terms of their job description, the HOD was responsible for all practical subjects in the school, whereas the ST1 was the senior manager at department level. The support could be in the form of funding, provision of teaching and learning resources, even advocacy for the subject. To help respondents make informed judgement on this issue, guidance was provided in the questionnaire. For teachers, the same rating scale shown in section 5.7.3 was used to measure their opinion on this matter. Chart 5.9 presents the findings based on teachers’ perceptions.
The results showed that the majority (64%) of respondents reported very satisfied to completely satisfied with the support received from their senior teachers. While for the school heads and HODs, the results showed a fairly even spread and perhaps suggest that situations in schools are different.

A similar question was asked the senior teachers to share their views on the level of support they received from their school heads. The next section presents these findings.
“I don’t think we are getting any support from anybody. I don’t think they have the interest of the students at heart. The only time they talk to us is during results analysis” (ST1).

“Practical subjects are headed by a scientist. Though I would say it’s not bad, sometimes you need someone with a similar background. Nobody understands the issues we are facing in the department” (ST2).

“I would say the current Head is very supportive” (ST3).

“There is really not enough support, so the support in short is really lacking. Regional support; there is not much support” (ST4).

“I would say the school head is trying; whenever we have a challenge, we get to him and he writes a letter to the Ministry. Regional office: There is no support at the moment” (ST5).

“There is some willingness” (ST6).

“I would say that I am really on my own, they are just confined to their offices in the administration” (ST7).

“Frankly speaking, I do not get support from the administration. I don’t see them in the department; it doesn’t only happen in D&T, it also happens in Home economics” (ST8).

ST1s’ perceptions on administrative support

Interview transcripts: Field data - Case Study 2

Regarding administrative support at school level, data collected from senior teachers showed a split reaction. The majority (5 out of 8) reported that school heads were less supportive (ST1; ST2; ST4, ST7; ST8). The remainder appreciated efforts made by their school heads (ST3; ST5; ST6). Overall the findings show varying experiences and indeed mixed feelings about administrative support at school level.
At regional level, the officers cited many challenges as follows:

“The support from management; they see D&T as a failing subject and yet expensive” (PEO1).

“The reality is it is very difficult to get to higher offices. I think they are limited in knowing what is happening in the D&T department. We have recommended such things as in-service training, but that has not happened” (PEO2).

“I’m really having it tough, I’m not breaking through” (PEO 4).

INSET officers’ perceptions on administrative support
Interview transcripts: Field data - Case Study 2

In terms of their working relationship with their superiors in the regions, the findings suggest a rather gloomy picture. The officers decried the lack of support from their superiors. Whereas, in terms of funding for the subject, the officers attributed limited funding for D&T to lack of knowledge by the authorities in terms of what the subject entailed. They also accused the management for lack of action on their recommendations. Another reason advanced was that the management could not justify spending more money on a subject which was perceived to be producing poor results (PEO1; PEO2).

Having gained some insights into the level of administrative support from the perspectives of teachers and in-service officers, the next level of data collection attempted to assess the state of the equipment used in schools.
5.8.5 State of Equipment in Schools

This section addresses the state of equipment in schools because it arose across all the data sets as one of the major factors contributing to the teachers’ lack of practical experience in teaching control technologies and CAD/CAM content areas. This situation prompted the researcher to ask for permission from the senior teachers to assess the state of their facilities. Permission was also sought to take pictures of the facilities so as to enable the reader to make sense of the situation in schools. To exemplify, the state of equipment in schools, photographic evidence was collected in respect of control labs of control technology workshops and CAD/CAM equipment.

Figures 5.8 and 5.9 show a typical electronics lab in senior secondary schools. School A is one of the first five model schools which were used in the piloting of the Cambridge D&T curriculum in 1987 (Ndaba, 1994). At the time these schools were deemed to be well equipped with state of the art facilities had already been included in their original plans (Ndaba, 1994). For example, the author who taught at school A observed that at piloting each school had four control labs, two of those were specially designed for pneumatics while the other two were for electronics. There was also a CAD/CAM lab and a computer room. The schools were also supplied with teaching and learning resources associated with these content areas.

Figure 5.8: An electronics control lab (School A - South central)
Source: Field data - Case study 2
School B is one of the oldest schools, which prior to the BGCSE offered mainly the traditional technical subjects. Because the BGCSE D&T curriculum required the teaching of control technologies, in 1999 the ministry of education upgraded all the old schools to make provision for the teaching of control technologies.

Figures 5.10, 5.11, 5.12 and 5.13 exemplify the situation in schools in terms of the provision of equipment to cater for the teaching of pneumatics. As observed in all the four schools, the government provided the physical infrastructure but did not provide the necessary equipment. It was also observed during the touring of facilities that the schools did not have modelling kits and other teaching and learning resources needed to support the teaching and learning of this content area.
School B shown in figure 5.11 is one of the oldest and was upgraded in 1999 to bring it to the level of school A. It has been over a decade since upgraded, but the lab shows that equipment has not been supplied. On the other hand, school A also finds itself in a similar situation because the equipment which was supplied at piloting has become out-dated but has not been replaced.
Overall, in all the four schools in the sample it has been observed that, there was the physical infrastructure. The schools have also been supplied with a compressor and the necessary piping to the work stations. The installation had not been commissioned and tested to ensure that compressed air flows to the workstations as well as to also ensure that the equipment is working properly. This suggests that the labs have not been set up. This situation also poses a safety concern for
teachers and students. Furthermore, it was observed that the schools do not have modelling kits to enable teachers to gain some practical experience on the use of this technology. Indeed this situation further validates teachers’ claims that there is no equipment and other resources to support the teaching of this content area.

The next section presents the findings in respect of the state of equipment for CAD/CAM. The teaching of this content area requires a computer room and a CAD/CAM lab with computer numerically controlled (CNC) machines.

Based on the interview with the senior teachers, it was reported that schools had been supplied ten (10) computers; two (2) CNC machines, a CNC centre lathe and a milling machine. The computers are not connected to the Internet and do not have the relevant technology software. The computer room caters for a maximum of twenty (20) students.

Figures 5.14 and 5.15 exemplify the state of CAD/CAM equipment in two schools, one in the south central and the other in the southern region.

![Figure 5.14: State of CAD/CAM equipment (School E - South central)](image)

Source: Field data - Case study 2
It was observed that in both schools, the machines were kept in a crowded place which suggests that were lying idle. To illustrate this situation, at one school when the senior teacher was asked why the machines were not being used he explained that: “The main problem with the machines is the circuit breaker; every time the machine is switched on, it trips. The other problem is the software; the teachers find the CAD/CAM software that works on the machine not user-friendly” (ST7). At one of the new schools, the situation was even more desperate because the senior reported that they were still waiting for the machines (T8).

At school E (Figure 5.14) the senior teacher reported that: “equipment was supplied in 2002 and it has never been utilised. The training person who was supposed to in-service us had problems” (ST2). From this situation, it was noted the equipment was supplied over ten years ago and considering that the computers and related softwares which operate these machines need regular updates, it may be that these machines were obsolete. Also observed was that the two schools used different models of CNC machines. One questions the rationale for supplying schools with
versions. The researcher would argue for this type of equipment to be standardised for two reasons. First, it would enable the training of as many people as possible on the same machine, which might be a challenge when they were using different models because of different configurations. Second, it would also be possible for the government to negotiate a better deal with the supplier especially where large procurements were involved. In one of the group interviews the consensus was that: “the schools are equipped, but teachers do not know how to operate the machines” (GI, Data set 2).

To sum up, it was observed that although the schools were supplied with CAD/CAM, the equipment is not being used for the following reasons:

- The equipment had not been properly commissioned to ensure that was working properly. Some schools cited electrical problems with some CNC machines.

- The data revealed that teachers were not adequately trained on its use. The reasons for limited capability have been reported in table 5.1. The main factors which contributed to low capability were lack of practical experience and inadequate preparation of teachers during their initial training.

- The equipment itself was old including the computers that operated the CNC machines.

- Also, it seemed schools had been supplied with different machines which makes it a challenge to conduct training for them.

Therefore, based on the empirical evidence presented concerning teacher capability and the level of resources, the conclusion was that this content area was not being taught at all in schools.
5.8.6 **Priority Areas for In-Service Training (Q 3)**

This question asked teachers to rank different content areas of the curriculum according to what they perceived to be their highest and lowest priority for training. The responses were measured using a rating scale shown below:

![Rating Scale](image)

In order to determine the highest priority in terms of teachers’ training needs, a frequency count was used. Chart 5.10 presents a short-list based on teachers’ ranking.

**Chart 5.10: Teachers’ priority areas for in-service training**

![Bar Chart](image)

In terms of the rank order, the results show that CAD/CAM is the highest (85%), which suggests that majority of respondents identified it as a critical area. The second highest is pneumatics (70%), followed by electronics (50%). The fourth on the list is DTP (45%). These findings correlate with the ones already presented in section 5.8 whereupon a majority (64%) of respondents had reported a very low to moderately low capability in CAD/CAM. The second most affected subject in terms of low capability was pneumatics; it also recorded the highest number of respondents with no background in the subject (Chart 5.4). The rating for electronics was positive (Chart 5.3). Therefore, teachers’ low rating in CAD/CAM
suggests that it would make sense to place it highest on their priority list as shown in chart 5.10.

The same question was asked to senior teachers and education officers. The results for senior teachers have been summarised below.

“I think we need to bridge the gaps in control technology. There is that part of CAD/CAM, equipment was supplied in 2002 and it has never been utilised. The training person who was supposed to in-service us had problems” (ST2).

“We have long pleaded that most of our teachers are not conversant with electronics, pneumatics and technical drawing” (ST3).

“Our teachers don’t have the practical skills, and most of them lack technology skills” (ST4).

“Pneumatics and electronics; they don’t even attempt. In terms of electronics, they seem to have a phobia” (ST5).

“The teachers are lacking in some areas. There are some shortfalls in some skills in areas of electronics and pneumatics. When it comes to CAD/CAM is a no go area” (ST6).

“I would say our skills in this area are limited. Though some teachers would say, they are good in electronics, if you assess it in their students’ work, you can see that this subject is not being taught adequately. The content areas most affected are pneumatics, followed by electronics” (ST7).

**ST1s’ perceptions on teacher capability**

**Interview transcripts:  Field data - Case Study 2**

- Five out of eight senior teachers reported that teachers were not competent to teach control technologies components of the curriculum. Electronics and pneumatics seem to be the most affected (ST2; ST3; ST4; ST5; ST6; ST7).
• CAD/CAM was identified as another critical area for training. It was reported that CAD/CAM equipment was supplied but teachers received very little training on its use (ST3; ST6; ST7).

### 5.9 Discussion

This section discusses the main findings of this piece of research by collating evidence from across the data sets. To get a complete picture on the issues, key findings are discussed in conjunction with the literature review and their implications. The section concludes by making recommendations for further research. To guide the discussions, reference will be made to the research questions. The discussions will focus on the following issues:

- Teacher capability (RQ1 and RQ2)
- Areas of need in the curriculum and other restraining factors (RQ3)
- The nature of the teacher support system used in Botswana (RQ4)
- Views and perceptions about the current support system (RQ5)
- Suggestions for a more viable support system (RQ6)
- Summary

#### 5.9.1 Teacher Capability to Deliver the Curriculum

The exact definition of capability is problematic because of its wide interpretation. For example, the term is often used interchangeably with competency to denote “the integrated knowledge, skills, judgment, and attributes that people need to perform a job effectively” (Mind Tools, 2012). On a basic level, capability implies “the ability to do something successfully or efficiently” (Oxford Online dictionary, 2012).

In the instruments which were used for capturing data on teachers’ ability to teach the various content areas of the curriculum, the following definition was provided to ensure uniformity in interpretation. Mishra and Koehler (2006) define content knowledge as the “knowledge about the actual subject matter that is to be learnt or taught” (as cited in Schmidt et al., 2009, p.125).
The research literature on what constitutes teacher knowledge is a conundrum (Kimbell, 2012; Shulman, 1987; Mishra and Koehler, 2006; Hiebert et al., 2002). This is because teaching is increasingly becoming complex (Shulman, 1987). In general teacher knowledge encompasses inter alia subject matter mastery, curriculum knowledge, pedagogical skills, and knowledge of pedagogical content as well as varied teaching repertoires (Hiebert et al., 2002).

The debates about what constitutes teacher knowledge are pertinent to D&T because teaching in this context is a “complicated practice that requires an interweaving of many kinds of specialised knowledge” (Koehler and Mishra, 2009, p.61). Koehler and Mishra assert this point by arguing that teachers are required “to master more than the subject matter they teach” (p.65). Additionally, they maintain that teachers must also have a deep understanding of the manner in which the subject matter can be changed by the application of particular technologies.

The issue of teacher knowledge in D&T is a conundrum (Kimbell, 2012; Schmidt et al, 2009). Unlike other certificated subjects D&T teachers are trained as generalists as such they “are required to develop competence over a diverse range of subject areas” (Canavan and Doherty, 2007, p.295). Canavan and Doherty (2007) explain that this situation has proved to be problematic even for practising teachers because they also require support for the development of their own competence in line with curriculum requirements. As a consequence, it was observed that teachers resorted to implementing the curriculum along lines of personal preference or practitioner confidence (ibid, p.295).

In terms of Botswana, the current practice is that teachers are expected to teach all content areas. This is a challenge because it is not possible for one to master all content areas. One senior teacher acknowledged this limitation:

“most teachers are conversant in delivering resistant materials, but there are problems in mechanisms, structures, pneumatics and electronics. When it comes to CAD/CAM is a ‘no-go’ area” (Case study 2 - Field data, ST6).
Based on this evidence, it would appear that a teacher who is weak in some content areas may focus more on areas he/she feels comfortable in and avoid content he/she finds challenging. Chikasanda et al. (2011) observed a similar trend in Malawi where the curriculum was implemented around “personal preferences, subject confidence, individual skills and knowledge” (p.24).

5.9.2 Roles and Responsibilities of INSET Officers

The Principal Education Officers (PEOs), in Botswana are the INSET officers employed by the department of HRD to provide the necessary support to schools. They provide training opportunities for teachers at regional level to enable them to update and maintain their subject and teaching skills. They are based in the regional office to be closer to schools. Previously, their mandate was to provide in-service training to D&T teachers at both junior and senior school levels. However, recently due to on-going restructuring exercise, their mandate has been changed to that of a human resource development officer. The ‘new order’ means that, they are not only responsible for training of development of D&T teachers, but all the staff in their regions. Due to shortage of staff in other subjects, for example some combine D&T with Art or ICT. For example, the officer for the north east region reported that he combined D&T with ICT. According to him this was problematic because the implementation of ICT cuts across all subjects; from primary through to senior secondary school.

In addition to lesson observations, INSET officers also prepare a budget for in-service training although in the words of one INSET officer, the funds “come in one basket” to cater for other subjects. This is an issue which the officers are not satisfied with. One officer pointed out that “the funding is there, but I wouldn’t say I’m satisfied” (Case study 1 - Field data).

5.9.3 Facilities and Resources in the Regions

The regional office has an education centre which is a self-contained facility with all the necessary resources to support in-service training across all subjects. Centres also have hostels to accommodate workshop participants from distant schools. However, it noted not all regions have education centres (north east). It
was noted that there were some disparities in terms of provision of facilities. For example, one region (south) had specialised workshops for electronics; pneumatics and CAD/CAM. One officer acknowledged this limitation that “I would say resources are there, but do not meet subject demands” (Case study 1 - Field data). Given this situation, it suggests that teachers based in this region have to travel to other regions for in-service training.

5.9.4 The Nature of the Current Teacher Support System

This section discusses the findings related to the nature of a teacher support system used in Botswana. The findings are discussed in conjunction with the issues which arose from the literature review. In order to inform the discussions, a definition of professional development is provided.

Teachers’ continuous professional development (CPD) is defined as “the growth that occurs as the teacher moves through the professional career” (Glatthorn, 1995, cited in Villegas-Reimers, 2003, p.11). The process involves workshops or short-term courses that aimed at offering teachers new information on a particular aspect of their work (OECD, 2005). The goal of CPD is to “prepare teachers to enact the curriculum appropriately for its design in their classrooms” (Fishman et al., 2000, p.5). In-service training and professional development activities are identified as enablers though teachers can be upgraded to keep up with developments in the field (OECD, 2005; Villegas-Reimers, 2003). Similarly, in Botswana, CPD has been identified as one of the key strategies for the “enhancement of the performance and status of the teaching profession” (Report on the Organisational Restructuring of the Ministry of Education, 2006, p.14).

CPD in D&T education was an increasingly constant feature because of rapid technological developments (Hughes, 2005; Kohler and Mishra, 2009). The D&T teachers were supported with their professional development needs through workshops or short-term courses delivered on one-shot basis. The aim of this kind of arrangement was intended to target as many teachers as possible. Delivered in this manner it typifies a one-size-fits-all model because it attempts to cater for the needs of a diverse clientele without taking cognisance of their backgrounds and individual learning needs as well as the fact that they operate under different
contexts. Timperley et al. (2007) share a similar view that professional development is multi-layered in the sense that the teachers’ needs are different and so are school environments under which they operate as well as the diverse student needs that they serve. The effectiveness of professional development activities has always been subjected to criticism because often the impact of these activities on student learning depends on how well teachers engage with both the new information and their existing understandings (Durrant and Holden, 2006; Tabulawa, 1998; Villegas-Reimers, 2003; Timperley et al., 2007; Welch and Mueller, 2003).

In terms of the effectiveness of the current teacher support system the data showed a general agreement that it was not effective. A number of challenges were cited. For example, in-service officers reported that due to the on-going restructuring their new roles rendered them ineffective because they were required to perform many other duties and responsibilities. One INSET officer explains this situation: “In our schedule, there isn’t much time to find a slot to conduct a workshop” (PEO4). Some officers reported that some regions were large to be managed by one person. This situation was also exacerbated by lack of transport to visit schools. In terms of the effectiveness of the current in-service support system one officer acknowledges that: “It is not that effective, looking at the area; the region is wide and the schools are far apart; some schools are not easy to reach” (Case study 2 - Field data, PEO3). Consequently, “the rate at which we have been visiting schools will be reduced” (ibid).

In-service officers cited budgetary constraints as a limiting factor in terms of their ability to support schools. According to them this situation affected schools the most because of limited funding for D&T. One officer highlights this challenge: “We try to support teachers, unfortunately when they get back to schools, they don’t have materials to try with and engage students” (Case study 2 - Field data, PEO1). A reduction in the budget for D&T was attributed to the introduction of other practical subjects like physical education. The funding for practical subjects is shared equally by all practical subjects. The funding for practical subjects is consequently, the officers felt that it compromised the teaching and learning because teachers resorted to theory teaching at the expense of practical work.
In summing up, it was found that the teacher support system used in Botswana typifies a top down model. The premise of this type of model was to reach many participants in a short time and frequently treats teachers as identical. Given that the schools operate under different contexts, a localised model for delivering in-service training and professional development in schools seems to be a more viable solution (Schwille and Dembele, 2007; Jovanova-Mitkovska, 2010). The localised model puts the teacher in the position of having some responsibility for their own professional development. If such a perspective was built into CPD framework in Botswana it means that training and development can be differentiated for individual needs to a greater extent. Schools can leverage on the existing staff development support system to capacitate this effort. For example, the school-based staff development officers and senior teachers can be trained professionally to enable them to deliver in-service training more effectively including the development of curriculum support materials. Since these people are closer to the teachers, this arrangement would ensure more follow-up support and continuous mentoring. In support of a school-based in-service support system, Schwille and Dembele (2007) emphasised that more effective models are those:

“...conducted in school settings and linked to school-wide efforts in which teachers participate as helpers to each other, and as planners with administrators of the in-service activities, emphasis on self-instruction with differentiated training opportunities, teachers in active roles, choosing goals and activities for themselves, emphasis on demonstration, supervised trials and feedback, training that is concrete and on-going over time, and on-going assistance and support available upon request” (p.108).

5.9.5 Areas of Need

This section addresses the findings related to RQ3 which sought to help identify priority areas in the curriculum in terms of where attention should be focused. The section comprises two parts. The first part focuses on the gaps in knowledge and skills among the teachers. The second discusses other restraining factors.

Generally, in terms of the capability to deliver the curriculum, it was found teachers were more adequately prepared to teach the traditional crafts including
some control technologies like mechanisms and structures. The data also showed that teachers felt more comfortable to handle graphics and product design. However, teachers’ own self-rating a low capability in CAD/CAM and pneumatics. This finding was also supported by that of their immediate supervisors.

In the sample (n=66), it was found that advanced technologies such as computer-aided designing and computer-aided manufacturing (CAD/CAM), were not being taught in schools. At worst, many teachers reported that they no longer taught these curriculum areas because of lack of equipment and the necessary expertise. At one school the effects of limited teacher capability in the pneumatics content area has been noted in students’ performance in midyear examination results. With reference to pneumatics, one senior teacher confirms this situation at school which he describes: “compelled us to do something about it because it was examined last year” (Case study 2 - Field data, ST7). To illustrate his point, he reported that in a past examination paper which contained some questions on pneumatics, he noted that a student with the highest mark had scored 60%, while the majority of students scored below 50%.

Looking across the data sets, there is sufficient evidence to suggest that CAD/CAM and pneumatics are the most critical areas for in-service training. Based on these findings, the researcher would argue that this limited capability by teachers in advanced technologies restricts the development of learners’ technological capability.

5.9.6 Other issues arising from the Data

This section highlights some of the other factors which arose from data analysis. These factors were deemed significant because even though they had not been considered in the original data collection instruments, they were considered by some respondents as having some bearing on the implementation of the curriculum and the morale of the teachers. These issues were identified as follows:

- Allocation of students into the subject was found to be problematic. It was observed that the subject was being taken by students with low academic ability (ST1; ST2; ST4). One senior teacher expressed a concern that more
students were being pushed into D&T without considering resource implications (ST1).

- Time to implement the curriculum was identified as another limiting factor. It was generally felt that the time allocated for D&T was not enough. ST4 also noted that time was not being used productively.

- The curriculum is perceived to be congested; some senior teachers have expressed a concern that in trying to cover all the content, some teachers tend to rush through the topics (ST1; ST5).

- It was also highlighted that coursework was demanding on part of students. Surprisingly, a large percentage of marks were allocated to project documentation at the expense of the final product (ST4; ST6).

- A general disgruntlement by teachers was reported which was attributed to unsatisfactory conditions of service. As a consequence, senior teachers found it difficult to motivate teachers to work as hard as they used to (ST1; ST5; ST6).

### 5.10 Conclusions and Implications

The next sections present conclusions based on issues which arose from this study and their implications on the implementation of the BGCSE D&T curriculum. The focus of the study was in two-folds. Firstly, it assessed teachers’ capability to deliver the curriculum. Secondly, it endeavoured to provide an in-depth understanding of the nature of a system used to support teachers’ efforts. The goal was to identify gaps in knowledge and skills among the teachers and use informed insights gained to recommend corrective actions. The conclusions are organised into the following headings:

- Teacher knowledge and skills;
- Continuous professional development;
- Provision of resources for D&T in schools;
- Summary;
- Recommendations for the next phase.
Chapter 5 – Case Study 2 Report

5.10.1 Teacher Knowledge and Skills

A determination of teacher capability in D&T is a topic of perennial discussion primarily because of the breadth of knowledge covered in the subject (Atkinson, 2006; Kimbell, 2012; Kohler and Mishra, 2009). Moreover, this issue is compounded by the nature of teaching in D&T which requires an interweaving of many kinds of specialised knowledge (Kohler and Mishra, 2009). It is even a more daunting task for the teachers because of a diverse and changing student population, a rapidly changing technology in the workplace, as well as the demands for excellence from all segments of society (Shulman, 1987). The evolutionary nature of technology poses even a greater challenge because it necessitates that change in D&T education is an increasingly constant feature (Hughes, 2005).

As a consequence, the D&T practising teachers need a support system that would ensure their continuous growth and development. In respect of Botswana, the findings revealed that CPD is a problematic issue because many teachers did not keep sufficiently up to date because of a lack of in-service training. Elsewhere, Canavan and Doherty (2007) argued that it is equally important that teachers entering the profession should be deployed strategically within an environment that nurtures them, values their new skills and motivates them.

In the author’s view and others in the field the consensus it that teachers cannot master the subject knowledge across all aspects of a D&T curriculum (Atkinson, 2006; Koehler and Mishra, 2009). Nevertheless, there is a need to set standards in terms of an acceptable level of subject knowledge that the D&T teachers must demonstrate cannot be over-emphasised. For instance, in England, Atkinson (2006) noted that trainees are mandated to gain qualified teacher status (QTS) before they can teach in state schools. Atkinson found that in England teaching standards are set by the government through the Teacher Training Agency (TTA). Similarly in Botswana, the government recently instituted Botswana Qualifications Authority (BQA).

In view of the period over which Botswana introduced the D&T education in her education system one may assume that by now the curriculum should be well
established. The results of this study revealed a mismatch between the knowledge and skills possessed and those that are emphasised in the curriculum. Specifically, in terms of teachers’ capability in advanced technologies such as CAD/CAM and pneumatics, where there was a widespread agreement across the data sets that these content areas are not widely taught in secondary schools. Although lack of equipment was cited as one of the reasons for not teaching these content areas, however, the main reason reported even by teachers’ own admission is that of lack of confidence and expertise. If this situation is not addressed, teachers’ lack of confidence in the above-mentioned content areas has the potential of ultimately reducing this curriculum to its former CDT status.

Chikasanda et al. (2011) adds to this view by relating the experience in Malawi where “some technical teachers even proposed a return to the craft and skills based curriculum and scrap off technological studies” (p.24). Similarly in Scotland, Canavan and Doherty (2007) observed that teachers were “fragmented and polarised with multiple agendas based around personal preferences, subject confidence, individual skills and knowledge” (as cited in Chikasanda et al., 2011, p.24). Elsewhere, Atkinson (1990) observed divisions between those who wanted to “protect what they perceived to be their individual boundaries and those who believed in the need for hard technology and a sound knowledge base” (p.10).

In order to maintain high standards for teachers in Botswana, this study has drawn attention to the need for a competency framework in the D&T education. This framework should be developed in conjunction with the newly formed Botswana Qualifications Authority (BQA) because one of its mandates is to define and set national standards across all professions. This arrangement would provide an ideal platform to determine the core competencies against which teachers can be assessed of their eligibility to deliver a D&T curriculum. The competency framework will also address the gaps in knowledge and skills among the teachers as well as their teaching practices and beliefs which were caused by training teachers in different institutions (Ndaba, 1994).
5.10.2  Provision of Resources for D&T in schools

Allocation of funds for the purchase of materials for practical subjects was a rather tricky issue to handle because there were various parties involved in the budgeting and procurement of teaching and learning resources. The main sponsor was the government through the MOESD but because of the pyramidal management structure there were various departments involved before the service was delivered to the schools. In schools, the school head warrant holder, has the prerogative to decide on the school budget once the funds have been released by the ministry. The procedure is that various departments in the school submit their budget proposal through the school head’s office. It was found that the funds for the purchase of materials for practical subjects are shared equally between three departments say, Art and Design, Agriculture and D&T. From this situation, there were some discrepancies in the sense that firstly the enrolment in each subject is different, and secondly the D&T education is made up of different content areas with some needing specialised equipment. Indeed, the author who was once a head of department for D&T also argues that the rationale which was used to allocate funds during the Cambridge era cannot be applied to the BGCSE D&T curriculum because the Cambridge curriculum catered for mainly three content areas namely woodwork, metalwork and technical drawing. One officer concurs that: “The subject was built from the traditional setup” (Case study 1 - Field data, Set 3). It seems this lack of understanding by the authorities of what the subject entails hampers the implementation effort (Case study 1 - Field data, Set 1). One in-service echoed the same sentiment that: “In practice it could have been ok if teachers had time and resources. The students are introduced briefly to various components of the syllabus” (Case study 1 - Field data, Set 6). The author argues that funds should be allocated according to the number of students enrolled in the subjects as well as to cater for the different content areas in the subject.

Also related to provision of resources is the issue of maintenance of equipment which seems to have been overlooked. The most affected pieces of equipment were CNC machines and computers which are in a state of disrepair. The CNC machines have some electrical problems, while the computers are very old and need to be
replaced. The computers by nature need regular software updates including virus protection and occasional hardware maintenance.

5.11 Summary

One of the objectives of this research was to identify and validate the key factors that affect the implementation of the BGCSE D&T curriculum in schools. The main ones have been identified as:

- A limited implementation strategy.

- Teacher competency. This was found surprising because the data captured on teacher qualification and work experience, showed that all the teachers in the sample possessed a degree qualification. The major ones cited in the teacher questionnaire as well as in the interviews with senior teachers. In terms of teacher competency to deliver the curriculum, for their part, in-service officers cited limited subject knowledge across the whole curriculum and poor teaching methods.

The other ones were administrative and financial support to ensure that the necessary facilities and teaching resources are made available to the teachers. In terms of administrative support, one does not understand the reasons why the sponsor would not want to commit more resources into the D&T education because it was reported that the BGCSE programme was launched D&T is one of the subject which benefitted immensely. This statement validates this viewpoint: “D&T has been a very expensive subject. There has been a lot of investment in the infrastructure within D&T. But sadly they don’t have enough knowledge of the use of the new equipment to handle electronics” (Case study 1 - Data Set 3).

In all the data sets, some of the inadequacies in teacher knowledge and skills have been attributed to initial teacher training programmes. Given this background, the researcher recommends that initial teacher education programmes must be aligned with the needs of the curriculum to ensure that student teachers have sufficient depth and breadth in subject matter knowledge. In these programmes more time should be allocated for the practical aspects of the D&T education to enable student teachers to develop practical skills and experience related to
teaching the subject. The need to maintain high standards during initial training and continuous professional development for those in the field cannot be over-emphasised (Boser and Daugherty, 1994; Durrant and Holden, 2006; Atkinson, 2006; Timperley, et al., 2007; OECD, 2005; Yates, 2007; Villegas-Reimers, 2003). Furthermore, curriculum planning and appropriate teaching approaches must be reinforced to transform them into effective teachers (Durrant and Holden, 2006; Fishman et al., 2003).

Overall, these findings corroborate with those highlighted in the BGCSE evaluation study (Ministry of Education and Skills Development, 2009). The evaluation study was designed to evaluate and provide feedback on the processes and implementation strategies of the BGCSE programme as directed by the RNPE. In terms of teacher capability, the report noted that: “the areas of electronics, mechanisms, pneumatics and CAD/CAM were a cause for concern. Teachers noted that they were not teaching these content areas due to lack of competency” (Ministry of Education and Skills Development, 2009, p.242). Because of these gaps in knowledge and skills to implement, the report recommends that teachers’ credentials should be reviewed and their skills audited. Whilst for teacher professional development in D&T education, the report revealed among others that “there is a policy vacuum relating to the provision of structured in-service training for teachers in senior secondary schools” (p.80). Moreover the report noted that: “where in-service training was provided, it was irregular and inadequate” (ibid, p.80). The report further recommends that in-service training and workshops for D&T teachers should be intensified to enable them to handle a range of content areas in the D&T curriculum (ibid, p.245).

Similar studies notably England, Scotland and New Zealand found that trying to implement change in the D&T curriculum becomes problematic if it is not supported by appropriate provision for staff development or support from senior management teams (Atkinson, 1990; Canavan and Doherty, 2007; Finger and Houguet, 2009).
5.12 Recommendations for the next phase

This study identified a range of factors that contributed to the partial implementation of the BGCSE D&T curriculum. Factors such as inadequate preparation of teachers during their initial training, lack of practical experience on the use of equipment for control technologies, and limited participation in professional development activities. Because of limited exposure or practical experience on the use of these technologies, the teachers claimed that it affected their confidence to deliver those content areas.

The most compelling issue in terms of the findings of this study is that of teacher competency. The following statement illustrates this point that: “Everybody is realising that when you introduce something new you need to go back to the teachers because they are the ones who are going to teach” (Case study 1 – Field data: Set 1; Set 3; Set 4: Set 5; Set 6). The foregoing statement validates and reinforces the realisation that the teachers are integral to the change process (Fullan, 2001; Morrison, 1998, Whitaker, 1993). Moreover, the data suggest that the curriculum is partially being implemented. One officer suggests what might have contributed to this situation: “I think when people went for training; nobody thought the curriculum was going to change” (Case study 1 – Field data, Set 6).

In the light of these findings the next phase of the study explored the viability of delivering a school-based in-service training and professional development to support teachers in the most affected content areas of the curriculum. The envisaged framework took into account the uniqueness of contexts under which schools operate, limited resources, teachers’ views, and best practices which focus on using teachers as change agents to influence and drive curriculum change.
CHAPTER 6

CASE STUDY 3
Chapter 6 - Case study 3

An exploration of the viability of a school-based professional development support system for D&T teachers: Insights gained from teachers who participated in this experimental model.

6.1 Introduction

This study sought to explore the strategies for implementing a school-based CPD support system which would promote effective implementation of the BGCSE D&T curriculum. In order to gain first-hand experience in the viability of this kind of system, it was deemed necessary to design an experimental study with some schools to trial some resources.

The study followed on the issues which arose from case study 2. These issues were that: although many teachers possessed the relevant qualifications and experience, the data showed that teachers lacked the practical experience and confidence in teaching control technologies and ICT content areas. One senior teacher acknowledged this situation at his school that: “most teachers are conversant in delivering resistant materials, but there are problems in mechanisms, structures, pneumatics and electronics...when it comes to CAD/CAM is a ‘no-go’ area” (Case study 2 – Field data, ST6). It was also reported that due to the broad mandate of the in-service officers they were unable to provide regular in-service training and continuous mentoring. The following statement explains the current scenario: “It is not that effective, looking at the area; the region is wide and the schools are far apart; some schools are not easy to reach” (Case study 2 - Field data, PEO3).

Furthermore, the system used was found to be generic in nature and not tailored to the individual schools and teachers’ needs. The point of departure is that the current ‘one-size-fits-all’ in-service model is not a viable option considering that schools operate under different contexts. In the light of these findings the need now was to consider the possibility of delivering in-service training directly to the teachers. Hence, a customised model for delivering in-service training and professional development in schools was deemed a more appropriate framework.
6.2 **Aims and Objectives**

This study was initiated in the form of a small-scale experimental study aimed at exploring the viability of implementing a school-based in-service support system. Thus, the central research question which guided this study was: *How can we design and implement a school-based in-service training support system within the context of the BGCSE D&T curriculum?* To answer this question the following objectives were formulated:

1) Produce a framework to support the delivery of school-based professional development support system for the D&T teachers in Botswana.

2) Develop resource materials based on specific needs of teachers in certain subject areas of the D&T curriculum.

3) Trial and evaluate the resources with the teachers in terms of their ability and confidence to teach those subject areas.

4) Evaluate and present a conceptual model of a more appropriate continuous professional development system for use within the context of the BGCSE D&T curriculum.

6.3 **Research Questions**

Since a support system was to be designed for use within a school system, the first task was to identify and invite schools and teacher participants from the D&T departments. Once the invitation was accepted, a need analysis questionnaire was designed to enable decisions about their generic specific training needs and priorities. To exemplify this support system, a customised training plan was developed and trialled with the participating teachers. At the end of trialling, group discussions and seminars were held with the teachers to evaluate the intervention. Hence, this research focused on the research questions outlined in figure 6.1.
### Case study 2 findings

<table>
<thead>
<tr>
<th>Teacher competencies</th>
<th>Development of RQs for case study 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>• The data showed that teachers had <strong>limited capability</strong> and low <strong>confidence</strong> in the new technology content areas. In terms of priority for in-service training, the most affected content areas were <strong>pneumatics, CAD/CAM and electronics</strong> (see section 5.8.6).</td>
<td>1. Which aspects of control technologies do teachers find challenging and what would be the best approaches to support them to develop their ability and confidence in those content areas of the BGCSE D&amp;T curriculum?</td>
</tr>
<tr>
<td>• It was also reported that teachers lacked exposure and <strong>practical experience</strong> in the above-mentioned content areas.</td>
<td>2. What resources do schools have to enable teachers to practise and develop their confidence to deliver control technologies and integrate them into other content areas of the BGCSE D&amp;T curriculum?</td>
</tr>
<tr>
<td>• A regional ‘<strong>one-size-fits-all</strong>’ approach was being used to deliver in-service training.</td>
<td>3. What are the best approaches to delivering a school-based personalised in-service training in the D&amp;T education to the teachers?</td>
</tr>
<tr>
<td>• The training focused more on skill upgrading and overlooked <strong>classroom practice</strong> and pedagogical issues.</td>
<td>4. What organisational factors facilitate or hinder the provision of school-based in-service and professional development in the D&amp;T education in Botswana?</td>
</tr>
<tr>
<td>• Provision of in-service training at regional level was <strong>not effective</strong> due to the <strong>vastness</strong> of some regions; <strong>limited resources</strong>; lack of <strong>training centres</strong> in some regions; and lack of <strong>expertise</strong> in some content areas by the in-service officers.</td>
<td>5. <strong>How can school-based in-service training and professional development be planned to promote the integration of new knowledge and skills into the teaching and learning?</strong></td>
</tr>
<tr>
<td>• It has been argued that professional development is more effective if it is based on real needs identified by the teachers in their daily activities. Such training should also offer the teachers the opportunity to reflect on their practice in their own environments (Villegas-Reimers, 2003).</td>
<td></td>
</tr>
<tr>
<td><strong>In-service training and Professional development</strong></td>
<td><strong>A needs analysis questionnaire; training seminars and Group discussions with the teachers</strong></td>
</tr>
</tbody>
</table>

### Figure 6.1: Development of research questions

**Illustration by the Researcher**

Research questions 1-4 address objectives 2 and 3 whilst the research questions 5 and 6 address objectives 1 and 4. Research question 5 is the over-arching research question.

### 6.4 Design and Implementation

This study focused on three school-based in-service training workshops which had been designed to explore the viability of such a support system. Traditionally in Botswana such workshops are conducted by in-service officers in educational centres and are used to target many participants from different schools. In this case, the main training lasted for three days with follow-up visits which ran over
the course of the school term. The aim of follow-up visits was to monitor and support individual participants’ progress throughout the task. The final visit culminated in a group discussion with all the participants to evaluate both the effectiveness of the support system and the outcomes of the activities in terms of capability.

6.5 Prior Planning and Fieldwork

Conducting school-based training requires prior because teachers perform other administrative duties other than just teaching. They also have their own individual schedules. Prior to fieldwork the researcher had to undertake the following arrangements:

- Paying initial visit to the participating schools for a plenary session with the heads of departments and the teachers regarding their training needs.
- Mobilisation of all the required resource materials.
- Since the training was to be conducted onsite rather than away from the school, the researcher had to negotiate with the schools for a more appropriate time for the training. The researcher had to strike a balance between giving the teachers sufficient time to practise and also being mindful not to cause undue disruption to the teachers’ work schedule. Otherwise, the training would need to be scheduled during school holidays.

In terms of implementation, the training was delivered in three phases. The first phase focused on helping teachers to set up the control laboratory. The second part focused more on developing teachers’ subject knowledge and confidence in the content area identified as their highest priority area. The third part addressed issues pertaining to curriculum planning and a review of past examination papers which dealt with the content areas in particular questions as well as exemplar students’ work.

The participating schools offered one of the control technology workshops as the venue for the training. In terms of the expertise needed to deliver the training, the researcher acted as a resource person because the content areas identified, were
the ones he was teaching at the University of Botswana. Moreover, the researcher had attended some foundation technology sessions with his supervisor at Loughborough University which helped him to gain new insights into the best way of delivering technology content areas. Figure 6.2 provides an outline for this case study.

**Figure 6.2: An Outline of Case Study 3**

*Illustration by the Researcher*

### 6.6 Participant Selection

Participation in this study was voluntary. Although some participants’ email addresses had been requested during field work in case study two, it was deemed necessary to extend the invitation to as many schools as possible. For this purpose, the researcher invited other teachers through an online forum ([https://www.facebook.com/groups/dntforumbotswana/](https://www.facebook.com/groups/dntforumbotswana/)) which he created in 2012. This is an online support system that was designed to bring Botswana D&T teachers together so that they could discuss issues affecting provision of the subject as well as to share ideas. It has been running for two years. Membership is
free and open to all those who are involved with the subject at various levels. Currently the network has close to 150 members.

Once accepted, letters were sent out by email to senior teachers inviting them to discuss with the teachers to determine whether they would be interested to participate in the study. This was important to build a good rapport with the participants in the initial stages of the project and to ensure ownership on the part of the participants.

Attendance was voluntary and those who accepted to participate were encouraged to attend all the sessions. This was to enable the researcher to evaluate the activities through a group discussion. However, a dispensation was granted to senior teachers because they had to attend emerging administrative duties. The activities engaged topics which had been identified by the participants themselves. Because the training was conducted during the school term, this necessitated careful planning to ensure minimal disruption to teachers’ work schedule.

6.7 Methods for Data Collection

This study employed three data collection methods namely: a needs analysis questionnaire; a group discussion and seminars. The complete data set for this study comprised three workshops, two of which were based on the pneumatics content area of the curriculum while the third one was based on the electronics content area.

The study was conducted in three regions (n=10) namely: South East, Southern and Kweneng. The workshops were hosted by the three senior secondary schools which participated in the study. The number of participants varied from school to school. Two of the schools were based in the city, whilst the other was based in a small town about 74 kilometres from the city. In terms of access to services such as companies that supply teaching and learning resources the researcher observed that the three participating schools operated under a similar context. However,
some differences were noted in terms of: their individual training needs, teacher’s self-efficacy\(^6\), the level of support offered by senior teachers and the level of resources. Also, the school in the southern region had an in-service officer, whilst the other two had none.

### 6.7.1 A Needs Analysis Questionnaire

Next, a web-based questionnaire ([https://www.survey.lboro.ac.uk/victoruel](https://www.survey.lboro.ac.uk/victoruel)) was designed with a needs assessment questionnaire to determine feasibility, the nature of training and deficiencies that needed to be addressed (see Appendix 6.1). Appendix 6.1 exemplifies a needs analysis questionnaire which had been designed for one school which had specifically requested training in the electronics content of the curriculum. The questionnaire was used to obtain information about the following:

- The specific training needs and priorities of the participating school in terms of individual teachers’ needs and those of the department;
- The kind of expertise required;
- Logistical issues. It was important to ensure that the activities fitted into the normal teaching time and overall scope of the curriculum;
- Also included in the questionnaire was a section wherein teachers had to provide an assessment of the level of resources in the content area specified.

The information provided enabled the researcher to personalise training to the specific needs of the individual teachers at the school. Also, this information was needed to enable the researcher to plan in advance in terms of participant information, ethical considerations as well as the resources which would be

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\(^6\) Bandura (1994) defines self-efficacy as “beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives”.

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required prior to the commencement of the training. Pre-reading and initial tasks or brief assignments were also sent out to the participants.

Participants were given autonomy to identify their training requirement and agree with the researcher on times which fitted with their work schedule. Consequently, the workshops in all the three participating schools were held in the afternoon. Also, as an incentive to participate in the study, the researcher provided all the training materials. The schools provided the venue and some basic materials.

6.7.2 Seminars and Workshops

Upon arrival in Botswana, the researcher paid a visit to the participating schools to establish their needs, confirm the number of participants and negotiate a tentative schedule for the training as well as to assess the level of resources.

Because of lack of equipment for control technology in schools particularly pneumatics and electronics, one of the challenges was that the teachers lacked experience in what was required to set up a control technology lab. So the first task for the researcher was to show the participants how to set up a pneumatics lab. Setting up of labs is an important aspect of the organisation of the teaching and learning environment in D&T that needs to be inculcated among the teachers. The researcher guided the participants through this task. The researcher borrowed the equipment from the southern region, which had been lying idle at the education centre. Figure 6.3 illustrates a set-up which was created by the participants.

Figure 6.3: Picture illustrating an improvised set up for a pneumatics lab

Field data - Case study 3
The set up comprises a 75 litre compressor and ten (10) workstations. Each workstation has a pneumatics kit that enables the students to work in pairs. The kit contains different components ranging from valves and actuators to enable students to engage in a number of practical tasks related to pneumatic applications.

Because few participants (n=9) were involved, the training was arranged in a way that would enable the participants to work individually as well as in pairs or groups. Individual tasks were designed to give the participants more time to practise as well as to develop their confidence. Figure 6.4 shows participants working individually on the tasks. While the group tasks we used for more challenging tasks which included more components.

Figure 6.4: Participants working individually
Field data - Case study 3

Figure 6.5 shows participants working in groups on more challenging tasks.

Figure 6.5: Participants working in groups
Field data - Case study 3
At the end of three-day training course, a group discussion session was arranged to help evaluate the framework as well as to help identify constraints.

### 6.7.3 Exemplar student projects

One of the criticisms of professional development training is that it tends to focus more on skills’ upgrading and pays less attention to classroom practice (Afshri et al., 2009; Koehler and Mishra, 2009). With this in mind, the researcher designed the activities such that they would enable the participants to reflect on how they would apply the new knowledge and skills to the teaching and learning. For this reason, the researcher shared with the participants some ideas of how pneumatics technology could be incorporated into students’ project work. The researcher showed the participants an exemplar project which had been designed and made by his 3rd year D&T students at the University of Botswana. Figure 6.6 exemplifies a pneumatically operated car barrier. The project was used by the researcher to exemplify how different content areas of the curriculum like mechanism, structures and pneumatics can be integrated into project work.

![Figure 6.6: An Exemplar project work - A pneumatically operated barrier](image)

As seen in figure 6.6, the project integrates knowledge and skills across a number of content areas. This project also served an ideal platform to generate a discussion with the participants about the issue of curriculum integration.
6.7.4 Group discussion

The group discussions involved one senior teacher and three-four teachers per school who are aspiring to teach the technology content areas. However, invitation was also extended to other interested members of the department to create a sense of belonging, trust and openness (Jaques and Salmon, 2007; Goodland and Hirst, 1990; Liamputtong, 2011). Furthermore, this arrangement was intended to inculcate the spirit of teamwork and cooperation. The discussions adopted a seminar approach to promote a free and relaxed atmosphere while at the same time ensuring critical conversations between the facilitator and the participants occur (Goodland and Hurst, 1990; Brookfield and Preskill, 1999). The group discussion was used as a reflective forum to explore further both the benefits and potential challenges of the model being trialled. The group discussion was found appropriate because of its potential for the cross-proliferation of ideas (Jaques and Salmon, 2007; Liamputtong, 2011).

6.8 Data analysis

Because of the qualitative nature of the data collected a thematic approach already explained in section 3.8 was deemed appropriate (Ibrahim, 2012; Robson, 2011; Miles and Huberman, 1994). The analysis was based on a combination of teachers’ personal evaluations and group discussions. The analysis was also corroborated with literature review findings.

6.8.1 Strategies for reporting

Brookfield and Preskill (1999) noted that: “discussion works best when the questions asked provoke many legitimate responses” (p.84). Brookfield and Preskill (1999) suggest two approaches. The first approach is where each group is invited to summarise the issues explored in response to the question assigned. The second one is where the group is called on to share the most significant insights illuminating. This study employed the first approach because it allowed the groups to respond to standardised set of questions. This way enabled the group responses to be compared at the data analysis stage. Furthermore, key themes or concepts which emerge across the groups were used to inform the development of
important features for the conceptual model. The discussions were audio recorded to allow the data to be analysed at a later stage.

6.8.2 Limitations of the study

One of the limitations was the time factor. As already mentioned, the training was conducted in the afternoon to avoid disrupting teachers’ normal schedule. This happened to be a busy time for the teachers because they were helping students with their major design projects. The study would have benefitted the schools more if it had been timed to coincide with school calendar holidays. In this way it would have given them sufficient time to practise and to avoid disrupting teachers’ normal work schedule. Moreover, it would have given them more time to reflect on how the new knowledge and skills gained could be incorporated into the scheme of work for the next term.

6.9 Findings and Discussion

The next section discusses the range of issues which emerged relating to the implementation of a school-based support system for the D&T education within the context of Botswana. Teacher professional development has been identified as one of the key strategies for: “the enhancement of the performance and status of the teaching profession” (Directorate of Public Service Management, 2006, p.14).

For the purpose of presenting the findings, the following structure is followed. First the findings in respect of the individual workshops are presented with some reflective analysis of insights gained in the data. Then a discussion is carried out pertaining to issues arising across the three participating schools. From this discussion, conclusions drawn in terms of identifying the major issues reported in the data. The final section discusses policy implications arising from these findings.
6.9.1 Establishment of the criteria for evaluating the framework

To assist the participants with the evaluation, the researcher devised some criteria which were used as reference points. The researcher emphasised to the participants that in their evaluation they should focus on the following four key aspects:

a) Their own personal development in terms of addressing their deficiencies in the content area as well their level of confidence as a result of attending the training;

b) Issues of curriculum planning in terms of how the content area could be integrated into the whole curriculum;

c) Resource implications.

The above criteria were used across all the three schools. However, for purposes of reporting the findings, school C findings are not reported here because the training had been arranged by the in-service officer for the teachers in the southern region. A group interview was conducted with this group to collect additional information for case study two. So the findings in respect of school C are reported under group interviews in case study 2.

For ethical reasons, the names of the school which participated in the study are not mentioned by their real names. Instead a coding system was used. So the three schools which participated in the study are coded as follows:

- School A (Data set 1)
- School B (Data set 2)
- School C (Data set 3)

A similar coding system was used for the participants as follows:

- Teacher = T
- Senior teacher = ST
Table 6.1 summaries the demographic information of school A.

<table>
<thead>
<tr>
<th><strong>Table 6.1: Demographic information for School A</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>School A (Data set 1)</strong></td>
</tr>
<tr>
<td><strong>Region</strong></td>
</tr>
<tr>
<td><strong>Focus of training</strong></td>
</tr>
<tr>
<td><strong>Date</strong></td>
</tr>
<tr>
<td><strong>Staffing situation</strong></td>
</tr>
<tr>
<td><strong>Group size</strong></td>
</tr>
<tr>
<td><strong>Group composition</strong></td>
</tr>
</tbody>
</table>

School A is one of the oldest schools based in Gaborone city. In-service training in the department was described as desperate. One teacher describes this situation that: “we don’t have formal in-service workshops” (Case study 3 – Field data, Set 1). The region has been without an in-service officer for over ten years. One teacher claimed that ever since he came into the field, he has never attended any in-service training. When asked how they were managing without in-service support, one teacher commented: “It’s a struggle; it’s difficult; you try to cover this and that which you think is important” (Case study 3 – Field data, Set 1). This view was also expressed by one senior teacher that: “Our curriculum, we just touch the topics here and there” (Case study 3 – Field data, ST8).

The three teachers who participated in the training had been trained at the University of Botswana. Their level of knowledge and skills in electronics was good, but they had specifically requested training in the use of microcontrollers. Programming falls under the Information Technology (IT) content area of the BGCSE D&T curriculum (Ministry of Education and Skills Development, 2000). The specific objective which makes reference to this content area reads: “Learners should be able to recognise that computer systems can control machines and equipment” (ibid).
The training was based on microcomputer control using the Logicator PICAXE programming software. The Logicator was deemed an appropriate starting point to learn about programming because it is flowchart-based software for quick and easy programming. It has been developed for use with low-cost PICAXE chips. It is an open source available at: http://www.picaxe.com/Software. This means it is free to download and use for private home use.

The actual training was conducted over three days, and then several follow up visits were made to give teachers one to one support. Follow up visits were made on Fridays when the teachers were free from teaching.

### 6.9.2 Insights gained in respect of microcomputer control training

The next section presents some of the insights gained as a result of running a school based training at school A. The topic initiated by the teachers themselves. They reported that they had a challenge teaching microcomputer controls because the topic was not covered during their initial training. Regarding the use of microcontrollers in electronic product design one teacher expresses his delight that: “I’m really excited about what I have learnt; I knew there was a simpler way of doing things” (Case study 3 – Field data, T1).

One teacher had already trialled the resources with his students and reported that: “already students are excited” (Case study 3 – Field data, T2). However, his greatest challenge was that of the old computers. Another major challenge he highlighted concerned funding for the new content areas because they are not catered for in the budget for materials for practical subjects. Moreover, the teachers cited the challenge of acquiring the hardware associated with this technology because there are no local companies which supply the modelling kits.

The intention after training was that the teachers would gradually introduce the use of microcontrollers to a few students in their major design projects. However, the challenge they faced was with acquiring the hardware. The other challenge the teachers faced was to do with computers; the department had very old computers. The teachers reported that the computers were supplied in 2000, and the IT Company which was responsible for providing technical support had declared
them obsolete. So, the computers did not meet the system requirements for running the Logicator PICAXE microcontroller software. Fortunately all the three teachers had their own laptops and suggested to use them. So the researcher installed the software on their laptops. For the hardware, the researcher supplied them. To enable the teachers to continue practising after training, the researcher donated them to the teachers.

Another challenge which the teachers cited was to do with team teaching especially with the other members who did not attend the training. For example, when asked about team teaching, the teachers expressed some reservations about the idea because they claimed that they did not trust their other colleagues would play their part. One teacher highlighted this concern that: “some teachers are not so resourceful and that the other teacher may not teach his or her part very well” (Case study 3 – Field data, Set 1). They claimed that they once experimented with the idea but it did not yield the desired results because often when examination results come out credit goes to the wrong person. Moreover, the other fear was that because team teaching would involve three or more teachers when students fail it would be difficult to apportion the blame.

Other problems which were cited as affecting the department were:

- Leadership
- Limited capability of some teachers in some content areas
- Low morale and lack of commitment by some members of the department
- Lack of cooperation which makes team teaching a challenge.

Human resource was identified as the weakest area in the department. The general perception was that the department lacked a capable and visionary leader. So given this situation, one could sense that the training may not have the desired effect.

The next section reports on the findings in respect of school B. For administrative purposes, this school falls under the Kweneng region. But geographically the
The school is in Gaborone city. The school is one of the five newly opened and the senior teacher at the school reported that the government had earmarked it to be one of the centres of excellence in the country.

Table 6.2 presents the demographic information about the school.

<table>
<thead>
<tr>
<th>Region</th>
<th>School B (Data set 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focus of training</td>
<td>Pneumatics</td>
</tr>
<tr>
<td>Date</td>
<td>19 July 2013</td>
</tr>
<tr>
<td>Staffing situation</td>
<td>6 teachers including senior teacher 1</td>
</tr>
<tr>
<td>Group size</td>
<td>9 participants</td>
</tr>
<tr>
<td>Group composition</td>
<td>3 female teachers; 5 male teachers; 1 Workshop Assistant</td>
</tr>
</tbody>
</table>

**NB:** Staffing refers to the number of teachers in the D&T department at the hosting school. However, for the purpose of training the number of participants increased because invitation was extended to teachers from the neighbouring schools.

School B was opened in 2011. According to the senior teacher, the greatest challenge was that equipment did not arrive until the school term had started. Apparently the Ministry was supposed to supply equipment but there were some delays because the company which had won the tender to supply equipment failed to deliver it in time. It was a big tender which included three other new schools. She noted that the situation was complicated by the fact that the company which had won the tender seemed to have no idea about the equipment to be supplied.

On his preliminary visit to the school to arrange the workshop the researcher found that the department had one pneumatic kit which was incomplete. So he resolved to borrow equipment from the southern region. The in-service officer was very cooperative; he arranged transport for them to be delivered at the school.

The next challenge was that the department has laboratories which have not been set up because equipment has not yet been supplied. So as was done in the southern region, the teachers were shown how to set up the labs.
6.9.3 Findings in respect of pneumatics training

This section presents the findings in respect of the participants’ level of knowledge and confidence after attending training.

“Pneumatics was a new thing to me, I have been fearing it but after attending this training I can confidently stand in front of the students and deliver it” (T1, Data set 3).

“I was a beginner coming into this training, I have never done pneumatics. This has given me such a confidence which I never had” (T2, Data set 3).

“Yesterday I looked at the syllabus breakdown, most objectives have been covered. I had little knowledge especially with the valves; I can now explain how the components work” (T3, Data set 3).

“I attended one before, but with this one it was hands-on, I’m quite far, I can rate myself as 10/10” (T4, Data set 3).

“I feel very confident now. You were linking this to real life situations” (T5, Data set 3).

“I appreciate and applaud you for arranging this workshop; I can stand in front of the students” (T6, Data set 3).

“At least with electronics I had the basics, but now comparing with this one, I have developed keen interest” (T7, Data set 3).

A follow up question asked the participants to comment on the advantages of a school-based support system as opposed to the regional one. Below is a summary of their views:

“The arrangement is good because it addresses the needs identified by the teachers themselves” (Data set 3).

“It’s good idea because it’s done in other professions” (Data set 3).

I like the fact that it’s quite intimate. But we cannot throw away the regional one because it reaches out to the needs of a larger group” (Data set 3).
• Everybody in the department is involved at the same time unlike the regional where schools are limited by the number of teachers they can send.

• All members of the department receive first-hand knowledge and skills in which case in terms of application of skills, they can support each other better because they have all attended the same training.

• With the regional one, one cannot always guarantee that the person sent to represent the department would attend for the entire duration of the course. Yet again one person may not have the confidence to train others.

• The participants attended with their senior teacher something which they felt enhanced the chances of making more impact in terms of applying the new knowledge and skills into the teaching and learning.

6.9.4 **Provision of Resources**

Regarding the capacity to implement a school-based CPD support, one of the major constraints is that of provision of resources. One of the issues about change management is that of senior management’s commitment in terms of provision of resources (Fullan, 2001; Kotter, 1996). The resources in this case include not only the physical infrastructure as is currently the situation in many schools, but procurement of the necessary equipment, and to ensure that the equipment is commissioned as well as to train the teachers on its use. Provision of resources was also reported by in-service officers as a major constraint for schools. For example one officer commented that: “*We try to support teachers, unfortunately when they get back to schools, they don’t have materials to try with and engage students*” (Case study 2 – Field data, PEO1). A reduction in the budget for the D&T curriculum was attributed to the introduction of other practical subjects like physical education.
6.9.5 **Funding for the D&T curriculum**

The allocation of funds for practical subjects appears to be a conundrum across the schools. One teacher describes the situation: “that one is a disaster” (Data set 2). This is a matter that needs to be addressed with more vigour and determination.

The current practice is that funds for practical subjects are shared equally between three departments that include: D&T, Art and Home Economics. Due to the inclusion of new subjects under the Creative and Vocational optional group which D&T is part of, that has put a lot of strain on the department’s limited budget. The funds are used to enable teachers to buy material for teaching purpose during the course of the term as well as to cater for major design projects for final year students. The fact that the D&T department does not get any additional funding to cater for final year major design projects suggests that the department’s budget is not sufficient to cover all the content areas. One teacher highlights this oversight that: “D&T is not about funds for practical subjects...we need funding for maintenance of equipment and for replacing worn out parts” (Case study 3 – Field data, Set 2). The researcher would add that the funding situation in respect of the D&T education in Botswana compromises the teaching and learning in other learning areas and it also encourages teachers to resort to theory teaching at the expense of practical work. The following statement supports this view: “we are more theory based than engaging students in practical work” (Case study 3 – Field data, Set 2).

6.9.6 **The development of subject leadership**

Leadership refers to guiding authority that determines and enables change to occur (Hiatt and Creasey, 2012). The role of leadership in change management is to set direction, solve problems, create a vision and lead others in an organisation to a better future.

Training has been identified as the cornerstone for building knowledge about the change and the required skills (Hiatt and Creasey, 2012). It was found that the current in-service officers have not been trained sufficiently to deliver professional development programmes for teachers in D&T. One of the key issues about change
management is the development of leadership and management skills (Kotter, 1996; Hiatt and Creasey, 2012). As part of a leading coalition, in-service officers and senior teachers act as change managers and mentors; as such they need to be empowered with the knowledge and skills on how to coach others through change.

The management of the D&T curriculum has become problematic because there are more teachers involved as well as many more content areas. The senior teachers need to delegate some of the duties and responsibilities to other members of the department. To make the management of the curriculum easier, there is a need to identify subject leaders for different components of the syllabus. The criterion should be based on teachers’ strength and interest in the specialist area. Once identified, these teachers should be given appropriate training in their specialist areas of the curriculum such as electronics, pneumatics and computer aided design and manufacture. The ultimate goal is to achieve some parity in capability across all the schools. Through a collective and sustained effort, these interventions will enable schools to cover all the content areas of the new curriculum and accordingly lead to improved student learning.

6.9.7 Teacher support and mentoring system

The next question asked the participants to comment on how they were being supported at school level to continue with their professional development. A follow-up question asked participants how they were being encouraged to initiate their in-service training development plans, the consensus was that: “We don’t have much platform; we write in our personal development plans (PDPs)... but we don’t know where it goes” (Case study – Field data, Set 3). This view was also supported by one of the senior teachers who acknowledged that: “I would admit to say that is one area that is lagging behind” (Case study 3 – Field data, ST8). It was reported that schools have a staff development officer (SDO) who is responsible for conducting in-service training, at school level. However, the nature of this support system is designed for the entire school and usually focuses on Performance Management System (PMS) and does not address the needs of the individual teachers. Then again, one teacher claims that it is not effective because
“even after a need analysis from the department has been done, nothing happens”
(Case study 3 – Field data, Set 3).

6.10 Summary

Research leading to the development of technology as a school curriculum places emphasis on the importance of students developing technological literacy essential for living in a technologically mediated society. This was the philosophy that underpinned the development of the BGCSE D&T curriculum. The D&T education was seen as a catalyst for Botswana’s economic growth and development. To articulate this philosophy, deliberate attempts were made to include more advanced technologies as opposed to the craft, design and technology based content which had been inherited from the Cambridge curriculum. However, upon implementation it was found that, teachers lacked practical experience and the confidence to deliver those new content areas. Ultimately, the way the existing curriculum is delivered in schools has little scope for developing student technological knowledge and capabilities which would enable them to understand, create, control and manipulate technology.

This experimental study explored opportunities and challenges relating to the provision of a school-based CPD support system especially in the new content areas of the curriculum. The study was necessitated by the findings which arose from case study 2. From these findings it was noted that current regional in-service support system used in Botswana is limited, fragmented, and not tailored to individual teacher’s needs. Coupled with the widespread lack of resources reported, the system also lacks active leadership both at regional and school levels. Because the schools operated under different constraints, need now was to explore the viability of a school-based system as an alternative. In order to evaluate the effectiveness of this system some professional development activities were planned and conducted by the researcher in the case study schools.

A needs assessment questionnaire was designed and the case study schools were asked to complete it by indicating their specific needs. Furthermore, a meeting was held between the researcher and the participating schools to discuss and agree on
their most pressing training needs. A self-negotiated training was designed based on the identified needs. At the end of the training, which lasted for three days, a group discussion was held with the participants. Table 6.3 provides the names of the participating schools and the focus of training for the respective schools.

Table 6.3: Study Sample used in Case Study 3

<table>
<thead>
<tr>
<th>Region</th>
<th>School</th>
<th>No of teachers</th>
<th>Focus of training</th>
</tr>
</thead>
<tbody>
<tr>
<td>South East</td>
<td>Gaborone senior sec</td>
<td>3</td>
<td>Electronics - microcontrollers</td>
</tr>
<tr>
<td>Kweneng</td>
<td>Mogoditshane senior sec</td>
<td>6</td>
<td>Pneumatics</td>
</tr>
<tr>
<td>Southern</td>
<td>Lobatse senior sec</td>
<td>5</td>
<td>Electronics - microcontrollers</td>
</tr>
</tbody>
</table>

The notion of a school-based support system arose from the findings of case study two which showed that the current regional support system was ineffective. The key issues which arose from that study were identified as: a limited CPD support system for teachers and limited opportunities for teachers to practise and develop their confidence especially in the advanced technologies content areas of the BGCSE D&T curriculum. Moreover, this framework was premised on the notion that teachers as change agents are a vital resource that can leverage change (Finger and Houguet (2007; Fullan, 2001; Morrison, 1998). For example, a study by Carless (1997) has shown that: “teachers are on the whole, poor implementers of other people’s ideas” (cited in Finger and Houguet, 2007, p.310).

This study focused on how to develop teacher capability and confidence in the specific content areas of the curriculum. This experimental work involved three schools. The data collected were used to evaluate the effectiveness of a school-based in-service support system. For this purpose, an on-site and teacher-led training was conducted based on their specific areas of need. Insights gained from preliminary analysis of data collected through seminars and group discussions showed positive feedback among the three schools which participated in this experimental study. Overall these findings, although they are based on small samples have validated and supported the argument raised in the literature that teachers as the primary implementers of new curricular, their capability combined
with an effective curriculum support system and provision of resources are crucial to successful implementation. There is therefore a need to establish a sense of urgency in terms of creating optimum conditions for teacher growth and professional development across the broad spectrum of this curriculum.

The findings showed that the main form of professional development available to the teachers was staff development or in-service training which consisted of one-shot workshops or short-terms (De Vries et al., 2013; Villegas-Reimers, 2003). However, it has been argued that teacher professional development is a journey which starts after their initial training; teachers are expected to continue throughout their careers because of the need to adapt to the changing needs of their society and its children (De Vries et al., 2013). According to De Vries et al. (2013) CPD is perceived as: “an important way to improve schools, increase teacher quality, and enhance student learning” (p.78).

The study has identified opportunities and challenges within the context of Botswana in terms of the provision of a school-based CPD support system. For example, one opportunity identified is that there is already a support system in schools which is coordinated by a staff development officer. However, the existing support system has been criticised by teachers and in-service officers as being just an administrative tool. They argue that it has little connection to teachers’ professional practice. To make it more relevant and effective, the system needs to be reviewed with the objective of shifting its focus away from a predominantly administrative tool to a professional development model. This professional development model should help teachers to develop the capabilities needed to improve the quality of teaching and learning in the D&T. The findings suggest that teachers play a minor role in their own professional development which leads to the assumption that their working environment work does not provide them with that opportunity. At school one senior teacher confirms this situation that: “I would admit to say that is one area that is lagging behind” (Case study 3 - Field data, ST7). This situation was also reported in a group interview wherein the consensus was that: “We don’t have much platform; we write in our personal development plans (PDPs)... but we don’t know where it goes” (Case study 3 - Group interview data). At
another school the situation was even more desperate because: “a good number of teachers do not seem to show much interest” (Case study 3 - Field data, ST8).

In view of the fact that it would take time to develop the necessary capacity to implement a school-based support system it would not be advisable to discard the regional in-service support system because some regions like the southern have well equipped education centres. Such a centre can be used by schools which are not well resourced. Moreover, the centres can serve as meeting points for teachers across the schools to deliberate on issues of common interest such as curriculum planning, development of resource materials and networking.

In order to help teachers implement the curriculum, some guidance materials need to be developed especially for the most affected content areas of the curriculum. The development of such materials should be informed by the on-going revision of the BGCSE curriculum.

Also noted was that the current BGCSE D&T curriculum is fragmented and still rooted in the traditional crafts subjects. There is a need to establish a more comprehensive and integrated curriculum to address this challenge. An integrated framework should be developed in conjunction with the office of Curriculum Development and Evaluation to provide more specific guidance on the implementation of such a system.

### 6.11 Further Work

As already highlighted in section 6.8.2, one of the constraints was that the training was held during the school term as such the researcher did not have enough time to evaluate the effectiveness of this intervention. In the original plan outlined in figure 6.2, the researcher had intended to use the Delphi technique to evaluate and help reach consensus on a more appropriate framework for in-service training within the context of Botswana. It was intended to invite different experts involved in the provision of the D&T education and in-service training. The Delphi technique would enable a group of experts (panellists) to evaluate the framework independently. An analysis of the responses would lead to a formative report. The findings would then be shared with the panellists at the end of each round.
Sharing the findings would enable them to see how others have responded to the issues. In this manner it would enable the development of a finer grained framework.

The researcher proposes an in-service training framework that is premised on the notion that the development of teacher’s competencies should not only result in teacher's personal growth and development but should also seek to promote a reflection on classroom practice and students’ learning outcomes. Further research is needed to explore how these elements can be integrated into the envisioned in-service model for Botswana.
CHAPTER 7

CONCLUSIONS AND IMPLICATIONS
Chapter 7 – Conclusions and Implications

7.1 Introduction

This chapter concludes by reflecting on the whole research in terms of the extent to which it addressed the main research question. It also draws together significant issues arising across the literature, the three case studies and their implications for further research. The chapter finishes by highlighting some of the limitations of this inquiry.

This research examined the management of change based on an out-dated English Design and Technology curriculum to a locally designed one in Botswana. Research leading to this study showed that since inception (2000), this new curriculum had been reviewed once in 2009 which meant that when this research commenced in 2011, the curriculum in question had already entered a second phase without being reviewed. The first review should have taken place in 2006 (Ministry of Education and Skills Development, 1998).

To obtain a holistic picture in terms of how this curriculum was being implemented in schools, the management of this change was profiled through three consecutive case studies. To deepen understanding, the findings at the end of each study were used to develop new research questions that led to further research. The inquiry was driven by the research question: What is the nature of change from the Cambridge D&T curriculum to the Botswana model and how are teachers being supported to implement the curriculum? The main research question comprised two parts:

1. Part 1 - What is the nature of change from the Cambridge D&T curriculum to the Botswana model?
2. Part 2 - How are teachers being supported to implement the curriculum?

The first, addressed the following issues:

- The motivation for change.
- Change management capability.
• Awareness of the need for change.
• Stakeholder participation.
• The context in which the change took place.
• The capacity to implement and level of readiness.
• Administrative support, and
• How the change had impacted on the teachers.

To address the issues listed above, a pilot survey reported in chapter 4, was designed to enable the researcher to collect data from various stakeholders involved with the curriculum. The survey addressed the following objectives which were:

   a) To gain insights into the nature and scope of change from the Cambridge curriculum to the locally developed D&T curriculum for senior secondary schools in Botswana.

   b) To measure the level of awareness and support for the new D&T curriculum by the various stakeholders involved with the implementation of this curriculum in Botswana.

   c) To identify and validate the key factors that facilitated or hindered the implementation of the BGCSE D&T curriculum and to consider how these might be overcome to ensure effective implementation.

7.2 The nature and scope of change

The first part of the main research question explored nature and scope of the change from the Cambridge curriculum. This was addressed partly in section 2.3 of the literature review that was done to familiarize the researcher with change management principles. From this literature, it was found that the approach adopted to implement the BGCSE curriculum typified a transitional type of change. Transitional change seeks to achieve a state that is different from the existing one. The premise of this type of change is that it needs to be planned and is usually characterised by periodic reviews. The information gained from initial literature
was then used to develop research questions against which to assess the nature of change. Subsequent to this literature, a pilot survey described in chapter 4 was designed to collect data that assisted to gain those insights. Specifically, the research question number 2 (RQ2) provided in section 4.4 addressed the nature of change. The questions related to this question asked respondents to share their opinions and perceptions on the nature of change. The respondents from which the data were collected are shown in figure 4.4. From the data, it was found that the implementation of the BGCSE curriculum was guided by the Curriculum Blueprint of 1998 (Ministry of education and Skills Development, 1998).

The Curriculum Blueprint itself was not an implementation strategy. It was a document that outlines curriculum development activities leading up to implementation. It also provided guidance on when the different phases of the curriculum would be implemented. Therefore, in terms of planning for the transition, the data showed that there was a limited implementation strategy for this curriculum. In terms of periodic reviews, the Curriculum Blueprint recommended that the curriculum be reviewed every five years (Ministry of Education and Skills Development, 1998). The data showed that the BGCSE D&T curriculum had already entered its second phase by four years without being reviewed (Republic of Botswana, 2009).

In terms of the scope of change, it was found that the D&T curriculum was part of a major educational reform by the government of Botswana. This reform had stemmed from a Presidential Commission on education (1992) which sought to review the whole education system of Botswana. Factors which led to this review have been discussed in section 1.12. In terms of implementation, it was observed that unlike its predecessor that was piloted in five schools before full implementation, the BGCSE D&T curriculum was implemented fully from the start. It is recommended that such large scale reforms need to be broken down and piloted before full implementation (Kotter, 1996). Piloting helps to identify problems on a scale and enables corrective measures to be put in place before full scale implementation (Fullan, 1993; Fullan, 2001).
7.3 The key factors that hindered the implementation

Studies have shown that the environment in which the change takes place, combined with limited implementation capability, employee resistance and limited resources often act as barriers to change (Hiatt and Creasey, 2012; Hiatt, 2006; Fullan, 2001; Kotter, 1996). To succeed in this kind of environment requires organisations to build the necessary change management capability which would enable them to drive these reforms forward. However, it has been observed that often change initiatives are poorly managed, not well resourced and not seen through by the sponsor.

7.4 Reference to the RNPE

As already indicated in section 1.20, the move away from Cambridge was driven by political and socio-economic factors. The most pressing factors were those of relevance and administrative costs involved in running the Cambridge Overseas examinations. After three decades of following the British education system, a need was felt to localise the secondary education curriculum, with the aim of making it more relevant to Botswana’s strategic vision for human resource development and economic growth. In terms of Botswana’s vision for technology education, the underpinning philosophy for the development of this curriculum was to prepare children, who are the future work force for transformation from an agro-based economy to an industrial economy consistent with technological and global changes (Republic of Botswana, 1994; Republic of Botswana, 2009). The D&T curriculum was designed to provide students with relevant skills particularly in this era of widespread and rapid technological change (Republic of Botswana, 1994). With this vision in mind, when the D&T curriculum was being developed attempts were made to include new learning areas such as electronics, pneumatics, CAD/CAM and ICT. The ultimate objective was to broaden the curriculum which was predominantly craft based. Unfortunately, upon implementation it was found that many practising teachers lacked the confidence to teach these content areas mainly because they were barely taught during their initial training. The problem was exacerbated by limited funding to enable the schools to acquire the necessary
equipment and other teaching and learning resources associated with these content areas.

In terms of meeting the objectives of the RNPE, the findings demonstrated the considerable gap between government policies and the situation on the ground in terms of: commitment by government to see the change through; change management capability and provision of resources needed to drive these reforms. As a consequence, the new curriculum offered little scope for the development of technological knowledge and skills as aspired by the government in the RNPE. This research has identified that to align the curriculum to the socio-economic needs of a country, there has to be a link between strategy and policy (Stacey, 1993).

7.5 Contribution of the understanding of the nature of change

Literature review for research on the management of change highlights that managing change and its implementation are complex processes and as such require those leading change to get the balance right between the technical and social issues (Harvard Business School Press, 2003; Kotter, 2012). Studies have shown that organisational leaders are often well aware that change needs to happen but do not know how to go about delivering it; where to start; who to involve and how to see these initiatives to the end (Kotter, 2012; PROSCI, 2014).

Change is a constant feature in any organisation because the driving forces that influence an organisation's operations are continually and inevitably changing. Therefore, this illustrates why building change the necessary management capability and competence needs to be institutionalised as a framework for enabling implementers to make successful transition through a change process. The author suggests that change itself should be managed in the same manner as a project. This would require that when a change is initiated, a project leader is appointed to oversee and coordinate all the activities relating to this endeavour. The project leader must know that sponsor (government) would expect a return on investment on each initiative that they fund. Equally important is need for the sponsor to demonstrate commitment to building an organisational capability. For the change effort to gain the necessary traction and momentum change
sponsorship should not focus just on funding and resources, the sponsor must be active, visible and sustained throughout the change initiative.

### 7.6 How teachers were being supported through the transition

The second part of the main research question sought to assess how the teachers were being supported to implement the curriculum. The objective sought to determine how teachers could be supported to implement the curriculum more effectively. This has been addressed by both case studies 1 and 2. These two studies included questions which assessed the capacity to implement the change from the perspective of the implementers (teachers and in-service officers). Case study 3 aimed to explore mechanisms of providing in-service support to teachers at school level.

Research has shown that to be effective in leading change, organisations need to customise and scale their change management efforts based on their unique contexts and the needs of those impacted by the change (Kotter, 1996; Hiatt, 2006; Hiatt and Creasey, 2012). Studies on curriculum change have found that classroom teachers were usually the ones at the receiving end of educational reforms in terms of expectations by policy makers, school administrators, and the general public (Finger and Houguet, 2007; Fullan, 1993; Hughes, 2005). A study by Sade and Coll (2003) showed that: "teachers are rarely receptive to change, except when they believe it is beneficial to student learning" (cited in Finger and Houguet, 2007, p.310). From this understanding, it is evident that teachers play a critical role in the successful implementation of a new curriculum and therefore change management capability is a pertinent issue for education (Morrison, 1998; Fullan, 2001; Whitaker, 1993).

The findings showed that all the teachers in the sample had relevant qualifications and noted that some of them had been trained overseas. However, it was surprising to find that many of them could not teach the new technologies’ content areas. These findings suggest that the teachers are not adequately trained to fully implement this curriculum. In the light of this situation Kotter (2012) observes
that: “new initiatives fail far too often when employees, even though they embrace a new vision, feel disempowered by huge obstacles in their paths” (p.10).

In terms of administrative support a major constraint cited in the data was that of provision of resources to enable teachers to deliver new content areas. It was reported that the government committed to providing mainly the physical infrastructure, but there were delays providing the necessary equipment. In some cases equipment was supplied but was not commissioned. In other instances, equipment was supplied especially CAD/CAM equipment, unfortunately, in all the schools that participated in this research, the equipment was lying idle. When investigating reasons the machines were not being used, teachers claimed that the software that operated the machines was not user-friendly. The other challenge cited was that the machines had some electrical wiring problems. This finding suggests that because of limited teacher expertise in CAD/CAM and lack of equipment for pneumatics, these content areas were not widely taught in secondary schools.

In view of the situation described in the foregoing paragraph, the researcher argues that failure to provide for these learning areas denies students the opportunity to discover career opportunities related to these fields. Failure to provide for these advanced technologies has implications for the future of children who may want to pursue related careers in the newly established Botswana International University of Science and Technology (BIUST). This situation parallels McCormick’s (1993) argument that the introduction of technology education into national curricular was intended to prepare students to live in a rapidly changing technological world (Rasinen, 2003). In terms of preparing children to participate in the technological world, Rasinen highlights that, the situation inside classrooms suggests that there is little evidence that of the widespread use of new technologies by teachers and children alike (ibid). This situation has led to some like Rogers (2002) arguing that, in order to feel more comfortable in the use of new technologies, the teachers need to have enough access to the technological resources to enable them to become more proficient and confident in teaching them.
Besides relevance, another criticism about the Cambridge D&T curriculum was that the model was too academic and male dominated. Therefore, one of the objectives for localising the curriculum was to broaden its scope such that it would cater for a wider clientele of students as well as to accord equal access to all children. To broaden the scope of the curriculum, deliberate attempts were made to include advanced technologies. In contrast, it was observed that the BGCSE D&T curriculum was prescriptive and did not offer students much choice. The objective-driven type of curriculum typifies the behaviourist model. This model is tightly framed around very strict examination regime. This is a paradox, because the government advocates a learner centred and problem solving approach. Such an objective-driven curriculum has been criticised for being counter-productive to the constructivist learner-centred pedagogy (Tabulawa, 2009). In the researcher’s view, this model limits teachers’ creativity because they tend to use objectives as a checklist, which reduces the teaching and learning to the bare minimum.

This finding has two implications: firstly that there has not been any change from its predecessor, which implies that the subject has continued along the traditional lines. Secondly, this finding reflects a negative picture in terms of articulating Botswana’s vision espoused in the RNPE of preparing children to thrive in a technological world which would be realised by moving towards an industrial economy (Republic of Botswana, 1994). This leads to the conclusion that this vision remains an illusion rather than a possibility.

### 7.7 Sustainability the change

Studies have shown that employee training and provision of resources can help increase organisational capacity to handle new change (Hiatt and Creasey, 2012; Hiatt, 2006; Fullan, 2005). However, those efforts alone will not suffice; unless measures are instituted to ensure that change is entrenched into the organisational culture. To ensure that change is sustained, mechanisms must be put in place to consolidate the effort (Fullan, 2001; Hiatt and Creasey, 2012). Otherwise, people may return to their old ways of doing things. Bourne and Bourne (2012) made a similar observation that: “most change efforts fail because people revert to their old ways rather than get stuck in the new ways” (p.13).
Another reason why the momentum that created change collapses is because the change sponsor or initiator does not see the change through to the end.

In terms of ensuring that change is sustained, the researcher argues that teachers should be an integral part of the change initiative. The school environment in which teachers serve should create optimum conditions for them to engage more in research aimed at nurturing professional growth and improved classroom practice. The enablers would include: development of subject leaders; school based mentoring and support systems; provision of resources to undertake the change and teachers’ continuous professional development throughout the transition period. An equally important consideration would be time for teachers to practise and test their new skills after in-service training.

### 7.8 Summary

The research was conducted against the backdrop of issues and concerns in Botswana which have been highlighted in the Final BGCSE Evaluation Report of 2009 (Republic of Botswana, 2009). The challenge of implementing the D&T curriculum at senior secondary level was compounded by limited research into this area. Much of the research done in Botswana focused on the earlier years of schooling and addressed issues pertaining to the historical perspective of the subject, teachers’ and students’ perceptions and classroom experiences in the teaching and learning of D&T education (Ndaba, 1994; Moalosi, 1999; Fox, 1988; Molwane, 2003; Moalosi, 2007; Gaotlhobogwe, 2010). The lack of research in the subject area has limited the efficiency of any curriculum review process. On the other hand, the researcher noted considerable research into this area in more developed countries, notably England, Australia, New Zealand and the United States (Atkinson, 1990; Rasinen, 2003; Williams, 2007). The contexts of these countries differ to that of a developing country like Botswana (Ndaba, 1994; Lewis, 2000; Williams, 2007). However, studies in these contexts provided insights which helped to lay the theoretical framework for this research project.

The Revised National Policy on Education of 1994 identified D&T as one of the key learning areas within the BGCSE programme curriculum (Republic of Botswana,
1994). However from these findings it has been noted that the subject is going through a turbulent period. This situation was exacerbated by a diminishing administrative support. Another major challenge was that D&T faces competition for funds and curriculum time from other new practical subjects which have been introduced into the BGCSE programme. Teachers reported low student enrolment in the subject and it remains to be seen whether the subject will retain its economic importance.

In summing up, this thesis reports in-depth, multi-phase case study approach that examined the nature, scope and implementation capacity of a new D&T curriculum designed for senior secondary schools in Botswana. Specifically the research aimed to use insights gained from the findings to make informed decisions about how to manage the transition so as to ensure effective implementation in senior secondary schools.

The research suggests three important implications for those leading change.

1. First, both business managers and educational institutions change management is a complex technical and social activity. To ensure success, it is important for those initiating or leading change to have an understanding of the inner working of the context or organisation within which the envisaged change will take place. It has been found that sometimes it is the structure under which changes take place that act as an impediment (Bourne and Bourne, 2012; Harvard Business School Press, 2003). The change was implemented in a hierarchical structure. Harvard Business School Press (2003) observed that: “hierarchical companies are good at telling people what to do than getting employees to collaborate” (p.25). Studies have shown that people resist solutions imposed on them by people who are not familiar with the day to day operations (ibid). One of the ways of overcoming the problem of hierarchy would be to move more towards decentralisation (ibid).

2. Second, to lead change requires a strong, credible and visionary leadership. Therefore, leadership development is a capability that the MOESD will need to build across all the levels. The data showed that D&T lacked credible and
visionary leaders to drive in forward. The in-service officers who perform the role of change leaders are few on the ground. The findings showed that there were four officers operating in a total of ten regions.

3. Third, the success of any change depends on the individuals’ desire to embrace, support, and implement a required change. In education, teachers are critical resource and change agents. This suggests that to achieve success, governments need to create an enabling environment by empowering them through knowledge and training, provision of resource and continued presence of the sponsor through the change process.

The author concludes by arguing that change management, regardless of size and scope, requires a clear vision; implementation strategy; sustained administrative support and a powerful guiding coalition to drive it forward. In addition to these, great changes require a powerful arm of the government working in collaboration with other key stakeholders to push them forward. At the same time, the human side of change should never be overlooked. It has been found that, if empowered with knowledge and resources, individuals in an organisation are a vital resource and change agents (Hiatt and Creasey, 2012; Hiatt, 2006). Finally for change to ‘stick’, it needs to be anchored into the organisational culture.

Botswana is one country that has attempted to adopt a British model of D&T education. Unfortunately one of the challenges of adopting a ‘foreign’ curriculum is that a philosophy developed for one country may not be transposed unchanged to meet a totally different context. Moreover, the countries in question are at different levels of development specifically in terms of the human capacity, political will, provision of resources as well as how their education systems are managed and supported.

Currently this curriculum is under review for implementation in 2016, there will be a need to give a fresh look at content of the curriculum with the view of determining the relevance of some content areas. A more in-depth study is needed to determine the future direction of the D&T education in Botswana both from the local and global perspective. As was experienced in England and New Zealand, implementing curriculum change is an enormous task; the government alone
cannot effect change, it is a collaborative effort between various stakeholders (Harvard Business School Press, 2003). To support collaborative effort, Chikasanda (2010, p.16) notes that: “the political will in the whole process played a significant role as shown by the establishment of a Ministerial task group” (also see Jones, 2003; Atkinson, 1990; Eggleston, 1996).

7.9 Limitations of the Study

The researcher notes that due to the small samples used especially for the pilot study, the findings may have limited reliability. Also, the findings are based on the data collected from six regions (n=10), as such the findings might have limited transferability beyond the settings to a wider set of contexts.

In terms of data analysis, because of the qualitative nature of the study most of the data collected were based on participants’ own reflections and experiences with the new curriculum. Good qualitative research needs to be able to draw interpretations and be consistent with the data that is collected (Cohen et al., 2011; Creswell, 2009; Miles and Huberman, 1994; Silverman, 2010). One of the objectives of the study was to help identify and validate the key factors which affected the implementation of this curriculum. With this in mind, thematic analysis was deemed an appropriate strategy to help detect and identify factors or variables from the perspective of the various stakeholders involved with the curriculum. Therefore, the participants’ interpretations were significant in terms of giving the most appropriate explanations for their perceptions, judgements and thoughts. Some of these data were collected through the use of interviews. Finger and Houguet (2007) note that one of the limitations associated with interview is that the researcher relies on participants’ recollections of experiences. These recollections may be suspect, as participants may exclude information they deem unnecessary or for ethical reasons may not be willing to divulge.

Another challenge encountered by the researcher was that of the data collection for the pilot study, as it was done between December 2011 and January of 2012. This was a difficult period because teachers had engaged in national strike the previous year. As a result, many prospective participants were not willing to
participate. Those who participated in the questionnaire either left some sections blank or provided responses which were not so helpful especially where they were asked to justify their answers. This situation may have contributed to a low response rate (n=22) for the questionnaire. To increase the sample size, the researcher used an online survey. Again, this was also not so successful because many teachers did not have Internet access in their schools. Only ten completed the online questionnaire, thus raising the original number to thirty-two (n=32).
CHAPTER 8

RECOMMENDATIONS
8 Chapter 8 – Recommendations

8.1 Introduction

Based on this study, several recommendations are provided for further research in terms of measures that need to be put in place and policy implications. These recommendations address the following research objective which was established at the beginning of this study:

\[ d) \text{ Apply the findings of the study to aid the on-going review and effective implementation of the BGCSE D&T curriculum.} \]

8.2 Gaps in teacher knowledge and skills

The study has revealed that since the introduction of the Bachelor’s degree programme in Design and Technology at the University of Botswana, there is a steady increase of teachers graduating from this institution. One of the issues which arose from the findings was that teacher training institutions played a minor role in the development of the D&T curriculum. The role of teacher training institutions is pivotal in this regard by ensuring that their programmes are relevant and aligned to the needs of the curriculum which their graduates eventually serve. Professional adequacy of teachers graduating from these programmes is one of the issues that need to be addressed. Professional adequacy refers to teacher capability in terms of their proficiency to deliver the curriculum effectively (Atkinson, 2006; Finger and Houguet, 2009).

In the early 1990s up to 2006, many teachers were being trained overseas notably in England and Australia (Ndaba, 1994; Williams, 2007). Many of the deficiencies in teacher knowledge and skills have been attributed to inadequate preparation of teachers during initial training. This finding was surprising considering that many of the teachers were trained overseas. Logically one would expect overseas universities to provide a relatively higher quality education and training than those who had trained locally. Hence, the expectation was that these teachers would be adequately prepared to deliver this curriculum. For this reason, the researcher suggests a more in-depth study to ascertain current teaching cadre’s
credentials to determine their skill level and competency across all the content areas of the curriculum. The information obtained through a skills audit will help identify gaps in knowledge and skills among the teachers as well as to determine where attention should be focused.

The need to set subject specific professional standards or competencies for D&T teachers has also been highlighted in the Republic of Botswana (2009, p.80) Currently, the Botswana Qualifications Authority is proposing a common quality assurance system that is aimed at maintaining standards across all professions in Botswana. However, this one-size-fits-all framework would not serve the subject well because of complexity of the nature teaching and learning in D&T. For example, a D&T teacher is required to combine different knowledge and skills across many disciplines of the subject, whereas in other professions someone may be specialising in one or two subjects. In this manner, it would be difficult to adhere to common standards.

There are two possible directions to address these deficiencies. The first option is to retrain all the teachers, a move which will not only be costly but has many practical implications. The second route is to conduct a skills-audit with the objective of identifying the priority areas and then design training that is specific to those needs. The latter is a more viable solution. However, the starting point would be to develop a more comprehensive framework for delivering a D&T curriculum and determine how those deficiencies can be addressed.

8.3 The development of subject leadership at all levels

“Empowering people to effect change... without the right skills and attitudes, people feel disempowered” (Kotter, 2012).

One of the key enablers about change management is the development of leadership and management skills (Kotter, 1996; Hiatt and Creasey, 2012). The role of leadership in change management is an important matter because of the critical role a leader performs role in terms of creating a vision, aligning relationships around that vision and inspiring others to achieve the vision (Hiatt, 2006; Kotter, 2012; Newton, 2007).
Currently the subject is operating without a senior officer at national level. Also, the study revealed that six regions out of ten are operating without D&T in-service officers. At regional level one officer acknowledged this problem that: “we are thin on the ground” (Case study 2 - Data set 6). Yet, again, at school level the data showed that the bulk of the duties performed by senior teachers are more inclined to administrative matters than developing their leadership skills.

This situation suggests that these subject leaders are gradually being drawn away from their leadership duties which require them to guide and mentor teachers. The author would argue that leadership and management should be accorded equal status. However, to perform these roles effectively, senior teachers need to be empowered with the knowledge and skills on how to lead and coach others through change (Whittaker, 1993; Fullan, 2012).

8.4 The development of a national competency framework

This research has drawn attention to the need for a competency framework in D&T. Among the major issues which arose across these studies was that many of the D&T teachers have been trained in different countries namely, England, Australia and Botswana. These countries offered programmes for teacher training which served different needs in terms of the knowledge and skills deemed essential for delivering technology education. This has resulted in a teaching profession which is fragmented in terms of the knowledge and skills required to deliver a D&T curriculum. Moreover, because of a lack of a teacher competency framework for D&T teachers (Republic of Botswana, 2009), it is not clear what knowledge and skills are deemed essential to deliver this new D&T curriculum. Hence, there is a need to define teacher subject knowledge in D&T from the perspective of Botswana and develop a set of competencies or standards that will be used to measure the professional adequacy of D&T teachers.

8.5 The development of a school-based CPD support system

Training has been identified as the cornerstone for building knowledge about the change and the required skills (Hiatt and Creasey, 2012). Unfortunately, in Botswana, this study has (in case study 2) shown that there is a lack of clarity and
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consistency across the schools in the provision of in-service support and professional development for teachers. Although this was investigated on a smaller scale in case study 3, further research could explore on a broader scale the viability of institutionalising a school-based support system. The researcher proposes a more academically oriented model as an alternative to the current PMS. In the researcher's view, PMS is more of an administrative tool and does not link teachers' professional development to students' experience and learning outcomes. Figure 8.1 shows a conceptual model for a localised in-service support system.

![A conceptual model for a school-based support system](image)

**Figure 8.1: A conceptual model for a school-based support system**

Adapted from: Nadler and Tushman’s (1997) model (Cited in Cameron and Green, 2009, p.131)

This framework views the school as a sub-system of a larger organisation and draws on inputs from both the internal and external sources (strategy, resources and environment) and transforms them into outputs (the desired results). Within the context of Botswana, the researcher identifies four (4) enablers which are pivotal to the success of this school based CPD model. These are: (a) a supportive school environment, (b) a senior teacher 1, (c) an in-service officer, and (d) an external expertise. These would serve as the core supporting structure at school level.
The support system does not exist in isolation from the national human resource development strategy. In essence, the system should promote networking with external collaborators like other schools, teacher training institutions or the private sector to provide external expertise as may be deemed necessary. However, to bring the service closer to teachers the support system needs to be localised and personalised by providing a platform for individual teachers to take ownership for their own professional development as opposed to the current PMS which teachers perceived more as an administrative tool.

In terms of implementation, it should be contextualised so as to address factors already highlighted in the study which include inter alia: the school environment in which the teachers work, geographic location, length of service and financial constraints.

### 8.6 A national professional development framework

Internationally strategies for professional development have now become much more complex, long term and embedded in schools (Villegas-Reimers, 2003). In terms of Botswana, the study has revealed that there is a policy vacuum in the provision of in-service training and professional development in D&T (Republic of Botswana, 2009). Moreover, one of the limitations of the in-service officers in Botswana is that they have not been trained professionally to deliver professional development programmes. Other challenges are that the officers are also ‘thin’ on the ground and not well resourced. The national professional framework will need to commit more resources into this initiative. Therefore, the aim of this framework is to provide access to high-quality professional development service to D&T teachers whatever stage they are at in their careers. The envisaged framework should be aligned with the provisions of the newly established Human Resource Development Council (HRDC) and the BQA. The establishment of these two statutory bodies is intended to “consolidate and rationalise all quality assurance functions from various public and private education and training providers” (Dr Venson-Moitoi, Minister for Education and Skills Development, cited by Botswana Press Agency (2013). According to Venson-Moitoi, the BQA will “set teaching and learning standards for education and training providers and ensure international
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recognition for the national qualifications system and the international comparability of qualifications” (ibid).

Under this new arrangement the MOESD will be responsible for human resource development (Botswana Press Agency, 2013). The HRDC would take on the role of planning and funding, while BQA would deal with the national qualifications system (ibid). Furthermore, another bill is being prepared for the establishment of a Teachers’ Council. This council, once ratified, will regulate the teaching profession (Botswana Press Agency, 2013). These developments have been necessitated by the need to align education and training to the needs of the economy as well as to ensure that Botswana’s tertiary qualifications are accepted globally (Botswana Press Agency, 2013).

The envisioned framework should be guided by the following tenets: It should:

- provide opportunities for all teachers to gain professional recognition for their professional development as espoused in the BQA framework;
- help teachers to use their professional development and school based experiences, as evidence, in the form of Accredited Prior Learning towards professional qualifications;
- set clear criteria and use a standardised system that would enable teachers to gain professional recognition for their professional development and achievement.

8.7 The development of a change management framework

Change is unavoidable because of increasing internal and external pressures (Morrison, 1998; PROSCI, 2014; Stacey, 1993). Some of the major issues which arose from the study were those of a limited capacity to implement and a limited implementation strategy. Research has shown that organisations have begun realising that change management is a core competency that needs to developed and entrenched into their cultures (Kotter, 2012; PROSCI, 2014; Hiatt and Creasey, 2012). For example, PROSCI (2014) study suggests a direct correlation between project success rates and effective change management. They claim that “projects
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with excellent change management are six times more likely to meet objectives than those with poor change management, and they are more likely to be completed on time and on budget as well" (ibid).

Another issue which arose was that of ineffective communication and collaboration between the various organs of the MOESD. This coupled with a limited implementation necessitate the development of a more effective change management strategy. The framework addresses change management at three levels: the current state, transition state and future state. Figure 8.2 illustrates this conceptual framework.

Figure 8.2: Conceptual framework for the management of change

NB: The double-headed arrows represent the dialogue and channels of communication that exist between individuals and groups within an organisation.

In terms of implementation, the roles played by the various stakeholders are defined as follows:

- **Change Sponsor**: Refers to the Government of Botswana through the MOESD.
• **Change Manager:** Should be the Permanent Secretary in the Ministry of Education. He/she reports to the Minister for education.

• **Project Manager:** This should be someone which specialist or change management skills and experience employed specifically to oversee the implementation of the project. However, it should be someone who understands the organisation and its culture. He/she should in conjunction with core team develop the implementation plan. The Project manager will ensure that the project has all the resources required to deliver the project, they are in place before and during implementation, so the project is delivered on time, to quality and within budget. He/she reports to the Minister who is the Change Manager.

• **Change Core Team:** Refers to a special team set up to implement change. Their primary role is to coordinate and provide direction to the sub teams under their jurisdiction like Curriculum Development Task Group. This team reports to the Permanent Secretary in the MOESD. The composition of this team is provided in figure 8.2.

• **Communications Manager:** Is responsible for all communications relating to the project. His/her role is to facilitate a two-way communication with the various stakeholders involved in the implementation as well as to maintain records of correspondence. The Communications Manager should sit in all the meetings of the various task groups.

• **Curriculum Development Task Group:** This group is responsible for the design and development of the curriculum including instructional materials. It is chaired by someone from the CD&E office.

### 8.8 The development of reinforcement mechanisms

Feedback or reinforcement mechanisms serve as a link between the input and output elements of a CPD framework. In this manner, teachers’ professional development activities can be adjusted according to the level of impact on students’ learning outcomes. Moreover, feedback mechanisms serve as a yardstick
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through which the effectiveness of CDP activities can be assessed and to help inform corrective actions.

For purposes of continuous monitoring and evaluation, the inspectorate arm of the department of Secondary Education needs to be strengthened. Currently, in some regions, this job is being done by education officers. Officers interviewed reported frustration and dissatisfaction at lack of action on the evaluation reports by those responsible. In order to give school inspection the integrity and credibility it deserves, this task needs to be undertaken by an autonomous professional body.

8.9 Curriculum planning and integration

One of the major findings about the development of the BGCSE D&T curriculum was the addition of new content areas which unfortunately resulted in a congested curriculum. Because of this, the teachers reported that it was cumbersome to deliver effectively especially coupled with their own limitations in some content areas. Hence, the author suggests a syllabus breakdown framework. This framework attempts to map out all the content areas in a grid. In planning this syllabus breakdown the schools will need to take into consideration: the staffing requirement, the level of resources, the amount of content to cover and the time frame. In terms of the staffing requirement, the syllabus breakdown will help the schools to determine the most effective way the teachers could be deployed. Furthermore, the syllabus breakdown provides a platform through which the curriculum can be delivered in an integrated manner.

Whilst the findings across the data sets suggested that teacher competency was a critical area, equally important would be the need to consider how to plan and deliver the curriculum in a manner that would ensure effective student learning. Therefore, the planning of such a framework should also take into consideration how the new knowledge and skills by the teacher could be integrated into other learning areas of the curriculum and their pedagogical implications.
8.10 **Policy implications**

A number of policy implications for teachers’ CDP have arisen from the study and the literature review, these are as follows:

- Teachers’ CPD must be thought of as a long term process. It should start with initial preparation and end when the teacher retires from the service. This calls for collaboration between teacher training institutions and other key stakeholders in terms of the processes and policies that support teachers’ professional development.

- In order to enhance the impact on the success of educational reforms as well as to realise the benefits of CPD activities on students’ learning, teachers need to take a more leading role in decision-making processes about educational reforms.

- Teachers’ professional development must be systematically planned, supported, funded and researched to guarantee the effectiveness of this process.

- Teachers must be encouraged to participate in programmes designed for their development. In addition, teachers must be given the time and the financial support to be active designers, implementers and participants of professional development opportunities.

- Schools, teacher-training institutions and other stakeholders must work collaboratively in order to ensure the development of teachers from the very beginning of their careers.

- Given the current economic situation of limited financial resources and human capacity, the Ministry should consider strengthening partnerships with the private sector or other agencies to support teacher professional development activities, both financially and by offering expertise that addresses the needs of teachers.
8.11 Future Research Areas

Three major issues have arisen from this study which will require further research. First, the researcher argues that the RNPE as a driving framework for the education system has been overtaken by events. This is against the argument that an education as a social service needs to stay relevant to the changing global economic landscape. Considering the time and context in which this policy was developed, one notes that the context has changed substantially. From the findings it seems that many of the problems with the design and implementation of the D&T curriculum stem from a lack of understanding by the government and the teaching fraternity about philosophy of technology education. Therefore, going forward, there is a need for a unified identity and a coherent vision in terms of the purpose and philosophy of design and technology education in Botswana.

Second, the notion that the D&T curriculum needs to emulate a technological industrial expansion is not sustainable where industry is not established. In the case of the development of the BGCSE D&T curriculum, this situation is complicated by an attempt to transpose into the context of Botswana a model which was developed for a far more developed country. This is a cause for concern in Botswana where the country has a relatively small manufacturing base. The author argues that if the government of Botswana is still committed to the vision of using D&T education as leverage for economic and diversification, then this effort will require a review of the content of the D&T curriculum. To build on the work by Ruele and Mwendapole (2015) wherein the authors suggest:

“... the creation of creative arts strands such as jewellery design, leather works, graphic design, multimedia, textiles and ceramics within the current curriculum would be a great benefit to the country in terms of its vision for economic diversification (p.117).”

Third, the study has provided a basis for further research which will provoke questions about the future and the direction of the D&T education in Botswana. Further research is needed on the specific aspects of teachers' professional development that will create a significant effect on teachers' practices. Future interventions should not just focus on skill upgrading as is currently the situation.
but should seek to strengthen links between professional development training, changes in teacher knowledge, classroom practices and student outcomes.
References

Ackerman, L. (1997). *Development, transition or transformations: The question of change in organisations*. In Organisational Change (V. Iles, & K. Sutherland, eds), National Coordinating Centre for NHS Service Delivery and Organisations’ R & D, London.


Chomeya, R. (2010). Quality of psychology test between Likert scale 5 and 6 points. *Journal of Social Sciences, 6*(3), 399-403.


Gaothobogwe, M. (2010). Attitudes to and perceptions of design and technology students towards the subject: A case of five junior secondary schools in Botswana. (Unpublished PhD). University of Wales Institute, University of Wales Institute.


Robson, C. (2011). Real world research (3rd ed.). West Sussex, United Kingdom: John Wiley and Sons Ltd.


Ruele, V., & Mwendapole, C. (2015). Which comes first, the chicken or the egg: Rebalancing the focus of Design and Technology in senior secondary schools in Botswana. In M. Orey & R.M. Branch (Eds.), Educational Media and Technology Yearbook (Vol. 39), (pp. 115-122). New York, USA: Springer International Publishing.


APPENDICES

RESEARCH METHODOLOGY
Appendix 3.1: Ethical Clearance Form

RESEARCH PROPOSAL: VICTOR RUELE

1. Project Title

An Investigation of the Process of Local Design and Technology (D&T) Curriculum Implementation and Management: A case study of Botswana Senior Secondary Schools

2. Brief summary of the proposal for the benefit of non-expert members of the Committee. This should include the scientific reasons for the research, the background to it and why the area is important.

Since the introduction of the Botswana D&T curriculum in 2000, very little research has been done to assess how this new curriculum was being implemented in schools. A pilot study by the author (2011) found that both teachers and education officers complained that the curriculum is too congested and cumbersome to deliver effectively within the 2-year period. The following statement drives this point home (“Unfortunately we only have two years, more content to cover over a short period of time” (Field data, 2011, Set 5). Also, the study found that although many teachers possessed the relevant qualifications and teaching experience, however, their training emphasised more on the craft-based content areas: they were not adequately prepared to teach new technology content areas such as electronics, pneumatics and others (“I think when people went for training, nobody thought the curriculum was going to change” (Field data, 2011, Set 6). This asserts the need to assess teachers’ capability to deliver this curriculum in a holistic manner.

Furthermore, Teacher Training and Development (TT&D), which is the responsible for teacher training and professional development does not have the capacity to provide in-service training support to teachers (Ministry of Education, 2009). This has been evidenced by lack of officers in some regions (Field data, 2011). Lack of in-service training support undermines efforts to deliver the curriculum effectively.

Given the large sums of money already invested in the subject, further research is required to help understand fully the situation in schools and determine areas where attention should be focused.

So focus of case study 2 will be to investigate the provision of an in-service training support system for D&T teachers in Botswana. The study will examine in greater depth the kinds of support which teachers will need to enable them to deliver the curriculum more effectively.

Details of responsible investigator (supervisor in case of student projects)

Title: Mr
Forename: Nigel
Surname: Zanker

Department: Design School

Email Address: N.P.Zanker@lboro.ac.uk
Personal experience of proposed procedures and/or methodologies

- The Researcher is a lecturer in the Department of Industrial Design and Technology at the University of Botswana. He has worked as a teacher and head of department in the secondary schools and teacher training college for over 20 years. He is involved with the training of D&T teachers both locally and regionally and has been involved in other professional activities for teachers.

- The study is a qualitative inquiry which will employ grounded theory method as the theoretical framework that will guide the methods and procedures for data collection and analysis. It will initially involve a small-scale scoping survey to facilitate the collection of baseline data from key participants.

- The survey will collect data from regional directors and education officers for D&T in based in the six (6) regions of Botswana. Data will be collected from senior teachers and a selected group of D&T teachers based in those regions.

- The data will be captured through a self-completion semi-structured questionnaire, individual semi-structured interviews and group interviews. The analysis of data collected and the findings will provide useful insights and focus for the next phase of the study.

4. Names, experience, department and email addresses of additional investigators

- Sole Investigator

5. Proposed start and finish date and duration of project

Start date: July  Finish date: September 2012  Duration: 2 months
Start date for data-collection: July - September 2012

NB. Data collection should not commence before EAC approval is granted.

6. Location(s) of project

- Ministry of Education and Skills Development – Gaborone - Botswana

- For the questionnaire data will be collected from teachers based in schools in six (6) regions in Botswana. However, for group and individual interviews data will be collected from four (4) regions. These are: Central, North, South and South Central regions.

7. Reasons for undertaking the study (e.g. contract, student research)

- PhD research student
8. Do any of the investigators stand to gain from a particular conclusion of the research project?

- This is an action research which is aimed at improving the current practice

9a. Is the project being sponsored?  
Yes ☒  No ☐

**If Yes**, please state source of funds including contact name and address
- The applicant is a University of Botswana sponsored research student

9b. Is the project covered by the sponsors insurance?  
Yes ☒  No ☐

**If No**, please confirm details of alternative cover (e.g., University cover)

10. Aims and objectives of project

The specific objectives of the study are to:
1. Identify teacher competencies which are critical to effective delivery of the D&T curriculum;
2. Assess and evaluate the practicality of implementing the BGCSE D&T curriculum;
3. Propose and evaluate an appropriate a long-term in-service training support system for D&T teachers in Botswana.

11a. Brief outline of project design and methodology

*(It should be clear what each participant will have to do, how many times and in what order.)*

- Refer to question 3.

11b. Measurements to be taken

*(Please give details of all of the measurements and samples to be taken from each participant.)*

- The group and individual face-to-face interviews will be audio recorded as a record and memory aid for researcher to illustrate aspects of the findings.
- Questionnaires will capture data about teachers' views and experiences of the aspects of teaching and learning related to the BGCSE curriculum.

12. Please indicate whether the proposed study:

Involves taking bodily samples  
Yes ☐  No ☒
Involves procedures which are physically invasive (including the collection of body secretions by physically invasive methods)  

Yes ☐ No ☒

Is designed to be challenging (physically or psychologically in any way), or involves procedures which are likely to cause physical, psychological, social or emotional distress to participants  

Yes ☐ No ☒

Involves intake of compounds additional to daily diet, or other dietary manipulation / supplementation  

Yes ☐ No ☒

Involves pharmaceutical drugs (please refer to published guidelines)  

Yes ☐ No ☒

Involves testing new equipment  

Yes ☐ No ☒

Involves procedures which may cause embarrassment to participants  

Yes ☐ No ☒

Involves collection of personal and/or potentially sensitive data  

Yes ☐ No ☒

Involves use of radiation (Please refer to published guidelines. Investigators should contact the University’s Radiological Protection Officer before commencing any research which exposes participants to ionising radiation – e.g. x-rays)  

Yes ☐ No ☒

Involves use of hazardous materials (please refer to published guidelines)  

Yes ☐ No ☒

Assists/alters the process of conception in any way  

Yes ☐ No ☒

Involves methods of contraception  

Yes ☐ No ☒

Involves genetic engineering  

Yes ☐ No ☒

If Yes, please give specific details of the procedures to be used and arrangements to deal with adverse effects.

• N/A

13. Participant Information
• Number of participants to be recruited: For questionnaire it is intended to recruit 45-50 participants. The projected number of participants for group interviews is 6-8 people.

Details of participants (gender, age, special interests etc):

• The participants for both the questionnaire and group interview are D&T teachers, male and female aged 25 and above. These teachers have been in the field since 1990 when the Cambridge D&T was being introduced in Botswana.

• Whilst those for the individual interviews are in-service officers (D&T), and senior teachers.

How will participants be selected? Please outline inclusion/exclusion criteria to be used:

• Questionnaire participants will be identified using snow ball sampling technique while for individual and group interviews purposive sampling techniques will be used.

• All participants must be comfortable with participating in the study and have the right to withdraw at any stage should they wish to. The invitation letter to participants and the researcher’s subsequent meeting with them will provide explanation to this effect. Participants’ consent will be sought prior to the commencement of any aspect of the study.

How will participants be recruited and approached?

• As above

Please state demand on participants’ time.

• typically about 1 hour including the introductory and closing stages.

14. Control Participants

Will control participants be used? Yes ☐ No ☒

If Yes, please answer the following:

Number of control participants to be recruited: None

How will control participants be selected? Please outline inclusion/exclusion criteria to be used.
Appendices

- N/A
How will control participants be recruited and approached?

- N/A
Please state demand on control participants’ time.

- N/A
15. Procedures for chaperoning and supervision of participants during the investigation

- N/A
16. Possible risks, discomforts and/or distress to participants

- N/A
17. Details of any payments to be made to the participants

- N/A
18. Is written consent to be obtained from participants?

Yes ☒ No ☐

If yes, please attach a copy of the consent form to be used.

- Request letter to participants has been written and accompanied by a covering letter from the principal supervisor.

If no, please justify.

- The research is based on grounded theory principles which do not require control groups.

19. Will any of the participants be from one of the following vulnerable groups?

Children under 18 years of age ☐ Yes ☒ No ☒

People over 65 years of age ☐ Yes ☒ No ☒

People with mental illness ☐ Yes ☒ No ☒

Prisoners/other detained persons ☐ Yes ☒ No ☒

Other vulnerable groups (please specify ) ☐ Yes ☒ No ☒
If Yes, to any of the above, please answer the following questions:

What special arrangements have been made to deal with the issues of consent?

- Not applicable

Have investigators obtained necessary police registration/clearance? (please provide details or indicate the reasons why this is not applicable to your study)

- Since the study is conducted in Botswana, no police clearance is required. Only a research permit will be required. Research permit to enter schools in Botswana will be obtained with the assistance of the office of Research and Development (ORD) of the University of Botswana.

20. How will participants be informed of their right to withdraw from the study?

- Verbally and through the information sheet and consent form, which they will be required to sign prior to the start of the interview.

21. Will the investigation include the use of any of the following?

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If Yes, to any, please provide detail of how the recording will be stored, when the recordings will be destroyed and how confidentiality of data will be ensured?

- Data will be stored in a secure place in a coded format for the duration of the project. Data may be kept up to six years following collection of data.
- Participants will not be identified by name in any publication resulting from the study.

22. What steps will be taken to safeguard anonymity of participants/confidentiality of personal data?

- All data will be coded. All reference to participants in the report and subsequent publications/presentations will be anonymised. Efforts will be made to ensure that it is not possible to identify any of the participants from the images.

23. Please give details of what steps have been taken to ensure that the collection and storage of data complies with the Data Protection Act 1998?

Please see University guidance on Data Collection and Storage and Compliance with the Data Protection Act.
24. If human tissue samples are to be taken, please give details of and timeframe for the disposal of the tissue.

Please note that this information should also be outlined on the Participant Information Sheet

- NA

24. Insurance Cover

**It is the responsibility of investigators to ensure that there is appropriate insurance cover for the procedure/technique.**

The University maintains in force a Public Liability Policy, which indemnifies it against its legal liability for *accidental* injury to persons (other than its employees) and for accidental damage to the property of others. Any *unavoidable* injury or damage therefore falls outside the scope of the policy.

Will any part of the investigation result in *unavoidable* injury or damage to participants or property? 

  Yes [ ] No [x]

**If Yes**, please detail the alternative insurance cover arrangements and attach supporting documentation to this form.

The University Insurance relates to claims arising out of all *normal* activities of the University, but Insurers require to be notified of anything of an unusual nature

Is the investigation classed as *normal* activity? 

  Yes [x] No [ ]

**If No**, please check with the University Insurers that the policy will cover the activity. If the activity falls outside the scope of the policy, please detail alternative insurance cover arrangements and attach supporting documentation to this form.
25. Declaration

I have read the University's Code of Practice on Investigations on Human Participants and have completed this application. I confirm that the above named investigation complies with published codes of conduct, ethical principles and guidelines of professional bodies associated with my research discipline.

I agree to provide the Ethical Advisory Committee with appropriate feedback upon completion of my investigation.

Signature of applicant: 10 July 2012

Signature of Head of Department: .................................. Date ..................................
Appendix 3.2: Informed Participant Consent Form

Title of Study
An Investigation into the management of change in Design and Technology: A Qualitative Inquiry based on the Implementation of a New Curriculum for Senior Secondary Schools in Botswana

This is a PhD study being conducted under the supervision of Mr Nigel Zanker, PGCE/MSc Design and Technology Programme Director, Loughborough University Design School. If you have any questions or queries regarding the study, please contact him at:

Loughborough University
Direct Line: 01509 226661
Fax: 01509 226660
Email: n.p.zanker@lboro.ac.uk; www.lboro.ac.uk/ids

The following ethical guidelines will be observed during the course of this study in order to protect the interests and anonymity of the participant.

Confidentiality
Participants are assured that the confidentiality of all data gathered will be maintained and that the names or locations of participants will not be used in the printing of this study.

Right to privacy and to withdrawal from the study
Participants have the right to withhold from this study any information they deem to be private or not in the interest of the study.

Participants have the right to withdraw from the study at any time and to have any data arising from their interview which they deem inappropriate deleted from the study.

Data collection, Confirmation and Interpretation
Participants will be informed of the nature and purposes of the study, as well as the nature of their participation in it. Data collected during the course of the study will be analysed and in the context of the purpose of this study. All tapes and transcripts will be kept in a safe place during the course of the study and will be destroyed upon completion of the study.

Participants will be provided with the opportunity to correct factual inaccuracies in the data, and review interpretations made or conclusions drawn.

Both the participant and the researcher have read and understood the preceding ethical considerations and have agreed to participate in the study according to the noted guidelines.

Participant name: ___________________________  Signature: __________
Date: ______________

Researcher: ___________________________  Date: ______________
<table>
<thead>
<tr>
<th>ID</th>
<th>Part G (Q20) – Responses on issues affecting the subject</th>
<th>Keywords</th>
</tr>
</thead>
<tbody>
<tr>
<td>001</td>
<td>Lack of direction (Ministry); inadequate resources; lack of proper maintenance plan</td>
<td>Vision; resources; technical support.</td>
</tr>
<tr>
<td>002</td>
<td>Page missing</td>
<td>-</td>
</tr>
<tr>
<td>003</td>
<td>Negligence by the Ministry; there has been no Education Officer for D&amp;T for 10 years</td>
<td>Administrative support</td>
</tr>
<tr>
<td>004</td>
<td>Left blank</td>
<td></td>
</tr>
<tr>
<td>005</td>
<td>Allocation of students who are weak in science; introduction of topics which teachers do not have knowledge in; the syllabus is too congested/too many subjects in one.</td>
<td>Selection of students into D&amp;T; New content areas; congested syllabus.</td>
</tr>
<tr>
<td>006</td>
<td>Poor consultation and communication with people on the ground (teachers)</td>
<td>Lack of consultation and poor communication with teachers.</td>
</tr>
<tr>
<td>007</td>
<td>It is not taken serious as compared to others; D&amp;T curriculum is too broad.</td>
<td>Not a popular subject; syllabus too broad</td>
</tr>
<tr>
<td>008</td>
<td>Ignorance</td>
<td>Advocacy</td>
</tr>
<tr>
<td>009</td>
<td>Left blank</td>
<td></td>
</tr>
<tr>
<td>010</td>
<td>Not recognised as a subject</td>
<td>Status; Advocacy</td>
</tr>
<tr>
<td>011</td>
<td>Poor or no representation in high offices; some regions operate without Education officers</td>
<td>Administrative support;</td>
</tr>
<tr>
<td>012</td>
<td>Recycling the theme; long production of the folio; having all students doing the subject.</td>
<td>Bad practices; student enrolment</td>
</tr>
<tr>
<td>013</td>
<td>Mismanagement; lack of consultation from education officers and Examinations department</td>
<td>Management issues; consultation; stakeholders.</td>
</tr>
<tr>
<td>014</td>
<td>Appointing the wrong leaders; people who are not qualified for the job.</td>
<td>Leadership</td>
</tr>
<tr>
<td>015</td>
<td>Lack of consultation between stakeholders; lack of support</td>
<td>Consultation; stakeholders; support at various levels</td>
</tr>
<tr>
<td>016</td>
<td>Lack of support from Teacher Training and Development</td>
<td>Lack of in-service training</td>
</tr>
<tr>
<td>017</td>
<td>Limited financial resources; lack of support from relevant stakeholders; low student enrolment; teachers’ low morale; teachers’ attitude to teaching.</td>
<td>Financial support; support at various levels; student interest in the subject; teachers’ low morale; commitment by teachers.</td>
</tr>
<tr>
<td>018</td>
<td>Consultation not done when reviewing the curriculum; changes made are not funded for implementation</td>
<td>Lack of consultation with teachers; limited funding for the subject.</td>
</tr>
<tr>
<td>019</td>
<td>Workload</td>
<td>Teacher work-load</td>
</tr>
<tr>
<td>020</td>
<td>Left blank</td>
<td></td>
</tr>
<tr>
<td>021</td>
<td>No coordination between CD&amp;E; Botswana Examinations Council and the schools.</td>
<td>Lack of coordination between various departments and schools</td>
</tr>
<tr>
<td>022</td>
<td>Conflicting standards of interpreting the curriculum; too much workload for teachers, less remuneration; too much work for students; review long overdue – irrelevant practices</td>
<td>Conflicting philosophies; Teacher work-load; lack of incentives; students’ work-load; curriculum review overdue.</td>
</tr>
</tbody>
</table>
Appendix 3.4 A matrix for aligning research questions with data sets

<table>
<thead>
<tr>
<th>Research questions</th>
<th>A matrix for the data sets used to answer the research questions</th>
</tr>
</thead>
</table>
| 1. What factors have necessitated change from the Cambridge D&T curriculum to locally developed BGCSE D&T curriculum in Botswana? | Set 1: ✔️ ✔️ ✔️ ✔️ ✔️ ✔️ ✔️ ❌ Set 2: ✔️ ✔️ ✔️ ✔️ ✔️ ✔️ ✔️ ✔️ Set 3: ✔️ ✔️ ✔️ ✔️ ✔️ ✔️ ✔️ ✔️ Set 4: ✔️ ✔️ ✔️ ✔️ ✔️ ✔️ ✔️ ✔️ Set 5: ✔️ ✔️ ✔️ ✔️ ✔️ ✔️ ✔️ ✔️ Set 6: ✔️ ✔️ ✔️ ✔️ ✔️ ✔️ ✔️ ✔️ Set 7: ✔️ ✔️ ✔️ ✔️ ✔️ ✔️ ✔️ ✔️ Document review:  
  - The Report of the Commission on Education (1993);  
  - The Revised National Policy on Education (1994);  
  - Vision 2016;  
  - The Curriculum Blue Print (2001);  
  - The Cambridge Overseas Schools Certificate syllabus;  
  - The BGCSE Senior Secondary Education D&T Syllabus (2000);  
  - Any other relevant documents. |
| 2. What views and perceptions are held by various stakeholders regarding the change? | ✔️ ✔️ ✔️ ✔️ ✔️ ✔️ ✔️ ✔️ ✔️ |
| 3. What organisational factors have inhibited or facilitated change and effective implementation? | ✔️ ✔️ ✔️ ✔️ ✔️ ✔️ ✔️ ✔️ ✔️ |
| 4. How can we plan and implement curriculum change more effectively in Botswana? | ✔️ ✔️ ✔️ ✔️ ✔️ ✔️ ✔️ ✔️ ✔️ |

**Key**
- Set 1: Teacher questionnaire;
- Set 2: Group interview (purposive sampled teachers to follow up on the questionnaire);
- Semi structured individual interviews
  - Set 3: Director (DSE);
  - Set 4: Director (CD&E);
  - Set 5: Director (TT&D);
  - Set 6: D&T Education officers;
  - Set 7: Head of department (IDT– University of Botswana).

**Source:** An Illustration by the Researcher
APPENDICES

CASE STUDY 1 - PILOT SURVEY
Appendices

Appendix 4. 1: Pilot Survey - Teacher Questionnaire

Date: ____________

ABOUT THIS SURVEY

The purpose of the questionnaire is to help collect data to be used in:

An Investigation of the Nature of Change and Transition from Cambridge to the BGCSE D&T curriculum

- The data collected will be used to identify and evaluate the necessary steps and strategies for managing curriculum change and transition in D&T to ensure effective implementation in schools.
- The information you provide will be used purely for academic purposes and will be treated with utmost confidentiality.
- It should take about 20 minutes of your time to fill in the questionnaire.

PART A: YOUR PERSONAL DETAILS

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Your name (Optional):</td>
<td></td>
</tr>
<tr>
<td>2. Gender:</td>
<td>M</td>
</tr>
<tr>
<td>3. Region you are based in:</td>
<td></td>
</tr>
<tr>
<td>4. Position/Post held:</td>
<td></td>
</tr>
<tr>
<td>5. Professional qualifications:</td>
<td></td>
</tr>
<tr>
<td>6. Name of awarding institution:</td>
<td></td>
</tr>
<tr>
<td>7. Number of years in the service:</td>
<td></td>
</tr>
</tbody>
</table>

NB: Please only write your name and contact details if you would like to participate in group interviews to be arranged at a later date.
11. How clearly communicated were the government of Botswana’s reasons for moving away from the Cambridge curriculum? Put a cross (x) in the box that best describes your view.

<table>
<thead>
<tr>
<th>Very clearly communicated</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>0</th>
<th>Did not receive any communication</th>
</tr>
</thead>
</table>

12. How would you describe your level of participation in decisions that led to the localisation of the D&T curriculum? Put a cross (x) in the box as applicable.

<table>
<thead>
<tr>
<th>Participated fully</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>0</th>
<th>Did not play any part</th>
</tr>
</thead>
</table>

13. In the space below give examples of specific role(s) you played during the introduction of the BGCSE curriculum?

PART D: CHANGES IN PRACTICE AS A RESULT OF INTRODUCING THE BGCSE D&T CURRICULUM

This part asks you to share your experiences regarding any changes in practice and new requirements you have experienced with the BGCSE D&T curriculum.

14. What new content areas are you teaching as a result of the BGCSE D&T curriculum?

15. In the space below list aspects of the BGCSE D&T curriculum which you feel you need more support in.
PART E: ADMINISTRATIVE SUPPORT: (LEADERSHIP AND PROVISION OF RESOURCES)

This part asks you to comment on the kinds of support and the level of support you have received to prepare you for the change.

16. In the space below list the **kinds of support** you received either at your school or regional office to enable you to deliver the BGCSE D&T curriculum more effectively.

17. In the space below, write the name(s) of departments or organisations **who** provided the support stated in 16 above.

18. How would you rate the **level of support** you have received from the providers stated in 17 above? Indicate your rating by putting a cross (x) in the relevant box on the right.

Use the following as a guide for the rating:

Excellent = 5; Very Good = 4; Good = 3; Fair = 2; Poor = 1; Very Poor = 0
PART F: YOUR OVERALL IMPRESSION ABOUT STATE OF THE BGCSE D&T  
(LEADERSHIP, RESOURCES, TEACHER MORALE AND CONFIDENCE)

This part asks you to share your views regarding your level of satisfaction with current situation in the BGCSE D&T curriculum in your school.

19. Put a cross (X) in the box that best describes your views about the range of issues affecting D&T in your school.

<table>
<thead>
<tr>
<th>How high is:</th>
<th>Very High</th>
<th></th>
<th>Very Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Your morale in D&amp;T?</td>
<td>5</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Your confidence in teaching D&amp;T?</td>
<td>5</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Your students' interest in D&amp;T?</td>
<td>5</td>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>How satisfied are you with:</th>
<th>Very Satisfied</th>
<th></th>
<th>Very Unsatisfied</th>
</tr>
</thead>
<tbody>
<tr>
<td>The level of teaching resources in D&amp;T?</td>
<td>5</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Your students' performance in D&amp;T?</td>
<td>5</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Provision of in-service training in D&amp;T?</td>
<td>5</td>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>How supportive is your:</th>
<th>Very Supportive</th>
<th></th>
<th>Very Unsupportive</th>
</tr>
</thead>
<tbody>
<tr>
<td>School head?</td>
<td>5</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Head of department/Senior teacher 1?</td>
<td>5</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Education officer for D&amp;T?</td>
<td>5</td>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>

20. If you have awarded low scores in question 19 above, in the space below list the main factors/issues which have influenced how you feel about those issues.
PART G: CURRENT AND FUTURE INTERVENTION STRATEGIES

This part asks you to share your experiences about strategies you are using in your school or region to help you cope with the implementation of the curriculum.

21. What teaching strategies are you using in your school or region to cope with the teaching of some challenging aspects of the BGCSE D&T curriculum?

22. How can we make improvements in the future to the way the current BGCSE D&T curriculum is being implemented? Write your suggestions in the space below.

Thank you very much for your time

If you have any questions about the survey or you would like participate in group interviews: Please do not hesitate to contact Victor Ruelo, PhD Scholar at Loughborough University. Mobile: +44788177600 Email: v.truelo@lboro.ac.uk
Appendix 4.2: Interview Schedule for Senior Officers and HODs

The interview involved the following:

- Director: Secondary Education
- Director: Curriculum Development and Evaluation
- Director: Botswana Examinations Council
- Director: Teacher Training and Development
- Education Officers (D&T)
- Heads of Department (D&T)

<table>
<thead>
<tr>
<th>Time:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date:</td>
</tr>
<tr>
<td>Place:</td>
</tr>
<tr>
<td>Interviewer:</td>
</tr>
<tr>
<td>Interviewee:</td>
</tr>
<tr>
<td><strong>Length of interview:</strong> 50 mins</td>
</tr>
<tr>
<td><strong>Resources:</strong> All the necessary documentation; Student ID; Audio recording devices (2); Dairy; Pens.</td>
</tr>
<tr>
<td>Section</td>
</tr>
<tr>
<td>----------------------</td>
</tr>
</tbody>
</table>
| Introduction (5 mins)| Greet the participant. Thank you for accepting my request to interview you. As you have already seen in the documents which I sent you, I’m from Loughborough University where I’m doing my PhD.  
• As a practitioner having being involved with the teaching of Design and Technology at various levels: I’m speaking to various stakeholders involved in the process of developing and implementing the BGCSE curriculum. I want to hear their views concerning implementation of this subject within the BGCSE programme.  
• What we will learn from today’s discussion will us devise more effective strategies of implementing this curriculum in the future.  
• I will treat your answers with utmost confidentiality. Unless with your permission, I will not include your name or any other information that could identify you in any report pertaining to this study.  
• This interview will be tape recorded to enable me to transcribe and analyse the data afterwards. I will destroy the notes and audiotapes after I have completed and published the results.  
• Do you have any questions about the study?  
• Before we proceed with the interview, I would request that you sign the Participant informed consent form. | • Social and political events;  
• Changes in policy;  
• Technological developments;  
• Other factors associated with initiating change. |
| Topic 1 (10 mins)   | The Cambridge Overseas Schools certificate (COSC) programme was discontinued at the end of 1999 across all subjects. This was replaced by the locally designed BGCSE programme.  
1. To begin, can you tell me about the circumstances that led to the decision to move away from Cambridge?  
a) Probe: Whose decision was it, Cambridge or the government of |
<table>
<thead>
<tr>
<th>Topic 2 (10mins)</th>
<th>Now I would like us to discuss the roles played by various stakeholders during this transition period.</th>
</tr>
</thead>
<tbody>
<tr>
<td>• The roles played by various stakeholders in decisions about the change.</td>
<td>2. <strong>Can you tell me about the roles played by various stakeholders in decision-making leading up to the localisation of the national curriculum?</strong></td>
</tr>
<tr>
<td></td>
<td>a) <strong>Who were these stakeholders?</strong></td>
</tr>
<tr>
<td></td>
<td>b) <strong>What roles did they play in the transitional process?</strong></td>
</tr>
<tr>
<td></td>
<td>• <strong>Probe: How much do you think you contributed to the whole process?</strong></td>
</tr>
<tr>
<td>Topic 3 (10mins)</td>
<td>Now I want us to discuss your impressions about the participation of teachers in this process.</td>
</tr>
<tr>
<td>• Teacher participation</td>
<td>3. <strong>At what level in the development processes were schools and teachers consulted and involved in decisions about the new curriculum?</strong></td>
</tr>
<tr>
<td></td>
<td>4. <strong>Can you describe how teachers participated in the curriculum development and implementation process?</strong></td>
</tr>
<tr>
<td></td>
<td>a) <strong>Probe: How much do you think they contributed to the whole process?</strong></td>
</tr>
<tr>
<td></td>
<td>b) <strong>Probe: What kind of support did teachers receive regarding the implementation of the BGCSE D&amp;T curriculum?</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Botswana?</th>
<th>b) <strong>Probe: What role did Cambridge play in decision making?</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• <strong>ownership;</strong></td>
</tr>
<tr>
<td></td>
<td>• <strong>shared vision;</strong></td>
</tr>
<tr>
<td></td>
<td>• <strong>degree of consultation;</strong></td>
</tr>
<tr>
<td></td>
<td>• <strong>level of communication;</strong></td>
</tr>
<tr>
<td></td>
<td>• <strong>level of involvement in decision making.</strong></td>
</tr>
<tr>
<td></td>
<td>• <strong>Capacity building;</strong></td>
</tr>
<tr>
<td></td>
<td>• <strong>level of resources;</strong></td>
</tr>
<tr>
<td></td>
<td>• <strong>professional development;</strong></td>
</tr>
<tr>
<td></td>
<td>• <strong>monitoring and evaluation.</strong></td>
</tr>
<tr>
<td>Topic 4 (5mins)</td>
<td>5. What is your assessment of the whole process of implementing the BGCSE programme?</td>
</tr>
<tr>
<td>------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>• Implementation strategy</td>
<td></td>
</tr>
<tr>
<td>• Capacity for change</td>
<td></td>
</tr>
<tr>
<td>a) Probe: What was the implementation plan/strategy for BGCSE programme?</td>
<td></td>
</tr>
<tr>
<td>b) Probe: What capacity needed to be developed your department to prepare for this change?</td>
<td></td>
</tr>
<tr>
<td>• Change management plan;</td>
<td></td>
</tr>
<tr>
<td>• implementation plan or strategy;</td>
<td></td>
</tr>
<tr>
<td>• Capacity building;</td>
<td></td>
</tr>
<tr>
<td>• mobilisation of resources.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Topic 5 (5mins)</th>
<th>6. In your opinion, what organisational conditions have facilitated or hindered effective implementation of the D&amp;T curriculum?</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Challenges and future strategies</td>
<td></td>
</tr>
<tr>
<td>7. How can we plan and implement curriculum change more effectively in the future?</td>
<td></td>
</tr>
<tr>
<td>• Reactions to the change;</td>
<td></td>
</tr>
<tr>
<td>• Attitude to change;</td>
<td></td>
</tr>
<tr>
<td>• effects of the change;</td>
<td></td>
</tr>
<tr>
<td>• Resources</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>• Final thoughts (5mins)</th>
<th>Those were all of the questions I wanted to ask.</th>
</tr>
</thead>
<tbody>
<tr>
<td>8. Do you have any final contributions /thoughts about the focus of my study which you would like to share?</td>
<td>Thank you very much for your time.</td>
</tr>
</tbody>
</table>
APPENDICES

CASE STUDY 2
Appendix 5. 1: Case Study 2 - Teacher Questionnaire

Introduction

This questionnaire is intended to assess the capability across the BGCSE D&T curriculum. The information you provide will help to inform your individual professional development needs in the subject. It is part of the study I am carrying out to evaluate the provision of an in-service training support system aimed at helping teachers to deliver the curriculum more effectively.

The information you provide will be used purely for academic purposes and will be treated with utmost confidentiality.

Instructions

- This questionnaire consists of 4 parts namely A, B, C and D.
- Instructions relating to the various parts of the questionnaire are provided in their relevant sections.
- If you wish to make any additional comments and/or suggestions, please do so on the back of the questionnaire.
- It should take about 10 minutes of your time to fill in the questionnaire.

Part A: Teachers' personal knowledge and skills in the subject

This part asks you to make an assessment of your personal knowledge and skills; and your level of confidence in delivering all the different content areas of the curriculum.

1. How would you rate your ability to teach the topic areas listed in table 1 below? Please put a cross (x) in the box that best describes your answer.

Key: 6 = Exceptional; No background = 0

Table 1 - Personal knowledge and skills

<table>
<thead>
<tr>
<th>Syllabus Topics</th>
<th>Topic areas</th>
<th>Your ability in the topic area</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Technology</td>
<td>Electronics</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pneumatics</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Structures</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mechanisms</td>
<td></td>
</tr>
<tr>
<td>Information technology</td>
<td>CAD/CAM</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Desktop publishing</td>
<td></td>
</tr>
<tr>
<td>Resistant materials and their related tools and processes</td>
<td>Wood</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Metal</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Plastics</td>
<td></td>
</tr>
<tr>
<td>Design communication</td>
<td>Graphics</td>
<td></td>
</tr>
<tr>
<td>Design practice</td>
<td>Design folio</td>
<td></td>
</tr>
</tbody>
</table>
2. If you awarded yourself **low scores** in any of the areas (**in table 1**) please explain why you feel this way in the box below.

3. How would you rate your **level of confidence** in teaching the topic areas listed in table 2 below? Please put a cross (x) in the box that best describes your answer.

**Key: 6 = Very High Confidence; No Confidence = 0**

**Table 2 – The level of confidence to teach the content**

<table>
<thead>
<tr>
<th>Topic areas</th>
<th>Level of confidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Electronics</td>
<td></td>
</tr>
<tr>
<td>2. Pneumatics</td>
<td></td>
</tr>
<tr>
<td>3. Structures</td>
<td></td>
</tr>
<tr>
<td>4. Mechanisms</td>
<td></td>
</tr>
<tr>
<td>5. CAD/CAM</td>
<td></td>
</tr>
<tr>
<td>6. Desktop publishing</td>
<td></td>
</tr>
<tr>
<td>7. Wood (including tools and processes)</td>
<td></td>
</tr>
<tr>
<td>8. Metal (including tools and processes)</td>
<td></td>
</tr>
<tr>
<td>9. Plastics (including tools and processes)</td>
<td></td>
</tr>
<tr>
<td>10. Graphics</td>
<td></td>
</tr>
<tr>
<td>11. Design folio</td>
<td></td>
</tr>
</tbody>
</table>

4. If you awarded yourself **low scores (in table 2)** in terms of your **confidence level** in any of the areas please explain why you feel this way in the box below.
Part B: Identification of teachers’ in-service training needs

This part asks you to help us identify an in-service training support system which will help to equip you with the necessary knowledge and skills to enable you to deliver the D&T curriculum more effectively.

5. In order to support you in delivering the whole D&T curriculum, please indicate the content areas which you will need training in. In table 3 below put a cross (x) in the box that best matches your preference.

Key: 5 = Highest priority; 1 = Lowest priority.

Table 3: Priority areas for training

<table>
<thead>
<tr>
<th>Content areas</th>
<th>Preference for Training</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5</td>
</tr>
<tr>
<td>a) Electronics</td>
<td></td>
</tr>
<tr>
<td>b) Pneumatics</td>
<td></td>
</tr>
<tr>
<td>c) Structures</td>
<td></td>
</tr>
<tr>
<td>d) Mechanisms</td>
<td></td>
</tr>
<tr>
<td>e) CAD/CAM</td>
<td></td>
</tr>
<tr>
<td>f) Desktop publishing</td>
<td></td>
</tr>
<tr>
<td>g) Wood (including tools and processes)</td>
<td></td>
</tr>
<tr>
<td>h) Metal (including tools and processes)</td>
<td></td>
</tr>
<tr>
<td>i) Plastics (including tools and processes)</td>
<td></td>
</tr>
<tr>
<td>j) Graphics</td>
<td></td>
</tr>
<tr>
<td>k) Design folio</td>
<td></td>
</tr>
</tbody>
</table>

6. Please choose three (3) of your highest priorities for training in table 3 above and give the specific topics which you would like to receive training in. Give your answers in table 4 below.

Table 4: Specific topics for in-service training

<table>
<thead>
<tr>
<th>Content area</th>
<th>Specific topics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Part C: The practical issues affecting the delivery of the D&T curriculum

This part is intended to obtain your views and opinions about the main issues affecting your capacity to implement the BGCSE D&T curriculum.

7. Please put a cross (x) in the box that best describes your assessment of the current situation in your school.

**Key: 6 = Completely Satisfied; 1 = Very Dissatisfied**

**Table 5 – Issues affecting the delivery of the BGSE D&T curriculum**

<table>
<thead>
<tr>
<th>Issues to consider</th>
<th>Your assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6</td>
</tr>
<tr>
<td>a) Students’ academic capability (in your school)</td>
<td></td>
</tr>
<tr>
<td>b) Qualifications of teachers (in your school)</td>
<td></td>
</tr>
<tr>
<td>c) Experience of the teachers (in your school)</td>
<td></td>
</tr>
<tr>
<td>d) Amount of content to cover in the 2-year period</td>
<td></td>
</tr>
<tr>
<td>e) Provision of teaching and learning resources</td>
<td></td>
</tr>
<tr>
<td>f) Number of periods allocated for teaching D&amp;T</td>
<td></td>
</tr>
<tr>
<td>g) Administrative support offered by your School head</td>
<td></td>
</tr>
<tr>
<td>h) Support offered by the HOD (Practical subjects)</td>
<td></td>
</tr>
<tr>
<td>i) Support offered by Senior teacher (Grade 1)</td>
<td></td>
</tr>
<tr>
<td>j) Support offered by Principal education officer (D&amp;T)</td>
<td></td>
</tr>
<tr>
<td>k) Provision of in-service training in D&amp;T</td>
<td></td>
</tr>
</tbody>
</table>

**NB: Administrative support** may be demonstrated by provision of funding and resources for the subject as well as by other means aimed at promoting the subject.
Part D: The factors affecting implementation and suggestions for improvement

The part asks you to provide your assessment of the main factors affecting the delivery of the D&T curriculum and offer suggestions on what could be done to improve the situation.

8. In the space below list the issues (in table 5 above) which you have awarded low scores (1 – 3) and provide reasons for your rating.

<table>
<thead>
<tr>
<th>Issues</th>
<th>Reasons for awarding low scores (in table 5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

9. What are your suggestions on how the issues you mentioned in 8 above could be addressed?
Thank you very much for your time

To explore further the issues raised in this questionnaire, group interviews will be arranged in your region at a later stage. If you would like to participate, please provide your name and contact details below.

Name: ___________________________  Mobile no: _______________________

Email address: __________________

If you have any questions about the survey please contact: Victor Ruele, PhD Scholar at Loughborough University, Mobile: +447436851800 E-mail: v.t.ruele@lboro.ac.uk or Vicrhuu@gmail.com
### Appendix 5.2: Interview Schedule for Senior Teacher 1s (ST1s)

<table>
<thead>
<tr>
<th>Date:</th>
<th>Time:</th>
<th>Place:</th>
<th>Interviewee:</th>
<th>Duration:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Questions</th>
<th>Codes</th>
<th>Responses</th>
<th>Themes/Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Can you briefly explain your roles and responsibilities in the department?</strong></td>
<td>ROL</td>
<td></td>
<td>• <strong>Roles and Responsibilities</strong></td>
</tr>
<tr>
<td>a) How many teachers do you have in your department?</td>
<td>STA</td>
<td></td>
<td>• <strong>Assessment of adequacy of staffing</strong></td>
</tr>
<tr>
<td>• <strong>Probe:</strong> How you describe their expertise in the subject and level of teaching experience?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) What teaching approach do you use to deliver the curriculum? (Do your teachers specialise or they are generalists?)</td>
<td>STR</td>
<td></td>
<td>• <strong>Assessment of teaching strategies employed</strong></td>
</tr>
<tr>
<td>• <strong>Probe:</strong> What is your view on this approach?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c) What teaching and learning resources do you have which enable you to deliver the programme effectively?</td>
<td>RES</td>
<td></td>
<td>• <strong>Assessment of the level of resources.</strong></td>
</tr>
</tbody>
</table>
### Questions, Codes, Responses, Themes/Issues

<table>
<thead>
<tr>
<th>Questions</th>
<th>Codes</th>
<th>Responses</th>
<th>Themes/Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2. Can you tell me how your teachers are being supported to deliver the curriculum?</strong></td>
<td>CPD</td>
<td>• Nature of current teacher support system</td>
<td>• Effectiveness of current teacher support system</td>
</tr>
<tr>
<td><strong>a) What professional development programmes have you planned for your teachers?</strong></td>
<td>CPD</td>
<td>• Adequacy of planned teacher professional development programs</td>
<td></td>
</tr>
<tr>
<td><strong>b) How do you collaborate with teachers in your department to promoting their professional development?</strong></td>
<td>CPD</td>
<td>• The level of teacher participation in their own CPD</td>
<td></td>
</tr>
<tr>
<td><strong>c) How satisfied are you with the support you offer the teachers?</strong></td>
<td>SAT</td>
<td>• A measure of satisfaction regarding support offered to teachers</td>
<td></td>
</tr>
<tr>
<td><strong>d) What is your view of the adequacy of time given to teachers for their professional development?</strong></td>
<td>TIM</td>
<td>• Adequacy of time to practise the new skills</td>
<td></td>
</tr>
<tr>
<td><strong>d) How satisfied are you with the resources given to your department?</strong></td>
<td>SAT</td>
<td>• A measure of satisfaction with level of resources</td>
<td></td>
</tr>
<tr>
<td><strong>e) How would you describe the level of support you receive from; 1- the school management; and 2- the regional office?</strong></td>
<td>ADM</td>
<td>• Level of administrative support offered</td>
<td></td>
</tr>
</tbody>
</table>
- **Probe:** How do you monitor your teachers’ continuous growth and professional development in subject?

| MON |

3. **Identification of main issues affecting the implementation of the D&T curriculum?**

| COMP |  
|---|---|
| a) What knowledge and skills are critical for delivering a D&T curriculum? | **A measure of the level of teacher competencies in the subject.** |
| SUP |  
| b) What are the specific aspects of teaching and learning do you think D&T teachers need support in? | **Identification of specific needs** |
| FAC |  
| c) What issues in your department do you think affect implementation? | **Identification of restraining factors in schools.** |

| PRIO |

- **Probe:** Which of these do you regard as high priority issues?

|  | **Identification of priority areas** |
4. *Before we close our interview, would you like to make any further comments or suggestions?*

Suggestions or ideas which might help us to develop a more effective teacher support system

**Concluding remarks**

- Please note that I may need to get back to you in the future for clarification on some issues pertaining to this interview.

- So let us keep channels of communication open.

Thank you very much for your time
Appendix 5. 3: Interview Schedule for INSET Officers (PEOs)

<table>
<thead>
<tr>
<th>Questions</th>
<th>Codes</th>
<th>Responses</th>
<th>Themes/Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. As an officer responsible for D&amp;T, can you explain what your roles and responsibilities are?</td>
<td>ROL</td>
<td></td>
<td>• <strong>Roles and Responsibilities</strong></td>
</tr>
<tr>
<td>a) Can you describe your working relationship with schools?</td>
<td>COLL</td>
<td></td>
<td>• <strong>Relations or level of collaboration with schools</strong></td>
</tr>
<tr>
<td>b) What kinds of services does your office offer to schools?</td>
<td>SER</td>
<td></td>
<td>• <strong>Services provided to schools</strong></td>
</tr>
<tr>
<td>Questions</td>
<td>Codes</td>
<td>Responses</td>
<td>Themes/Issues</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
<td>-------</td>
<td>-----------</td>
<td>---------------------------------------------------</td>
</tr>
<tr>
<td>c) What capacity do you have which enables you to deliver on your mandate?</td>
<td>CAP</td>
<td></td>
<td>• Capacity to deliver; and Resource provision</td>
</tr>
<tr>
<td>d) How satisfied are you with the mandate and resources you?</td>
<td>SAT</td>
<td></td>
<td>• Level of satisfaction with mandate and resources</td>
</tr>
<tr>
<td>2. Can you tell me about a support system you are using to help teachers to deliver the D&amp;T curriculum in schools?</td>
<td>CPD</td>
<td></td>
<td>• Description of the nature of current teacher support system</td>
</tr>
<tr>
<td>a) Can you describe how the current teacher support system works?</td>
<td>CPD</td>
<td></td>
<td>• Effectiveness of current teacher support system</td>
</tr>
<tr>
<td>Question</td>
<td>Code</td>
<td>Adequacy of planned teacher professional development programs</td>
<td></td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
<td>-------</td>
<td>---------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>b) What kinds of professional development programmes have been planned for D&amp;T teachers in your region?</td>
<td>CPD</td>
<td>Adequacy of planned teacher professional development programs</td>
<td></td>
</tr>
<tr>
<td>c) What roles are played by schools in planning these programmes?</td>
<td>COLL</td>
<td>The level of collaboration with schools in CPD of teachers</td>
<td></td>
</tr>
<tr>
<td><strong>Probe:</strong> How have you encouraged teachers to participate in their own professional development in your region?</td>
<td>CPD</td>
<td>The level of teacher participation in their own professional development.</td>
<td></td>
</tr>
<tr>
<td><strong>Probe:</strong> What is your view of the adequacy of time given to teachers for in-service training?</td>
<td>TIM</td>
<td>Adequacy of time to practise the new skills</td>
<td></td>
</tr>
<tr>
<td><strong>Probe:</strong> How does your office monitor teachers’ continuous growth and professional development in D&amp;T?</td>
<td>EVAL</td>
<td>Coaching/Mentoring; Monitoring and Evaluation.</td>
<td></td>
</tr>
</tbody>
</table>
3. **Identification of main issues affecting the implementation of the D&T curriculum?**

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>a)</strong> <em>In your experience, how supportive are schools heads to the service you are offering schools?</em></td>
<td>ADM</td>
<td>• A measure of <em>administrative support</em> at school level</td>
</tr>
<tr>
<td><strong>b)</strong> <em>What competencies are critical for delivering a D&amp;T curriculum at school level?</em></td>
<td>COMP</td>
<td>• A measure of the level of teacher <em>competencies</em> in the subject.</td>
</tr>
<tr>
<td><strong>c)</strong> <em>What issues in schools do you think affect the implementation of D&amp;T?</em></td>
<td>FAC</td>
<td>• Identification of <em>restraining factors</em> in schools.</td>
</tr>
</tbody>
</table>

- **Probe:** *How much have these issues affected the implementation of the subject in schools?*

- **Probe:** *Which of these do you regard as high priority issues?*

  - **EFF**
  - **PRIO**

  - • Assessment of the *effects* on teaching and learning
  - • Identification of *priority areas*
4. Before we close our interview, would you like to make any comments or suggestions for future planning?

<table>
<thead>
<tr>
<th>Suggestions or ideas which might help to develop a more effective support system</th>
</tr>
</thead>
</table>

Concluding remarks

- Please note that I may need to get back to you in the future for clarification on some issues pertaining to this interview.

- So let us keep channels of communication open.

Thank you very much for your time
### Appendix 5.4: Tables with Coded Segments – Case Study 2 - Teacher Questionnaire

<table>
<thead>
<tr>
<th>ID</th>
<th>Teachers’ responses to low capability in CAD/CAM</th>
<th>Codes</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>T3</td>
<td>Studied CAD but lacked practice due to lack of equipment;</td>
<td>PRAC EQUI</td>
<td>5 2</td>
</tr>
<tr>
<td>T17</td>
<td>I did not have extensive training in CAD/CAM applications as well as Desktop publishing</td>
<td>ITT</td>
<td>1</td>
</tr>
<tr>
<td>T19</td>
<td>CAD was and has never been taught at most schools and often the equipment would not be in a good condition</td>
<td>EQUI</td>
<td>2</td>
</tr>
<tr>
<td>T24</td>
<td>Whilst studying did not get to master the practical aspects much</td>
<td>ITT PRAC</td>
<td>1 5</td>
</tr>
<tr>
<td>T28</td>
<td>CAD/CAM has not been taught to many teachers and even resource persons cannot teach it with confidence</td>
<td>ITT OTHER</td>
<td>1 7</td>
</tr>
<tr>
<td>T35</td>
<td>Covered the course at tertiary level and since then I haven’t had any practice on this course.</td>
<td>ITT PRAC</td>
<td>1 5</td>
</tr>
<tr>
<td>T39</td>
<td>Since I completed my studies, I have never taught CAD/CAM.</td>
<td>PRAC</td>
<td>5</td>
</tr>
<tr>
<td>T41</td>
<td>“The school I’m teaching in has malfunctioning machinery. Therefore there is less practice on this. The little skills that I have acquired during my school days are disappearing”.</td>
<td>EQUI PRAC</td>
<td>2 5</td>
</tr>
<tr>
<td>T42</td>
<td>“Lack of practice due to shortage of materials/resources”.</td>
<td>PRAC RES</td>
<td>5 3</td>
</tr>
<tr>
<td>T45</td>
<td>Never trained or resourced in this area at college or in-service training.</td>
<td>ITT INSET</td>
<td>1 4</td>
</tr>
<tr>
<td>T46</td>
<td>“Did the course theoretically, no practical or less practice made”.</td>
<td>ITT PRAC</td>
<td>1 5</td>
</tr>
<tr>
<td>T47</td>
<td>“Lack of training”</td>
<td>INSET</td>
<td>4</td>
</tr>
<tr>
<td>T48</td>
<td>CAD/CAM remains a challenge because since I did it at university (sic)</td>
<td>PRAC</td>
<td>5</td>
</tr>
<tr>
<td>T50</td>
<td>“I did not get enough practice/exposure of pneumatics and CAD/CAM at tertiary level”; “Lack of teaching and learning resources”.</td>
<td>ITT PRAC RES</td>
<td>1 5 3</td>
</tr>
<tr>
<td>T51</td>
<td>“CAD/CAM equipment not working, therefore no practice”.</td>
<td>EQUI PRAC</td>
<td>2 5</td>
</tr>
<tr>
<td>T52</td>
<td>“No practical” (sic).</td>
<td>PRAC</td>
<td>5</td>
</tr>
<tr>
<td>T54</td>
<td>Covered it in my BEd programme and had never practiced it again</td>
<td>PRAC</td>
<td>5</td>
</tr>
</tbody>
</table>
Appendix 5.5: An Example of Qualitative Data Analysis – ST1s Responses to Q3 (b)

- **ST1**
  - "The teachers are different in terms of their abilities" → Abilities
  - Notes that teachers are different in terms of the level of knowledge and skills → Insights
  - In addressing the gaps in knowledge and skills one-size-fits-all may not be the right solution → Implications

- **ST2**
  - "Most of them are not bad; I think we need to bridge the gaps in control technology" → Abilities
  - Notes limitations in control technology → Insights
  - Highlights the uniqueness of individual teacher’s situation → Implications
  - Not quite satisfied → Skill upgrading or training

- **ST3**
  - "I would say that we're making an attempt in electronics; pneumatics we have discarded because we do not have supportive materials" → Abilities
  - Appreciates efforts made by teachers in electronics → Gaps
  - Notes limitations in pneumatics → Insights
  - Highlights teachers' limitation in pneumatics → Implications
  - Content area is not adequately resourced → Skill upgrading or training

- **ST4**
  - "Our teachers don’t have the practical skills, and most of them lack technology skills. The greatest challenge is imparting the knowledge" → Abilities
  - The greatest challenge is in imparting knowledge → Practical skills
  - Lack of practical skills may be impacting negatively on student learning → Gaps
  - Technology skills → Implications
  - Provision of resources and training → Skill upgrading or training
Appendix 5. 6: Sample Coded Questionnaire Script

- T41
  - “The school I’m teaching at has malfunctioning machinery. Therefore there is less practice on this. The little skills that I have acquired during my school days are disappearing”.
  - Analysis of the data and coding:
    - Equipment not in good condition (EQUI)
    - Limited skills or expertise (ITT; EXP)
    - Lack of practice (PRAC)

- T42
  - “Lack of practice due to shortage of materials/resources”.
  - “Lack of confidence and passion for the subject”.
    - Analysis of the data and coding:
      - Limited practical experience (PRAC)
      - Resources to practise with (RES)

- T43
  - “There is no equipment in most schools that I have taught in as such I never had a chance of practising the skills I learnt at the university”.
  - Equipment not in good condition (EQUI)
  - Limited skills or expertise (ITT; EXP)
  - Lack of practice (PRAC)
  - Analysis of the data and coding:
    - Teacher’s negative attitude toward the subject (ATT)

- T44
  - “CAD/CAM – Never trained or resourced in this area at college or in-service training. No background”.
  - “Did the course theoretically, no practical or less practice made”. “Desktop Publishing – never did it before”.
    - No background in the subject due lack of exposure during initial training (ITT)
    - Lack of in-service support (INSET)
    - Limited practical experience or exposure during initial training (ITT; PRAC)
    - Analysis of the data and coding:
      - Limited practical experience or exposure during initial training (ITT; PRAC)

- T45
  - Limited practical experience or exposure during initial training (ITT; PRAC)
APPENDICES

CASE STUDY 3
Appendix 6. 1: A needs Assessment Questionnaire

Personalised training plan

Introduction

Hello everyone. My name is Victor Ruele. I'm currently pursuing doctoral studies at Loughborough university, in England.

This is a needs analysis proforma intended to help plan and design resource materials to support the teaching and learning of the electronics content area of the BGCSE D&T curriculum. With this study I intend to work with you to trial and evaluate a school-based in-service training system which is aimed at helping you to cope with some new content areas of the curriculum.

The information you provide will be used purely for academic purposes and will be treated with utmost confidentiality.

Instructions on how to fill out this form are provided in their relevant sections.

It should take about 15 minutes of your time to fill the form.

A needs Analysis Proforma

1. Kindly provide your personal details in the table below

<table>
<thead>
<tr>
<th>Name:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of your School:</td>
<td></td>
</tr>
</tbody>
</table>

To add your details, just click inside the window below
Appendices

<table>
<thead>
<tr>
<th>Region:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender:</td>
<td></td>
</tr>
<tr>
<td>No. of students per class:</td>
<td></td>
</tr>
</tbody>
</table>

This section will help us determine the appropriate starting point for you. Please answer it as honestly as you can.

2. Are you currently teaching electronics in your school?
   - Yes
   - No

If you answered No above, go to question 4

3. If you answered with a Yes in question 2, which classes have you been teaching?
   - Form 4
   - Form 5
   - Both

4. Which of the following best describes your current level of knowledge in electronics? Please select the option that best matches your answer.
   - Beginner
   - Intermediate
5. This question assesses your capability to deliver electronics in your department.

<table>
<thead>
<tr>
<th>Question</th>
<th>Space</th>
</tr>
</thead>
<tbody>
<tr>
<td>How would you describe your level of interest in electronics?</td>
<td></td>
</tr>
<tr>
<td>What are your personal strengths that enable you to cope with the teaching of electronics?</td>
<td></td>
</tr>
<tr>
<td>How much support do you give each other as colleagues in your department? (Optional)</td>
<td></td>
</tr>
</tbody>
</table>

**Part A: Your personalised training plan**

This part asks you to help us plan and design training that is relevant to your individual needs and those of your department.

6. Please indicate the area of electronics you will need training in.

<table>
<thead>
<tr>
<th>Electronics Type</th>
<th>Space</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analogue electronics</td>
<td></td>
</tr>
<tr>
<td>Digital electronics</td>
<td></td>
</tr>
</tbody>
</table>
### Appendices

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Electro-mechanical devices</td>
<td></td>
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<tr>
<td>Interfacing circuits</td>
<td></td>
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<tr>
<td>Microcontrollers</td>
<td></td>
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<tr>
<td>PCB design and manufacture</td>
<td></td>
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<tr>
<td>Product design using electronics</td>
<td></td>
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<tr>
<td>Problem solving using electronics</td>
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<tr>
<td>Others, please specify</td>
<td></td>
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</tbody>
</table>

7. To help us prioritize your needs, please rank these topic areas according to your most pressing need. Use the following rating scale below for guidance: 6 = Highest priority; 1 = Lowest priority.

<table>
<thead>
<tr>
<th></th>
<th>6</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
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</thead>
<tbody>
<tr>
<td>Analogue electronics</td>
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<tr>
<td>Digital electronics</td>
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<tr>
<td>Electro-mechanical devices</td>
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</table>

4/7
Part D: Classroom practice and challenges

The part asks you to describe the strategies you are using to teach electronics and the challenges you are facing.

8. [missing question text]

<table>
<thead>
<tr>
<th>Please write your answers in the space below</th>
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</thead>
<tbody>
<tr>
<td>What strategies are you currently using to teach electronics?</td>
</tr>
<tr>
<td>How will you integrate electronics into the whole D&amp;T curriculum?</td>
</tr>
<tr>
<td>What are the major challenges in teaching electronics in your school?</td>
</tr>
<tr>
<td>How would you like to be assisted to overcome these challenges?</td>
</tr>
</tbody>
</table>

9. This section assesses the level of resources pertaining to the teaching of electronics in your school. A list of recommended equipment and resources are provided.

<table>
<thead>
<tr>
<th>Please write comments against each item regarding its availability and condition.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electronics lab (is the lab set up and fully functional?)</td>
</tr>
</tbody>
</table>

5/7
<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>What are you using power your electronic circuit?</td>
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<tr>
<td>What kinds of electronic components do you have?</td>
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<tr>
<td>Prototyping/Breadboards</td>
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<tr>
<td>Basic electronic hand tools (e.g. side cutters, pliers etc)</td>
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<tr>
<td>Soldering stations/Soldering irons</td>
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<tr>
<td>PCB manufacture equipment and accessories</td>
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<tr>
<td>Storage units for components and tools</td>
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<tr>
<td>Electronic simulation softwares</td>
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<tr>
<td>What kinds of electronic modelling kits do you have?</td>
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<tr>
<td>Computers</td>
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<tr>
<td>Internet access</td>
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</tbody>
</table>

THANK YOU FOR PARTICIPATING IN THIS SURVEY

More info

info

/7
Appendix 6.2: A Sample of a School-based In-Service Training – Kweneng Region
Venue: Mogoditshane Senior Secondary School
Dates: 17 – 19 July 2013

Organisers: Mrs Lesetedi and Mr Meshack

| Resource person: V. Ruele |

**PNEUMATICS CONTROL - TENTATIVE PROGRAMME**

<table>
<thead>
<tr>
<th>DAYS</th>
<th>TIMES</th>
<th>ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DAY 1 – WEDNESDAY 17 JULY 2013</strong></td>
<td></td>
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<tr>
<td>0800hrs – 0830hrs</td>
<td>Registration and administrative matters</td>
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<tr>
<td>0830 – 0900hrs</td>
<td>Open forum</td>
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<tr>
<td>0900hrs - 1000hrs</td>
<td>Course introduction and setting up of workstations</td>
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<tr>
<td>1000hrs - 1030hrs</td>
<td><strong>TEA BREAK</strong></td>
<td></td>
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</tbody>
</table>
| 1030hrs – 1100hrs | **Key concepts and principles**  
  - Key concepts pertaining to will be introduced and defined including a general knowledge and understanding of basic pneumatic principles and applications. |
| 1100hrs – 1130hrs | **Equipment, materials and components**  
  - Mainly the compressor: Principles and procedures of industrial air compressors. This will include pneumatic principles, determining air compressor requirements, air treatment, pressure controlling, system maintenance, safety features and troubleshooting. |
| 1130hrs – 1200hrs | **Cylinders, their types, structure, and operation**  
  - The construction and operation of various cylinder types, mainly single acting and double acting actuators. Cylinder sizing and air consumption calculations will also be discussed. |
| 1200hrs - 1230hrs | **Control valves and valve actuators, construction, operation and application.**  
  - This will cover directional valve types, structure and operation, actuation methods, and switching positions, pathways. Spool, Pilot operated and poppet valve types will be illustrated and discussed. |

**NB:** In all the above sessions the participants will gain some knowledge and understanding of how pneumatic components function as well as gain practical experience in their use.
<table>
<thead>
<tr>
<th>DAYS</th>
<th>TIMES</th>
<th>ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>DAY 2</td>
<td>1230hrs – 1400hrs</td>
<td>LUNCH BREAK</td>
</tr>
<tr>
<td></td>
<td>0800hrs – 0830hrs</td>
<td>• Open forum (A discussion forum for any emerging issues)</td>
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<tr>
<td></td>
<td>0840 – 0910hrs</td>
<td><strong>Time delay operation</strong></td>
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<td>• The design, application and operation of time delay circuits using a reservoir will be illustrated and modelled.</td>
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<td></td>
<td>0915hrs - 1000hrs</td>
<td><strong>Sequential control</strong></td>
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<td>• The session will also cover the following: circuits for reciprocating movement, automatic return and sequential control.</td>
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<tr>
<td></td>
<td>1000hrs - 1030hrs</td>
<td>TEA BREAK</td>
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<tr>
<td></td>
<td>1040hrs – 1220hrs</td>
<td><strong>Circuit Presentation and Analysis</strong></td>
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<td>• This session will give participants guidance on layout and presentation of pneumatic circuits. It will explain the various layouts for schematic drawings.</td>
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<td></td>
<td>1230hrs – 1330hrs</td>
<td>LUNCH BREAK</td>
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<tr>
<td></td>
<td>1340hrs – 1440hrs</td>
<td><strong>Introduction to electro-pneumatics</strong></td>
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<td>• The session will cover the use of electrical switching circuits which employ a 3/2 solenoid/spring valve; 5/2 solenoid/spring return and 5/2 solenoid/solenoid valve; electro-pneumatic reciprocating circuit; micro switches and reed switch sensing.</td>
</tr>
<tr>
<td></td>
<td>1445hrs - 1545hrs</td>
<td><strong>Introduction to microcomputer controlled pneumatic systems</strong></td>
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<td>• These activities will cover the use of computer program to control reciprocating movement and sequential control of cylinders.</td>
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<td>1600hrs – 1630hrs</td>
<td>FEEDBACK SESSION AND CLOSURE</td>
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