Investigating the Impact of Information Communication Technology on Self-directed Professional Development of Teachers

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An investigation of the perceived impact of ICT on the self-directed professional development of Zimbabwean A-level science and mathematics teachers

Thesis presented in fulfilment for the requirements of the PhD Programme

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Abstract

The aim of this research was *to investigate the perceived impact of ICT on Zimbabwean A-level science and mathematics teachers' self-directed professional development.*

The study was based on a questionnaire survey of 254 teachers throughout the country. Supplementary data came from 54 interviews. Some observations of teachers using ICT in teacher-centres, e-mail correspondence, and field reports also contributed to the database of the study. An analysis framework was developed through the use of grounded theory on the interview transcripts. The framework yielded 9 themes relating to the teachers' use of ICT for their professional development. These were: (1) perceived professional identity; (2) career development; (3) Managing the ICT environment; (4) theoretical and content knowledge; (5) practical knowledge and skills; (6) adaptation; (7) professional networking and; (8-9) perceived benefits to teachers and students.

Chaos (complexity) theory was used to identify the major attractors (goals) for teachers' self-directed professional development using ICT. Two attractors were identified. These were personal professional development and classroom practice. However, an over-riding factor common to both attractors was identified as self-efficacy. The study identified the over-arching driver for self-directed professional development as the teacher's need to improve their self-efficacy. A two dimensional model of self-directed professional development was suggested. The systemic element of the model focused on the self-correcting impact of ICT use on professional development, whilst the personal element focused on self-efficacy as the central *stratum* for self-directed professional development.

The study concluded by acknowledging the potent role that ICT is playing in the self-directed continuing professional development of teachers in Zimbabwe, and recommended, among other things, the inclusion of A-level teachers in the development of localised online materials resources for their subjects. This will help to enhance relevance of the materials to the Zimbabwean context. This dissertation contains 96865 words.

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> The guide said to the explorer, my journey ends here, yours begins. From now on, you do not follow my footsteps in the sand – you have to make your own for others to follow….
> (Marx et. al., 1994 p1)

In Zimbabwe we have a saying: "*Nzombe yakabva mukurerwa*" (literally: An adult bull is the result of careful breeding). There are some people who have played a pivotal role in making this journey not only possible for me, but successful as well.

I extend my gratitude to the administration of the University of Zimbabwe, especially professor L. Nyagura, whose kind words of encouragement during my field-work in 2003/2004, gave me inspiration. I am also grateful to the Dean of Education, Dr. C. Dyanda who assisted me to negotiate for access into the schools. My thanks also go to my colleagues in the Department of Science and Mathematics Education, namely Dr. D. J. K. Mtetwa and Ms. R. Ngara, who provided moral and logistical support during the field-work phase of the project.

Several officers in the Ministry of Education, Sport and Culture in Harare and in the Regions played a crucial role in facilitating my access to the teachers' resource centres. I am therefore indebted to Dr. S. M. Mahere, Mr. Chinamasa and their colleagues for granting me access letters and for providing me with information concerning nationwide statistics on A-level schools and their enrolment. Education officers; Mr. Mushonga in Masvingo, Mr. W. Moyo in Bulawayo, and Mr. Chisindi in Mashonaland East, among others, played a pivotal role in ensuring that my questionnaires reached the teachers and were returned to me, for that I am grateful. My gratitude also goes to the A-level science, mathematics and geography teachers throughout the country, who allowed me into their milieu and enabled me to get first hand experience of their struggle for professional liberation. I am cognisant of the fact that the research

was carried out during a very difficult and trying period for the teaching profession, and yet they managed to make time, from their busy schedules, to assist me. Without their determination and courage in the face of difficulties, I would not have been able to carry on with the study.

I am also keenly aware that the production of this thesis was not easy. During the period when I was developing and writing my research, there were times when I was ready to give up, times when I felt as much on the verge of "researcher burnout" as the teachers' I was describing. I am very grateful to my colleagues and fellow Ph.D and M.Phil students in Department of Educational Studies, University of York, who provided useful advice and a sympathetic ear when I needed to discuss my problems with someone. In particular, I want to thank Lilian Sheu, Quimah Ismael and Marco Delgado.

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Finally, at the very core of my life as a researcher, I was anchored by those dearest to me – the people who sacrificed all to ensure my success – my wife, Ngonidzashe and sons, Tendaishe and Vimbainashe; and my dear friend and colleague, Dr. Martie Sanders. Thank you for believing in me and for encouraging me even when things appeared most difficult. Thank you also for opting to go without, in order to support my field-work and above all, thank you for being there when I needed you most.

List of Abbreviations

AEI	Australian Education Index
AIEMS	Action to improve English Mathematics and Science
BEI	British Education Index
BERA	British Educational Research Association
BSPZ	Better Schools Programme in Zimbabwe
BUSE	Bindura University of Science Education
CDU	Curriculum Development Unit
CSO	Central Statistics Office
DETYA	Department of Education, Training and Youth Affairs
EFA	Education for all
ICT	Information communication technology
ICDL	International computer driver's licence
NUST	National University for Science and Technology
PCK	Pedagogical Content Knowledge
PGCE	Post-graduate Certificate in Education
PG DipScEd	Post-graduate Diploma in Science Education
SEITT	Science Education In-service Teacher Training Programme
SOCQ	Stages of Concern Questionnaire
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Educational Fund
WORLD	World Links for Development
UZ	University of Zimbabwe
ZIMSEC	Zimbabwe Schools Examinations Council

Chapter 1: Background to the study

> *Educational reforms require that teachers learn new roles and ways of teaching that translate into a long time developmental process requiring teachers to focus on changing their own practice. The demands posed by daily teaching and other aspects of the dynamic school curriculum continue to absorb a bulk of teachers energy, thoughts and attention. (McDiarmid et. al., 2002 p 410)*

1.0 Introduction

The observation above summarises the state of education reforms the world over. New reforms in education are constantly being introduced in a bid to improve the quality of delivery. At the centre of all these reforms, teachers are the key players. However, in the developing world, teachers are expected to do so much with so little. In many cases, they are not adequately prepared for the reforms which are imposed upon them. In some cases, they have little institutional support. My own experience as a teacher in Zimbabwe, and as one who later on worked with science and mathematics teachers across the whole country, highlighted the enormous professional pressure that Zimbabwean teachers have to operate under. The teachers showed remarkable resilience in their daily struggle to make meaning of their existence as professionals. They continue to adapt to the changes mirrored in society, such as the introduction of information, communication technology (ICT) in commerce, industry and business.

I was fascinated by this resilience and adaptability especially with respect to ICT and chose to try and understand at greater depth what impact ICT was having on the teachers' professional development, considering that the teachers, were under no obligation to use ICT for their professional development and received negligible institutional support for these activities. This study was born

out of a need to develop a supportive and sustainable structure which would facilitate self-directed professional development initiatives by teachers.

1.1 The context of science and mathematics education in Zimbabwe

1.1.1 Country profile

Figure 1.1 shows Zimbabwe's geographical location in Southern Africa.

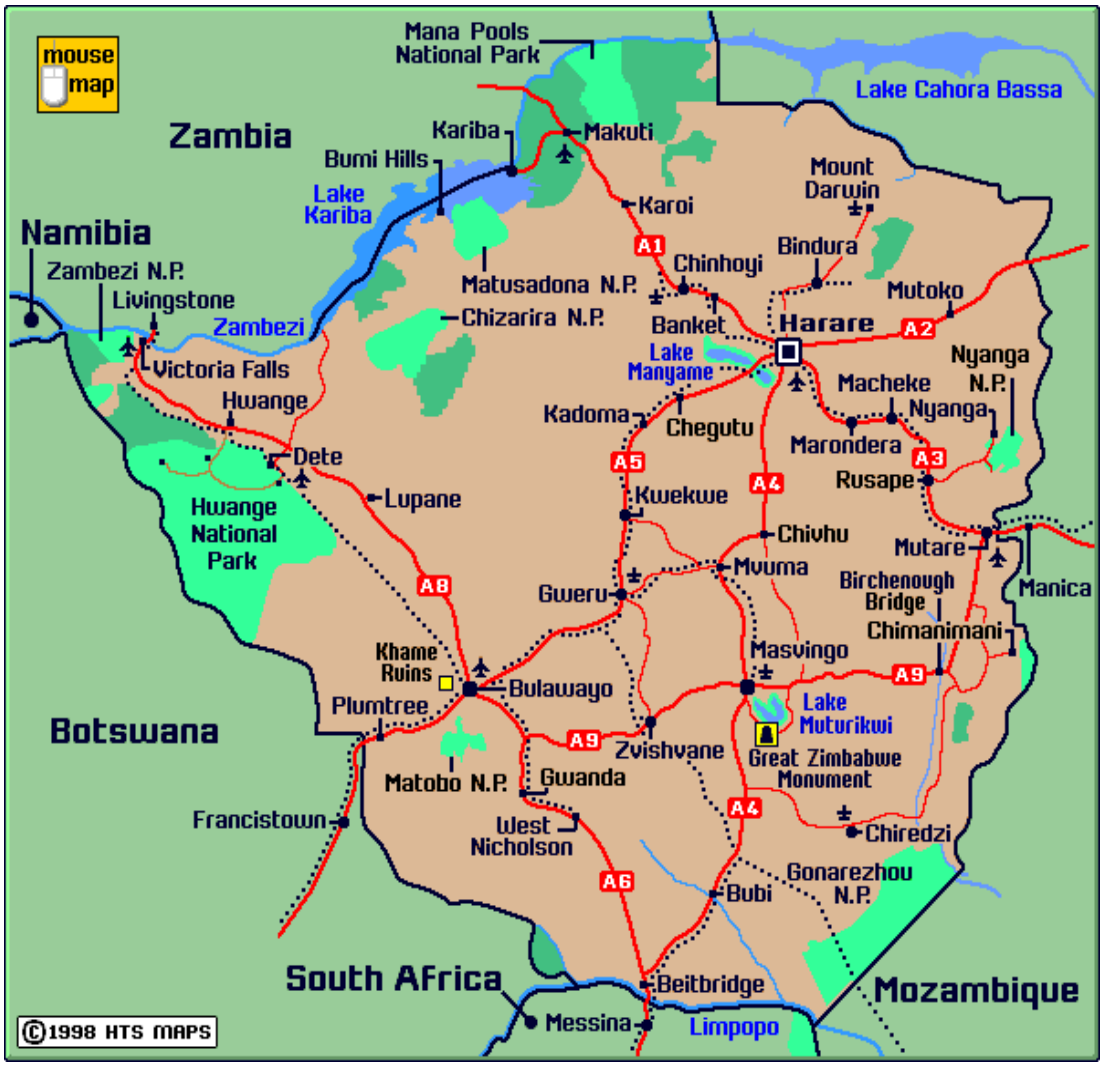

Figure 1.1 **Map of Zimbabwe** (HTS Maps, 1998)

With a population of 12.8 million (UNICEF, 2003), Zimbabwe covers almost 391,000 square kilometres of high plateau country. Most of the population live in the rural areas although Harare, the capital city is estimated to be home to almost 2 million people (CSO, 2000). The main ethnic groups are the Shona

(74%) and Ndebele (19%), with the rest of the population being of Asian, European and other ethnic minorities. The United Nations Development Programme (UNDP) estimates that the average life expectancy has dropped to 33 years as a result of the current HIV / AIDS crisis which has ravaged sub-Saharan Africa (UNDP, 2003).

Zimbabwe is a developing country in the low income group, with a low human development index in 2001 of 0.496 (UNDP, 2003). The human development index measures a country's development in terms of social, political and economic development benchmarks agreed upon by the United Nations. The index ranges from 0.3 for the least developed country, to 0.99 for the most developed country. Zimbabwe is currently ranked number 145 out of the 175 United Nations member states currently participating in the United Nations Development Programme.

Zimbabwe has a high adult literacy rate of 90.0% (EFA, 2005). The country has three official languages, i.e. English, Shona and Ndebele. Until recently, primary education was universal and subsidised.

1.1.2 Pathways to A-level teaching in Zimbabwe

At Independence in 1980, the new Government expanded the education system by increasing enrolment and investing in the education sector. The general education index increased from 0.46 in 1980 to 0.79 in 2001 (UNDP, 2003). The increase was caused by the rising enrolment at both primary and secondary levels (UNESCO, 2004). However, the increase in pupil enrolment was not mirrored by a similar increase in the training of teachers and over the years teachers have been presented with challenges to their professional practice, associated with large classes and diminishing resources (Chivore, 1986). The greatest pressure has been felt by A-level science and mathematics

teachers, who need specialised equipment, resources and training. The country's single university in the 1980s could not cope with the demand.

To meet some of these challenges, more teachers' colleges and universities have been commissioned, and curricula and programmes at the existing institutions had to be modified to cater for the increased demand.

By 2001 Zimbabwe had seven state and four private universities. Most of these are involved in initial teacher training. In addition, the government has entered into partnership with friendly countries, to help train science and mathematics teachers to teach up to A-level. This has increased the number of routes that prospective science and mathematics teachers could take to acquire their qualifications. The table below show some of the Teacher qualifications held by Zimbabwean A-level Science and Mathematics teachers.

	Length of Programme			
Training Institution	**Subject Theory**	**Professional Theory**	**Teaching Practice**	**Qualification**
University of Zimbabwe	24 months	2 hrs per week	nil	B. Ed
University of Zimbabwe	36 months	nil	nil	BSc
University of Zimbabwe	nil	6 months	3 months	Post-GradCE
University of Zimbabwe	3 months	3 months (concurrent)	18 months	PGDipScEd
National University of Science and Technology	36 months	Information not available	Information not available	BSc.
Bindura University of Science education	48 months	24 months (concurrent)	12 months	B.Sc.Ed
Cuba Programme	Total time = 60 months	Information not available	Information not available	Licentiate

Table 1.1 Qualification routes for science / mathematics teachers

The University of Zimbabwe (UZ) as the country's oldest institution, has initiated several programmes to increase both the quantity and quality of A-level science / mathematics teachers in Zimbabwe. The programmes highlighted in table 1.1 bear testimony to these initiatives. The traditional route (*Bachelor of Science* (BSc) + *Post graduate certificate in education* (PGCE)) offers the University's own initial teacher training programme. The *Bachelor of Education*

(B.Ed) programme is aimed at upgrading college-trained teachers and hence the focus on subject content. The *Post-Graduate Diploma in Science Education* (PG DipScEd) programme is a recent initiative aimed at producing resource teachers who can act as mentor teachers in their regions. The emphasis of the programme is on professional knowledge and practice.

The Bindura University for Science Education (BUSE) provides Bachelor of Science Education (B.Sc.Ed.) qualifications. BUSE was the first university dedicated to science education. The National University of Science and Technology (NUST) was conceived as a university with strong industry and technology links and therefore focuses more on subject content theory. Its graduates have to enrol with the University of Zimbabwe (UZ) for the PGCE programme in order to operate as qualified graduate teachers.

In other universities both within the country and without, the foci differ depending on the orientation of the university.

Unfortunately, as can be deduced from the above argument, the diversity of training routes also presents challenges to further professional development as, although they all cover training in the essential strands of teacher education, i.e. subject content, professional foundations and teaching practice, the training institutions have no standardised curriculum (Maringe, 2005).

Zimbabwe has been divided into 10 educational regions to facilitate administration of the country's rapidly expanding educational system. However, for administrative reasons, two regions (Matebeland North and Bulawayo) remain fused together because the former region has poor infrastructure, thus effectively, nine educational regions are operational, (see page 69). In 2001 Zimbabwe had 172 high schools which offered A-level subjects in Biology, Chemistry, Geography, Mathematics and Physics (Ministry of Education, 2001)

If one assumes that each of these schools employs at least one teacher per A-level mathematics / science subject, then these subjects are taught by at least 860 teachers who have received their initial qualification through the routes identified in table 1.1.

This means that in 2001 science and mathematics A-level subjects in schools were taught by teachers from a mixture of backgrounds having a range of competencies and skills in their specialist subjects and pedagogy. Depending on where they obtained their teaching qualifications, these teachers also have very different views about the epistemology of teaching, professionalism and what it means to be a teacher (Maringe, 2005).

1.1.3 Challenges facing A-level science / mathematics teachers in Zimbabwe

The establishment of the Zimbabwe Schools Examinations Council (ZIMSEC) in 1994 and the localisation of O-level examinations in 1998 (reported in Machinga, 2000) was inevitably accompanied by a shift in perspective and emphasis on the O-level curricula, as new syllabi were introduced. Localisation of O-level examinations resulted in a gap in pupil knowledge between what they learned in O-level and teacher expectations at the start of the lower sixth form (i.e. the first year of A-level). This meant that lower sixth teachers could no longer make assumptions about pupil prior knowledge when introducing topics and this was viewed as a drop in the quality of educational provision at O-level (Engels and Ncube, 1995). Thus A-level teachers had to cover the pre-requisites as well as the unwieldy, content-rich A-level syllabus within the 18 month provision for A-level. Teachers were faced with the onerous task of finding ways to assist increasingly less able students to cope with the demands of A-level work.

Due to the country's "developing nation" status, the expansion in education could not be matched with a proportional expansion in resources and personnel. Therefore teachers found themselves teaching large classes of ill-prepared students with fewer textbook and equipment resources (Engels, 1994). In the high density suburbs of Harare and Bulawayo, typical A-level classes can have up to 32 students per class.

Another big problem for teachers of all science and mathematics subjects has been the introduction of new topics such as Remote-sensing, Biotechnology and Astronomy have been introduced. The problem is that some teachers have not covered these same topics during their training and feel out of their depth when they have to teach them (McKenney, 2001).

Some other problems linked to the lack of resources for teaching including a lack of institutional support for teachers' professional development (Mushayikwa *et al.*., 1999) and to the introduction of the performance appraisal system which has tended to heighten anxiety among teachers.

All these problems have combined together to cause stress and frustration to teachers as they are still expected to produce good passes at the end of A-level and in some cases this means that they have to use their own resources to ensure that their students do well.

1.1.4 The use of ICT in professional development activities in Zimbabwe

In its Science and Technology Policy Document, the Government of Zimbabwe has stressed the central role played by the Information Communication Technology (ICT) industry in spearheading the economic development of the country (SLO, 2002). Indeed, the United Nations (UNDP,

2003) links information access to socio-economic development in its human development goals and states:

> Access to information enables empowerment and speeds up community development through increases in productivity, creativity and locally sprung innovative solutions to problems. (UNDP, 2003 p 144)

Several researchers, for example Nonaka and Tekeuchi (1995), Perraton and Creed (2000) and Cawthera (2001), have also linked unequal economic development with access to technology. The division between those with access and those without has been termed the “digital divide” and Perraton and Creed (2000) argued:

> ..The digital divide compounds existing inequalities between people within and between countries: the disparities of access are not random, but correlate strongly with income, education, ethnic origin, location and gender…(p. 4)

Beardon (1994) also recognised that the unequal distribution of information processing capability between and within societies creates unequal distribution of power. Hodson (1992) contends that acquiring ICT skills is especially important for science teachers because the computer is increasingly becoming an important tool for scientific research. Scientists use computers as modelling tools, as well as for theory building.

The education system, as a primary agent for change has to lead in the fight for information access through ICT and thus prepare future citizens for a better life (Cawthera, 2001). The problem therefore lies in determining the exact relationship between ICT and educational practice. However, as Herdman (1996) observed: