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Towards a conceptual framework for the design of a qualification in Music Technology at post-secondary institutions in South Africa

by

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ABSTRACT

This study examines the implications of education policy in South Africa on a transformational qualification design for Music Technology as a field of study. The study constructs a conceptual framework that informs the design of a qualification in Music Technology at post-secondary school level, using the knowledge and trends in the field of Music Technology and taking into account the requirements of South African education policy. An exemplar of the qualification, a Certificate in Music Technology at National Qualifications Framework Level 5, as required in the South African education framework, is presented.

The main research question that this study addresses is:

- How does the nature of the field of Music Technology and current South African education policy contribute to the development of a conceptual framework that informs the design of a qualification in Music Technology?

This research question is broken down into two specific sub-questions:

- What is the current nature of Music Technology internationally and as an emerging field of study in South Africa?
- What are the implications of current South African education policy for transformational qualification design?

The findings that emerge from the investigation of the research questions are:

- Music Technology is a vast, dynamic and constantly evolving field. Internationally as well as in South Africa, knowledge production in Music Technology is interdisciplinary in nature.
- Literature on Music Technology and technology–based education internationally shows no clear consensus with regard to qualification outcomes in Music Technology.
- The transformational agenda of South African education policy requires qualifications to integrate education and training, address the imbalances of the

past education practices and contribute towards the life performance roles of learners.

- South African education policy provides a qualification framework based on learning outcomes comprising of a combination of theory and practice. This serves the life performance roles of learners that guide the construction of a qualification in Music Technology.

Training in Music Technology internationally produces graduates with diverse specialties. Often these graduates do not meet national employment requirements in areas of music industry and education in countries where such requirements are established. This research addresses the gap that exists in South African education policy with regard to Music Technology as an emerging field of study in South Africa, to guide providers of education and to address national employment requirements.

The research is predominantly a qualitative study that uses literature survey, an overview of international trends in Music Technology, a critical analysis of existing South African programmes, interviews and Internet surveys.

Keywords:

Music Technology, Music Technology instruction, qualification design, outcomes-based education, South African education policy, interdisciplinary study, conceptual framework, curriculum development, post-secondary qualification, Certificate in Music Technology.

DEDICATION

I dedicate this work to my late parents, Devroop and Chaiterwanthee Ramnunan, who instilled in our family the value of education and who under very difficult circumstances made it their life's goal to give me, my brothers and sister a decent education.

Though we have made great strides
in reconstructing South Africa's education system,
a great deal more needs to be done.
(Mandela 1999: 5)

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CONTENTS

ABBREVIATIONS AND ACRONYMS

ABSA	Amalgamated Banks of South Africa
AC	Assessment Criteria
ANC	African National Congress
AT	Audio Technology
ATKV	Afrikaanse Taal- en Kultuurvereniging
C2005	Curriculum 2005
CBE/I/T	Computer-based Education/Instruction/Training
CCO(s)	Critical Cross-field Outcomes
CD(R)(RW)(ROM)	Compact Disk (Recordable)(Rewritable)(Read Only Memory)
CISLM	Computers, Information Systems and Laboratory Management
CM	Computer Music
CMI	Computer Music Instrument
COTEP	Committee on Teacher Education Policy
DAT	Digital Audio Tape
DCC	Digital Compact Cassette
DoE	Department of Education
DVD	Digital Versatile Disk
ELO(s)	Exit Level Outcomes
EMI(s)	Electronic Musical Instrument(s)
ETQA(s)	Education and Training Quality Assurer(s)
FET(B/C)	Further Education and Training (Band/Certificate)
FM	Frequency Modulation
GET(B/C)	General Education and Training (Band/Certificate)
HET(B/C)	Higher Education and Training (Band/Certificate)
HSRC	Human Sciences Research Council
IRC	Internet Relay Chat
IRCAM	*Institut de Recherche et Coordination Acoustique/Musique* (Institute for Research and Coordination of Acoustics and Music) (Paris, France)
ISME	International Society of Music Educators
IT	Internet and Telecommunications
IUPUI	Indiana University-Purdue University, Indianapolis, Indiana, USA

MAC	Apple Macintosh Computer
MDM	Multimedia and Digitized Media
MENC	Music Educators National Conference (USA)
MEUSSA	Music Education Unit Standards for Southern Africa
MIDI	Musical Instrument Digital Interface
MIT	Massachusetts Institute of Technology (USA)
MMCP	Manhattanville Music Curriculum Project
MN	Music Notation
MP3/MPEG 3	Motion Picture Expert Group, Layer 3
MS	MIDI Sequencing
NGO(s)	Non-Governmental Organization(s)
NQF	National Qualifications Framework
NSB	National Standards Body
OBE(T)	Outcomes-based Education (and Training)
ORTSTEP	ORT-Science and Technology Education Project
PBL	Problem-based learning
PC	Personal computer
PROTEC	Programme for Technological Careers
R	Research in Music Technology
RCA	Radio Corporation of America
RPL	Recognition of Prior Learning
RS(s)	Range Statements
SA	South Africa
SANLAM	Suid-Afrikaanse Lewensassuransiemaatskappy
SAQA	South African Qualifications Authority
SASOL	Suid-Afrikaanse Steenkool-,Olie- en Gaskorporasie
SGB	Standards Generating Body
SO(s)	Specific outcomes
UK	United Kingdom
UP	University of Pretoria
USA	United States of America
UNISA	University of South Africa
WWW	World Wide Web

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NOTES TO THE READER

1. The abbreviations CBE, CBI, CBT will be collectively referred to as CBE unless otherwise stipulated.
2. David Elliot's (1995: 12-13) four basic meanings regarding music education, "education in music", "education about music", "education for music", and "education by means of music", will underpin the use of the term "music education" in this study.
3. The term "Music Technology" refers to the course/subject/field of study, as opposed to the term "music technology", which refers to the technology/activity in music. Likewise the use of the upper case "M" in Music refers to the discipline whereas lower case "m" for music implies the generic use of the term.
4. The use of the upper case in "Field" refers to the Organizing Field classification of the National Standards Body 02.
5. To prevent confusion between the National Standards Body's "Field" (Organizing Field) and Music Technology as "field" (which is actually an area within the music sub-field), I shall refer to Music Technology as "a field of study".
6. The use of the term "component" in this study refers to a designated area of study within Music Technology that I have classified on the basis of its content. Such components will be indicated by the use of the upper case, for example Music Notation.
7. The areas of Sound Engineering, Audio Engineering and aspects relating to sound recording, manipulation and/or audio recording, will collectively be referred to as Audio Technology.
8. Several authors use the term "definition" loosely. When referring to definitions other than mine, for the sake of correct citation I adopted these authors' loose usage of the term as suggested in their literature.
9. In cases where part of a quotation has been used, I chose to indicate the omitted part(s) by means of three dots (...), preceding or following the quotation, depending on the part of the quotation being cited.
10. The use of the terms "historically advantaged" or "historically disadvantaged" within the South African context has political connotations. "Historically advantaged" refers to those sectors of the South African population that were granted a privileged status by virtue of their race (White in this case, or of European descent) with regard to social status, funding and education by the apartheid government prior to the 1994

democratic elections in South Africa. “Historically disadvantaged” refers to sectors of the population (Black, Indian and Coloured citizens) that were deprived of the earlier mentioned privileges. Therefore a “historically advantaged” institution would refer to a “white” institution.

11. It has been the request of the respondents to the Questionnaires (Appendix A and B) to remain anonymous. Their confidentiality will therefore be maintained throughout this study.
12. The term “post-secondary” is used in this study to include all education institutions that offer qualifications beyond NQF Level 4, which include colleges, private providers of education, technikons and universities.
13. The institutions included in the survey in Chapter 3.3 were chosen arbitrarily, based on the notion that they offered some or other programme in Music Technology. Their research expertise, depth of their programme, historical advantage in terms of how early in the 20th century their programme came into existence or inter-departmental research correlation were not factors. Therefore the data presented in this section does not lend itself towards generalizations as the only truth.
14. In government documents there are sometimes grammatical and/or spelling mistakes. Instead of repeatedly identifying these mistakes, [*sic*] will only be used once after citation of these documents.
15. For the sake of consistency with South African Qualifications Authority literature, the terms “Organizing Field” and “NQF Level” or “Level” (when referring specifically to the level descriptor pegging), will be used with the upper case.

CHAPTER 1
INTRODUCTION

The purpose of this chapter is to present an overview of the study, outlining the critical foci and rationale for the research, methodological issues and research procedures.

1.1 Education legislative context

The birth of democratic government in South Africa (SA) in 1994, led to the generation of a plethora of legislation that intended to introduce fundamental changes within different government sectors[1]. The education legislative framework formed one of the critical components for large-scale system wide change. This framework requires the education system and curricula to transform by addressing issues of accountability, redress, mobility and equity for all South Africans, especially those who were educationally disadvantaged prior to the first democratic elections in 1994. In meeting the national education needs, it has become necessary that education also moves forward by keeping pace with international developments (SAQA 2000c) regarding higher education's social accountability, curricula relevance and mode of instruction (Drucker 1994; Glidden 1997).

In South Africa, the current Minister of Education, Professor Kader Asmal, contends that the higher education sector in South Africa has not engaged in rigorous debate and research on critical questions that confront it, such as: the erosion of the performing arts at arts and education institutions; the impact of outcomes-based education on the humanities; and the impact of the increasing shift towards interdisciplinary approaches in undergraduate education on the future of traditional disciplines (Asmal 2000c: i). This study attempts to engage in critical discourse on the implications of SA education policy on qualification design in Music Technology.

1.2 The need for this study

Internationally, Music Technology programmes have been designed to cater for individual countries' educational (pedagogic) and economic (industry) needs: for example, the programmes at Berklee College of Music (USA), Queensland University of Technology

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[1] Examples of sectors include Health, Social Welfare and Education.

(Australia), and the School of Audio Technology (New Zealand) cater primarily for industry needs, while Monash University (Australia), Northwestern University (USA), and the University of Southampton (UK) fulfil educational (pedagogic) as well as economic needs. These claims by the institutions are rooted in ensuring the employability of future learners to sustain the economic viability of a nation in terms of global competitiveness. Educators therefore respond accordingly.

In South Africa, most institutions have introduced Music Technology programmes in response to international trends in the field (Devroop 2001b). However, due to the vagueness surrounding national employment requirements in areas of music industry and/or education, current training in Music Technology is producing graduates with differing specialties who, in most cases, are uncertain of their career paths.

The uncertainty surrounding the Music Technologist's role in South Africa is compounded through the dispersal of Music Technology in Music departments' curricula into diverse and sometimes unrelated areas of study (see Chapter 2.1.4). Several of these Music Technology programmes appear to be tailored toward the Sound-Production/Post Production Engineer, the training of Composition and Music Theory students, or majors in Electro-acoustic Music. This situation arose partly through the absence of registered Standards Generating Bodies (see Chapter 4.1.2) and the inability on the part of the institutions offering the course(s) to reflect the transformational changes required by the new education framework.

According to the South African Qualifications Authority (SAQA) Act 58 of October 1995 (RSA 1995: 1) current and new Music Technology programmes in South Africa need to be registered with the South African Qualifications Authority (SAQA). The registration process has been delayed due to a host of factors, including bureaucratic and financial factors, stakeholder participation and the shortage of standards writing skills.

In order to fast-track the standards generation process and foster educational growth it is preferable that all stakeholders (including learners, educators and providers of education) learn to adjust to transformational and technological change, since they all share in educational responsibility. It is this change that ultimately will yield new career paths in music and challenge existing roles and competencies.

1.3 Rationale and the main research question

In order to understand the development of the main research question in this section, the relationship between the researcher and the research will be clarified and some background to the research will be provided.

Between 1998 and 2001 I implemented a Music Technology programme at the University of Pretoria (UP). This programme, which was UP's first, was used as the platform to pilot the potential outcomes and knowledge content for a future draft qualification in the form of an undergraduate course. The UP programme formed the basis for a case study using Music Technology within an existing curriculum (see Chapter 4.3). Other means of implementing such a Music Technology programme, such as a certificate or diploma programme, were not possible at the time. The Music Technology programme at UP (hereafter referred to as a course in this section, because this is its current academic classification) was instituted as an elective in the fourth year of specialized Music study. A needs analysis formed the basis of this course. The course introduces prospective music specialist students to a basic knowledge of Music Technology for their potential careers as musicians, educators, therapists and musicologists. The course focuses on using the computer as a tool to enhance the music making, creation and production processes. The structure of the course was developed using the areas of specialization of existing international Music Technology curriculum models. Since its implementation, the UP course has been reviewed after each successive year. The primary recommendations made by the following external educators in the field of Music Technology were implemented in the Music Technology course at UP: Marc Duby (Technikon Pretoria), who suggested making the course more user-friendly and vocationally orientated; Jürgen Bräuninger (University of Natal-Durban), who preferred a project-based course with continuous assessment as opposed to an examination-based course where learners were evaluated only twice in the year (June and November); Jay Fern (Indiana University-Purdue University, Indianapolis) and David Mash (Berklee College, Boston), who recommended structural and content changes to reflect international trends.

Apart from this formal course instituted at UP, colleagues, research assistants and I hosted short courses, which dealt with isolated areas of specialization (see core competencies discussed in Chapter 3.3.1) of Music Technology, at various education institutions in South Africa: University of the Free State (Bloemfontein), Musikon (Bloemfontein), University of Pretoria (Pretoria), Independent Examinations Board of South Africa (Johannesburg), South

African Society of Music Teachers (Pietermaritzburg branch) and St. Anne's College (Hilton). After a period of three years I arrived at the following list of needs (in no specific order) with regard to these groups of learners, albeit with different musical abilities and levels of musical expertise:

- Formal, sequentially structured courses in Music Technology;
- Clear guidelines with regard to the areas of specialization (core competencies) within the field of study of Music Technology;
- A logical, sequential progression of learning content;
- Project-based tasks and assignments whereby learners could synthesize both theoretical and practical skills;
- A learning programme that fosters problem-solving skills within projects and assignments, as opposed to merely acquiring disciplinary knowledge;
- Assessment criteria that could be used to evaluate learners' progress in order to enable mobility within the field of study and between other qualifications;
- Clear exit level outcomes that support career possibilities within this field of study and promote employability; and
- A design profile tailored for music education students with little background in technical and scientific disciplines.

These needs were used to guide the ongoing design of the course at UP. Due to the limited curriculum, scope and transferability of course credits I identified at undergraduate level, I took part in a short course in January 1999 at Indiana University-Purdue University School of Music (IUPUI), under the supervision of Professor J. A. Fern. The short course at IUPUI allowed me the opportunity to design a broad framework for the field of study of Music Technology. It was during this course at IUPUI that I reflected upon the course I designed at UP and compared these two courses and other similar courses/programmes offered in the USA. However, apart from the IUPUI course, the only other documented course I found at the time was one designed for secondary schools in the USA, called *Fundamentals of Music Technology* (1994) by Dennis Mauricio and Steve Adams. In cases where formalized courses in Music Technology existed, the majority of the course leaders were reluctant to divulge content or course structural designs. The reasons for this reluctance are unknown to me. During the period at IUPUI, I redesigned the UP undergraduate programme and designed a new Honours programme in Music Technology for UP. These programmes are currently implemented at UP. The IUPUI course provided me with a platform from which to conceptualize a broad approach for Music Technology as a field of study, at both undergraduate and postgraduate levels.

In South Africa, meanwhile, bureaucratic obstacles, lack of participation by the key stakeholders[2] in education, institutional restructuring and, most importantly, lack of funding were hampering the national education transformation process[3]. National government, who were calling for change on all education fronts, were incapable of providing the financial support necessary to bring about change.

Professor Caroline van Niekerk of UP saw the need to initiate the process of transformation in music education. In 2000 Van Niekerk decided to undertake the generating of unit standards[4] (discussed in Chapter 4.1.4.3) for music education in South Africa. She constituted a team of post-graduate researchers called MEUSSA (Music Education Unit Standards for Southern Africa). MEUSSA's objective was and is *inter alia* to generate and present to the South African Qualifications Authority (SAQA) a set of draft unit standards for music education. The purpose of the MEUSSA project was to accelerate the process of registering new qualifications and unit standards on the National Qualifications Framework (see Chapter 4.1.2). I was identified as a MEUSSA team member who could explore the possibilities of unit standards and/or qualification design for Music Technology at post-secondary level. To date, six MEUSSA team members[5], as part of their doctoral research, have successfully accomplished the task of unit standards generation in diverse areas of music education.

The MEUSSA team addressed issues pertaining to unit standards writing and the transformation of South African Music curricula, at all levels of the education spectrum through discussions, video and tele-conferencing, e-mail correspondence and

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[2] Representatives of the state, organized labour, organized business, providers of education and training, critical interest groups, the community and learners.

[3] Transformation refers to a change both in structure and in character. Transformation is discussed in greater detail in Chapter 4.1.1.

[4] A unit standard is an education specific term associated with outcomes-based education that has been introduced into the South African education context (see Chapter 1.9 and Chapter 4.1.4.3 for a detailed explanation).

[5] A. Bennett, R. Bosman, J.P. Grové, A. Hoek, A. Röscher and U.L. Wolff.

presentations. The curricula and transformation issues were enhanced with inputs made by both the international and national Critical Friends of the project. These discussions and inputs played a pivotal role during the formative stages of this research.

My involvement with the MEUSSA team and the Standards Generating Body (SGB) for Music at the Higher Education and Training level (I am current Chairperson of this SGB) that deals with issues of standards generation in Music Technology, and curriculum developer as a provider of education (University of Pretoria) coupled with my experience as a learner in Music Technology (student at IUPUI in Music Technology), heightened my awareness of the difficulties of incorporating an emerging field of study in South Africa with the transformational agenda of education policy. The three roles that I fulfil have a strong correlation with the curriculum development process outlined in Chapter 5.2. The difficulties experienced at these three levels (SGB, Provider and Learner) gave birth to this research, especially the underlying main research question.

The main research question that underpins this study is:

- How does the nature of the field of Music Technology and current South African education policy contribute to the development of a conceptual framework that informs the design of a qualification in Music Technology?

1.4 Research sub-questions

The main research question stated in Chapter 1.3 is broken down into two sub-questions, which will provide foci for this research. In order to identify the key issues that would form the basis of a conceptual framework for qualification design, an examination of the field (Music Technology in this case), issues pertaining to South African education policy and how both the field and policy interact, need to be established. The specific sub-questions that will underpin this research are:

- What is the current nature of Music Technology internationally and as an emerging field of study in South Africa?
- What are the implications of current South African education policy for transformational qualification design?

1.5 Purpose of this study

Rather than presenting formulaic response to South African Qualifications Authority guidelines, this research provides a basis for the writing of national standards in Music Technology based on critical discourse that is underpinned by a theory for qualification design. The research also assists in accelerating the current standards generating process.

In answering the research questions posed in Chapter 1.3 and 1.4, this study constructs a conceptual framework that will inform the design of a qualification in Music Technology at post-secondary school level, using the field of Music Technology and the philosophy of outcomes-based education (OBE)(Spady 1994: 13-19), and taking the South African education policy context into account. This conceptual framework could form the theoretical basis for the generation of qualifications in other fields located within a similar education context. In answering these research questions this study contributes to education research by:

- Firstly, attempting to contextualize global trends in Music Technology to the South African socio-political and transformational conditions. This is sought through dealing with the challenges of designing a qualification in Music Technology that meets international trends whilst at the same time addressing the transformational agenda of accountability, redress and equity;
- Secondly, conceptually relating key concepts identified in the field of Music Technology and education policy that should guide the design of a qualification in Music Technology;
- Thirdly, in attempting to locate qualification design in Music Technology within a curriculum development framework, this study develops a holistic curriculum development model that includes three levels, namely the design of a qualification, and the development and implementation of a learning programme (for teaching, learning and assessment); and
- Finally, constructing an exemplar of a certificate qualification in Music Technology at NQF Level 5.

The benefits of this study are deemed as:

- Addressing the lack of research in this transformational area of education in South Africa.
- Providing a framework for continued scholarly discourse/discussions.
- Providing the reader with insight into:
    - Current research in Music Technology;
    - Current national and international trends in Music Technology; and
    - A basic framework for standards writers.
- Initiating a point of departure for subsequent research.
- Designing an exemplar Certificate qualification in Music Technology.

1.6 Research methodology

This study is eclectic in nature and therefore adopts research methodology that focuses on gathering background information to support the literature review. The qualitative research approach is used, in which three research tools are dominant: a literature review, interviews and personal communication, and Internet surveys (see Chapter 1.6.3) of various Music Technology programmes offered internationally.

1.6.1 Literature review

For this research, current literature relating to the use of education and music technologies and their manifestation in music and education was reviewed. Reasons for the use of specific technologies (see Chapter 3.3) were gleaned from books, journals, case studies and periodicals.

Available studies (see Chapter 3.2) similar to this research were examined in order to obtain an international perspective of the field of study. The results of these studies were compared and mapped against information obtained via the Internet (see Chapter 1.6.3) relating to courses offered in Music Technology at post-secondary institutions worldwide. This investigation unearthed a broad overview regarding the areas of focus in the field of study of Music Technology. The structure, format and content of these reviewed studies were synthesized to form the structural basis for this research.

Following a detailed review of the standards (and in some cases* unit standards) present in the education frameworks of Australia*, Canada, Germany, Holland, New Zealand*, Scotland*, the UK, and the USA by the MEUSSA team, particular similarities between the South African and New Zealand frameworks became apparent.

1.6.2 Interviews and personal communication

In order to establish national trends in Music Technology, a questionnaire was devised and administered telephonically to all South African post-secondary institutions purporting to have programmes in Music Technology in 2001. A copy of the questionnaire and the findings thereof are available in Appendix A and Chapter 3.4 respectively. It was also necessary to conduct a sample of six telephonic interviews to gather additional data on selected aspects of Music Technology (Appendix B). All of the institutions that participated in the questionnaire and interview responded with enthusiasm and were keen to view the results, because they envisaged this study could have a direct impact on the future of their Music Technology programmes.

During the ISME International Conference (July 1998) in Pretoria, I interviewed Andrew Brown of Queensland University in order to obtain his views on Music Technology curriculum content and to describe the rationale and purpose behind the Music Technology programme at Queensland University in Australia.

Following the interview with Andrew Brown, an interview with Professor David Mash, Vice President of Technology at Berklee College of Music, Boston was undertaken in Boston. Issues in the interview covered curriculum content, course design, equipment and laboratory requirements, supporting literature and a discussion on the rationale and purpose of the Music Technology programme at Berklee College of Music. E-mail correspondence with Professor Mash was maintained in order to verify data obtained in Boston and to utilize his expertise as an advisor on subject specific issues related to this research.

From both discussions (Brown and Mash) it was clear that their programmes were designed against the backdrop of their country's specific industry needs. Their programmes were tilted toward equipping students with knowledge and skills that were marketable and industry focused. In both these discussions it was apparent that the industry trends and needs in the USA were starting to manifest themselves in the Australian music industry. The balance between theoretical (academic) and practical (vocational) skills with Music Technology programmes seemed of central importance in both countries, unlike South Africa where existing programmes are predominantly theoretically biased.

Apart from the above interviews, leading experts (Brown, Fern, Fields, Lansky, Mash, Ram and Webster) in the fields of Music Technology, educational technology, education, science and technology, as well as relevant personnel at SAQA were consulted on issues pertaining to their areas of specialization. An extensive e-mail correspondence between specialists (Brown, Fern, Fields, Lansky, Mash and Webster) in the field of Music Education, Music Technology and SAQA related issues was maintained in order to constantly update subject-specific information and gather expert opinion with regard to curriculum design and South African education policy issues.

1.6.3 Internet surveys

The Internet was used to ascertain international trends in Music Technology. Where possible, precautions were taken to access the most recently updated websites in order to extrapolate the latest available data. These surveys focused on the diversity of Music Technology programmes offered, the areas of specialization that make up Music Technology, the nature of the subject matter and the possible career paths available to Music Technologists. In the case of certain websites, the course coordinators were willing to engage in online chats[6] with me on issues pertaining to curriculum, course content, current trends and their perceived future directions for Music Technology.

1.6.4 Validity and reliability of data

In order to establish whether the data obtained from the individual sources were valid, a methodological triangulation was used. The data obtained from the literature review, interviews and correspondence and the Internet surveys were analyzed separately. These data from the three sources were mapped against each other and the results (see Chapter 3.3 and 3.4) yielded a clear correlation of the data obtained amongst the sources.

[6] IRC or Internet relay chats.

1.6.5 Education policies examined

The generic use of "national education policy", or "education policy" in this research refers to the following South African legislation and policy documents:

- Skills Development Act (Act 97 of 1998);
- Higher Education Act (Act 101 of 1997);
- White paper: a Programme for the Transformation of Higher Education, July 1997;
- SAQA Act (Act 58 of 1995);
- NSB Regulations (Regulation 452 of 28 March 1998);
- Criteria and Guidelines for the Assessment of NQF Registered Unit Standards and Qualifications;
- The National Qualifications Framework (NQF): An Overview;
- The NQF and Curriculum Development;
- The NQF and Quality Assurance;
- The NQF and Curriculum 2005; and
- The NQF and Standards Setting.

Any references made to policies other than the above, nationally or internationally, are clearly cited in this study. Only those policies that have a direct impact on this study were examined. From this point on, South African education policy will be referred to as education policy.

1.7 Scope and limitations of this study

The vibrant world of technology encompasses a wide range of parameters. Any attempt to detail the complete technological world would be beyond the scope of this study. Technologies employed in this research are examined on the basis of their capabilities of creating, performing, appraising and processing music because they would most likely impact on the educator for use in an educational setting, besides being the most accessible and available tools in use.

Several types of music technology (identified in the survey in Chapter 3.3) are considered to be beyond the scope of this study. These include:

- Entertainment technology;
- Music adventures and games;
- Administrative and marching band charting;
- Computer-based librarians and editors;
- Audio-visual presentations;
- Programmed instruction;
- Teaching machines;
- Television and film; and
- Acoustic musical instrument development (see also Chapter 2.1.1.).

The term "technology" in the context of this research refers primarily (but not exclusively) to computers and all of the music and non-music peripherals (mixing consoles, guitar effects, valve amplifiers, and the like) that are needed to perform music tasks with computers. These peripheral devices include such hardware as electronic musical instruments, MIDI devices, printers, scanners, CD players and audio technology equipment, and software such as sequencing (the storing of musical information in a desired order), audio processors and multimedia.

The following limitations of this study were not regarded as seriously detrimental, because this was an individual effort based on critical discourse about education theory, education policy and an emerging field of study. This study was therefore not a mere technicist response[7] to education policy. The limitations included that:

- The qualification design did not engage stakeholder participation because this was logistically and financially not feasible.
- The MEUSSA team only comprised music educators who were generating standards (one sixth of the stakeholder representation), which raises questions about the legitimacy of the process of standards generation in terms of legislative requirements.
- The qualification was not peer reviewed for its validity because no post-secondary institution in South Africa has implemented outcomes-based education as yet. Besides, existing Music Technology practitioners and

[7] A mechanical response using jargon or subject/discipline specific language, in order to satisfy a particular need or requirement.

educators in South Africa were found to be largely unfamiliar with current South African education legislation.

- Since all post-secondary institutions in South Africa are not equally resourced in terms of technology equipment, facilities and expertise, the qualification attempts to describe the current state of the use of technology among a selective segment of the population.
- The attitudes and values of learners and educators toward technology and its implementation were not investigated.
- The telephonic interviews conducted among post-secondary institutions nationally expressed the views of the Music Technology course leaders and not necessarily the views of the learners. Therefore the voices of a key stakeholder group, namely the learners, are unheard (a serious concern amongst standards writers).
- This study used as its basis current documentation on education in South Africa, even though much of this is in a state of flux.

1.8 Assumptions

This study is justified in terms of the current education policy documentation (see Chapter 1.6.5) pertaining to Education and Training in South Africa, where the disciplines of Mathematics, Science and Technology are given prominence according to current legislation (DoE 1997). It is assumed then that Technology as referred to in this document, implies technology in all of its manifestations, including that of educational technology of which Music Technology is a component. A qualification or curriculum based on Music Technology is therefore assumed to be a priority.

The legitimacy of national education policy is not interrogated in this study. It is assumed that national education policy is based on the vision of the mass democratic movement that includes historically disadvantaged communities and which prioritises the issues of redress, equity and accountability.

1.9 Explanation of terms

Several of the terms explained in this section are defined in education policy documents or South African Qualifications Authority literature.

Assessment	Is the process of determining capability, which is carried out by observing and evaluating performances.
Assessment criteria	Provide evidence that the learner has achieved the specific outcomes and are explained and detailed in the range statements.
Competence	Involves the capacity for continuing performance within ranges and contexts resulting from the specific integration of a number of specific outcomes.
Credit	Is the recognition that a learner has achieved a unit standard.
Critical cross-field outcomes (also referred to as critical outcomes)	Describe the qualities, which the NQF identifies for development in learners, regardless of the specific area or content of learning, i.e. those outcomes that are deemed critical for the development of the capacity of lifelong learning.
Curriculum	Includes all aspects of teaching and learning, and is everything that influences a learner, from the teachers and the work programmes right down to the physical structures (DoE 1997: 10).
Curriculum development	Is the development of units of learning consisting of learning outcomes, assessment criteria, range statements, evidence requirements and learning materials.
Curriculum framework	Is a philosophical and organisational framework, which sets guidelines for teaching and learning.
Curriculum 2005	Is a lifelong learning document for the 21^{st} century where education is the tool for developing a person to his or her full potential in South Africa. This document is still available for public comment and has not been finalized at the time of this research.
Essential Outcomes	Are cross-curricular, broad generic outcomes that inform teaching and learning (Committee for development work on the NQF 1996: 15).
Exit level Outcomes	Are the planned combinations of learning outcomes - both specific and critical - that are required for competence at the particular level of the qualification.

continued overleaf

Explanation of terms (continued)

Field – see Organizing Fields	
Learning area	Is a term replacing the traditional "subject". It represents a broader knowledge field, which is informed by the commonalities it shares with other learning areas, such as to ensure that fragmented views of learning are counteracted.
Learning programme	Is a term replacing a traditional "syllabus". It is a vehicle through which the curriculum is implemented at various sites such as schools, comprising a set of learning activities in which the learner will be involved working toward the achievement of one or more specific outcomes.
Level descriptors	Are hierarchical classification levels determined by the NQF according to incremental complexity of process, learning, responsibility and application. Currently eight levels exist with level eight being the most difficult.
Model C Schools	Are historically advantaged state-aided schools that were classified as such around the 1990s, instituted by government's education policies at the time.
National Qualifications Framework	Is a framework for providing lifelong learning opportunities utilizing nationally recognized levels.
Organizing Fields (sometimes referred to as Fields)	Are fields not based on traditional disciplines or subjects; nor are they based on economic sectors. These fields are a convenient mixture of fields and sub-fields to make standards generation possible. They are based on a hybrid of both subject disciplines and occupational areas. The NQF divides all education and training, for organizational purposes, into 12 Fields.
Outcomes (see also Essential, Exit level and Specific Outcomes)	Are the results of a learning process, formal, non-formal or informal, and refer to knowledge, skills, attitudes and values within particular contexts (DoE 1997: 4).
Outcomes-based education	Is an educational approach linked to the National Qualifications Framework, focusing on the results of a learning process.
Performance criteria	Are criteria against which the achievement of specific outcomes by the learner may be assessed (DoE 1997: 4).
Qualification	Means the formal recognition of the achievement of the required number of the range of credits and such other requirements at specific levels as may be determined.

continued overleaf

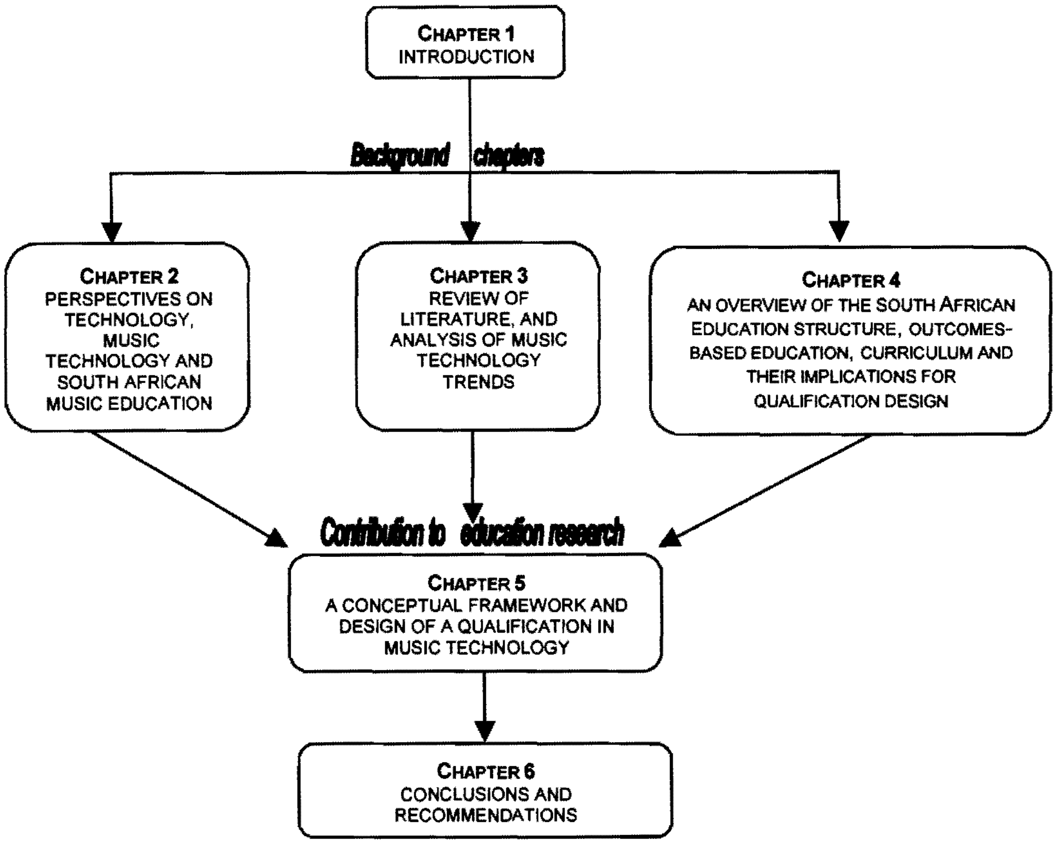
Explanation of terms (continued)

Range statements	Indicate the scope, depth, level of complexity and parameters of the achievement, and include indications of the critical areas of content, processes and context, which the learner should cope with, in order to reach an acceptable level of achievement.
Specific Outcomes	Are contextually demonstrated knowledge, skills and values, reflecting critical outcomes (Committee for development work on the NQF 1996: 15).
State-of-the-art technology	Refers to the most recently invented "high-tech" devices including the microcomputer, electronic keyboard, compact disc, CD ROM, and laser disc player.
Sub-fields	Exist within the 12 Organizing Fields. Sub-field delineation is a dynamic exercise; it will change over time for purposes of operation. Sub-fields are temporarily frozen to facilitate standards generation.
Technology Education	Is concerned with technological knowledge and skills. It also requires the creation of awareness and some understanding of technological processes and the impact of technology on both the individual and society (COTEP 1996: 64).
Title matrix	Is a conglomeration (matrix) of titles, where each title reflects a main outcome of learning for which an individual deserves national recognition in a specific field.
Unit Standards	Are nationally registered sets of specific learning outcomes with their associated assessment criteria and other technical information required by the South African Qualifications Authority. It describes the outcomes of learning and the standard of performance that must be achieved.

1.10 Overview of this study

The interrelationships of the six chapters that constitute this study are illustrated in Figure 1.1.

Figure 1.1: Structure of this study



Chapters 2, 3, and 4 serve as background discussion towards answering the research questions with Chapter 5 and 6 being the contribution to music education research.
The following description highlights the content of the next five chapters in this study.

Chapter 2 - presents perspectives on Technology, Music Technology and South African music education. The etymology and some perspectives of the term “technology” commence the chapter. A search for a definition follows, explaining different notions of technology and music and the historical development of technology in music. The South African Music Technology context is briefly examined, coupled with the predicament facing music education. The chapter concludes by placing Music Technology within the current South African education context. The key concepts and/or recurring issues that are identified in the chapter will be used to realize the conceptual framework in Chapter 5.

Chapter 3 - reviews literature in technology and Music Technology to examine and to place technology education within the broader context of education. An analysis of Music Technology trends internationally follows in order to identify key issues that will guide the conceptual framework for qualification design (Chapter 5), whilst at the same time establishing areas of specialization, interdisciplinary relationships and the job market related to the field of study.

Chapter 4 - presents an overview of the current South African education structure, outcomes-based education, and curriculum, and their implications for qualification design. In this chapter, concepts and recurring issues related to Music Technology are identified. These concepts and issues form the basis for the conceptual framework in the next chapter.

Chapter 5 - provides a list of the concepts identified in previous chapters and locates these within a framework. Only the key concepts that impact on qualification design from the field of Music Technology and those relating to education policy are mapped. The conceptual framework provides a foundation for the design of a new qualification. The qualification design is then positioned within a holistic curriculum development model showing the relationship between the three levels (qualification design, learning programme development and learning programme implementation). Using the conceptual framework, and the curriculum development model a Certificate in Music Technology is designed.

Chapter 6 - deals with the conclusions and recommendations of this study. The conclusions highlight certain findings that answer the main research question and sub-questions. Recommendations as to how these findings could be addressed conclude this study.

Appendices - list the subsidiary information with regard to the actual questions asked in the interviews in both questionnaires, present an overview of the career possibilities within the South African music industry sector and finally tabulate all of the recurring concepts/issues that have been identified in this study.

CHAPTER 2

PERSPECTIVES ON TECHNOLOGY, MUSIC TECHNOLOGY AND SOUTH AFRICAN MUSIC EDUCATION

The purpose of this chapter is to identify key concepts, recurring issues and areas of specialization in Technology, Music Technology and the predicament facing South African music education that will be used to shape the conceptual framework in Chapter 5.1.

2.1 Technology, music and education

This section traces the roots of the term "technology", explores perceptions of technology for the purpose of locating Music Technology within this discipline and places Music Technology within its musical and educational contexts, both internationally and in South Africa.

2.1.1 Technology defined

A variety of definitions for technology that informs this study have been explored. Of these definitions the Greek, French and English ones impact directly on this study. The term "technology" has its roots in the Greek word "technologia", which is made up of two words "technés", which means "art", "made by the human hand"; and "logikés", which means "study". It follows that technology is the study of art, the analysis of how "things" are made and work and how such knowledge can be used to make them better. The root "techné" "combines the meaning of an art and a technique, involving both knowledge of the relevant principles and an ability to achieve the appropriate results" (Wheelright 1996: 328). Technology, thus, implies reasoned application. The French use of the term "implies a high degree of intellectual sophistication applied to the arts and crafts" (Hall 1978: 91). The French use two terms, "technologie" and "technique", to give a more precise meaning to the English word technology. "Technologie" is used to refer to the study of technical processes and objects, whereas the term "technique" refers to the actual application processes (Willoughby 1990: 41). It is these two concepts that are mixed in the English usage of "technology", and this results in a failure to distinguish between its study and its application.

The term "technology" in the English language acquired limited use in the late 19th century as a way of referring to the application of science (knowledge) to the making and use of artifacts. In the 20th century, the attainment of formal knowledge is linked with the development of science and technology. More recent scholars (McGinn 1978; McDonald 1983; Vincenti 1984; Parayil 1991) emphasize the importance of knowledge in defining technology. The recognition of the centrality of knowledge leads to conceiving technology as more than artifact and as more than technique and process. This technological effectuation is the rational process of creating the means to order and transform matter, energy and information in order to realize certain valued ends.

2.1.2 A working definition of Music Technology

Although several authors (Williams 1992; Spotts & Bowman 1995; Rudolph 1996; Brown 1997c; Williams & Webster 1999; Lansky 2001) have all published in the field of Music Technology, to date apparently no clear definition of Music Technology exists. Attempts at defining Music Technology as a field, focus rather on a definition of technology that is related to music. Although each of these definitions makes a valid contribution towards understanding Music Technology, a fragmented perspective of the field emerges resulting from these definitions. In order to highlight this perspective I shall examine selected definitions in this section with a view towards establishing a working definition of Music Technology.

Williams (1992: 26) suggests a definition of "technology" that relates to computer technology. In his definition, the hardware and software required to give computer machines some semblance of intelligence should include a host of peripherals that interact with computers. Williams (1992: 29) goes further to add that a broader view of technology needs to be considered. This view should consider educational technology, a term that includes more critically the issues of teaching style and strategies, delivery systems, and curricula. In the latter, Williams considers technology from the point of view of educational technology. However, audio technologies and the issues of acoustics and psychoacoustics, which are central to studies in Music Technology involving audio, are not accommodated in his definition.

According to Spotts and Bowman (1995: 57), "technology is defined as the application of science concepts and knowledge to problem-solving, which may include many things, from processes to hardware". Both the definitions of Williams and of Spotts and Bowman are limiting in that the purposeful application to meet human needs as well as the needs of music are vital components. Rudolph (1996: 4) goes so far as to say, "the word 'technology' can be used to describe a wide variety of devices and applications in music and music education. By general definition, technology can be thought of as anything that uses science to achieve a desired result." The above definitions suggest a relationship between science and technology. I should add at this point that science and technology have different objectives. Basic science focuses on the understanding of ideas and concepts, which are expressed in linguistic or mathematical terms (Hindle 1966: 4-5). Technology, on the other hand, seeks means for making and doing "things" which can include the results of basic science (e.g. the use of lazers in Compact Disk technology or the use of fuzzy logic in appliances). It is a question of process, expressed in terms of three-dimensional "things" (Hindle 1966: 4-6). Technology would then be about applied science.

I find Brown's (1999b) discussion around searching for a definition to be quite complex. In his discussion Brown (1999b) states that "because the world appears to us through our interaction with it," technologies are "products of the objectification of experience". These objects, symbols and theories reflect one's understanding of particular aspects of the world. "In this process of working with technologies we progressively develop both our own understanding of the world and the representations of it. The medium for technological representation may be linguistic, visual, sonic, physical, imaginative, or mathematical." What Brown implies with this description is that technology manifests itself through our senses and our interaction with these technologies. Certain technologies according to Brown (1999b), for example computers, synthesizers and electric guitars, are more identifiable as technologies than acoustic music instruments (violins, oboes, etc.).

Acoustic music instruments on the other hand, in relation to society today, are less recognizable as technologies because of their introduction in the early stages of human history. According to Brown (1999b), symbolic technologies such as music notation and mathematics are even more identifiable, while theoretical technologies (which could include symbolic technologies in their representation) for music, systems of tonality and physical laws of acoustics are less apparent. These differences can be attributed to the manner in which human beings perceive such technologies. If one were to consider Brown's (1999b) comments, the field of Music Technology is vast, encompassing a multitude of technologies.

It follows that technology is integral to human existence, since it is individuals and groups who determine the technologies that are developed and how they are applied. Technology then adds to the changes in cultural, social, environmental and economic circumstances. A justification for this latter statement is the impact technology has had on the model of the composer-performer-listener triangle. According to Lansky (2001), this model permeates most art musics of the world where the composer is genius/author, the performer is genius/servant, and the listener respectfully adores both. Receiver of the greater glory, either composer or performer, varies from time to time and place to place. This is determined by the context in which the work is created.

Lansky (2001) goes on to add that in this three node model (composer, performer, listener), there is a basic conspicuous feedback loop. Each node responds to the actions, abilities and appreciations of the other unless, of course, the composer is dead. This network needs social institutions to provide a context for communication and interaction, typically concerts, in which some play while others listen. Even with recording today, concerts are seen as the excitation function of this network. Musicians and composers tend to think of recording as documentation of live performance, and perhaps as a less than perfect substitute for reality; an illusion and incomplete and distorted image (Lansky 2001).

To summarize Lansky's description above, the impact of technology on this triadic paradigm is as follows:

Listeners - are now involved in listening to digital recordings in the form of CDs, DVDs, MP3s and other data formats; they can also manipulate recordings (compile and re-edit exiting recordings) to satisfy their own needs and tastes and influence live music performance recordings.

Performers - engage with instrument technological advances and interactive performances with technology, and are in a position to manipulate the output of sound waves, by means of amplification, movement on stage, and the like, according to their needs and desire.

Composers - no longer need to use pencil and paper, but computers, and take cognisance of the new way in which music is perceived, generated and realized through the use of computers.

The impact of Music Technology on society and on economic factors can be noticed in the milieu of popular culture, where machines have had an immediate and rather drastic effect. The importance of the roles of concerts and recording has been switched (Lansky 2001). Recording is the norm and concerts are modifications of recordings, or a marketing ploy for CD sales. Concerts are, however, often pale substitutes for recording, because the illusion has become incomplete reality, and is usually an orgy of celebration for the new album (Lansky 2001).

Taking into account the definitions and descriptions surrounding Music Technology examined in this section, I propose the following working definition. This definition is a synthesis and elaboration of the definitions/descriptions expressed by Williams (1992: 29) where he addresses the issues of teaching style and strategies, delivery systems and curricula; Spotts and Bowman (1995: 57) in which they emphasize the application of science concepts to problems solving; Rudolph (1996:4) in which he talks of a wide variety of devices and applications to music and music education; and Lansky (2001) who speaks of the impact of technology on the music triangle.

> Music Technology is that part of the technological field which requires the application of engineering, scientific and music knowledge and methods combined with technical and music skills to music activities; it lies in the occupational spectrum at the end closest to the musician.

The occupational spectrum in this definition implies that the Music Technologist's focus lies closer to music than to technology. It is also assumed that knowledge is applied in both the technical and music skills. This research will be located within the electronic technology spectrum. Electronic technology, in the case of this study, refers to equipment predominantly using microprocessors with a view to achieving results in the field of music and audio technologies that are used in music creation, performance, appraisal and processing. The reasons underpinning this focus stem from the historical development of technology in music (see Chapter 2.2), and the Internet survey of international Music Technology trends (Chapter 3.3), showing that aspects of electronic and audio technology dominate international technology development and curricula.

2.1.3 The emergence of Music Technology as a field of study

The growing presence of technology in the music industry today is something that should neither be ignored nor underestimated. According to Bash (1990: 7-8), music performance and the role of music in television, film and multimedia are being defined through advances in technology. Economic indicators reflect the interest in technology, where in the USA as of the year 1989 for example, Americans owned over 17 million keyboards and synthesizers (Bash 1990:7-8).

Already in 1992 a survey (PR Newswire Association 1992: 15) found that 34% of all American households used a personal computer in work, school or at home. According to Jaeschke (1996: 1), it was also predicted that by the end of 1994, 4.5 million USA households were expected to be using CD-ROM equipped computers and that by the year 2000, users of the Internet computer link would have exceeded television viewers. This is a clear indication that the use of technology in most facets of life (music, business and communications) is on the increase.

Williams and Webster (1999: xxv) go even further in stating that, in the latter part of the 20th century, one cannot imagine any aspect of music that is not in some way touched by technology. Considering this view, educators "cannot fight a tidal wave … to be relevant to young people in the 21st century, we [educators] must speak their language and use their tools" (Chung 2000: 26). What Chung highlights is the notion that, as an educator, one does not have much of a choice when it comes to the use and integration of technology into the mainstream of music instruction. Besides resisting change, educators must accept that "most of today's college students have grown up with more technology and often are more technologically literate than many of their professors" (Albright & Graf n.d.: 13). These learners or students often take technology for granted as part of their everyday lives. This latter trend has vital social implications for the providers of education, in that it questions the traditional roles of the learner and provider. According to Glidden (1997):

> we [educators] are required to change from a centuries-long era in which educators thought of themselves as experts in their disciplines and as the masters of knowledge in their respective fields. Now we [educators] are forced to accept the fact that the knowledge explosion prevents most of us from being true experts and masters of all.

What Glidden is suggesting is that educators need to take cognisance of the knowledge boom and adjust their mode of providing information by reassessing their role in education. Today, learners often possess current knowledge and pave the way for knowledge production, which places them at the forefront of the knowledge boom. Glidden goes on to add that rather than being a "sage on the stage" one is forced to be a "guide on the side". Knowledge and expected outcomes of learning have now become a social construct, which is in direct contradiction to past practices where the providers of education decided the content and outcomes of learning – a top-down approach. The knowledge boom in Music Technology can therefore be considered an agency for social transformation in that the manner in which music is and will be created, performed, received and taught has evolved and will continue to do so with the impact of newer technologies. Other role players in knowledge production, for example the learners, need now also be taken into account.

An "alternative" music market as opposed to the mainstream has emerged especially for the computer musician in the last 10 to 15 years (Waugh 1997: 200). In the 1980s, just two decades ago, it would have been inconceivable that one could earn a living writing music for computer games, creating sound effects, recording and designing sounds for sample CDs, creating MIDI files, scoring QuickTime movies or even writing music for company presentations. Even the areas of sales and merchandising of software, backup support, technology consultancy and multimedia have opened new job possibilities for the graduating music student. These trends require music educators to rethink their approach to music education by taking cognisance of these emerging employment opportunities.

The need to incorporate Music Technology as a field of study into the mainstream of music study, was recognized as early as 1985 at Berklee College of Music in Boston, USA (Mash 1999) and University of York, UK (University of York 2002). Both the Music Technology programmes at Berklee College and York University were the first of its kind. However, experiments, studies and research using music technology in electronic music (1940s) and computer music (1950s) had already been undertaken in Europe and the USA (see Chapter 2.2), prior to the Berklee programme. Up until the early 1990s, several journals (*Perspectives of New Music*; *IEEE Computer and Computer Music Journal*) write about music and technology but do not specifically make references to music technology.

The term "music technology" began to appear in electronic music journals, articles on electro-acoustic music and in Internet web sites during the 1990s - its exact first appearance is uncertain. Between the years 1992 and 1996, at the time of the publication of the first texts to use the term "music technology" in their titles or series, *Fundamentals of Music Technology* (1994) by Mauricio and Adams, *Music Technology* series (1995) under Francis Rumsey's editorship and *Experiencing Music Technology* (1996) by Williams and Webster, this term became used to describe technology related courses in music at several institutions in the USA (Berklee College of Music, Indiana University-Purdue University, Northwestern University and University of Illinois, to mention a few.). By the end of the 20th century, several institutions internationally were offering programmes (certificates, courses, diplomas and degrees) in the field of Music Technology.

2.1.4 Music Technology in South Africa

Although Music Technology was introduced as a formal study[8] programme during the 1990s and in the USA, parts of Europe and Australia, its manifestation as a programme of study at South African music departments only emerged towards the end of that decade. This could be deduced from the learning programmes/courses that are offered at some of the music institutions (in alphabetical order) in South Africa: Natal Technikon, Rhodes University, Technikon Pretoria, University of Cape Town, University of Natal-Durban, University of Port Elizabeth, University of Pretoria, University of South Africa, University of Stellenbosch, and University of the Witwatersrand. See Chapter 3.4 where an overview of Music Technology trends in South Africa is documented.

Against this upsurge in new Music Technology programmes, I was asked, in 1997, to set up a programme in Music Technology at the University of Pretoria. My programme commenced in 1998 as part of the mainstream Bachelor of Music degree. The Music Technology course formed part of a group of optional courses at fourth year level under the classification *capita selecta*. Other courses in this group were Music Therapy, Ethnomusicology and Chamber Music. The content and expected outcomes of the course were introductory in nature, pegged[9] at National Qualifications Framework (NQF) Level 5 (see Chapter 4.1.2).

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[8] Earlier programmes that involved technology and music, such as those at IRCAM since the 1950s, were probably not called Music Technology programmes at the time.

[9] A term used in South African Qualification Authority documentation to refer to locating or positioning on the National Qualifications Framework.

The learners (approximately fifteen each year) received two hours of instruction per week over two semesters of fourteen weeks each. The assessment of learners' progress was established through fifteen projects, encompassing the ten core components (see Chapter 3.3.1) and an oral examination at the end of the course. This undergraduate course was subsequently developed to post-graduate level degree programmes (Honours with five students and Masters with two students).

The undergraduate course at the University of Pretoria merely introduced learners to the field of study in order to "whet the appetite", with no integrated strategy for the implementation of technology as a field of study in its own right. The undergraduate course, Honours and Masters Music Technology degrees formed the Music Technology programme at UP. The issues of marrying South African education policy with Music Technology as a field of study, at UP over the period of three and a half years, prompted the research toward this study. Contact with other Music Departments in South Africa (Devroop 2001b) indicated that my own situation was indicative of a national trend.

Institutional feedback with regard to Music Technology issues took place through administering a questionnaire and interviews that were conducted telephonically. The telephonic administering of the questionnaire and interviews, as opposed to postal questionnaires, was undertaken to ensure a 100% response rate. All of the telephonically contacted institutions (Devroop 2001b) alluded to the fact that their introduction of Music Technology was determined by the following variables: cost effective ways to attract more students; staying in touch with what appeared to be fashionable international trends; as a mechanism to indicate education transformation; and to attract more funding from the academic institution to offset departmental financial cut-backs (Devroop 2001b). In almost all of the cases, except the University of Pretoria and University of Potchefstroom, the tendency to introduce Music Technology as a field of study commenced with differing specializations. Audio Technology (sound engineering and audio recording) was the primary focus of several programmes instead of equally weighting all of the Music Technology components (see Chapter 3.3.1). The dominance of Audio Technology in these programmes is still apparent. In the case of the University of Natal-Durban, the Music Technology programme is closely aligned to courses in Composition and Electro-Acoustic music. A detailed analysis of South African Music Technology trends in South Africa is presented in Chapter 3.4.

2.2 Historical development of technology in music

The synopsis[10] of the historical development of technology in music that follows, serves as an indicator as to the depth and breadth of Music Technology. The historical development presented in this section can be traced back to music compositions, literature on electro-acoustic music, hardware such as audio recording equipment, electronic musical instruments and computers, software and audio/video recordings. As a discussion of technological advancement in acoustic music instrument design lies outside the scope of this study, I shall here offer only a chronological outline of the development of electronic and audio technologies.

2.2.1 1877-1905: Early experiments

Edison's phonograph (1877) used a diaphragm with a needle attached to make indentations on a moving strip of paraffin-coated paper-tape. This device led to a continuously grooved, revolving metal cylinder wrapped in tin foil.

One of the first music instrument inventors to take advantage of electricity was Thaddeus Cahill, builder of the Telharmonium (ca.1898), a 200 ton instrument designed to play music to a wide audience over the telephone network (Disley n.d.). Here, the sound spectra were synthesised by combining the output of a series of alternating current (AC) generators (a technique called additive synthesis in which outputs of several oscillators are added together to produce a composite sound) (Chadabe 2000). This instrument was played by means of a touch-sensitive polyphonic keyboard (Cahill 1906: 519). It was not until the mid-1980s that a touch-sensitive feature was incorporated into the modern synthesizer. The failure of the Telharmonium was largely due to the interference it generated with other telephone traffic (Hunt & Kirk 1999: 10).

Most of the initial experiments with instrument design were discontinued with the development of vacuum tube technology.

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[10] Detailed historical developments are documented in, among others, Chadabe's *Electric Sound: The Past and Promises of Electronic Music* (1997); Williams and Webster's *Experiencing Music Technology* (1999); Chadabe's "The Electronic Century. Parts 1-4" in *Electronic Musician* (2000); "120 Years of Electronic Music" in *Electronic Musical Instrument* (1998); and "*Audio recording: History and development*" (Jones International 1999).

2.2.2 1906-1960: Vacuum tube era

In 1906, Lee De Forest patented the first vacuum tube or triode, a refinement of John A. Fleming's electronic valve (Electronic Musical Instrument 1998). Although the vacuum tube's main use was in radio technology, De Forest discovered that it was possible to produce audible sounds by using the tubes – a process called heterodyning. This was an effect made by two high radio frequency sound waves of similar but varying frequency, that combined to create a lower audible frequency, equal to the frequency difference between the two – approximately 20Hz – 20Khz (Electronic Musical Instrument 1998). De Forest's heterodyning led to his invention of the Audion Piano (1915). Other instruments that exploited vacuum tube technology were Léon Theremin's Theremin (1919) and Maurice Martinot's Ondes Martinot (1928). These instruments produced sound by means of the beat or difference effect (Rossing 1990: 151), using two oscillators to produce an audible beat frequency of the desired pitch. In the case of the Theremin, the performers moved their hands around a rod and aerial, while with the Ondes Martinot an electrode was moved around the aerial by the performer (Disley n.d.).

The Hammond Organ (1929), developed by Laurens Hammond, used the principle of synthesizing sounds by combining pure sine waves of different frequencies to make a complex waveform (additive synthesis). The Hammond organ generated sounds in the same way as the Telharmonium. However, the pitches of the Hammond organ approximate to even-tempered tuning. Unique to the Hammond was its drawbar system of additive timbre synthesis (Rossing 1990: 523) and stable intonation. Most electronic instruments of the time produced unstable intonation. The primary difference between the Hammond and its electronic predecessors was that it allowed precise control of the volume of each harmonic (Disley n.d.).

Meanwhile Edison's phonograph had evolved into the popular 78rpm record, which became the high fidelity Long Playing record, or LP, by 1948 (Disley n.d.). Plastic audiotape and "optical" audio storage (storage onto film) was invented in the 1930s. The magnetic tape opened new avenues for personal recordings, in that recordings or parts thereof could be cut, copied, pasted and manipulated using various techniques (such as time stretch and fast playback), and then stored according to the sound engineers'/composers' requirements or needs (Jones International 1999). The development of cinematic sound and the storage thereof created a new medium of audio storage. These so-called "optical" sound tracks on the edge of film were used to record sound and allowed a form of direct synthesis (Hunt & Kirk 1999: 13).

Pierre Schaeffer, a sound technician working at Radio-diffusion-Télévision Française (RTF) in Paris, used magnetic tape technology in his composition *Étude aux Chemin de Fer* (1948). This marked the beginning of studio realizations of a sound collage called *Musique Concrète*. Compositions by Pierre Henry (*Vocalize and Antiphone* – 1952), Edgard Varèse (*Déserts* – 1950-54) and Iannis Xenakis (*Behor I* – 1962) used this technology as well. The RTF Studio primarily concerned itself with the manipulation (tape transformation) of acoustic sound sources, that is, sounds from the real world. Karlheinz Stockhausen (*Kontakte* – 1959-60), Herbert Eimert (*Selektion I* – 1959-60) and György Ligeti conducted similar experiments with electronically generated sounds in Cologne at the Nordwest Deutscher Rundfunk using a studio equipped with electronic sound generators and modifiers (*Elektronische Musik*) (Chadabe 1997: 30-44).

The invention of the transistor, a device that controls the flow of electric current, launched by Bell Labs (Murray Hill, New Jersey) on 30 June 1948, transformed the scientific world (Sciencecentral & the American Institute of Physics 1999). Some scientists regard this as probably the most important invention of the 20th century (Sciencecentral & the Amercian Institute of Physics 1999). Although the first transistors were used in hearing aids and transistor radios, they soon made their way into music instrument design. The computer and music instrument industries immediately began designing computers and electronic musical instruments using transistors. These electronic musical instruments were faster (in terms of producing timbre changes), smaller, more economical and more powerful.

Les Paul developed the 8-track recording system in 1953, the first ever multi-track deck (Schoenherr 2001). Paul's machine allowed musicians to record different parts of a song at different times, so that enough parts could be recorded to sound like an entire band. Thus was born the one-man band, which became ever more popular in the late 1990s with the widespread use of MIDI (Schoenherr 2001). MIDI is discussed later in Chapter 2.2.4.

The RCA (Radio Corporation of America) synthesizer in 1957 was a revelation in electronic music development in that, unlike the Hammond with its limited variety of timbre possibilities, this synthesizer allowed a wider range of sounds to be generated. These included reproductions of acoustic instrument sounds and sounds that had never before been heard. The principle behind this design was different from that of previous electronic instruments in that the RCA was "programmed" by paper-tape. Information input was done with a typewriter-like device that punched holes in a paper roll. The paper roll was then passed through a reader, and read by contacts between metal brushes that touched through the holes, thereby closing switches and causing the appropriate machine process to start or stop (Hunt & Kirk 1999: 18).

These RCA synthesisers had multiple attack, decay and glide possibilities, and could produce lifelike (to musician's ears) sounds, especially of the piano (Roads 1985: 117). The possibility for substantial complexity in rhythm and texture, combined with an extensive palette of timbre, were the qualities that Milton Babbitt later found important for his works *Philomel* (1963) and *Vision and Prayer* (1964) (Chadabe 2000). The RCA Mark II synthesizer, a development of the initial model, was a forerunner of the programmable synthesizers that appeared circa 1978 (Sequential Circuits). The Mark II used a punched-paper-tape reader, a mechanism that prefigured the software sequencers of the MIDI age (Chadabe 2000). After the development of the RCA came the introduction of several real-time analogue synthesizers with a performance interface such as a conventional music keyboard, the sound being fed to loudspeakers. Whilst researchers in electronic engineering laboratories used these devices initially as the basis for the development of newer electronic musical instruments, musicians on the other hand sought the new instrumental sonorities.

Apart from the great strides made in synthesizer technology, whereby most of the functions were controlled by means of inputs in the form of commands, musicians also endeavoured to control these devices by means of conventional scores. It is worth noting that some synthesizers (RCA and later the Oramics system) often incorporated proprietary scoring systems. However, in 1957 the introduction of the computer saw the emergence of digital sound synthesis. In that year Max Matthews (Hunt & Kirk 1999: 21) wrote his *Music I* computer programme. Over the next few years, together with his collaborators, Matthews wrote a series of synthesis programmes that became known as the *Music-N* series: *Music II* (1958), *Music III* (1960), *Music IV* (1962) and the last in the series, *Music V* (1968). For composers this was revolutionary, in that they could now "compose sound itself, and computers and analogue synthesizers provided the means to do just that" (Chadabe 2000).

In 1958, the music industry's world standard for stereo records was established. This year heralded the selling of the first stereo LPs (Schoenherr 2001).

2.2.3 1960-1980: The performance interface

During the early 1960s, developments in computer music were centred at Bell Labs (New Jersey, USA) with Max Matthews and his collaborators. The impact of Matthews' work spread to the Massachusetts Institute of Technology (MIT) and to Princeton University, where sound synthesis became an important direction for music research. In Europe, the French government recognized the importance of this new technology and established the *Institut de Recherche et Coordination Acoustique/Musique* (Institute for Research and Coordination of Acoustics and Music) (IRCAM) in 1977. Jean-Claude Risset, who had worked with Max Matthews at Bell Labs, headed IRCAM's computer music department. International research in computer music provided the backdrop to the first round of creative music compositions with computers. James Tenney's *Analog #1* (1961), *Dialogue* (1963) and *Phases* (1963), which used stochastic methods to determine the sequencing of sounds, and John Chowning's *Sabelithe* (1977), *Turenas* (1972) and *Stria* (1977), which simulated sounds moving in space, were among the first computer music compositions (Chadabe 1997: 127). Many composers who were to follow, such as Charles Dodge, Larry Austin, Denis Smalley, Paul Lansky and others, realized that a significant problem with computer music was that computer programming skills were necessary for both composers and musicians (Chadabe 2000).

The solution to the problem of computer programming skills was provided with the birth of analogue synthesizers, which provided a new world of sound possibilities, without the need for programming skills. Most of these synthesizers were designed for performance and customized for an immediacy of response that simulated the performance capabilities of traditional music instruments. In the BBC Radiophonics Workshop in the early 1960s, Daphne Oram developed a system called Oramics (Oram 1972: 97). Oram's technique involved the drawing of sounds as waveforms and envelopes directly onto a transparent plastic sheet. As the plastic sheet was moved over a strip of photocells, the cells reacted to the pen-strokes on the film and subsequently controlled a monophonic voltage-controlled synthesizer.

In 1964, the inventions of Robert Moog (Moog modular synthesizer), Paul Ketoff (Synket and Synthesizer Ketoff) and Donald Buchla (Series 100) heralded the first round of analogue synthesizers. These were voltage-controlled modular systems – a collection of individual modules in which each module had a specific audio or control function. The audio modules comprised oscillators, noise generators, filters and amplifiers. The sounds were made using the subtractive synthesis technique. This technique was achieved through linking oscillators in frequency- or amplitude-modulation configurations to create complex waveforms, whereupon the focus shifted to the elements of the sound itself through use of filters to subtract partials (Chadabe 2000).

The Moog, a traditional (early) synthesizer, resembled a traditional piano, because of its keyboard, size and operation. The interest by commercial musicians in these new sound possibilities brought about the launch of portable models, such as the Minimoog, which made their appearance in many pop music bands. Transistor-based technology increased the portability of these devices. Wendy Carlos went on to record "Switched On Bach" (1968) which became a hit in 1969 and became one of the best selling classical music recordings ever (Chadabe 2000). Although several of these synthesizers were still monophonic, it should not be interpreted that later polyphonic synthesizers were superior. Several musicians today still prefer the analogue sound.

As technology advanced into the 1970s, computers, analogue synthesizers and other music technology equipment became less expensive, more portable and easier to use. They were also joined together in what were called hybrid systems (Chadabe 2000).

Several studios (Bell Labs, Murray Hill; Institute of Sonology, Utrecht; and IRCAM, Paris) employed computers as sequencers to generate control voltages for analogue synthesizers. Compositions reflecting the use of these combined technologies are: Emmanuel Ghent's *Phosphones* (1971) and Laurie Spiegel's *Appalachian Grove* (1974) at Bell Labs, and Gottfried Michael Koenig's *Output* (1979) at the Institute of Sonology.

A key trend that emerged in the 1970s was the increasing accessibility of digital technology (which involves representation of information in the form of binary numbers). Polyphonic capabilities and memories to store synthesizer settings were developed, commencing with the Prophet 5 in 1978. These polyphonic capabilities and memory storage systems evolved by the late 1970s into digital synthesizers developed at institutions like Bell Labs and IRCAM.

In 1979, the Fairlight Computer Music Instrument (CMI) was developed, using a technique already found in Oram's work in the early 1960s. The Fairlight depended on the technique of using a waveform that could be "drawn" by the performer directly on a screen using a light pen rather than synthesising it. Performers were now able to draw a waveform on a screen, or select from a library of pre-recorded sounds (Disley n.d.). The Fairlight CMI's novelty was the digital storage and playback of sound (sampling) combined with an interactive computer display.

The *Musique Concrète* and *Elektronische Musik* [11] trends were enhanced by Philips's invention of the compact cassette in 1963, which became the primary recording format well into the latter part of the twentieth century. In the USA in the 1960s many cars were fitted with 8-track stereo cartridge players (an automobile audio player utilizing an 8-track compact audiocassette to store audio signals) that allowed listeners to access any four different sections of a recording at the touch of a button. A battle ensued between 8-track cartridges and cassettes, with the latter emerging victorious (Jones International 1999). Blank and pre-recorded cassettes and tape decks established themselves largely due to their size and the advent of Dolby Noise Reduction (1969). This was an answer to the unpleasant hiss that confined the use of the audiocassette to the voice dictation market, and increased the audio storage opportunities for people to make their own recordings (Jones International 1999). The invention of Sony's Walkman (1979) has since added further flexibility and convenience to the enjoyment of cassette tapes (Jones International 1999).

2.2.4 1980 to the present: The digital domain

The development of digital technology (operations based on a series of numbers) from the 1980s onwards, particularly of the computer and its application to music synthesis, recording, storage and playback, is regarded by Hunt and Kirk (1999: 21) as of "the most important and influential developments in the technology of music in the twentieth century".

[11] The referenced sources on Electronic music in this thesis used the German term *Elektronische Musik* which referred primarily to the music of Karlheinz Stockhausen and his contemporaries at the Cologne Studios at the time. For the sake of consistency with these sources the German variant of the term is maintained.

Microprocessors were in abundance and increasingly powerful, and caused an explosion in the quantity of computer-based music instruments and processing systems.

Since precision of control over digital information was easier than with analogue information, the creation of sound (synthesis) using "artificial" means was possible. "Artificial" in this case refers to the creation of the sound by humans using some kind of electronics. Most people consider synthetic sounds to be those produced through the use of electronic devices, and since digital sound synthesis grew out of these techniques, they are referred to as "synthetic" sounds. The Casio "VL-tone" (1981) was the first synthesis and sequencer unit that appeared on the market (Hunt & Kirk 1999: 27).

Barry Vercoe of the Massachusetts Institute of Technology (MIT) in 1986 translated the latest version of the *MUSIC* programme, developed by Max Matthews and his collaborators, into the "C" programming language. Due to the flexibility of programmes written in C (they could run off most hardware and software platforms), Vercoe's translation was called Csound. Csound is today one of the most widely used direct synthesis programmes (Hunt & Kirk 1999: 22). This programming language allows the user to create sounds and use them as desired.

Several users of Csound experimented with ways of controlling dedicated synthesisers externally. This developed from mere control over simple analogue signals to the complex digital language of "Musical Instrument Digital Interface" (MIDI). The MIDI concept became a standard for the electronic music industry around 1983. MIDI was basically designed to turn sounds on and off by pressing keys on a synthesizer and was primarily the result of commercial interests (Chadabe 2000). From an economic perspective MIDI was a success. Its universal format allowed companies to present "the world with an original concept of music" (Chadabe 2000).

Yamaha's DX (1983) series of keyboard synthesizers (DX7, DX 21, DX100, DX7 FD II) was among the first to use MIDI technology (Chadabe 2000). Apart from its MIDI capabilities, the Yamaha DX7 keyboard synthesizer was a landmark synthesis device using Frequency Modulation or FM digital synthesis techniques and having a polyphonic velocity sensitive keyboard with "aftertouch", pressure bar, pitch modulation wheels and allowed various parameters to be controlled, such as the MIDI parameter "breath control" and the like (Hunt & Kirk 1999: 126-7).

Following the introduction of the Yamaha DX series, several instrument manufacturers (e.g. Korg, Roland and Kurzweil) began producing electronic MIDI instruments. By the mid-1980s, digital sound samplers (such as the Ensoniq "Mirage" and the Akai "S" series) became available at a reasonably low cost. These sound samplers made available novel sounds (synthesis), the recording and editing of existing sounds (sampling) and accurate playback without human input (sequencing) to the larger population (Hunt & Kirk 1999: 30).

However, for some users this still proved inadequate. So programming languages were developed such as MAX, written by Miller Puckett, which allowed composers to define interactive musical environments, and MIDAS (Hunt & Kirk 1999: 276), a multimedia language that includes MIDI commands, audio and video. These languages allowed the user to network computers, thus increasing processing power and in the case of MIDAS, allowing "working in a variety of ways, from graphically connecting together boxes that represent audio-visual functions to programming the system in computer code" (Hunt & Kirk 1999: 36).

On the audio technology front, the introduction of Compact Disc technology in 1982, made digital sound possible at an affordable price. It had a high sampling rate of 44.1kHz and a resolution of 16 bits, or 65536 levels of amplitude. But it was not easy to record in this format. As a result, the professional recording environment adopted the Digital Audio Tape (DAT)(1987) as its norm. This tape is smaller than a compact cassette, but caters for greater bandwidth (48kHz as opposed to 22.05kHz-24kHz in case of the compact cassette) (Rossing 1990: 566), which gives it much higher recorded audio quality. There have since been several attempts to bring affordable digital recording formats to the masses, including Philips' Digital Compact Cassette (DCC) and Sony's Minidisc. These formats employ compression techniques in order to reduce the amount of data stored. The compression process is achieved by removing information from the sound signal that in most instances the human ear would not register. In 1995 the Digital Versatile Disk (DVD) consortium agreed on a standard that would be used to encode compressed video and audio data onto a single disk. In 1996, DVD players started selling in Japan and were sold one year later in the USA (Schoenherr 2001). Michael Robertson formalized further developments in compression in 1997 with the MPEG 3 format (MP3), which enabled the distribution of entire movies over the Internet. These digital technologies culminated at the end of the 20th century with the release of Disney's *Fantasia/2000* in the IMAX film format with 6-channel digital sound (Schoenherr 2001).

The use of computers has added an entirely new dimension to Music Technology. Today, computers allow for a greater appreciation of acoustics, especially in areas of instrument design and the analysis of instruments and acoustic environments. For example, in Farina's (1998: 359-379) analysis, knowing the acoustic characteristics of instruments helps in the successful creation and restoration of many acoustic instruments and in the synthesis of electronic ones.

In the domain of MIDI, different music instruments can be interfaced with the computer, allowing for various types of experimentation in real-time performances, backtracks, composition and music notation. Computers play a significant role in the distribution of music over the Internet. However, most audio files were either very large or too highly compressed, and have first to be downloaded onto the user's machine in their entirety, prior to being played. The implementation of streaming audio over the Internet in 1995 (a process whereby audio files can be played as they arrive from the host site, that is, the user does not have to wait until the complete file has been sent) has resulted in a delivery mechanism less susceptible to delay associated with worldwide (postal) music distribution. Presently, large record companies such as Sony and Columbia Records are investigating the possibilities of having customers download and pay for specific tracks of CD recordings over the Internet (Hunt & Kirk 1999: 36).

Composers are also experimenting with computers in the creation of music within certain predetermined parameters (tonality, rhythm, instrumentation and the like), such as artificially intelligent jazz performers (Ramalho 1998: 105). Computers are used in the artificial intelligence context to respond to inputs made by the composer by generating a random response. Other areas of research into the use of computers lie in the implementing of new performance interfaces, for users unwilling or unable to utilize traditional interfaces such as the keyboard. The MIDIGRID, for example, allows users to perform music by dragging a mouse over a grid of sounds displayed on the screen (Hunt & Kirk 1999: 34). These technologies particularly help music making by severely disabled people.

2.3 The sub-domains of Music Technology

The adherents of *Musique Concrète* and *Elektronische Musik* defined new ways of musical composition (Baggi 1991: 6). According to the history of technology in music (Chapter 2.2), it is evident that these directions in composition also impacted on the manner in which Music Technology, the field, was approached. Music Technology programmes internationally seem to be based on the music processing and/or music creation paths (see Chapter 3.3 and 3.4).

2.3.1 Music processing

In the case of *Musique Concrète,* technology was used as a utilitarian tool selected for its speed, efficiency and opportunity as a means of expression that also impacted on the compositional process itself. Similarly, music technology can be efficient in accelerating the composition, analysis or publication process (Brown 1999b). Technology's role here is neutral; its use in this case is referred to as music processing. Most Music Technology programmes internationally and in South Africa (see Chapter 3.3 and 3.4) adopts predominantly the music-processing route. Of the ten core areas of Music Technology identified in Chapter 3.3.1, seven areas (MIDI Sequencing; Music Notation; Computer-based Education; Multimedia and Digitized Media; Internet and Telecommunications; Computers, Information Systems and Lab Management; and Audio Technology) are music processing based.

2.3.2 Music creation

In the case of *Elektronische Musik,* technology influenced the outcome of the composition. According to Brown (1999b), technologies used in *Elektronische Musik* were even selected because of the impact that they would have on a composition. The use of technology, which followed the *Elektronische Musik* developments (Max Matthews and his collaborators), initiated technology as an equal partner in the composition process. This development was termed music creation, where the composer entered data into the technological device (computers in most cases) that was then processed by the device and generated into a composition or sound. These advances in composition or sound creation resulted from the marriage of computer expertise and musical expertise, called computer music (Baggi 1991: 6). Computer music thus refers to two things: "the direct synthesis of sound by digital means and computer-assisted composition and analysis" (Baggi 1991: 6). Within the ambit of the core Music Technology areas of specialization, both creation and synthesis form integral constituents of two areas of specialization (Electronic Musical Instruments and Computer Music). Music creation would then be a sub-category of Computer Music. Music technology, in this case, therefore, forms an integral part of the composition in which the technology functions as an enabler within the music creation process.

Although computer music has existed internationally as a formal application of Computer Science for approximately thirty-five years (Baggi 1991: 6), its impact on the music curricula at South African post-secondary institutions has yet to be felt (Devroop 2001b).

2.4 Music Technology as a tool

According to Merriam-Webster (2001), a tool is "something used in performing an operation or necessary in the practice of a vocation or profession". This explanation suggests that a tool is some sort of "thing" that is used for an intended purpose. A more contextualized definition of a tool with regard to Computer Science (Merriam-Webster 2001) suggests that a tool "is an application programme, often one that creates, manipulates, modifies, or analyses other programmes". This later conception of a tool suggests a device that is allowed to have influence on a particular process or activity. These two definitions suggest a significant difference between a creative relationship with technology (a creative one) and a more common utilitarian one (a neutral, non-creative one). Irrespective of whether one approaches music technology from a creative or utilitarian viewpoint (see sub-domains of Music Technology, Chapter 2.3), technology in relation to composers, performers, listeners or educators for that matter implies tools, selected for their speed or cost and ready to be discarded when better evolved and more efficient tools become available (Brown 1999b).

Other considerations related to the notion of technology, as a tool, would include social and cultural values. An example of this view is expressed in the writing of Ivan Illich (1973: 21) who states that:

> An individual relates himself in action to his society through the use of tools that he actively masters, or by which he is passively acted upon. To the degree to which he masters his tools, he can invest the world with his meaning; to the degree to which he is mastered by his tools, the shape of the tool determines his own self-image.

This social perspective acknowledges the effect of tool selection on production and the impact the social forces elicit in shaping that effect. The connection between one's self-image and one's tool usage is also recognized: however, Illich portrays the user-tool relationship as one stimulated by control and mastery. This latter notion of mastery is one which musicians in particular appreciate, in that mastery over a music instrument, compositional process or computer music system, is a common tendency when working with tools.

Within this study the use of music technology (the activity) is considered a tool and in the broader context of social transformation in South Africa, Music Technology (the field of study), will be considered a tool for transformation within the South African education context. The latter is significant for music educators because the knowledge production in Music Technology is socially constructed. With the international pressure regarding the use of technology, it is hoped that Music Technology as a tool will help make progress with the predicament that is discussed next.

2.5 The predicament in South African music education

Christine Lucia (1986: 2), past chairperson of the Committee of Heads of University Music Departments (South Africa) and at present Chair of Music at Wits School of the Arts, Johannesburg, South Africa, highlighted some deficiencies of the present system of music education in South Africa as early as 1986, in the proceedings of the first national conference on music education in South Africa (*Theme: Music Education in contemporary South Africa*):

> South African music education stands in sharp contrast to music education in most other countries in the world, where the local musical culture is (in varying degrees) reflected in educational programmes at all levels. Our music education programmes, on the other hand, reflect almost exclusively the cultural tradition of Western Europe, and even that tradition is not adequately represented, in that Early Music, jazz, popular music and post-war classical music are largely excluded.

With the exception of the universities of Cape Town, Natal-Durban and Rhodes, few institutions have attempted to address these deficiencies seriously since 1986.

Entrance requirements for music study at a large number of institutions are still discriminatory with regard to the historically disadvantaged student in South Africa (Asmal 2000a). The discriminatory practices exist in areas of access towards formalized music studies. Recognition of prior learning (a primary component of outcomes-based education) or non-western art music practices are not regarded as adequate for studies towards currently registered music qualifications. Besides, having adjudicated most of the country's national music competitions it is apparent to me that there exists an imbalance in the number of participants of historically disadvantaged communities represented at these national music competitions (ABSA, ATKV, Sanlam, Sasol, and UNISA). This racial imbalance reflects the inequalities of the past education policies.

Compounding the problems of access, the 1993 Human Sciences Research Council's report on South African music education found that "tertiary courses do not address the needs of prospective music teachers" (Hauptfleisch 1993: 50) and more recently Hauptfleisch, in her 1997 thesis *Transforming South African music education: a systems view*, addressed the issue that "South African music education must simultaneously overcome a fragmentation legacy and define its role and nature within a new and largely unknown context of outcomes-based education. This requires current music education practices to change essentially in both structure and character." Hauptfleisch confirms Lucia's previous statement that South African music education has been characterised by restricted content and approaches resulting from the historical exclusion of many South African and world music practices from music curricula (Hauptfleisch 1997:9). Asmal (2000a) adds to this by criticizing current practices from a social and governmental policy perspective, and goes so far as to say that he

> will not be silent about the serious inequalities which exist in [music education] ... and will not allow access to continue to be denied to the vast majority of learners ... while many former white schools have levels of provision that ensure that all learners are exposed to music education.

The views expressed above suggest that current music education practices need redress, equity and access from both a curricular as well as a social and moral viewpoint. The notion of implementing a technology-based area of study is in keeping with the South African educational transformation agenda. The need to implement technology-based curricula poses a predicament to which music educators need to respond, internationally but more specifically in South Africa. This poses a challenge to music educators to transform by adopting a new pedagogic approach that sees technology as being a pivotal part of music education.

2.6 Music Technology within the current education system

It is self-evident that Music Technology straddles two disciplines – Music and Technology. Prior to the institution of the South African Qualifications Authority (SAQA) as the agency responsible to instruct bodies to implement the NQF (pre-1994), Music had existed as a subject in its own right controlled by the Department of National Education (Smit & Hauptfleisch 1993: 8). Initiatives to introduce Technology as a school subject date back before 1994. Before 1994 technology was offered as "design and technology", mainly at advantaged schools in education departments such as the ex-Natal Education Department. Historically disadvantaged schools and communities were dependent on non-government organizations (NGOs) such as ORTSTEP (ORT-Science and Technology Education Project) and PROTEC (Programme for Technological Careers) for some form of technology education (Kahn & Volmink 1997: 1).

The classification outlined in the *Standards Generating Body Manual – Fourth Draft* (SAQA 2000a: 5) recognizes Music as a sub-field under NSB 02 Field: Culture and Arts (see Table 4.2). According to the discussion following the Minister of Education Kader Asmal's address (Asmal 2000a), the classification of Music under the Field: Culture and Arts raised a concern among educators. Educators felt that if the arts were grouped together, Music would be marginalized; a concern expressed even at the highest level; "given declining budgets and prominence afforded to learning areas like mathematics, science and technology. There is a danger", said Minister Asmal, "that music education will be relegated to the margins of the teaching and learning process" (Asmal 2000a).

However, Curriculum 2005 (the national government's documentation on life-long learning, DoE 1997) places great emphasis on Technology, which is also one of the eight identified learning areas (see Chapter 1.9) into which the national curriculum has been divided (DoE 1997: 14,15). Technology in C2005 is used very broadly. However, computer technology is one of its central components. It could be assumed then that Music Technology would be given preference.

The Technology learning will promote "all aspects of technology: planning, design and manufacturing, and it is to be introduced from the lowest grades at school" (Dixon 1998: 2). The emphasis on Technology education by the Ministry of Education (Asmal 2000a) is a positive development for music educators, especially at the time when the arts are being marginalized. Music Technology presents itself as a “saviour” to music education, in that technology-based education is given preferential treatment by national government. Curricula, funding, employability, marketability and the goals of lifelong learning within the music sector need to embrace Music Technology as a transformational mechanism.

2.7 Summary

Definitions, discussions and developments in this chapter suggest that technology impacts on the economic, social, cultural and environmental contexts internationally. The increased usage of technology in all aspects of life requires educators to re-examine current educational practices by including strategies for technology-based education. Furthermore, they should realign current education practices to meet the demands of an interdisciplinary approach to education, i.e. application-based knowledge production as opposed to discipline-based knowledge production.

The technology definitions examined in this chapter suggest that the field of technology refers to both knowledge and skills that coexist. One could assume by this coexistence that the skills aspect in technology is underpinned by knowledge. Therefore, a qualification design in technology will need to take into account both aspects of knowledge and skills. It is also apparent that the construction of knowledge in technology is not solely the domain of academics. Learners are sometimes ahead of their teachers in knowledge production and application issues. Future knowledge production is fast becoming a social construct, where the inputs of all stakeholders in education are to be considered.

The increased usage of electronic musical and audio equipment and computers for music applications suggests a trend that supports the overall technology boom. The variety of devices, processes, products, applications and research related to music and technology has given birth to Music Technology, the field of study. The field of Music Technology, as is the case with technology, is about knowledge and skills that are related to music activities.

It is apparent from the historical trajectory that a body of technology knowledge has been developed over time. This body of knowledge relates to music and shows how emerging technologies have helped to move the field forward. The areas of audio technology, electronic musical instruments, Internet and telecommunications, music notation, and research are clearly identifiable through the historical development in music technology. These comprise five distinctive areas.

Areas that share common processing and application techniques, emerging from the historical development, can be grouped together. The most obvious of these areas are audio sequencing, digitized media and multimedia. These all work with digital data and could therefore be grouped into the area multimedia and digitized media, comprising the sixth area of development.

Since the computer forms the basis for most of the applications above, it is crucial to understand how computers work, the systems related to computers, computer laboratories and computer-based education and training. There is currently an increase in computer training/instructional software for musicians and music educators. Besides, formalized studies in computer literacy or informatics have traditionally fallen outside the ambit of arts-based disciplines. Therefore two areas that would supplement the above would be computers, information systems and laboratory management, and computer-based training (instruction or education), thus creating the seventh and eighth areas of specialization.

Although the sub-domains of Music Technology indicate that *Musique Concrète* and *Elektronische Musik* forms part of music processing (see 3.3.1.2 MIDI Sequencing) and creation (see 3.3.1.8 Computer Music), they impact on other technology areas as well. These areas relate to music synthesis and computer music. The principles that emerge from *Musique Concrète* and *Elektronische Musik* (tool and enabler concepts) can be applied to computer music. It would then be appropriate to categorize these developments collectively as computer music (area nine). Although area ten, sequencing related to MIDI, is also digital, it remains a specialized independent area because of its dependence on a combination of differing skills (composition, arranging, recording, mixing and mastering and music publication).

The categorizing of the historical developments into these ten separate areas shows the distribution of knowledge in Music Technology. These areas of specialization from this point on will be referred to as the core components (ten) of Music Technology. It should be added that the Technology Institute for Music Educators in the USA (Rudolph *et al* 1997: 2), which recognizes seven of these ten components (audio technology, computer music and research are not recognized) refers to these components as areas of competency. Also "electronic music instruments" are referred to as "electronic musical instruments". From this point further the term electronic musical instruments will be used. The core components derived in this chapter will be used to identify the core competencies necessary for qualification design Chapter 5. These components will be indicated by means of the upper case from this point on (see Notes to the Reader, no. 6).

The historical development and emerging Music Technology trends reveal that technology impacts on the traditional discipline of Music. The impact of technology on music within Music Technology suggests that the latter field is interdisciplinary in nature. Music educators therefore need to take cognizance of the interdisciplinary nature of Music Technology (dynamics of the field) and the impact of these technologies and find ways of integrating such technological advances into current teaching practices (pedagogy).

Much of the integration of technology in Music is apparent in the courses and qualifications in Music Technology that are available. Towards the end of the 1990s there has been a boom in Music Technology programmes that are offered internationally. These Music Technology programmes open new career paths for the music learner, by addressing the pedagogic and employment needs of societies internationally. South African music education institutions have responded to these international Music Technology trends by implementing similar programmes nationally. However, the South African programmes are largely academically driven with little input from the employment sector.

Music education, which responds to international trends in Music Technology, is in a predicament in that the approach towards pedagogy has shifted from being teacher-centred to learner-centred and the learning content needs to affirm the musics of global cultures. Most music education programmes are still largely dominated by western art music curricula, where indigenous knowledge systems have not been fully implemented as formalized studies within existing curricula at post-secondary institutions. Several of these music institutions have also not put into place mechanisms that address the issues of equity, access, redress and the recognition of prior learning (especially in the informal sector of education). Due to the fragmented education system in South Africa prior to 1994, these issues are pivotal in bringing about transformation and would therefore need to inform the design of new qualifications.

Although arts-based disciplines are threatened within the new education framework, being poorly funded and less important, when compared to disciplines such as Mathematics, Science and Technology, the survival of Music within this education framework is secured when combined with Technology. This is apparent from the prominence attached by national government to technology and technology-based education.

Finally, the concepts and recurring issues discussed in this chapter will be elaborated upon in forthcoming chapters. These concepts and issues will then be used to inform the construction of a conceptual framework in Chapter 5 to aid the design of a qualification.

CHAPTER 3

REVIEW OF LITERATURE, AND ANALYSIS OF MUSIC TECHNOLOGY TRENDS

In this chapter, studies are reviewed on the use of technology in education, both outside the domain of music and within music. Current trends in Music Technology are traced. The purpose of the reviews of studies and both the international and national analysis of trends is to identify recurring conceptual issues and trends that inform qualification design in Music Technology as an emerging field of study in South Africa. With regard to the review of the literature, several studies have valuable contributions to make to the field of Technology. However, only a few of these studies impact directly on the current research. These are discussed in some detail here, based on their content and relevance to my work.

3.1 Studies outside of music

Technology in education has become an accepted practice worldwide, yet debate surrounding the use of such technology is ongoing and contentious, as is apparent in the studies discussed below. This debate also impacts on Music Technology because certain core competencies (components of Music Technology) overlap with other generic Technology areas: for example, Multimedia and Digitized Media, the Internet and Telecommunications, and Computers, Information Systems and Laboratory Management. Over the past decade, discussion forums and the number of publications pertaining to technology in education have been on the increase, for example the online *Journal of Technology Education* and the *Journal of the International Forum of Educational Technology and Society*.

3.1.1 Dixon: *Developing of a learning programme for the learning area Technology at Colleges of Education* (1998)

The adoption of a new education framework[12] in South Africa in 1995, at primary, secondary and post-secondary levels, has demanded a re-examination, on the part of educators, of curricula and learning programmes. In her PhD thesis *Developing of a learning programme for the learning area Technology at Colleges of Education*, Dixon (1998: iv) sets out "to develop a learning programme for Technology for the intermediate phase [school grades 4-

[12] National Qualifications Framework. Discussed in Chapter 4.1.2.

6] as part of the teacher education programme at colleges of education." Her study is based on the impact of outcomes-based education, the National Qualifications Framework, Curriculum 2005, the COTEP document (1996), the Technical Committee's discussion document on the revision of norms and standards for teacher education (1997) and the latter's final report on curriculum development at colleges of education.

Dixon examines different curriculum models, as well as the issue of the curriculum development process at post-secondary institutions with particular emphasis on the institution to which she is attached (Hoxani College of Education, Mpumalanga, South Africa). Dixon's empirical research centres on questionnaires and statistical data analysed to ascertain the correlation between the learning area Design and Technology[13] and other learning areas. The results of her study culminated in a learning programme for Technology for the intermediate phase, as part of the teacher education programme. This programme, accompanied by a questionnaire, was distributed to various education specialists in South Africa and abroad for their input. These inputs were analysed and the resultant recommendations were included in the final learning programme.

Some of Dixon's findings include: The need for colleges of education to develop and implement technology education programmes to satisfy future educator needs; the transformation process being delayed as a result of the unstable nature of the NQF, its supporting structures and the dichotomies and uncertainties that exist in implementing national policy documents (C2005, COTEP discussion and final documents); and expectancy of unqualified and untrained curriculum developers (educators) to develop learning programmes, contributing to low educator morale. These were all factors that affected the transformation process (Dixon 1998: 224-26). Although these findings are interesting, the scope of this study is somewhat limited. No qualification in the field of Design and Technology exists as yet. Therefore it is premature to design a learning programme, because the outcomes and assessment criteria cannot be measured against any qualification (see Chapter 5.2). For this reason the strategy adopted by Dixon will not be applied to my study. It is also not clear whether this is a programme for Design and Technology or Technology as part of the Organizing Field Manufacturing, Engineering and

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[13] Design and Technology is a learning area where the study of design is an integral part of technology education. Through the process of design learners bring together knowledge, skills and attitudes about technology. The application of knowledge through design enables learners to employ higher-level thinking skills as well as apply a range of technical skills.

Technology (see Table 4.2). Dixon's treatment of Technology as an area of study conforms to what Gibbons and co-authors refer to as Mode 1 (disciplinary) or the traditional form of knowledge production (Gibbons *et al* 1997: vii), where Technology is treated primarily as the making of artefacts.

The present study nevertheless benefits from Dixon's research in that hers is one of the first studies that attempt to implement the requirements of current South African education policy.

3.1.2 Dooley, Metcalf & Martinez: *A study of the adoption of computer technology by teachers* (1999)

Computers are widely used in many areas of education and their use within Technology-based curricula is therefore noteworthy. Dooley *et al* (1999) undertook

> to determine the role of professional development and training in the adoption of computer technology and telecommunications in a training case study. Research questions included:
>
> 1. What were the percentage of concerns that were self, task, and impact[14] concerns among high-, middle- and low-using computer technology and telecommunications users?
> 2. To what extent did the findings match or not match Rogers' diffusion of innovation research[15] (1983) and the Concern-based Adoption Model[16] (Hall *et al* 1973) for innovation and diffusion?
> 3. What were the factors that made an impact in the diffusion process and how might these training environments further enhance professional development and interventions for diffusion?

Their study used naturalistic inquiry[17] in combination with a variety of qualitative and comparative methods (for data analysis) as its methodologies. These methodologies allow

[14] Self refers to the individual's concerns, task refers to operational concerns, and impact refers to concerns dealing with future decision making.

[15] The process through which an individual passes from first knowledge of an innovation, to forming an attitude toward the innovation, to a decision to adopt or reject, to implementation of the new idea and to confirmation of this decision (Rogers 1983: 20).

[16] A model that views change as a process rather than an event and examines the various motivations, perceptions, attitudes and feelings experienced by individuals in relation to change (Hall *et al* 1973).

the researchers to develop working hypotheses and grounded theories (Roger's Diffusion of Innovations and Hall *et al's* Concern-Based Adoption Model) within the context of the schools. The process was based on the confidential interviewing of various stakeholders in education in a targeted district in Texas, USA. The results of this study reflect the following responses to the three research questions (Dooley *et al* 1999):

- The percentage of concerns were: self = 23%, task = 38%, impact = 39%, with regard to how teachers felt on the continuum of users of computers and telecommunications, high = 23%, middle = 46%, low = 31% (in terms of teacher profiles). The respondents with high concerns felt that computers would not replace their positions.
- The findings closely matched Rogers' diffusion and innovation research and the Concern-based Adoption Model. Higher users of technology had a favourable attitude toward change and responded positively. Middle users were more deliberate, sceptical and cautious, with low users reflecting little interest, suspicion and resistance.
- Several factors (personnel concerns, administration factors, to name a few) can be attributed to the overall diffusion ("the process by which innovation is communicated through channels over time among the members of a social system" [Rogers 1983: 10]) of computer technology and telecommunications. These concerns of personnel, and administrative factors contribute to the change process.

The findings highlight the notion that teacher training and college courses are not quick-fix solutions to address technology training expertise. Attention also needs to be given to teachers training teachers. A weakness that could easily be overlooked with regard to Dooley *et al's* study is the exceptional circumstances relating to it. This case study uses an informal training set-up, which could be manipulated by the researchers (Dooley *et al*) to yield the desired results. Also, the particular school where the study was undertaken had many resources. The strength of this study, though, suggests that it is possible to translate diffusion and change studies into a variety of different contexts and apply them to a vast array of innovations.

[17] A research approach located between the quantitative and qualitative, in which one attempts to study something in its natural habitat.

3.1.3 Barnard: *Computers in FE (Further Education) biology – a study of how teachers' classroom practice can be affected by different types of software* (1999)

Also related to computers, Barnard's (1999) research "aimed to examine how the use of educational technology could affect teachers' classroom practice and vice versa". Her research focuses on nine classroom observations of teacher-student interaction with computers in the USA. Using Brown and McIntyre's (1993: 63) framework, which examines how teachers organized their thoughts about their usual classroom practice, based on classroom observations and follow-up interviews with schoolteachers, Barnard observes and analyses teachers' commentaries. Her analysis reveals a correlation between computer activity and the teachers' classroom practice. She concludes that the computer activity needed to fit in with the teachers' classroom practice in order for teachers to see it as a valuable learning activity. On the other hand, teachers made adjustments to their classroom practices by incorporating computer activity, which had value in its own right.

This study provides valuable insights into the interaction between teacher, student and technology. Observations suggest software developers might benefit from greater awareness of teacher's classroom practice and greater consideration of the details about how their software would be used as part of the teaching session.

3.1.4 Anand and Zaimi: *Computer-managed instruction: Evaluation of alternative methods of technology integration in higher education* (2000)

The study by Anand and Zaimi (2000) relates directly to the current research in that they set out "to compare the impact of using alternate methods of technology in undergraduate and graduate classes". The methodology is based on adopting the concept of Usability Testing through a series of interviews within projects. This process followed a systematic method of assessing student needs and perspectives during the process of technology integration. Initially, user-friendly ways of technology integration were employed with little lecturing. Gradually, custom-designed software focussing on self-paced instruction and self-evaluation materials was used as an alternative to mainstream instruction (where little technology was employed). The entire focus of the project was aimed at reducing barriers to technology integration through regular feedback. Feedback responses were integrated into the programme as part of updating the instructional resources provided via technology. The results of continuous feedback revealed that in order to successfully integrate technology, differential needs of the traditional as well as adult learners need to be taken into account.

The strengths of this study are reflected in the findings: Students accessed technology more regularly than previously and educators therefore needed to combine traditional instruction with technology-related experiences in order to create a positive perception of technology.

3.1.5 Reid: *Towards effective technology education in New Zealand* (2000)

The new South African education framework is based to a large extent on the New Zealand model (SAQA 2000c). Since the former is a relatively new framework, it would be significant to consider the New Zealand perspective on technology education. Reid (2000) examines the historical concept of technology education in New Zealand, since its evolvement from the British model. He explains how England and Wales designed and introduced a new technology curriculum. New Zealand then needed to develop a technology curriculum suited to their developing culture. Reid focuses on the process of curriculum development, elaborating on good features and certain difficulties that resulted from the introduction of Technology as a discipline in 1999. His discussion is preliminary in nature and is an interim account of a process that will be undergoing changes well into the 21^{st} century. Of his conclusions and recommendations, three are pertinent in the design of technology-based curricula (Reid 2000):

- Knowledge must constantly be acquired in order to understand and solve the problems of the time;
- The balance between *what to learn* and *how to learn* (within the subject specific discipline) must shift to the latter; and
- The success of the technology curriculum will depend upon its successful implementation in the schools, together with the development of an effective assessment programme.

The strength of Reid's research lies in the historical development of the technology programme in New Zealand, that it posits. This programme was devised and tailored to suit the needs of New Zealand. This could easily serve as a model for the South African context

– a working framework that takes into account South African needs against the backdrop of international trends and innovations.

3.1.6 Van Loggerenberg: *Implementing a problem-based learning model in the training of teachers for an outcomes-based technology curriculum* (2000)

A South African study that has direct implications on the current research is that by Van Loggerenberg who focusses on "preparing pre-service final year high school teachers in the natural sciences to facilitate learning in technology from an outcomes-based perspective" (Van Loggerenberg 2000: xvi). The study examines problem-based learning (PBL) as a curriculum design type in which the entire programme was structured around discipline specific problems that formed the basis for training pre-service teachers. The problems were diverse in nature, ranging from learner attitudes and motivation, to the depth and breadth of knowledge acquisition, to designing problem-based learning tasks. The rationale for employing the PBL approach was rooted in the following (Van Loggerenberg 2000: xvi):

- It is a strategy, which has the potential to operationalize OBE principles in learning environments.
- It is a strategy, which enhances that transferability of competence from university classroom to the real workplace because of its embedded characteristic of authenticity.
- The syntactical nature and structure of PBL and technology education show strong similarities.

The methodology employed, involved the development of a two-level OBE-PBL model that was used during the six-month training of pre-service teachers; then the pre-service teachers had to implement this model when they were required to facilitate learning in technology education in real schools for a month. Both quantitative and qualitative data were gathered from teachers and learners and the results revealed that pre-service teachers transferred their OBE-PBL competencies to such an extent that the post-test results of the experimental group were significantly better than their pre-test results. The post-test results of the experimental group were, however, not significantly better than the post-test results of the control group. In the final analysis, it became apparent that the experimental learners performed better in higher "cognitive questions that demanded meta-cognitive skills" (Van Loggerenberg 2000: xvii).

The strength of this study is that it represents a movement towards investigating the effectiveness of PBL as a curriculum renewal, teaching and learning strategy for OBE. An extensive background to OBE and various educational philosophies are examined during the study. Two limitations in this research are that it can only generalize the PBL approach to OBE in technology with regard to professional teacher training for OBE in the Technology and Science learning areas. Also, the researcher relied heavily on reports, questionnaires and conclusions by pre-service teachers, rather than extrapolating the data personally. This raises questions about the validity of data, because the researcher was not present during the full period of the pre-service teacher training sessions. Besides, the implementation with the pre-service teachers and learners needed to be extended over a longer period of time, which would probably yield more reliable and generalizable results.

3.1.7 Key emerging issues from studies outside of Music Technology

Although several issues and concepts are identified as being vital in the above review, only the concepts that have a direct impact on my study will be mentioned. The concepts that arise from the above studies are technology as a tool and Technology as a field of study. Most of the studies reviewed reflect technology as a tool to enhance the existing field of study, i.e. something that helps increase the pace of learning, experimentation, and so forth. Technology is seen as a vehicle to enhance existing teaching delivery systems, whereby cautions were expressed that teacher input in technology-based programmes is vital. Attitudes toward the use of technology are also vital for the implementation of technology education.

In Dixon's study Technology is treated as an area of study in its own right and conforms to disciplinary knowledge (as articulated in the disciplinary sciences of Physics, Chemistry and Biology), where the focus is on the production of knowledge. Van Loggerenberg who also focuses on disciplinary knowledge, highlights the need to examine problem-based learning within the OBE context, where the process of working toward understanding or resolution of a problem is important for the learner. The PBL approach implies a particular strategy for facilitating learning.

3.2 Studies in music

There are an increasing number of studies addressing curriculum design, combining technology and music and the introduction of electronic music into music education programmes. Unfortunately, due to the evolving nature of technology, many of these studies, although relevant, are already outdated in terms of their content because of the rapid development of technology itself. The principles that underlie the technology and the approach to technology are vital. Studies that are reviewed here are included because they were recently conducted and/or their findings are relevant and/or applicable to the field of Music Technology and qualification design in Music Technology in particular.

3.2.1 Faulk: *A curriculum guide designed to teach a basic knowledge of electronic music to undergraduate music education students* (1978)

Faulk's study is one of the earliest that addresses issues of curriculum design and electronic music. The purpose of his study was "to design a curriculum guide for a course that introduces prospective music teachers to a basic knowledge of electronic music" (Faulk 1978: 6). A primary objective of his study was to enable music education majors at USA institutions to teach electronic music effectively in grades four through twelve. Even twenty-four years ago, Faulk observed that the electronic music courses taught in some colleges and universities were designed with the composition or theory student in mind, where the prospective music educator, who was being educated to teach music in the public schools sector, was somewhat disadvantaged with a basic education in electronic music. Faulk based his research on the fact that the necessary hardware used in teaching a course in electronic music was relatively inexpensive and would be available in public schools.

Upon completion of a one-semester course in electronic music, data was collected through student questionnaires and the submission of final student compositions. Two of these student compositions were submitted to electronic music composers for evaluation. The curriculum guide devised by Faulk (1978: 50) was divided into six units:

1. Introduction to Electronic Music;
2. The Synthesizer;
3. The Tape Recorder and Manipulation Techniques;
4. Basic Compositional Techniques;
5. Electronic Music Compositions;
6. Using the Synthesizer to Teach Music.

Each of the units contained six facets: "exit level" student outcomes; acquired or basic content; suggested instructional procedures; materials and resources; evaluation; and supplemental reading.

Results showed that the students' knowledge of electronic music had increased notably after working through the six units. Furthermore, their competence had developed, enabling them to teach electronic music in grades four through twelve. Awareness of timbre sensitivity and musical structure, as well as an inclination to listen to all types of music also became apparent. Although this is a historically significant study in terms of being one of the earliest to design a curriculum guide for electronic music, the sample of students (six) was limited.

3.2.2 Sanders: *The effect of computer-based instructional materials in a programme for visual diagnostic skills training of instrumental education students* (1980)

Sanders was one of the influential early researchers who implemented computer-based instruction (see Chapter 3.3.1.4). His study set out "to determine the effect of computerized instruction on the ability of students to perform tasks of visual error-detection during instrumental methods-instruction in music" (1980: 6). The study was based on a post-test design; initial biases between the groups were reduced through a process of randomization. Twenty instrumental music method students were targeted for study. These students were divided into a control group and an experimental group. The control group utilized resources in a classroom setting under teachers' supervision, whereas the experimental group used similar materials in a computerized format without supervision, outside of the classroom.

Both groups had to perform visual error detection (no aural detection used) on an instrumentalist (saxophonists, flutists, and the like) according to preset criteria. The post-test was administered to both groups simultaneously. The attitude questionnaire was only completed after six weeks and each candidate participated in two interviews with the researcher (1980: 6).

On analysis of the broad research problem, certain research questions surfaced (Sanders 1980: 6):

- Within the parameters of the test group what association exists between practice and post-test score achievement?
- What was the correlation in the attitudes of the two groups toward the instruction they had received?

- And what was the relationship between student scores on the post-test and student attitudes in relation to the instruction among the selected groups?

The results of this study were derived from comparative post-test scores, practice times and the number of practice items completed. These results revealed that computer-aided instruction provided a highly effective and efficient method of delivering visual diagnostic skills instruction (Sanders 1980: 83). Student attitudes toward the integration of technology were positive. However, they also indicated that the learning process could be enhanced through additional teacher interaction (1980: 91). The weakness of this study lies in three areas:

- No attempts were made to compare the costs with regard to instructional computing versus conventional teaching;
- The instructional materials focus was on visual error detection only and avoided aural detection; and
- The researcher combined the effect of individualization (subjective opinions) and computerization (data extracted through the use of computers) instead of treating them as separate variables of the study.

3.2.3 Grijalva: *Factors influencing computer use by music educators in California independent elementary and secondary schools* (1986)

In 1986, Grijalva conducted a study that examined computer use in the curricular area of Music, with the intended purpose of assessing the status of computer use by independent school music educators in California, and identifying factors that influence such use (1986: 2). His study was based on the premise that independent schools were leaders when it came to allowing students computer access, while the integration of computers throughout the broader school curriculum remained an identified but unfulfilled goal.

Grijalva implemented a survey research design, using over one hundred music educators who were in the employ of 104 member schools in the California Association of Independent Schools during April of 1986. A return rate of 80% on the original sample was obtained.

The results of his findings with regard to music educators indicate that 38% of educators used computers for multi-purposes, administration and instruction; 26% used computers for instructional activities; and among the non-users, half were in the orientation and preparation status of computer use.

In this study, eighty factors relating to the effect of computer use were identified and statistically tested. Of these factors, thirty-seven were identified as significant influences, with the following being major influences: personal (gender, ownership, and the like), equipment and access, financial, instructional support, and curricular.

This study is relevant because it shows that computer use is not uncommon by music educators for tasks other than music. The integration of the computer into the Music curricula would be a challenge to curriculum designers and music educators alike.

The strength of this study lies in the correlation between the factors identified and the use of computers by music educators. However, for the purpose of my study the conclusions reached by Grijalva are not useful because they are based on a defined population. Besides, no attempt was made to ascertain whether higher levels of computer use were, in fact, desirable.

3.2.4 Fábregas: *Designing and implementing an electronic music program in a community music school in New York City* (1992)

The study undertaken by Fábregas provides guidelines for community music schools on how to design and implement an electronic music programme (1992: 12). This study was based on a pilot project at a summer camp, designed to introduce twenty-three children between the ages of six and fourteen of different musical levels and abilities to electronic instruments and ensemble playing.

The children were introduced to three types of electronic instruments (Casio DH 100 and DH 500 wind controllers, Kawai 50 WK keyboards and Yamaha DD5 drum pads). The children learnt to play each instrument while at the same time majoring in one of the instruments. Children with differing musical abilities were accommodated. Summative evaluations were based upon:

- Questionnaires and surveys filled out by students, parents and faculty;
- Live and tape recorded researcher moderated observations; and
- Oral teacher reports during staff meetings.

The results showed increased interest among students and teachers in the electronic instruments due to their accessibility and their novel features (such as interesting timbres). The electronic instruments also allowed the children to:

- Learn at an increased pace without having to grapple with technical problems that so often occur with acoustic instruments;
- Participate in the final ensemble performance after four weeks of preparation; and
- Improve their practising habits by motivating them to learn music.

The results in this study are similar to those of Grijalva (1986), in that the research is confined to a defined population at a specific summer camp. So the generalizability of findings would be questionable. Only issues pertaining to individual and ensemble performance are addressed, without actually introducing students to the principles of electronic music. On a positive note, the interest shown by the parents and the students toward electronic music paves the way for music educators considering to incorporate technology into mainstream music programmes.

3.2.5 Tredway: *A curriculum for the study of audio, video, computer, and electronic music technology for undergraduate music education majors based on a survey among members of the Florida Music Educators Association* (1994)

The Music Educators National Conference (MENC), the largest music educator body in the USA, has been in favour of the uses of technology by music educators, both for instructional and non-instructional purposes. With this policy as a foundation for music education also supported by the Florida Music Educators Association, Tredway (1994) sets out to provide undergraduate music education majors with a course of instruction by which fundamental knowledge and skills concerning audio, video, computer and electronic music devices can be attained (Tredway 1994: 6). In order to ascertain the most frequently used audio, video, computer, and electronic music devices and their applications, he developed a survey instrument and a panel of five music education professionals used a test/re-test method to evaluate this instrument for its validity (Tredway 1994: 104). A sample of 400 questionnaires was sent to members of the Florida Music Educators Association, to which 188 (47%) responded. The data received was analyzed according to the test/re-test method, after being subjected to four different types of treatment (Tredway 1994: 105):

- Mean responses;
- Mode for each item;
- Numerical responses that were ranked and correlated for each item; and
- Numerical responses that were ranked and correlated using the Spearman-rho formula[18] adjusted for tied scores.

This process was followed by the compilation of a curriculum providing basic skills and concepts for undergraduate music education majors in the areas of audio, video, computer and electronic music instrument technology. A panel of six education and music education professionals using a six point Likert-type scale[19] evaluated the subsequent curriculum. Two items following the evaluation attained a mean score below the acceptable minimum of 4.0, which required revisions of sections of the proposed curriculum (Tredway 1994: 106). Therefore, instructional activities were added to the curriculum, which reflected the commentaries of the evaluators.

Tredway's study provides good groundwork in laying the foundation for curriculum content and an approach to evaluating student's progress regarding audio, video, computer and electronic Music Technology. The issues of curriculum content and evaluation procedures inform the present study. The two weaknesses I identified lay in the construction of the curriculum: the curriculum must reflect the twenty-three survey items identified by the survey for their implementation into the curriculum, and the curriculum should not exceed ten hours of instructional time.

3.2.6 Jaeschke: *Creating music using electronic music technology: curriculum materials and strategies for educators* (1996)

Jaeschke's study (1996) was similar to that of Faulk (1978) and Fábregas (1992) in addressing the issue of curriculum studies using electronic Music Technology. As is evident in Fábregas' title (Chapter 3.2.4), the terms "electronic music" and "music technology" are used together (see Chapter 2.3), suggesting some kind of relatedness between the two areas. This is also particularly evident in Jaeschke's title. This study is one of the first to use the term "music technology" to denote a specific component of formal music studies.

[18] A formula used for the measurement of the correlation between two variables.

[19] A measurement scale used to obtain information by means of question and answer.

The purpose of Jaeschke's study was to create and field-test a concept-based creative music curriculum that would enable teachers to teach music while integrating electronic Music Technology into the classroom (1996: 4). Jaeschke based his hypothesis on the notion that "technophobia", financial concerns, and the absence of current curriculum materials were factors hampering the introduction of electronic Music Technology in the classroom. Jaeschke uses the creative music approach developed by the Manhattanville Music Curriculum Project (MMCP). A hands-on exploratory approach is the unifying component with the MMCP and Jaeschke's approach in teaching the fundamental concepts of music.

The study details the technological process involved in four areas of technology, namely

- Tape recording;
- Both open reel (*Musique Concrète*) and cassette multitrack;
- MIDI computer sequencing; and
- MIDI notation,

by means of strategies contained in eleven musical sequences. Although *Musique Concrète* by its very nature is interdisciplinary, the integration of the remaining three areas of technology suggests a move towards interdisciplinary knowledge production (i.e. computers, music and sound engineering). Gibbons and co-authors refer to interdisciplinary knowledge production as Mode 2 knowledge production (Gibbons *et al* 1997: vii).

Jaeschke conducts an extensive review of related material, listening examples and references, which he finds should form an integral component of the curriculum. Results of the study were obtained through a field test and questionnaire that were completed by professional music educators. Jaeschke presents a summarized report that includes suggestions and revisions regarding the effectiveness and feasibility of the project.

Jaeschke's study excludes certain pivotal areas of music technology, namely hard-disk recording, computer-based software teaching music theory, aural training, jazz improvisation and instrumental instruction, sound design and computer music. Jazz improvisation is important in that the musical freedom encountered in this genre lends itself towards composition and creativity when using music technology as a tool. However, this study impacts to an extent on my study in that it is designed to meet the nine national content standards[20] proposed by MENC (Pre-grade one to grade twelve) for music education. These standards are (MENC 1994a):

1. Singing, alone and with others, a varied repertoire of music.
2. Performing on instruments, alone and with others, a varied repertoire of music.
3. Improvising melodies, variations and accompaniments.
4. Composing and arranging music within specified guidelines.
5. Reading and notating music.
6. Listening to, analyzing and describing music.
7. Evaluating music and music performances.
8. Understanding relationships between music, the other arts and disciplines outside the arts.
9. Understanding music in relation to history and culture.

Although these content standards apply to the school music programme, they impact on the design of teacher training courses at post-secondary institutions. Prospective music educators are required to teach and assess against these standards; therefore these standards are pivotal in teacher training.

Since South African qualifications need to be internationally benchmarked (see Chapter 5.3.1.9), the Technology Institute for Music Educators (USA), who use these content standards in the design of their technology programmes, provide the ideal mechanism through which such benchmarking is possible.

3.2.7 Regenmorter: *Integrating technology into the music curriculum of a California community college* (1998)

The issue of integrating technology into the music curriculum is also addressed in Regenmorter's study. In this study, Regenmorter determines how Music Technology can be implemented in the educational setting. The question of what constitutes Music Technology, how it developed, and some objections to its use were examined (1998: 3-4).

Regenmorter focused on the community college setting and based his investigation on a study of periodicals, books, case studies, surveys and curricula of music departments that justified the use of specific technologies within their programmes. The current use of

[20] The use of the term standard, as used in this research, is not consistent internationally. MENC (USA) uses the term standard to suggest broad abilities required of learners rather than a particular level of achievement..

available technology at the American River College was examined. This was achieved through personal observations, interviews, a technology usage survey and documenting of all music technology equipment, software and peripherals that the department owned. Regenmorter offers particular strategies and models on how to effect the integration. The particular strength of Regenmorter's study lies in its literature review. The study programme suggested is limited, however, to just one specific situation and does not suggest itself as a model for other institutions of higher learning. Regenmorter's study benefits this current research in that it addresses the issue of integrating Music Technology, an emerging field of study, into the post-secondary music education curriculum. Also the strategies and models with regard to the integration of Music Technology inform the design of the qualification in Chapter 5.3.

3.2.8 Key emerging issues from studies in Music Technology

My review of studies in Music Technology suggests that most research in this field is being undertaken in the USA, where much of society as a whole is technology driven. It is apparent from the studies presented in the previous section, that several technology programmes are targeted at the music educator. This can be deduced from the use of the words music educator, music education, curriculum, schools, and so forth, in the titles of the studies reviewed. The emphasis placed on curriculum in most of the studies above highlights the need to introduce Music Technology into the existing music programmes at education institutions.

The two broad issues that arise from the previously mentioned studies are those surrounding curriculum transformation (the integration of technology into existing music programmes) and those dealing with content (knowledge). Curriculum transformation to accommodate emerging knowledge production (technology-based in the cases mentioned) needs to be addressed by music educators internationally. The boundaries of traditional disciplines need to be reviewed. With regard to content issues, I have identified the following components of the field of Music Technology, reinforcing the findings in Chapter 2.2 and 2.7:

- Electronic music;
- Electronic musical instruments;
- Audio technology; and

- The use of the computer as a tool that aids the process of composition and data processing (e.g. in the case of sequencing).

The description and application of Music Technology in the afore-mentioned studies suggest a general shift from disciplinary (Mode 1) to interdisciplinary (Mode 2) knowledge production. Mode 2 knowledge production operates within a context of application, in that problems are not set within a disciplinary framework. The Mode 2 knowledge, as is the case with Music Technology (music + technology), is in a non-hierarchical and heterogeneously organized form, in which the technology but not the principles (basics) are constantly changing.

Since Music Technology is a relatively new field in South Africa, texts and source material are generally informative, but do not always facilitate the design of curricula. However, an increasing number of writers, especially internationally, are paying attention to issues of curriculum design and learning programmes. As can be deduced from the studies discussed earlier, although areas of common ground exist, issues pertaining to curriculum design are often specific to the needs of particular learning environments and contexts. The issue of relevance is a vital consideration in the Music Technology programme design.

3.3 Post-secondary trends in Music Technology internationally

In order to establish current international trends in Music Technology, data were gathered and examined from Internet websites of post-secondary institutions that offered programmes in Music Technology. This data was used to ascertain what were the perceptions of post-secondary institutions internationally on the nature and status of Music Technology. The data did not trace links to other departments within the institutions that purported to offer Music Technology components. E-mail correspondence was also maintained with the programme coordinators who were willing to share structural and content composition of their programmes and comment on any ancillary information that was deemed necessary to my study. The primary purpose of this analysis was to establish trends relating to the various Music Technology components that were offered within each of the various programmes/ qualifications. The secondary purpose included ascertaining any interdisciplinary correlation existing between Music Technology and other disciplines and viewing the impact of Music Technology on career paths in music. Although this approach to data gathering is valid, it is, however, not intended for generalizations or as the only way to make conclusions about Music Technology's profile internationally.

3.3.1 Core components of Music Technology

The selection criteria for inclusion in the analysis required each institution to be a post-secondary institution and to have at least one Music Technology programme (degree, diploma, certificate, short course, semester course, and so on), offering a minimum of two Music Technology components (identified in Chapter 2.7). Following an online search of music programmes at various institutions, a total of fifty-five institutions (including South African institutions) were identified for inclusion in the analysis. All fifty-five institutions met the required selection criteria. According to the historical development of technology (see Chapter 2.2) and the summary provided in Chapter 2.7, ten components have been identified as central to the development of Music Technology (these are discussed below at Chapter 3.3.1.1 to 3.3.1.10 - the brackets indicate abbreviations). Apart from these ten core components some institutions offered other areas of Music Technology (acoustic instrument design, television and film, music adventures and games, programmed instruction, and teaching machines) as part of their programme.

3.3.1.1 Electronic Musical Instruments (EMI)

These are musical instruments that generate sounds electronically rather than acoustically. The range of these instrument types includes controllers, sound modules, synthesizers, digital pianos, vocal processors and samplers. Traditionally, tape recorders were also considered as electronic musical instruments. However, electronic musical instruments refer specifically to sound generation, synthesis, sequencing and arrangement rather than reproduction.

3.3.1.2 MIDI Sequencing (MS)

This is a digital process whereby the information sequences of a musical performance (note-on/off, tempo, dynamics, pitch, timbre, and the like) are captured by a computer/hardware device, processed and stored for purposes of further processing and/or output. The types of capturing techniques may differ, depending on the devices used. All sequencers these days are either software- or hardware-based.

3.3.1.3 Music Notation (MN)

This component refers to the processing of music notation by means of computer software as opposed to the traditional process of a printing press. Music software is designed to print scores, extract and transpose individual parts, scan scores and generate MIDI performances. Once the music data have been entered into a software programme, this data can then be transformed according to one's specific requirements.

3.3.1.4 Computer-based Education/Instruction/Training (CBE/I/T)

The computer and software are utilized for the purpose of supporting music education. These software programmes are tailored toward specific needs of the developing/ professional musician. They are used for music theory instruction, music history and analysis, developing ear-training skills, creation of accompaniment tracks, as well as drill and knowledge testing in a variety of areas in music and music education. Computer-based education is central to the development of Music Technology because it impacts on most aspects (teaching, learning, recording, evaluating, testing, amongst others) of music education.

3.3.1.5 Multimedia and Digitized Media (MDM)

This component refers to the integration of sound, text, graphics, animation and video in digital format. The primary focus is on using the computer and other hardware devices to create, manipulate, store and combine various media objects such as text, audio, video and graphics into a single presentation.

3.3.1.6 Internet and Telecommunications (IT)

As is the case with several disciplines using current technology, musicians are also introduced to the various digital formats, protocols, and access and design procedures that are associated with the digital transfer of data and the Internet. A large proportion of the music produced, archived and distributed today is accessible via the Internet (Mash 1999).

3.3.1.7 Computers, Information Systems and Lab Management (CISLM)

The computer has become a valuable tool not only for its use in music, but also for the added value it brings to musicians in general. Computers help educators manage information more effectively in their everyday lives. Some of the functions range from word processing, working with databases and spreadsheets, desktop publishing, presentations and an integration of laboratory equipment within their working environments.

Managing a technology facility, whether it is a single computer with a MIDI workstation or a full Music Technology multi-lab, requires administrative and management abilities. This would be combined with installing, upgrading software and maintaining systems. At a more advanced level an understanding of the configurations for electronic musical instruments, computers, MIDI interfaces, sound reinforcement, projection systems, sound and data networking, and how they interact with each other is vital. A knowledge of these issues will enable the Music Technologist to be better prepared to effectively integrate and manage music technology installations.

3.3.1.8 Computer Music (CM)

Computer Music refers to the computer as a musical instrument that generates (creates) and synthesizes sounds and acts as a partner (accompanist/soloist) in live performance. The emphasis in computer music is on the exploration of new sound parameters and compositions through technological means. Since music processing tends to dominate most technology-based programmes, Computer Music, in the Music Technology domain, addresses the issues surrounding music synthesis and creation.

3.3.1.9 Audio Technology (AT)

The term "Audio Technology", used by Tredway (1994:12), denotes an area of Music Technology that includes devices that allow for the recording, mixing, processing, mastering and/or playback of sound. Examples include, but are not limited to, magnetic and digital tape recorders, phonographs, harddisks and compact disc players. Equipment necessary for the amplification of sound (microphones, processors, amplifiers and loudspeakers), together with the techniques associated with sound recording, processing, duplication and distribution, is also included. This area of study is also commonly referred to as Sound Engineering.

3.3.1.10 Research in Music Technology (R)

The focus of a research component at the post-secondary (predominantly undergraduate level) is to familiarize learners with various research techniques and designs in Music Technology and to create new knowledge. The process involves the interpreting and extrapolation of research information from published sources. These techniques are examined with a view to formulating research questions, engaging in critical discourse and developing appropriate research topics. The initial research skills are generic ones with other fields of study. However, advanced research in Music Technology could follow to include research into areas such as surround sound (for example, room acoustic modelling using two/three dimensional wave-guide mesh structures; surround sound techniques and reverberation modelling), performance and synthesis (for example, neural control of music synthesis, interactive media spaces), computer music (for example, the study of grammars in music, stochastic/algorithmic composition), and the like. From this point on, this component will be referred to as Research.

Using the information presented in Chapter 3.3.1, an overview of international Music Technology components has been documented in Table 3.1 and Figure 3.1. The reasons behind this tabulation are to ascertain the spectrum of focus areas in Music Technology internationally, and not to analyze detailed programmes in countries that are technologically advanced in terms of the usage of and research into technology. The listing of the fifteen countries follows no preferential order, because this does not affect the nature of data. The sample taken was random and not limited to a specific number of programmes/components or certification offered in each country. In addition to providing an analysis of the most commonly offered Music Technology components within these programmes, it provides a logical point of departure for the establishment of any new Music Technology qualification that curriculum developers may be anticipating. Since all of the South African music institutions offering Music Technology are examined in Chapter 3.4, I sampled ten out of the seventeen institutions which I considered an adequate quota (59%) for the international sample.

The core components listed in Figure 3.1, which follows, correspond to the abbreviations used in this section, namely: Electronic Musical Instruments (EMI), MIDI Sequencing (MS), Music Notation (MN), Computer-based Education/Instruction/Training (CBE), Multimedia and Digitized Media (MDM), Internet and Telecommunications (IT), Computers, Information

Systems and Lab Management (CISLM), Computer Music (CM), Audio Technology (AT) and Research in Music Technology (R).

Table 3.1: International areas of focus regarding Music Technology core components

	Electronic Musical Instruments	MIDI Sequencing	Music Notation	CBE, CBI, CBT	Multimedia & Digitized Media	Internet & Telecommunications	Computers, Info-Systems, Lab Management	Computer Music	Audio Technology	Research
Australia										
Australian Centre for Arts and Technology (Austr. Nat. Univ.)	•	•			•	•	•	•	•	
Griffith University		•			•		•	•	•	•
Macquarie University	•	•			•	•	•		•	
Monash University	•	•	•				•			
Queensland University of Technology - B Mus	•	•			•			•	•	
Deakin University (Non-degree course: Art E Mus)		•	•	•	•	•				
University of Western Sydney		•						•	•	
James Cook University	•	•	•				•		•	
New Zealand										
Victoria University of Wellington	•	•			•	•		•	•	
University of Auckland	•	•	•					•	•	
University of Waikato	•	•	•				•	•	•	
University of Otago	•	•				•		•	•	
University of Canterbury	•		•	•	•			•	•	
Asia and Middle East										
University of Putra Malaysia	•	•	•		•			•	•	•
Theremin Centre for Electro-Acoustic Music, Moscow	•	•	•		•	•	•	•	•	•
University of Hong Kong	•	•	•	•		•		•	•	
Tel Aviv University		•	•					•		
Bahr-Ilan University (Israel)	•	•	•	•		•		•	•	

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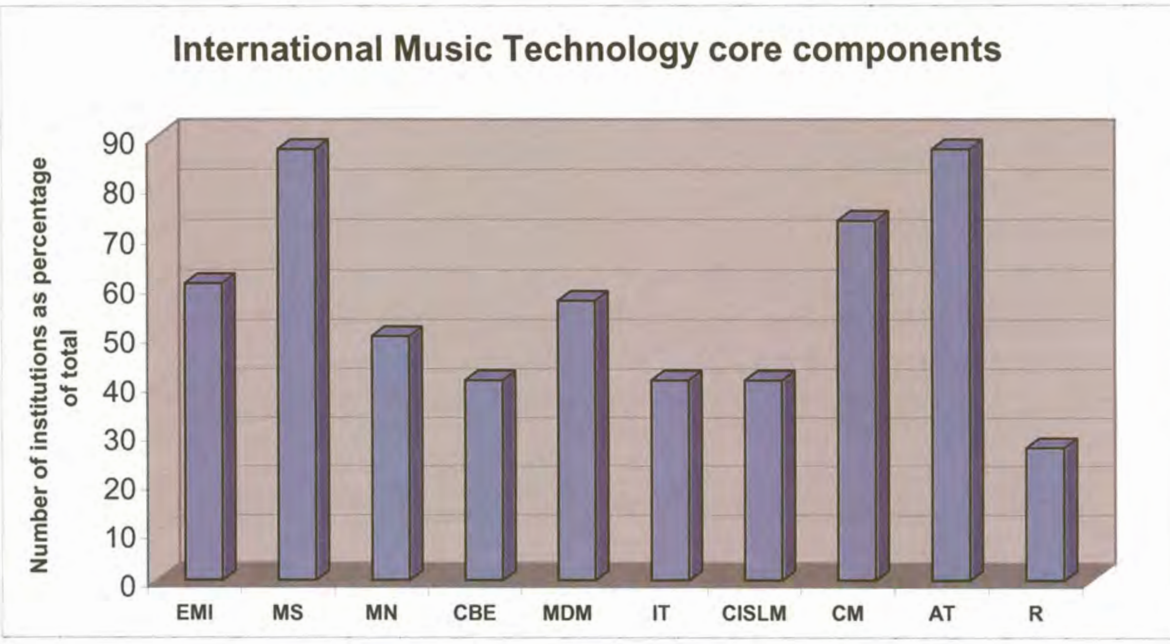
Table 3.1 (continued)

	Electronic Musical Instruments	MIDI Sequencing	Music Notation	CBE, CBI, CBT	Multimedia & Digitized Media	Internet & Telecommunications	Computers, Info-Systems, Lab Management	Computer Music	Audio Technology	Research
USA and Canada										
Berklee College of Music	●	●	●	●	●	●	●	●	●	●
Duquesne University	●	●	●	●	●	●		●	●	
Indiana University	●	●	●	●	●	●	●	●		●
Princeton University								●	●	●
Queen's University (Canada)	●	●		●	●	●	●	●	●	
Radford University	●	●		●	●			●	●	
Temple University	●	●	●		●	●	●	●	●	
Northwestern University	●	●	●	●	●	●	●	●	●	●
University of Northern Colorado	●	●	●	●	●		●	●	●	
University of South Carolina		●	●	●				●	●	
South Africa										
Rhodes University		●	●			●	●		●	
Technikon Natal		●							●	
Technikon Pretoria		●		●			●	●	●	
UNISA (University of South Africa)		●	●		●				●	
University of Cape Town		●			●			●	●	●
University of Natal-Durban		●	●		●	●	●	●	●	
University of Port Elizabeth		●	●		●		●		●	
University of Potchefstroom		●	●		●					●
University of Pretoria	●	●	●	●	●	●	●	●	●	●
University of Stellenbosch		●	●			●	●	●	●	
United Kingdom										
De Montfort University	●	●						●	●	
Keele University	●	●		●	●			●		
Leeds Metropolitan University		●		●	●	●	●		●	
University of Edinburgh	●	●		●	●			●	●	
University of Hull	●					●		●	●	
University of Kent	●	●	●			●		●	●	
University of Southampton		●	●						●	
University of Surrey		●						●	●	●
University of Sussex				●	●				●	
University of York	●	●		●	●	●	●	●	●	●
Europe										
FH Furtwangen – Hochschule für Technik und Wirtschaft	●			●	●		●		●	
Hochschule für Film und Fernsehen, Potsdam		●			●				●	
IRCAM Centre Pompidou, Paris	●	●	●	●	●			●	●	●
St Patrick's College, Maynooth, Ireland		●		●			●	●		
Royal Conservatory, The Hague, The Netherlands	●	●		●				●	●	
SAE Technology College, Paris	●				●	●		●	●	●
Technical University of Wroclaw, Institute of Telecom, Poland	●	●						●	●	●
Total number of institutions	34	49	28	23	32	23	23	41	49	15
Percentage	60.7	88	50	41.1	57.1	41.1	41.1	73	87.5	27.2

Figure 3.1: Weighting of Music Technology core components internationally



All institutions offered a minimum of two of the above specialization areas. Music Sequencing and Audio Technology were the most widely offered components, with 88% of all reviewed institutions offering these components. Computer Music was the next most widely offered area with 73% of all institutions, followed by Electronic Musical Instruments (61%) and Multimedia and Digitized Media (57%). Approximately 41% of all reviewed institutions offered the following components: Music Notation, Computer-based Education/ Instruction/Training, Internet and Telecommunications, and Computers, Information Systems and Lab Management. The area that was least offered by the reviewed institutions was Research in Music Technology (offered by only 27% of the institutions). While some institutions offered a minimum of two components, others offered all ten components.

The bar graph presented in Figure 3.1 above reflects the weighting of the core components that make up the field Music Technology. These components reflect the highest frequency in Music Technology programmes around the world. The core components identified above concur with the core components identified in Chapter 2.7.

3.3.2 Cross-curricula interaction

The data captured in the previous section (Chapter 3.3.1) were analysed with regard to core areas of focus, cross-curricula disciplines and music career opportunities. The core areas of focus (core components or components) have already been discussed (Chapter 3.3.1). This section will focus on the cross-curricular disciplines/areas and music career paths.

A close analysis of the content of Music Technology components shows that there is a cross-curricula inter-relationship between Music Technology and other disciplinary and professional areas. The relationship between Music Technology and these areas is illustrated in Figure 3.2.

Figure 3.2: Cross-curricula interaction of Music Technology and eight other areas

Each of these eight areas already has components that share common knowledge content (critical core areas) with Music Technology. Table 3.2 that follows maps the cross-curricula and critical core areas to the relevant components in Music Technology.

Table 3.2: Relationship between cross-curricula areas and Music Technology components

Cross-curricula area	Critical core area	Music Technology components
Music (as a sub-field)	• Performance • Aural training • Notation • Genre • Composition and Harmony • Form and Analysis • Music Theory • Research • Orchestration and Instrumentation • Arranging	• Electronic Musical Instruments • MIDI Sequencing • Music Notation • Computer Music • Audio Technology • Research
Physics	• Physics of sound (Theory of propagation) • Acoustics • Basic circuit theory	• Electronic Musical Instruments • Computers, Information Systems and Lab Management • Computer Music • Audio Technology • Research
Mathematics	• Numerical Systems: Decimal, Binary, Hexadecimal • Geometry	• MIDI Sequencing • Multimedia and Digitized Media • Computers, Information Systems and Lab Management • Audio Technology • Research
Computer Science	• Informatics • Hardware/Software • Programming • Internet • Human computer interaction	• Multimedia and Digitized Media • Internet and Telecommunications • Computers, Information Systems and Lab Management • Computer Music • Research

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Table 3.2 (continued)

Cross-curricula area	Critical core area	Music Technology components
Engineering	• Sound Synthesis • Digital Signal processing • Digital Audio • Hardware interfaces	• Electronic Musical Instruments • Multimedia and Digitized Media • Internet and Telecommunications • Computers, Information Systems and Lab Management • Computer Music • Audio Technology • Research
Multimedia	• Graphics • Animation • Video • Text • Sound • Human Computer Interaction • Instructional Design	• Midi Sequencing • Computer-based Education • Multimedia and Digitized Media • Audio Technology • Research
Education	• Teaching • Research • Training • Computer-based instruction • Edutainment	• Electronic Musical Instruments • MIDI Sequencing • Music Notation • Computer-based Education • Research
Music Industry	• Film Industry • Plays and Musicals • Television • Entertainment • Copyright • Marketing and Merchandising • Music Production	• Electronic Musical Instruments • MIDI Sequencing • Multimedia and Digitized Media • Internet and Telecommunications • Computer Music • Audio Technology • Research

The learning content within these cross-curricula areas impacts on the components of Music Technology. It should be mentioned, however, that in some cases (e.g. Engineering and hardware interfaces) this interrelatedness might be superficial. The overlapping of learning content illustrates the inter-relatedness between the various disciplines/areas. It needs to be mentioned at this point that qualification design based on the principle of inter-relatedness supports the NQFs transformational OBE (see Chapter 4.2.3) agenda that is underpinned by critical cross-fields (SAQA 2000a: 3).

3.3.3 Music career paths and Music Technology components

With data extracted from the international trends in preceding sections, I overviewed and mapped (Table 3.3) the possible career paths available in the Music Industry[21] internationally. The reason the international market was used as the basis for data in this section stems from the fact that several of these careers paths are not yet available locally. South Africa, with its new education structure, strives toward these international trends. Given the pace of change internationally, it is just a matter of time before these trends manifest themselves nationally as well.

In Table 3.3 the mapping correlates the broad and specific career direction opportunities with the core components (discussed in Chapter 3.3.1). The mapping highlights the interaction and relationship between Music Technology components and the Music Industry. It needs to be pointed out that not all core components manifest themselves in all of the career specializations. Certain career directions require a greater or lesser interaction with the core components. The careers in this table are not a complete listing of all possible careers in the Music Industry, but rather an overview of the primary ones (as identified in Appendix C). The careers have been grouped into broad career paths (career direction).

Table 3.3: Music career paths and their relationship to Music Technology core components

Broad career paths	Career specialization	Music Technology core components
Performance	• Vocalist/Instrumental Soloist • Session Musician • General Business Musician • Performing Artist • Orchestral/Group Member • Background Vocalist • Floor Show Band	• Electronic Musical Instruments • MIDI Sequencing • Music Notation • Computer-based Education • Audio Technology • Research

[21] A list from the South African Music Directory, which also identifies career opportunities, is provided in Appendix C.

Table 3.3 (continued)

Broad career paths	Career specialization	Music Technology core components
Songwriting	• Composer • Jingle Writer • Lyricist • Producer/Songwriter • Singer/Performing Songwriter • Staff or Freelance writer	• Electronic Musical Instruments • MIDI Sequencing • Music Notation • Computer-based Education • Audio Technology
Music Production and Engineering	• MIDI Engineering • Music Director • Producer • Programme Director • Recording Engineer • Studio Director or Manager	• Electronic Musical Instruments • MIDI Sequencing • Music Notation • Computer-based Education • Multimedia and Digitized Media • Internet and Telecommunications • Audio Technology • Research
Music Synthesis	• MIDI Technician • Programmer • Performing Synthesist • Music Sequencer • Sound Designer • MIDI Engineer	• Electronic Musical Instruments • MIDI Sequencing • Music Notation • Computer-based Education • Multimedia and Digitized Media • Audio Technology • Research
Film Scoring	• Film Composer • Music Editor • Music Supervisor/Director • Film Arranger/Adapter • Film Conductor • Film Music Orchestrator • Synthesis Specialist • Theme Specialist	• Electronic Musical Instruments • MIDI Sequencing • Music Notation • Multimedia and Digitized Media • Computer Music • Audio Technology • Research

continued overleaf

Table 3.3 continued

Broad career paths	Career specialization	Music Technology core components
Contemporary writing and Production	• Arranger • Composer • Conductor • Copyist • Jingle Writer • Orchestrator • Record Producer • Teacher • Transcriber • Publishing Editor	• Electronic Musical Instruments • MIDI Sequencing • Music Notation • Computer-based Education • Multimedia and Digitized Media • Computer Music • Audio Technology • Research
Music Education	• Choir Director • Post-secondary Music Educator • School Music Educator • Music Supervisor • Private/Public School Instructor	• Electronic Musical Instruments • MIDI Sequencing • Music Notation • Computer-based Education • Multimedia and Digitized Media • Internet and Telecommunications • Computers, Information Systems and Lab Management • Audio Technology • Research
Music Therapy	• Private Music Therapist • Hospital Music Therapist • Nursing Home Therapist • Correctional Facility Therapist	• Electronic Musical Instruments • Computer-based Education • Multimedia and Digitized Media • Internet and Telecommunications • Computers, Information Systems and Lab Management • Research
Professional Music and Music Business/ Management	• Advertising Executive • Booking Agent • Business Manager • Field Merchandiser • Music Publisher • Personal Manager • Professional Manager	• Electronic Musical Instruments • Internet and Telecommunications • Computers, Information Systems and Lab Management • Research

continued overleaf

Table 3.3 (continued)

Broad career paths	Career specialization	Music Technology core components
Tours/Road Work	• Road Manager • Sound Technician • Tour Coordinator • Tour Publicist	• Electronic Musical Instruments • Internet and Telecommunications • Computers, Information Systems and Lab Management • Research
Record Companies	• Artist & Repertoire Administrator • Artist & Repertoire Coordinator • Campus Representative • Consumer Researcher • Director of Publicity • Marketing Representative • Public Relations Officer • Publicist • Regional Sales Manager	• Computers, Information Systems and Lab Management • Internet and Telecommunications • Research
Music Researchers	• Musicologist • Ethnomusicologist • Archivist • Librarian • Music Historian	• Music Notation • Computers, Information Systems and Lab Management • Multimedia and Digitized Media • Internet and Telecommunications • Research
Music Related Jobs	• Multimedia team member • Editor • Music Consultant • Educational Planner • Artist Manager • Instrument repair • Piano Tuner • Press Agent • Product Demonstrator • Talent Agent • Clinician • Merchandiser	• Electronic Musical Instruments • MIDI Sequencing • Music Notation • Computer-based Education • Multimedia and Digitized Media • Internet and Telecommunications • Computers, Information Systems and Lab Management • Audio Technology • Research

continued overleaf

Table 3.3 (continued)

Broad career paths	Career specialization	Music Technology core components
Other	• Radio Disc Jockey • Instrument Sales Representative • Intern • Music Shop Manager • Music Shop Salesperson • Musical Instrument Builder/Designer • Record Shop (or Department) Manager • Record Shop Clerk • Computer Music Programmer • Music Critic/Journalist	• Electronic Musical Instruments • MIDI Sequencing • Computer-based Education • Multimedia and Digitized Media • Internet and Telecommunications • Computers, Information Systems and Lab Management • Research

It is apparent from Table 3.3 that Music Technology has a role to fulfil in most music or music-related careers. In some instances, like Recording Engineering, the role might be substantial, whereas in others (e.g. a Booking Agent) this might be superficial through the use of basic technologies (Internet, Web-design, Computer usage, and the like). In each of the broad career paths listed, no less than three core Music Technology components manifest themselves. It should also be added that MENC (2001) lists Music Technology as a specialized area of music study, with three identifiable career paths: Multimedia Publishing, Sound and Video Editing, and Technology-based Music Instruction Design. The above listed music career paths (Table 3.3) are not mentioned by MENC. It could be assumed, though, that these career paths are recognized because seven (Audio Technology, Research and Computer Music are omitted) out of the ten core components are identified as core components by MENC with regard to the study of music.

Additional information, extrapolated from the international Music Technology trends in Chapter 3.3, indicates the following international trends (in no specific rank order):

- With few exceptions (for example, Berklee College of Music, University of York and IRCAM), formal Music Technology qualifications at most institutions were non-existent a decade ago.
- Music programmes are showing an increased use of technology within existing programmes.

- There is an increase in the number of educational institutions offering Music Technology.
- Several Music Faculties/Departments offer Music Technology as a field of study in its own right or components thereof within their respective music programmes.
- New technological developments are immediately integrated into Music Technology programmes.
- New career paths have been created for the "computer" musician.
- Post-graduate studies in Music Technology are possible at certain institutions.

3.4 Analysis of South African Music Technology trends

In order to place current research in context, an evaluation of the state of Music Technology in South Africa was undertaken. A number of institutions are currently or in the process of offering Music Technology curricula in South Africa. However, prior to my investigation it remained unclear to what extent, if at all, such curricula were in keeping with national education policy requirements as determined by the South African Ministry of Education. Furthermore, there currently exists no clear consensus regarding specific components (knowledge content) of Music Technology that should be offered and whether uniform standards (outcomes) should be established for institutions that offer Music Technology programmes. Clearly, there remains uncertainty regarding the status of Music Technology at post-secondary institutions in South Africa.

To address these questions and to fully understand the current status of Music Technology in South Africa, I telephonically administered a questionnaire (see Appendix A and B) to survey all post-secondary institutions offering music in South Africa. The purpose of the questionnaire was to gain insight into the current status (if any) of Music Technology at post-secondary institutions in South Africa. Questions were included to establish the number and type of institutions that offer Music Technology, enrolment, the extent to which Music Technology is offered (programmes and/or qualifications), specific components that comprise the Music Technology curriculum and whether Music Technology curricula are in line with the principles of outcomes-based education, as required by education policy. The entire population of SA post-secondary institutions (N = 17) that offer music was included.

In order to develop the questionnaire, a review of questionnaires used in similar studies was undertaken (Grijalva 1986: 115; Fábregas 1992: 128-161; Tredway 1994:110-114; Jaeschke 1996: 367-370, amongst others). Questionnaires were reviewed with regard to their relevance to the overall purpose of the study, content and structure. Several questions were adapted and used in the current questionnaire. Additionally, informal interviews were conducted with researchers who are well versed in questionnaire construction and development at the University of North Texas, Denton, Texas. Many items in the questionnaire were edited and revised, based upon suggestions from these researchers (see Personal Communication 2001).

The design of the questionnaire was based on extrapolating the required data to meet the needs of the research sub-questions.

- Firstly, given the backdrop of international trends in Music Technology, questions were structured to ascertain the nature and status of Music Technology in South Africa.
- Secondly, issues pertaining to how South African education policy requirements were addressed at the respondent's institutions were examined.
- Finally, how did institutions that purported to offer Music Technology accommodate the requirements of policy within their existing education institutional structures?

Administration of the questionnaire was conducted over the telephone with instructions and questions being read to participants and their responses documented. The questionnaire was conducted in this way in order to expedite administration, and obtain a 100% return rate. Table 3.4 indicates that of the total number of post-secondary institutions surveyed in South Africa, 82.3% were universities, 11.8% were technikons and 5.9% were colleges of education.

Table 3.4: Questionnaire results pertaining to Music Technology programmes offered in South Africa in 2001

Type of Institution	Frequency	Percentage
University	14	82.3
Technikon	2	11.8
College	1	5.9
Total	**17**	**100**
Music Technology programmes offered		
Yes	13	76.4
No	4	23.6
Total	**17**	**100**
Type of Music Technology curricula		
One semester course	4	23.5
Two semester course	2	11.7
Certificate	0	0
Diploma	0	0
Degree	1	7.7
Major in Music Technology	6	35.2
No programme in Music Technology	4	23.5
Total	**17**	**100**

Overall, 76.4% offered some form of instruction in Music Technology, while the remaining 23.6% offered no instruction. In the case of the former, Music Technology was awarded equal importance when compared to other majors such as Performance, Composition and Music Education. Just over a third (35.2%) of the number of institutions that offered Music Technology, offered a major in Music Technology, while the remaining institutions offered either a one semester course (23.5%) or a two semester course (11.7%) in Music Technology, thus confirming the notion that Music Technology may be used as an elective or "filler" course. Such courses were offered with the intention of exposing students to Music Technology rather than affording them the opportunity to major in Music Technology. Only one institution offered an undergraduate degree in Music Technology. What emerged from the results of the questionnaire was that no institutions offered either a certificate or diploma in Music Technology.

At this point in the analysis a weakness in the construction of the questionnaire emerged: no provision was made to determine what type of institution (university, technikon or college) offered specific curricula (one semester course, two semester course or major in

Music Technology). Such information would be valuable in assessing how Music Technology fitted into the curricula of the various institution types. This weakness, however, does not limit this study because it falls outside its scope.

Table 3.5 indicates that the music student population at South African institutions in 2001 ranges from twelve to 450 students for the smaller to larger institutions. The enrolment for previous years in this case is insignificant because this study examines the current state of Music Technology. An average of approximately 129 students per institution study music in South Africa. Of this average, thirty-one students (23%) are currently enrolled in Music Technology classes/courses at the various institutions that offer Music Technology curricula.

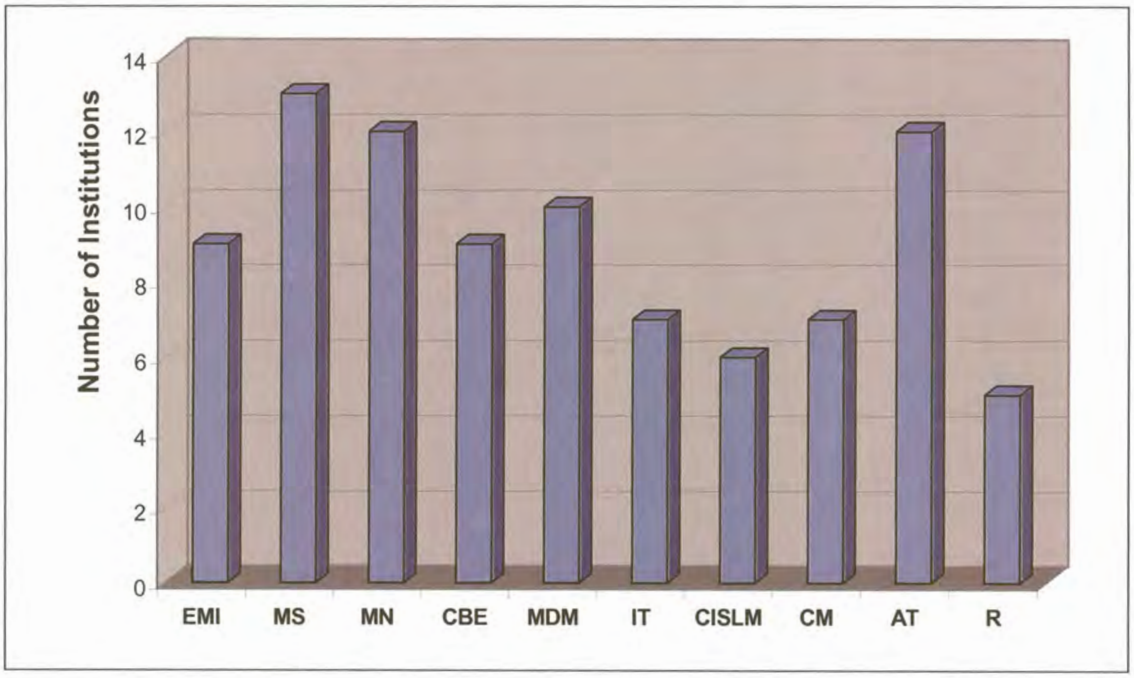
Table 3.5: Student population distribution in Music Technology studies in South Africa in 2001

South African Institutions	Minimum	Maximum	Average
Total number of students enrolled at the seventeen institutions offering Music	12	450	129
Number of years Music Technology has been offered	1	15	6.54
Number of undergraduates enrolled in Music Technology classes/courses	1	80	29
Number of graduates enrolled in Music Technology classes/courses	0	6	2
Total number of students enrolled in Music Technology classes/courses	1	86	31
Hours of instruction students receive in Music Technology per week	1	5	2.85
Total number of Music Technology components offered	3	10	7

Subsequent analysis of enrolment distribution indicates that there are distinct differences between the numbers of undergraduates and post-graduates. While the average number of undergraduates studying Music Technology is twenty-nine, there are on average only two graduates studying Music Technology per tertiary institution in South Africa. The disparity between the number of undergraduates and post-graduates studying Music Technology may be attributed amongst others (funding, availability of programmes, employment opportunities, and the like) to the enrolment profile (undergraduates and post-graduates) currently studying music.

Table 3.5 also reveals that students receive an average of approximately three hours (2.85) of instruction in Music Technology per week. The minimum amount of instruction students receive is one hour, with the maximum being five hours per week. This questionnaire also sought to obtain information on the number and types of Music Technology components offered. Results in Table 3.5 indicate that institutions offer a minimum of three and a maximum of ten components. On average, the various tertiary institutions offer seven Music Technology components. The components offered include: Electronic Musical Instruments, MIDI Sequencing, Music Notation, Computer-based Training, Internet and Telecommunications, Computers, Information Systems and Lab Management, Multimedia and Digitized Media, Computer Music, Audio Technology and Research. Figure 3.3 provides a breakdown of the number of components offered at various institutions.

Figure 3.3: Institutions offering Music Technology core components in South Africa



The Music Technology components most commonly offered included MIDI Sequencing (offered at all thirteen institutions), Music Notation and Audio Technology (offered at twelve of the thirteen institutions offering Music Technology). Multimedia and Digitized Media were offered at ten of the participating institutions while Electronic Musical Instruments and Computer-based Education were each offered at nine institutions. The Music Technology components that were least offered included: Internet and Telecommunications (seven institutions), Computer Music (seven institutions) and Computers, Information Systems and Lab Management (six institutions). Research was offered at five of the thirteen institutions that offered Music Technology.

The third and final section of the questionnaire sought to obtain information on:

- The background and training of the instructors that taught Music Technology;
- The purpose of each institution's Music Technology programme and whether their programmes were in line with OBE;
- The NQF level that programmes were pegged at; and
- The perceived need for national standards in Music Technology.

Of the seventeen institutions surveyed only thirteen offered some programme/certification in Music Technology. These thirteen institutions were used as the basis for the data extrapolated in Table 3.6. Results in Table 3.6 indicate that 53.8% of instructors had no formal training in Music Technology, but had rather obtained their knowledge through self-study. Conversely, 23.1% had obtained a degree in Music Technology and also 23.1% of the instructors had taken a short course at some point in their careers. Clearly, the majority of instructors that are currently teaching Music Technology at tertiary institutions in South Africa have no formal training in Music Technology.

Table 3.6: Analysis of questionnaire results according to national education requirements

Instructor Background and Training in Music Technology	Frequency	Percentage
Degree	3	23.1
Short course	3	23.1
Self-study	7	53.8
Total	**13**	**100**
Music Technology programme in line with OBE		
Yes	8	61.5
No	5	38.5
Total	**13**	**100**
OBE Type		
Traditional	7	53.8
Transitional	1	7.7
Transformational	0	0
No OBE	5	38.5
Total	**13**	**100**
Purpose of Music Technology programme		
Educational (for teaching purposes)	5	38.5
Industry requirement	4	30.8
Course elective	3	23.1
Other	1	7.7
Total	**13**	**100**
Need for National Standards in Music Technology		
Yes	12	92.4
No	1	7.6
Total	**13**	**100**

From the total number of institutions surveyed, the respondents indicated that more than half (61.5%) of their Music Technology programmes meet the requirements for OBE. Of those meeting OBE requirements, 53.8% of courses are structured to address traditional OBE (see Chapter 4.2.1), while 7.7% are meeting the requirements for transitional OBE (see Chapter 4.2.2). None of the institutions are addressing the requirements for transformational OBE (see Chapter 4.2.3), which is the approach adopted by the Ministry of Education.

Some 38.5% of the institutions indicated that the purpose of their Music Technology programmes was educational, intended for teacher training. Almost 30.8% of institutions indicated that their programmes were designed to meet industry requirements, while 23.1% indicated that Music Technology was included in their music curricula merely as an elective course. Finally, there was overwhelming consensus for the need for national standards in Music Technology, with 92.4% of institutions responding in the affirmative. Clearly, instructors at post-secondary institutions in South Africa support the need for national standards. Such standards will not only ensure that institutions are meeting the needs of students and industry, but that they keep pace with international trends.

It should be noted that a review of the different institutions that responded to the questionnaire also revealed that Music Technology was clearly more accessible to urban than to rural institutions. For purposes of confidentiality, names and specific locations cannot be provided. However, I was able to assess that institutions that were historically disadvantaged (see Notes to the reader, no.10) tended not to offer Music Technology. Of those institutions that did offer Music Technology, all students had access to Music Technology courses.

Supplementary data acquired at the time of conducting the telephonic questionnaire indicated the following:

- Some tertiary institutions claim to have been offering Music Technology over the past decade, albeit under different course classifications: Electro-Acoustic Music, Electronic Music, Sound Engineering, Music Composition.
- Most of these "Music Technology" courses have been based on or been largely influenced by international models.
- There is some national consensus with regard to the core components and competencies that make up Music Technology as an emerging field of study in South Africa when mapped against the core components identified internationally (see Chapter 3.3.1 and 3.6).
- There is growing interest among most Music Departments to have formal courses/qualifications in Music Technology.
- The career paths available to Music Technologists in South Africa are limited due to the fact that this is a new field of study.
- Music positions overall are being marginalized due to economic pressure. This can be deduced from the recent closure of Music Departments (University of Durban-Westville, University of Western Cape), the State Theatre (Pretoria), Orchestras (National Symphony Orchestra, NAPOP) and the abandonment of Music as a specialist subject at many schools.
- Although Music Technology is the most recent new qualification offered in some post-secondary music institutions, current educational policies have not been implemented, as international qualifications and models continue to form the basis for these programmes.

The South African, as well as the international, trends examined indicate that the field of study, Music Technology, is growing and has become an integral part of the curricula of most South African post-secondary Music Departments. The questionnaire (Appendix A) therefore highlights the need for this research. The inclusion of Music Technology as a field of study within existing music curricula is becoming imperative in order to keep abreast of industry expectations and international trends.

3.5 Identification of South African needs in Music Technology

An analysis of the needs of the South African music industry, as articulated by the Standards Generating Body for Music Industry, coupled with the results that emerge from the questionnaire (see Chapter 3.4), revealed the urgent need for the following:

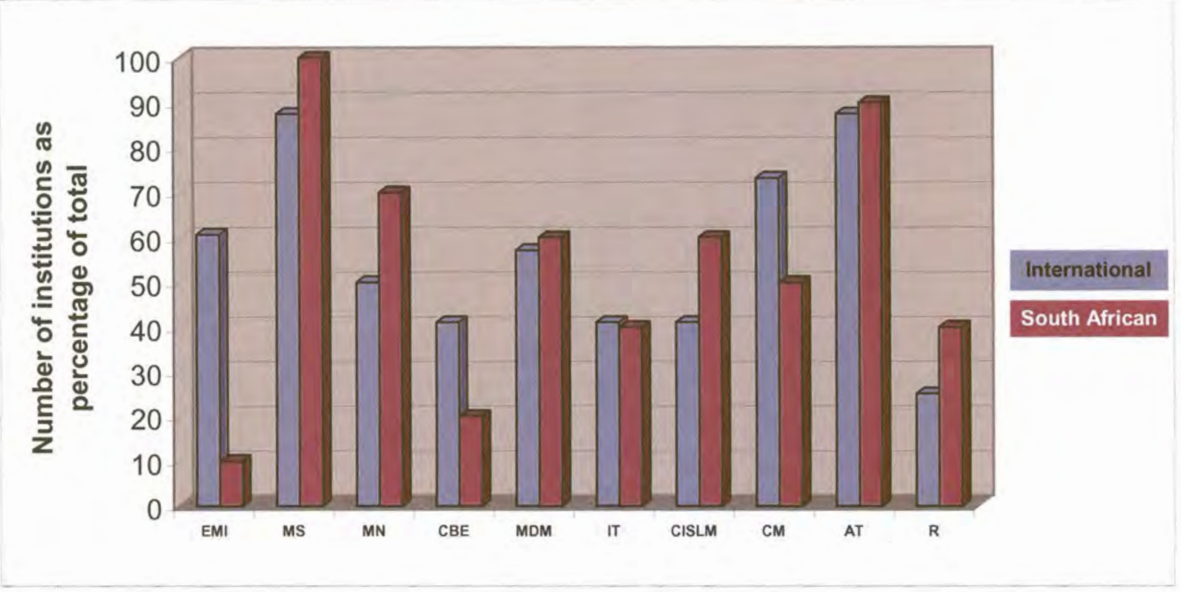
- A qualification to provide access for the majority of music students who require to express themselves creatively through Music Technology;
- National standards in Music Technology;
- A qualification in Music Technology that identifies with the needs of the South African music industry, supported by the education sector;
- A clearly defined qualification that is flexible in its content in order to reflect and accommodate the changing technological environment;
- A means of upward educational mobility toward higher qualifications in Music Technology, the field of study;
- Identification with career opportunities available to learners with such a qualification;
- Identification of components that contribute toward the development of career opportunities;
- Clearly defined sets of outcomes that form the basis of a qualification; and
- A qualification that addresses the transformational needs of South Africa, while at the same time keeping abreast of international trends.

The issues addressed in the analysis in Chapter 3.4 and earlier in this section identify the international (see Chapter 3.3) and national trends, while at the same time examining the needs of the music industry in South Africa. Since the transformation of South African education towards meeting the requirements of OBE is seen as an ideal, my proposed qualification presented in Chapter 5.3.1 will attempt to address these requirements.

3.6 Comparison of international and South African Music Technology core component trends

Figure 3.4 illustrates a comparison between the international and South African Music Technology component trends.

Figure 3.4: Comparison of International and South African core component trends



The South African institutions represent 18% of the total number of institutions analysed. In order to ascertain differences/similarities between the international and South African institutions, they were mapped against each other. The results show that the Music Technology component distribution that reveals a relationship is situated in the areas of MIDI Sequencing, Multimedia and Digitized Media, Internet and Telecommunications, and Audio Technology. These areas indicate between 2% to 12% similarity. The areas specifying approximately 20% difference are Music Notation, Computer-based Education, Computers, Information Systems and Lab Management, Computer Music, and Research. The greatest difference was reflected in the Electronic Musical Instruments component of greater than 50%.

Six of the ten components of Music Technology in South Africa show a difference of 20% or more in relation to international trends. This difference could be accepted as normal, since international institutions in most cases do not have to conform to a central education controlling body as is the case in South Africa. Besides, there is no common consensus as to what constitutes Music Technology. Since the South African trend mirrors the international one, the formalizing of these components within Music Technology curricula in South Africa would be beneficial to prospective institutions opting for learning programmes in Music Technology.

3.7 Summary

The review of literature outside of music suggests that technology is a fast developing field internationally. Most curricula around the world (in technologically more developed countries) are designed to meet specific cultural needs of designated societies. With the design of these curricula, certain concepts relating to curriculum, qualification design and Music Technology recur. Two such concepts that impact on this study, highlighted thus far, concern technology programmes and education policy and the interdisciplinary nature of technology. These two concepts will be explored later (Chapter 5.1) in this study.

The concepts identified above also manifest themselves in studies within music. The studies reviewed suggest that there is an increased usage of music technology internationally towards the latter part of the 20th century. Therefore, fields of study like Music Technology need to be integrated within the broad framework of curriculum design. With regard to the nature of Music Technology, it is evident that this field of study is located within the broader study of music, resulting in a shift from Mode 1 (disciplinary knowledge) to Mode 2 (interdisciplinary knowledge).

The use of music technology within the studies reviewed in this chapter suggests that the computer is primarily utilized as a tool in the music making process. It is this notion that locates several Music Technology programmes in the USA in the domain of music processing, according to the MENC standards for Music Technology (Rudolph *et al* 1997: 43), a significant domain of Music Technology.

Furthermore, two additional concepts identified in this chapter suggest Music Technology as a tool that can be used to enhance and broaden the base of the discipline Music; and as an equal partner (enabler) in the music creation process, through components such as Computer Music and Electronic Musical Instruments. However, within the South African Music Technology context, as can be deduced from Chapter 3.5, the second concept of Music Technology as an equal partner in the music creation process is marginalized, if not absent.

There is a correlation between international trends with the ten components that constitute the field of study and the interdisciplinary nature of Music Technology. It is important to note the close relationship between Music Technology, music industry and the job market. The job market in particular reflects the emergence of new career paths for the Music Technologist. Therefore the integration of theory and practice is crucial in the designing of a qualification in Music Technology.

Although South African educational institutions follow international trends, these new career paths have yet to manifest themselves locally. The delay in this development could be attributed to several factors, some of which include:

- Most institutions are still conforming to traditional educational practices (traditional and transitional OBE) and have yet to implement transformational OBE;
- Aligned to transformational OBE, are the issues related to equity, access and redress for a vast majority of historically disadvantaged learners;
- Vertical and horizontal academic mobility between institutions; and
- The need for Music Technology to be recognized as a formal field of study with clearly defined competencies within the mainstream of the discipline Music.

There is, therefore, a need to transform the current educational and music educational structures to generate national standards in Music Technology. This transformation needs to take cognisance of systemic and curricula implications suggested by national policy, which will be discussed in the next chapter.

CHAPTER 4

AN OVERVIEW OF THE SOUTH AFRICAN EDUCATION STRUCTURE, OUTCOMES-BASED EDUCATION AND CURRICULUM AND THEIR IMPLICATIONS FOR QUALIFICATION DESIGN

In order to transform the education practices that existed within the country up to 1994, the South African Ministry of Education decided in 1996 to adopt a new education structure (National Qualifications Framework) and philosophy/approach (Outcomes-Based Education). Changes in education structures bring with them rethinking and re-examination of existing structures, philosophies, curricula and their related components. These developments have a particular impact on the design of new and future qualifications. Although changes in qualification structure and curricula are necessary, I argue that such changes also need to be viewed within the total context of education transformation and against the backdrop of international education reforms and trends.

A brief overview of the education framework as envisaged by the National Qualifications Framework (NQF) and the South African Qualifications Authority (SAQA) policy and its conceptual implications for qualification design are presented in this chapter. The underpinning outcomes-based philosophy (OBE), curriculum issues and their implications for qualification design will also be placed in perspective.

4.1 The South African education structure

The past legacy of South African education created several problems, one such problem being the denial of many non-white citizens access to a diverse and quality education (SAQA 2000c). Education authorities nationally questioned the traditional perception of education, which accepted that higher education (up to a first post-secondary qualification level) should be completed by the early twenties. This expectation was simply not possible for many historically disadvantaged people (Blacks, Indians and Coloureds). Coupled with this is the perception that many people would only appreciate the value of pursuing education later in their lives and to deny them access on the grounds of age was unreasonable. Another premise that called for the need for learning to be offered on a lifelong basis was rooted in the notion that the demands of modern economy may well mean that individuals will change career paths several times during their working lives. It is imperative to allow such learners to re-start learning they have left earlier in their lives and transfer credits from one institution to another. In order to facilitate this process, the South African Qualifications Authority Act was promulgated on 4 October 1995. The act aims "to provide for the development and implementation of a National Qualifications Framework [NQF] and for these purposes to establish the South African Qualifications Authority [SAQA], and to provide for matters connected therewith" (Olivier 1997: 1). The primary responsibility of the NQF is to bring about systemic and curriculum reform through the following objectives (RSA 1995):

- Create an integrated national framework for learning achievements.
- Facilitate access to, and mobility and progression within, education, training and career paths.
- Enhance the quality of education and training.
- Accelerate the redress of past unfair discrimination in education, training and employment opportunities, and thereby
- Contribute to the full personal development of each learner and the social and economic development of the nation at large.

Fundamental to the task of reform are the issues of transformation and the principles of outcomes-based education (discussed later in Chapter 4.1.1 and 4.2 respectively).

4.1.1 Transformation

The use of the term "transformation" in the South African context has political implications. These political implications suggest a need to redress the racial, socio-economic, educational, and a host of other discriminatory practices that were the result of years of apartheid oppression.

4.1.2 Composition of the National Qualifications Framework (NQF)

The need for creating a qualifications framework is not a uniquely South African phenomenon: such frameworks, which influence the South African one, already exist in Australia, Canada, New Zealand and Scotland (SAQA 2000c). South Africa simply aligns itself with international trends.

In my capacity as Chairperson for the Music Standards Generating Body (discussed later in this section) on Higher Education and Training, certain reflections arose with regard to qualification registration. The underlying principles of the NQF on issues of transparency and accountability on the part of providers of education emerged as a result of a lack of clarity regarding the criteria for awarding qualifications. Often within individual institutions, departments espoused assessment procedures leading to the awarding of qualifications on the basis that a shared understanding of assessment criteria existed among members of staff when, in practice, this was not so. Situations where qualifications were being unevenly awarded, both within and amongst departments, became apparent. When comparisons are made of the way entire institutions award qualifications, the situation is even more problematic. Transparency of criteria dealing with the awarding of qualifications at a national level was a necessity. In this context institutions would, in the new structure, be held accountable for the manner in which those criteria are observed and, importantly, for the quality of learning experiences offered to students who need to meet those criteria. A qualifications framework, in this case the NQF, was therefore crucial to this process.

In terms of the SAQA Act, SAQA will establish structures (referred to as bodies) to implement the NQF. The most important of these bodies (discussed in detail later in this section) are (SAQA 2000a):

- Education and Training Quality Assurers (ETQAs) - responsible for monitoring and auditing achievements in terms of national standards and qualifications and to which specific functions relating to monitoring and auditing of national standards and qualifications have been assigned;
- National Standards Bodies (NSBs) - responsible for establishing education and training standards; and
- Standards Generating Bodies (SGBs) – responsible for preparing draft unit standards (discussed later in this section) and qualifications.

All three of these bodies form part of a hierarchical structure, in which the functions of ETQAs are dependent on the relevant NSBs and SGBs.

It is beyond the scope of this research to give a detailed account of the "new" South African education structure, which has been well documented in government (SAQA 2000c) and other sources[22]. For the purpose of this study I have highlighted aspects pertaining to higher education and their relevance to this study. It should also be noted that much of the language used to describe the NQF and OBE is very specialized and jargonized. Local standards generators have coined the term "SAQA-ish" (Olivier n.d.: i), derived from the acronym SAQA (**S**outh African **Q**ualifications **A**uthority), to describe this jargon. However, since current curriculum documentation uses "SAQA-ish", which is a trend that seems to be adopted among most education stakeholders, it will be explained and used in the rest of this study.

The rationale for the restructuring of the Education and Training system in South Africa could be viewed against the following backdrop:

- There is a need to create an equitable education and training system, which serves all South Africans. Such a system will need to accommodate those who are in conventional institutions, but also the learning needs of those who have not enjoyed formal education and training.
- In order to achieve significant levels of economic growth and to become internationally competitive, the quality of education and training will need to be greatly improved.
- Education and training have unfortunately been separated, both by the way they are organized and by the way society thinks about them. An approach is needed that makes education and training more flexible, efficient and accessible.

The NQF is the answer to the integration of education and training into a single, coherent and unified approach. Its aim is to unify qualifications in education and training, based on set standards that are nationally applicable. In order to attain these objectives, the NQF clearly requires the use of a unifying organizing principle. The learning outcome has been identified as the one best suited for this purpose. This organizing principle underpins an outcomes-based approach to education (explained in Chapter 4.2). In a sense, this approach demands that institutions of higher learning should produce strategic human resources.

In many respects, this approach can be viewed as challenging the very fabric of institutions of higher learning, especially universities. Universities have up to now often been perceived

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[22] See Reference List: E. Dixon (1999: 32-100) and A. van Loggerenberg (2000: 51-113).

as serving individual disciplines rather than society (White Paper on Education and Training 1995). Internationally, however, societies, which fund universities, now require the latter to meet the human resource needs.

The South African Qualifications Authority Act (Act no. 58 of 1995) established the NQF, upon which national standards and qualifications will need to be registered, and the SAQA brief is to oversee this process. The NQF consists of eight levels, grouped into three bands: Level 1 (General Education and Training Band); Levels 2 to 4 (Further Education and Training Band); and Levels 5 to 8 (Higher Education and Training Band). General Education and Training (GETC) deals with compulsory learning and Adult Basic Education and Training. The Further Education and Training Certificate (FETC) is made up of various certificate programmes that are on a par with the school grades ten, eleven and twelve. The Higher Education and Training (HET) band deals with post-secondary (post-school) studies.

The NQF Levels indicate the pegging of qualifications offered by the providers of education. The qualification type can be pegged at any level, according to the requirements of the provider. For example, a certificate qualification can be pegged at Level 8 if a provider of education so desires. The structure of the NQF is illustrated in Table 4.1.

Table 4.1: Structure of the NQF (adapted from Van Loggerenberg 2000: 63)

NQF Level	Band	Qualification Type
Higher Education and Training		
8 7 6 5	Higher Education and Training (HET)	• Post-doctoral research degrees • Doctorates • Masters degrees • Professional Qualifications • Honours degrees • National first degrees • Higher diplomas • National diplomas • National certificates
Further Education and Training Certificate (FETC)		
4 3 2	Further Education and Training	National certificates
General Education and Training Certificate (GETC)		
1	General Education and Training	Grade 9 | ABET Level 4 (Adult Basic Education and Training Levels 1 to 3) National certificates

The process of registering and standardizing qualifications on the framework is made possible through the use of twelve Organizing Fields into which qualifications are grouped. These fields are presented in Table 4.2 (SAQA 2000a: 5):

Table 4.2: NSB Organizing Fields and Sub-Fields (SAQA 2000a: 5)

NSB	Organizing Fields	Sub-Fields
01	**Agriculture & Nature Conservation**	• Primary Agriculture • Secondary Agriculture • Nature Conservation • Forestry and Wood Technology • Horticulture
02	**Culture & Arts**	• Design Studies • Visual Arts • Performing Arts • Cultural Studies • Music • Sport • Film, Television and Video
03	**Business, Commerce & Management**	• Finance, Economic & Accounting • Generic Management • Human Resources • Marketing • Purchasing • Procurement • Office Administration • Public Administration • Project Management • Public Relations
04	**Communication Studies & Language**	• Communication • Information Studies • Language • Literature
05	**Education, Training & Development**	• Schooling • Higher Education & Training • Early Childhood Development • Adult Learning
06	**Manufacturing, Engineering & Technology**	• Engineering and Related Design • Manufacturing and Assembly • Fabrication and Extraction
07	**Human & Social Studies**	• Environmental Relations • General Social Science • Industrial & Organizational Governance and Human Resource Development • People/Human Centred Development • Public Policy, Politics & Democratic Citizenship • Religious & Ethical Foundations of Society • Rural & Agrarian Studies • Traditions, History & Legacies • Urban & Regional Studies
08	**Law, Military Science & Security**	• Safety in Society • Justice in Society • Sovereignty of the State
09	**Health Sciences & Social Services**	• Preventive Health • Promotive Health & Developmental Services • Curative Health • Rehabilitative Services
10	**Mathematical, Physical Computer & Life Sciences**	• Mathematical Sciences • Physical Sciences • Life Sciences (see NSB 01 & 07) • Information Technology & Computer Sciences • Earth & Space Sciences • Environmental Sciences
11	**Services**	• Hospitality, Tourism, Travel, Gaming and Leisure • Transport, Operations & Logistics • Personal Care • Wholesale & Retail • Consumer Services
12	**Physical Planning & Construction**	• Physical Planning, Design and Management • Building Construction • Civil Engineering Construction • Electrical Infrastructure Construction

Music is a sub-field that falls under the Organizing Field NSB 02: Culture and Arts.

The Act provides for the establishment of a National Standards Body (NSB) for each of these Organizing Fields. The primary requirements of the NSBs are to define the boundaries of the field; define a framework of sub-fields; and establish Standards Generating Bodies (SGBs) for each field.

- The representative members (not more than thirty-six) that constitute the NSBs are nominated by organisations that are deemed to be "national stakeholder bodies with a key interest in the field" (SAQA 2000a: 8)(see Footnote 2).

The SGBs (established by the NSBs) are required to (SAQA 2000a:10) :

- Generate qualifications and standards;
- Update and review standards;
- Recommend standards and qualifications to NSBs;
- Recommend criteria for the registration of assessors and moderators or moderating bodies; and
- Perform such other functions as may from time to time be delegated by its NSB.

These SGBs should consist of not more than twenty-five representatives in total, drawn from key education and training stakeholders in the sub-field, various interest groups and specialists. At the time of this research, three SGBs for the sub-field music have been established: Music Industry, General/Further Education and Training, and Higher Education and Training. I presently serve as Chairperson of the Music SGB responsible for Higher Education and Training.

4.1.3 Learning outcomes

A learning outcome is the result of learning; it is an actual demonstration in context of what learners know and can do as a result of their learning. The process of standardizing and registering qualifications on the NQF will only be possible once all qualifications are registered. These qualifications have to list the outcomes learners will have to attain in order for the applicable qualification to be granted.

With regard to higher education, teaching traditionally focused on areas of content knowledge, which was assumed to be necessary for students to perform the higher order tasks expected of graduates.

With regard to OBE, this assumption is questioned. Simply knowing or understanding discipline-based content alone does not enable a person to do things; instead, students actually have to be taught to do those things. Therefore an outcomes-based approach would involve using the discipline in order to educate students to achieve these learning outcomes. The pure understanding of disciplinary content is not an outcome. Outcomes-based education implies that everything (curriculum design, planning, teaching, assessing, writing support materials) will be developed and organized around the intended learning outcomes at the end of a learning programme.

At this point it is useful to briefly tabulate the reality of the present education context and the vision of the new education structures in South Africa. Table 4.3 is a synthesis of existing institutional reality and policy intentions.

Table 4.3: Comparison of the old and new education systems in South Africa

OLD	NEW
Exam/tests	Continuous Assessment
Rote learning	Understanding, active learning
Passive learners	Active problem-solving learners
Teachers as drivers	Teachers as facilitators
Timetables rigid	Timetables flexible - notional time
Subjects/disciplines	Learning areas
Pupils/students	Learners
Teachers	Educators
Cross-curricular	Integrated
Programme organiser	Themes
Aims/objectives	Outcomes

One of the complaints from most employers with regard to graduates has been their lack of ability to work independently and to solve problems. The move towards an outcomes-based approach is an attempt to ensure that competencies relating to problem solving and independence are developed within institutions of higher education. The need to teach students how to solve problems will involve teaching them how to identify a problem, generate diverse solutions to it, test those solutions against one another and make recommendations on the basis of these tests.

Achieving the above necessitates a shift away from disciplinary content and promotes student interaction with each other and with the educators. The disciplinary content simply becomes a medium students use to achieve the outcomes of the course.

Using learning outcomes as the organizing principle requires that descriptors should be written for all levels of the framework. The function of these descriptors is to order qualifications across all fields within the education system. Table 4.4, suggested by SAQA (2000d: 9), can be used as an example to describe the scope of learning at all eight levels of the framework.

Table 4.4: Scope of learning according to the NQF (SAQA 2000d: 9)[*sic*]

Level	Knowledge	Information Processing	Problem Solving
1	Narrow ranging	Recall	
2	Basic Operational	Basic processing of readily available information	Known solutions to familiar problems
3	Some relevant theoretical	Interpretation of readily available information	A range of known responses to familiar problems based on limited discretion and judgement
4	Broad knowledge base incorporating some theoretical concepts	Basic analytical interpretation of a wide range of data	A range of sometimes innovative responses to concrete but often unfamiliar problems based on informed judgement
5	Broad knowledge base with substantial depth in some areas	Analytical interpretation of a wide range of data	The determination of appropriate methods and procedures in response to a range of concrete problems with some theoretical elements
6	Knowledge of a major discipline with depth in more than one area	The analysis, reformatting, and evaluation of a wide range of information	The formulation of appropriate responses to resolve both concrete and abstract problems
7	Specialised knowledge of a major discipline	The analysis, transformation, and evaluation of abstract data and concepts	The creation of appropriate responses to resolve contextual abstract problems
8	In-depth knowledge in a complex and specialised area	The generation, evaluation, and synthesis of information and concepts at highly abstract levels	The creation of responses to abstract problems that expand or redefine existing knowledge

On examining the above table, it is useful to bear in mind that Level 6 is equivalent to a bachelor's degree, Level 7, master's degree and Level 8, a doctoral degree. Descriptors in music, specifically, have not as yet been written.

Translating the above into outcomes, a bachelor's candidate, for example, would need to be able to display knowledge of a major discipline with depth in more than one area; analyze, reformat and evaluate a wide range of information; and formulate appropriate responses to resolve both concrete and abstract problems. Current bachelor's programmes require candidates to do all these things.

Upon registering qualifications on the NQF against descriptors (see Chapter 5.1.2.9), it will be possible to establish that institutions are indeed meeting the standards they claim for their qualifications and that they are offering their learners the learning experiences which allow them to achieve these standards.

One of the main criticisms of the NQF at higher education level is that the initial requirement that learning outcomes should be written for all courses and modules leading to qualifications, reduces learning to small units, which are antithetical to the goals of universities in particular. Due to this criticism, agreement has been reached between the various education role players that universities will be allowed to register whole qualifications on the framework. This implies, for example, that outcomes must be written for the "whole" Bachelor of Music (BMus) and Bachelor of Arts (BA) degrees and that the whole degree will then be registered.

Learning outcomes, which are central to the OBE approach, can be classified into three types:

- Critical outcomes, which are designed to inform all teaching and learning and are embedded in all qualifications, from school through to university (see Chapter 4.2.4);
- Specific outcomes which are contextually demonstrated knowledge, skills and values; and
- Exit level outcomes, which are the contextually demonstrated end-products of the learning process.

These outcomes have to be achieved in order for learners to qualify for a credit, unit standard, or qualification (explained below in Chapter 4.1.4). To place current research into the broad education context, issues pertaining to SAQA guidelines with regard to qualifications will now be discussed.

4.1.4 Qualification design

Qualifications are the pillars around which learning programmes are designed. These qualifications are made up of clusters of registered unit standards that meet professional, entrepreneurial and institutional needs. They therefore can be "defined as a combination of learning outcomes with a defined purpose or purposes, intended to provide qualifying learners with applied competence and a basis for further learning" (SAQA 2000a: 45).

4.1.4.1 The qualification

In order for qualifications to be registered on the NQF, certain criteria (SAQA 2000a: 46) need to be satisfied. A qualification must

- Represent a planned combination/sequence of/other learning elements (courses/modules) that has clear purpose/s and which will provide qualifying learners with an overall outcome of demonstrable integrated advancement in education and training.
- Comply with the NQF's objectives including access, mobility, progression and quality. Here it is necessary to show that the critical outcomes have been included to enjoy a meaningful, integrated qualification that meets the challenges of lifelong learning and that has currency.
- Be internationally comparable, where applicable.

According to NSB regulations (SAQA 2000a: 45), two types of qualifications are catered for:

- A qualification based on exit level outcomes and associated assessment criteria; and
- A qualification based on unit standards.

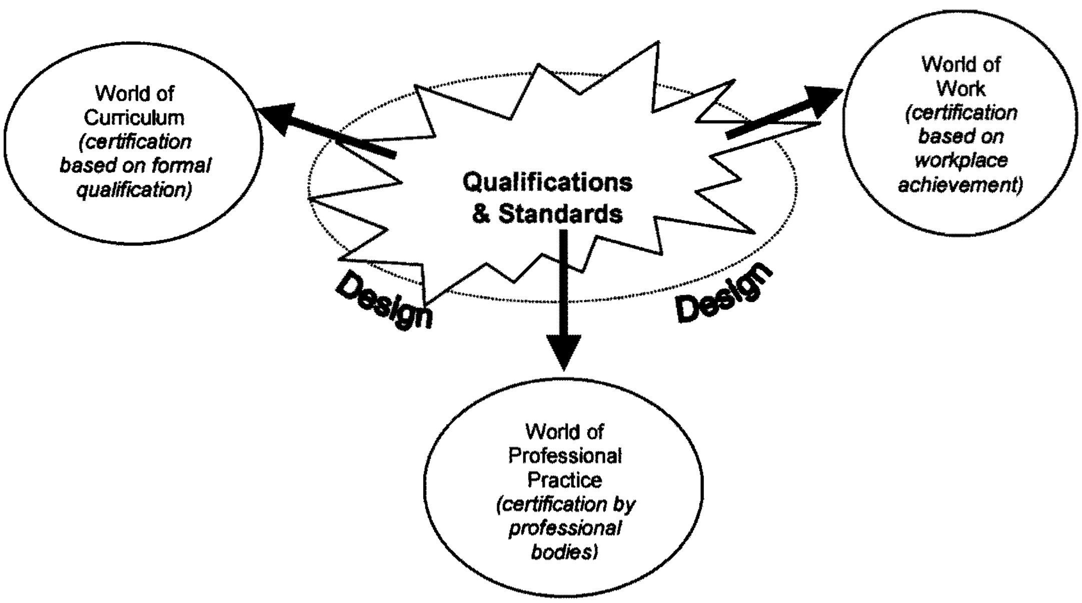
The present research focuses on designing a qualification that is based on exit level outcomes. Discussions amongst the various stakeholders in higher education suggest that there is consensus with regard to qualifications based on exit level outcomes instead of unit standards-based qualifications. By adopting the exit level outcomes approach in this study, flexibility of progression within the education structure is facilitated, whereby the learner is allowed upward mobility (by continuing one's study toward a higher qualification) and transferable skills within the education spectrum toward a specialized qualification in Music Technology or other qualifications (Bachelor of Arts, Bachelor of Science, Bachelor of Engineering).

The qualifications based on exit level outcomes (see Chapter 1.9) and unit standards (explained later in Chapter 4.1.4.3) are used primarily as (SAQA 2000a: 38):

- A guide to learners;
- A guide to educators who are responsible for preparing the learning material;
- A description of the endpoints of learning (the targets towards which learning should aim);
- Guidelines as to what needs to be assessed, its context and the standards of performance needed; and
- A means of recognising achievements.

From the above information it is apparent that qualifications and unit standards are of central importance for the development of learning programmes and assessment activities. In order to meet the challenge facing the NQF, an integration of both education and training (labour) needs to be achieved. In this manner a balance between theoretical and vocational skills can be accomplished. The design of future qualifications and unit standards therefore needs to be the result of a consultative process between all the necessary stakeholders. Figure 4.1 illustrates this interactive process.

Figure 4.1: The anchoring of the worlds of curriculum, professional practice and work to the qualification design process (adapted from SAQA 2000a: 40)



Should standards be exclusively written in any one of these worlds (see Figure 4.1), there is a possibility that the would not be applicable to the other worlds. Qualifications and standards (centre of the diagram) act as the anchor to which the other worlds attach the design of their practices. The design layer lies between the standards and the world of practice. Professionals in curriculum design use standards for curricula, but the standards themselves are not curricula. Professionals in the workplace use standards to design work-based programmes, but the standards are not these programmes; professional certification bodies will define their licensing requirements against standards, but these standards are not themselves licensing prescriptions (SAQA 2000a: 40).

Historically, standards were written in one world. This has been the case in Music at institutions of higher learning (particularly universities)(see Chapter 2.5). A challenge facing the National Qualifications Framework is: if standards were to be written in only one of the worlds in Figure 4.1, then they will not be applicable to the other two worlds, resulting in three separate frameworks: worlds of work, curriculum (see Chapter 4.3), and professional practice (SAQA 2000a: 40). It follows that the transition that is currently adopted by most institutions of higher learning in re-structuring existing programmes, according to a generic template within the framework of traditional OBE (see Chapter 4.2.1), is insufficient.

All three worlds (see Figure 4.1) will have to comply with national standards, albeit for different needs. The world of work needs standards for various purposes, which could range from performance appraisal, to recruitment criteria, to career "laddering", to industrial bargaining. In the world of curriculum, practitioners need standards against which curricula can be written. The world of professional practice requires standards to define competent practice so that professionals can be licensed to practise in South Africa (SAQA 2000a: 37).

4.1.4.2 The credit system

The use of credits results in horizontal and vertical mobility within the qualifications framework. These credits are accumulated at various stages within the education structure: that is, at a specific school level or by means of acquiring certain competencies that comply with the related unit standard and/or qualification. The level indicators used, correspond to those stipulated by the NQF.

The credit system used by SAQA (SAQA 2000a: 6) is based on the principle that one credit equals ten notional hours of learning. These notional hours of learning refer to the learning time required by the average learner to attain the required outcomes. This includes contact time, time spent in structured learning in the workplace, individual learning and assessment.

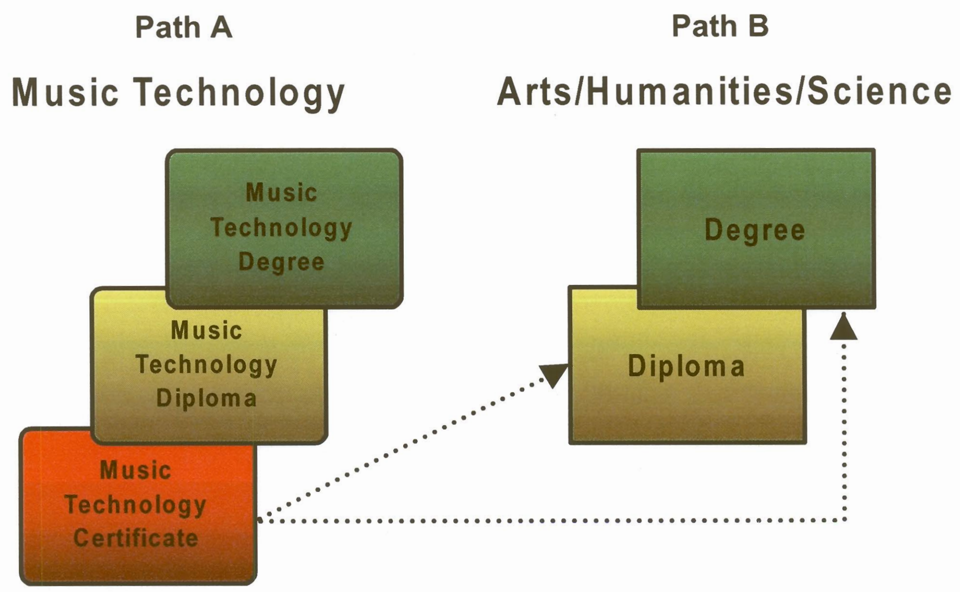
Qualifications need to be made up of at least 120 credits with a minimum of seventy-two credits at or above the level at which the qualification is to be awarded. The remaining credits (forty-eight) may be obtained below and/or above the level at which the qualification is to be awarded. SAQA (2000a: 95-96) proposes the following with regard to post-secondary education:

Table 4.5: Credit allocation as per whole qualification (SAQA 1997: 15-16)

National Certificate	Minimum of 120 credits, at least 72 of which are at or higher than the level of the certificate
National Diploma	Minimum of 240 credits, at least 72 of which are at Level 5 or higher
National Degree	Minimum of 360 credits, at least 72 of which are at Level 6 or higher

The design of the qualification in Music Technology, proposed in this study, is pegged at NQF Level 5, being the national certificate level. The design process at this level allows the qualification to lend itself to two differing qualification paths (see Figure 4.2): a certificate in its own right which serves as the foundation qualification toward a specific qualification (degree) in Music Technology (see Path A); and a certificate programme that could be treated in its entirety as an area of study within a more generalized programme in music, such as a BMus or BA programme (see Path B).

Figure 4.2: Draft qualification structure for Music Technology



The flexibility in the Music Technology certificate qualification/programme satisfies two key NQF guiding principles, those of transferability and broad focus (see Table 4.7), in terms of the qualifications design.

4.1.4.3 Unit standards

Unit standards are end-statements of the achievement of certain competencies that also form the foundation for possible unit standards-based qualifications. Their purpose is to provide an assessor document, the foundation to develop learning programmes and an educator's and trainer's guide for preparing learning materials. These unit standards describe the specific context-related outcomes that need to be attained by learners. As learners meet the requirements that indicate that they have mastered specific outcomes described in a unit standard, they accumulate credits toward a desired qualification. Once a minimum number and combinations of these credits have been accumulated, learners attain the level of competence in a particular Learning Area and receive a qualification (DoE 1996: 26).

These unit standards are used to describe the smaller manageable outcomes that make up the main outcomes. In order to achieve unit standards or qualifications, learners will need to follow a course or learning programme. Education and Training Quality Assurers (ETQAs) subject the learning programmes to quality assurance. Since learning programmes are provider-specific against a particular qualification or standards, they cannot be registered on the NQF - only unit standards and qualifications can be registered.

4.1.4.4 Range statements

Range statements indicate the complexity of the critical, specific and exit level outcomes. These range statements also refer to the technology involved, dimension, scope, depth and other parameters associated with the unit standard (Olivier n.d.: 25-26). The relationship between qualifications, unit standards and outcomes is illustrated in Figure 4.3.

Figure 4.3: The relationship between qualifications, unit standards and outcomes (adapted from Van Loggerenberg 2000: 68)

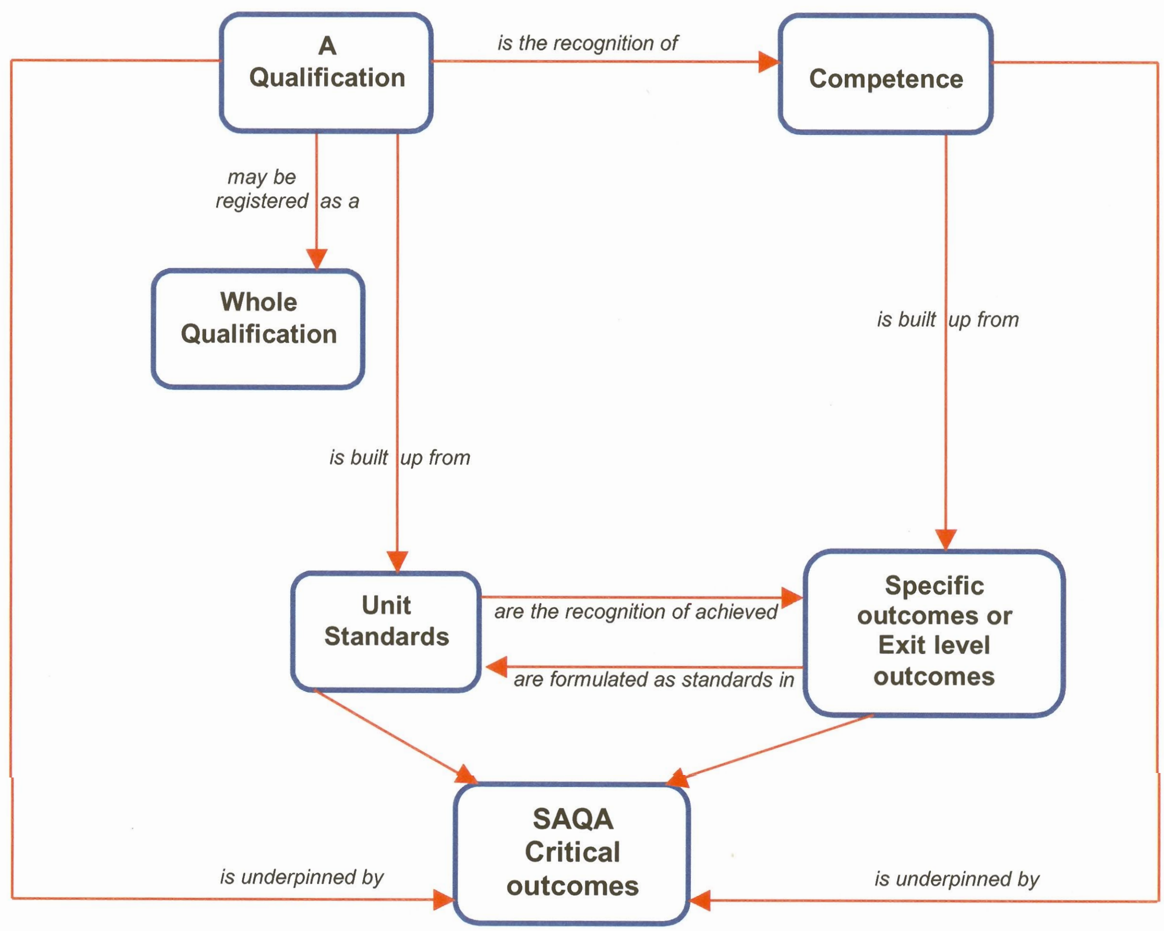


Figure 4.3 presents the relationship between qualifications, unit standards and outcomes, which form a core aspect within the new education structure. The vital components within this structure that have direct implications for qualification design will be contextualized in the qualification design in Music Technology in Chapter 5.3.

4.1.4.5 Composition of a qualification

All qualifications are composed of three primary learning units, namely Fundamental, Core and Elective units.

Table 4.6: Composition of a qualification (SAQA 2000b: 42-43)

Fundamental learning	Core learning	Elective learning
Refers to learning which "forms the **grounding** or basis needed to undertake the education, training or further learning required in the obtaining of a qualification".	Refers to learning, which is "compulsory learning required in situations **contextually relevant** to the particular qualification".	Refers to learning that is a "selection of additional credits at the level of the NQF specified, from which a choice may be made to ensure that the **purpose** of the qualification is achieved".

A simpler explanation of the three learning areas would be: Fundamental learning refers to the learning that forms the basis for future study. In terms of the learning needs, fundamental learning may or may not be fundamental to the purpose of the qualification. Core learning implies the transferable learning widely applicable to the field or discipline. Elective learning refers to more specialized learning. In most instances, "elective" and "specialization" are often used in the same sense.

4.1.5 Guiding principles in qualification design

The NSBs and SGBs are ultimately responsible to SAQA for the setting of national standards. Both these bodies have specific functions within the NQF. The NSBs are responsible for establishing education and training qualifications and/or standards and the recommendation of registration of qualifications, whereas the SGBs are only responsible for the generation of qualifications and/or standards. These bodies need to adhere to the principles that govern their function. Since the design of a new qualification is the focus in this study, the procedures of the SGBs in generating standards will be followed. Table 4.7 lists the guiding principles in qualification design for the SGBs.

Table 4.7: Guiding principles in qualification design (SAQA 2000a: 14-15)[*sic*]

Consultation	SGBs must consult widely with those who have an interest in their area.
Relevance	Qualifications and standards must be relevant to the requirements and needs of all their users.
Transferability	SGBs must promote the recognition of transferable skills to assist learners who may need to change their learning or career direction.
Efficiency and Accessibility	SGBs must set and maintain standards, and wherever possible keep costs down.
Innovativeness	Standards generation is a dynamic process. SGBs must accommodate innovation that derives from changing technology, new products, services, markets, skills and knowledge in their specialist areas.
Broad Focus	SGBs must consider the impact of their planned outputs on all levels of the NQF. Although the focus of an SGB's standards generation may be at a particular level, the implications for all levels must be considered.
Minimal Duplication	It is a fundamental principle of the NQF that every qualification and standard will be unique. If a standard is to be used in several qualifications, users concerned must agree on its form, and not create their own versions.

The qualification design in this study will aid in fast-tracking the registration of Music Technology as a qualification onto the NQF. The guiding principles and structure of qualification design required by SAQA contribute towards the construction of a conceptual framework that will be used to design the qualification in Chapter 5.3.

4.2 Outcomes-based education (OBE) and critical outcomes

The NQF is entrusted with bringing about systemic, as well as curricula change. William Spady (1994: 94-96), an American educationist who is regarded in education circles as one of the fathers of the OBE approach, makes the point that outcomes-based education is not only about curriculum change. It is about changing the nature of how the education system works, which is the guiding vision, a set of principles and guidelines that frame the education and training activities that take place within a system. Since OBE forms the cornerstone of education transformation in South Africa, I shall attempt to provide some insight into what education implications this philosophy has on qualification design.

OBE and international constructs attempt to respond to the challenges of a

> relative failure of their respective workforces to cope with changing economic realities and to compete on world markets. This concern has led to a re-examination of the aims and objectives of education, and, subsequently, to reform of curriculum and assessment (Black & Atkin 1996: ix).

In the South African context, OBE has been adopted as the approach for reform to address broader political, socio-economic and vocational issues. OBE in itself has many different forms. A danger that arises with these different forms is that old curricula, with their apartheid baggage, could be dressed up in OBE jargon. This is partly due to the generic use of the term OBE by the Ministry of Education, as well as by educators. Spady distinguishes between three broadly defined approaches: traditional, transitional and transformational OBE (Killen 1998: 2). The differences between these forms of OBE will now be explained.

4.2.1 Traditional OBE

Traditional OBE uses the existing curriculum as the starting point to formulate outcomes. This implies that outcomes are generated from the existing curriculum. Similar to objectives, outcomes are written from the existing syllabus content in traditional subjects. In this understanding of OBE, education planning and implementation are based on subject matter categories, also referred to as a disciplinary approach (Mode 1 knowledge production). The long-term outcomes of learning and how they relate to each other in society are not clearly discernable. These outcomes are therefore not generalizable to other learning areas or contexts outside of school (Spady 1994:18-19). My experience with the interim registration of qualifications on the Higher Education Music SGB reveals that most post-secondary education institutions that offer Music qualifications in South Africa have merely applied traditional OBE, re-organising their existing learning programmes according to the given templates required by SAQA. Since these learning programmes have been in place for some years now, they have been granted interim registration until 30 June 2003. In the case of most of these learning programmes, a generic model has been used to restructure existing programmes in order to obtain interim registration.

4.2.2 Transitional OBE

Transitional OBE focuses on higher order competencies and their role in relating and potentially integrating unconnected, content-focused curriculum areas in education planning and implementation. Spady (1994: 193) suggests the term "interdisciplinary" (Mode 2 knowledge production) to characterise this approach. Less emphasis is placed on particular kinds of knowledge and information because the curriculum design processes start with outcomes and not with the existing syllabi in mind. These outcomes are "relatively complex

… are generalizable across content areas and require substantial degrees of integration, synthesis, and functional application" (Spady 1994: 19).

4.2.3 Transformational OBE

A curriculum designed around long-term outcomes, which relate to the future life performance roles of learners, is referred to as transformational (Spady 1994: 18). This radical option, and perhaps the most complex of the three types, has been adopted in South Africa (Killen 1998: 2). According to the principles of the transformational OBE approach, the existing education system and curriculum impede the development of a new society and do not meet the long-term real life needs of the learners.

The critical outcomes (see Chapter 4.2.4) that underpin this approach, describe the package of competencies in terms of knowledge, skills, attitudes and values, which learners will need in order to be lifelong learners. Spady (1994: 19) emphasises that transformational outcomes "require the highest degrees of ownership, integration, synthesis, and functional application of prior learning because they must respond to the complexity of real life performances". Killen (1998: 26-27) makes it very clear that these outcomes are performance abilities and not just content, scores, averages, percentages or credits, and stresses that these outcomes must drive the curriculum, not vice versa. National Government in South Africa proposes outcomes driving curriculum and training and the transformational OBE approach to bring about education transformation. Such transformational OBE is adopted in the design of the qualification in Music Technology offered in the present study.

By striving to integrate education and training into a single, coherent and unified approach, it should be possible for all learners to achieve national qualifications through a variety of mechanisms and delivery systems. This integration principle is to be achieved by means of the NQF (SAQA 2000a: 2-3). "The important thing to remember about the NQF is that its intention is to bring about transformation" (SAQA 1997: 2). In other words, it is not just a classification system for qualifications.

4.2.4 Critical outcomes

One of the most significant ways in which SAQA has changed the requirements for curriculum design is through the development of a set of critical outcomes. The critical outcomes or critical cross-field outcomes adopted by SAQA support all learning programmes and curricula in South Africa. These outcomes express the characteristics and competencies that all South African learners should demonstrate, regardless of their age, sex, profession and status in society (Killen 1998: 7).

There are eight critical outcomes of which the eighth includes "developmental outcomes" (DoE 1997: 10). These outcomes, when reached, will ensure that learners acquire the knowledge, competencies, attitudes and values that will allow them to contribute to their own success, as well as to the success of their family, community and nation as a whole (DoE 1997:13). These critical outcomes are, as the name suggests, not dependent on or restricted to a specific learning context. They represent the knowledge, competencies, attitudes and values, which are flexible and transferable from one context or problem situation to another. In these outcomes are embedded the seeds for cultivating lifelong learning ability. They are the formulations of the life roles to be performed by learners.

The original eight critical outcomes proposed by SAQA (DoE 1997: 16) are reduced to seven in the *Discussion document* (Technical committee 1997: 82). The critical outcomes state that the learner will

- Identify and solve problems in which responses show that responsible decisions using critical and creative thinking have been made.
- Work effectively with others as a member of a team, group, organisation or community.
- Organize and manage oneself and one's activities responsibly and effectively.
- Collect, analyse, organize and critically evaluate information.
- Communicate effectively using visual, mathematical and/or language skills in the modes of oral and/or written presentation.
- Use science and technology effectively and critically, showing responsibility toward the environment and health of others, and
- Demonstrate an understanding of the world as a set of related systems by recognizing that problem-solving contexts do not exist in isolation.

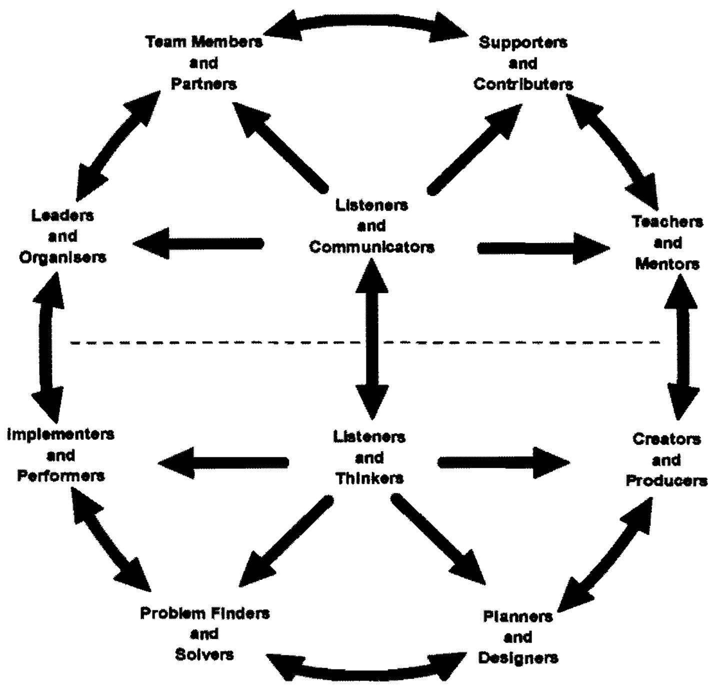
The developmental outcomes should be read in conjunction with the above listed critical outcomes. To enhance the full personal development of a learner, as well as social and economic development *per se,* any learning programme needs to make an individual aware of the importance of the following outcomes (Technical committee 1997: 82):

- Reflect on and explore a variety of strategies to learn more effectively.
- Participate as responsible citizens in the life of local, national and global communities.
- Be culturally and aesthetically sensitive across a range of social contexts.
- Explore education and career opportunities.
- Develop entrepreneurial opportunities.

These critical and developmental outcomes are instrumental in realising the vision of South African education, which is to prepare individuals to become lifelong learners. They form the backbone of transformational OBE. The NQF is the system of progression and articulation in education, which will make continued learning possible, but the critical outcomes describe the competencies needed to sustain a culture of lifelong learning. These outcomes encapsulate the real life roles that learners have to perform. Spady (1994: 21) suggests ten life performance roles that require complex applications of many kinds of knowledge and all kinds of competencies as people confront the challenges surrounding them in their social systems. These ten life performance roles are divided into two groups of five each (suggested by the dotted line in Figure 4.4). He suggests that five of the life performance roles deal with social and interpersonal performance roles that inherently involve interactions among people (Spady 1994: 69-71). These roles are indicated in Figure 4.4 above the dotted line (Spady 1994:70):

- Listeners and communicators are to comprehend and express ideas, information, intention, feeling and concern for others in ways that are clearly understood and appreciated.
- Educators and mentors enhance the thinking, skills, performance orientation and motivation of others through the mediation they provide, the counsel they give, and the example they set.
- Supporters and contributors invest time, ideas and resources to improve the quality of life of those around them.
- Team members and partners contribute their efforts to collaborative endeavours and seek agreement on goals, procedures, responsibilities and rewards, setting aside personal preferences, anticipating obstacles, and supporting the participation of others to achieve the results.
- Leaders and organizers initiate, coordinate, and facilitate the accomplishment of collective tasks by perceiving and defining intended results, determining how they might be accomplished, anticipating roadblocks, and enlisting and supporting the participation of others to achieve the results.

Figure 4.4: Fundamental life performance roles (Spady 1994: 69)



Below the dotted line in Figure 4.4 are performance roles, inherently more technical and strategic in character. These are the roles that individuals potentially should carry out entirely on their own, but which also might involve others. These include (Spady 1994: 70-71):

- Learners and thinkers develop and use cognitive tools and strategies to translate new information and experiences into sound action. They might use their repertoire of knowledge and strategies to extend their capacities for successful action by assimilating, analysing and synthesizing new ideas and experiences.
- Implementers and performers apply basic and advanced ideas, information, skills, tools and technologies as they carry out the responsibilities associated with all life roles.
- Problem finders and solvers, anticipate, explore, analyse and resolve problems by examining their underlying causes from a variety of perspectives and then develop potential solutions to them.
- Planners and designers develop effective plans, methods, and strategies for anticipating and resolving issues and problems and for charting new courses of action.
- Creators and producers seek new possibilities for understanding or doing things and who translate those possibilities into original, workable products or processes that change the working or living environment.

Spady's life roles are similar to the critical cross-field outcomes that aim to prepare individuals to become lifelong learners. The critical outcomes in South Africa represent these life performance roles.

From the explanation in this section (Chapter 4.2.4) it is apparent then that, when one refers to OBE in the South African context, one is actually referring to transformational OBE.

With transformational OBE as the education philosophy that shapes the education structure for South Africa, the design of all new and existing qualifications needs to be reviewed. Designers of new qualifications need to take into account the new education policy and position these qualifications within the broader international and national context of curriculum and curriculum development.

Education reform has generally been coupled with political change; this is a phenomenon that has occurred over years in many other countries. Therefore, the political and education changes manifesting themselves in South Africa are not unique. What is significant, though, is that education reforms need to be interpreted and critically evaluated from the broader perspective of curriculum theory.

The transformation of curriculum generally has serious implications for every dimension of education and the role-players that deal with curriculum. Learning institutions in South Africa seeking to change their curriculum practice need to take cognisance of what government is trying to achieve through its education reforms. Since this research deals with the design of a new qualification, issues pertaining to curriculum and the implications thereof will now be examined.

4.3 Definition of curriculum

Since education is everybody's business, the idea of curriculum is elusive and epistemologically ill defined. There does not seem to be any consensus as to where curriculum matters end and the rest of education begins.

As long as thirty years ago, Rule (Lewy 1991: 26) identified some 119 different definitions for curriculum that may be delineated along the lines of the specific and prescriptive versus the broad and general (Ornstein & Hunkins 1998: 10). It is not my aim to trace the many changes of meaning that the concept "curriculum" has undergone, but to determine its meaning in the context of NQF, OBE and C2005. For this reason I have used two definitions to construct a working definition of curriculum for this study. The first definition by Van Rooy describes curriculum as "the interrelated totality of aims, learning content, evaluation procedures and teaching-learning activities and opportunities and experiences which guide and implement the didactic activities in a planned and justified manner" (1996: 92).

The second even broader definition stated in the document issued by the South African national Department of Education describes curriculum as "everything planned by educators that will help develop the learner", including "everything that influences the learner, from the educators and the learning programmes, assessment criteria and extra-mural programmes, right down to the physical buildings" (1997: 10). These definitions suggest that curriculum is a planned course of study intended to bring about a behavioural change. Both definitions ignore the political change and transition in South Africa since 1995. This political change and transition resulted in a movement away from Christian National Education, as was epitomized by the apartheid government, toward OBE, which is the policy of the current government. The transition from one to the other deliberately focuses on correcting the imbalanced education, social and economic sectors maintained by the previous government prior to the 1994 democratic elections in South Africa. The international context in both definitions is also ignored as a significant aspect of change. Finally, curriculum needs to be seen as the sum total of all the activities that happen in a school. With the above-mentioned definitions, the covert or hidden outcomes of learning are not part of curriculum assessment. Therefore the working definition proposed is:

> Curriculum is considered a plan or programme for instruction and learning prepared in the light of national education needs, visions and goals in the milieu of international practices and trends which contain references to selected and sequenced learning content.

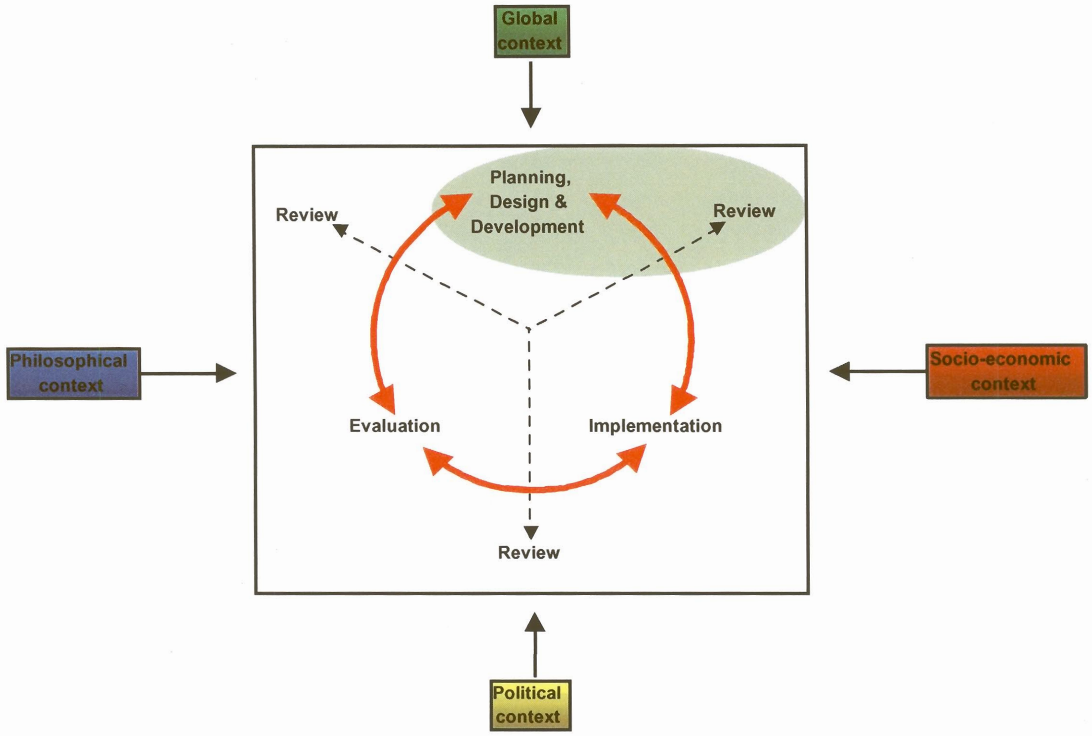
4.4. Curriculum development process

The process of curriculum development could be standardized in three key stages: planning, design and development; implementation; and evaluation. These three stages in the curriculum development process will briefly be explained. It should be mentioned that stage 1 comprises three components: planning, design and development.

1. - Curriculum **planning** – refers to the way in which particular aspects of life, knowledge, attitudes and values are selected from the total culture of society (for purposes of transmission) and are put into practice.
   - Curriculum **design** – refers to the organizational pattern of the structure of a curriculum.
   - Curriculum **development** – refers to the writing of instructional objectives, content, activities and evaluation procedures.
2. **Implementation** – refers to the process of putting a change in the curriculum into practice.
3. **Evaluation** – refers to the process of studying the merit or worth of the whole of the curriculum.

It should be noted that curriculum design does not necessarily precede curriculum development in a linear fashion. Instead, the two processes work and occur simultaneously. Each stage is reviewed prior to the introduction of the next stage. Therefore, the curriculum development process could be described as a cyclical, reflective, interactive process as shown in Figure 4.5.

Figure 4.5: Curriculum development process



The curriculum development process does not exist in a vacuum. It is located within the broader global, philosophical, socio-economic and political context, which all have a direct impact on the development process. This study is located within the oval shaded area, indicated in Figure 4.5 above.

Prior to curriculum development, a curriculum model has to be identified, which outlines the theory of the aspects to be considered, the sequence of events and how actions should be planned.

Various models of curriculum design exist (see Dixon 1998: 24-30), among which are three traditional models: the objectives model (product or output model), the process model (input model), and the situation analysis model or culture-analysis model. OBE uses a modified situation analysis model where the terminology differs somewhat. For this reason the objectives model and process model will not be discussed.

Kachelhoffer (1987: 86) cites the situation analysis model, which is cyclical in nature and comprises primarily four components (situation analysis, objectives, learning content/ experiences/opportunities and evaluation) as the most common model.

According to Dixon (1998: 25), the revised "outcomes-based situation analysis model" would comprise: situation analysis; learning outcomes; assessment criteria, range statements and performance indicators replacing learning content, learning experiences and learning opportunities and evaluation (of the whole process).

Using this OBE model as a framework, I propose a model in Chapter 5.2 that forms the basis of the qualification design in Music Technology.

4.5 Summary

The broad systemic and curricula implications for education transformation in South Africa suggested in this chapter indicate that the current education system needs to be radically re-examined. The new system needs to adopt transformational OBE as its guiding philosophy and be underpinned by democracy, transparency, accountability, equality and accessibility to all learners.

At present no clear implementation guidelines exist as to how the issue of transformation ought to manifest itself to bring about change within the current education context. Therefore, a developmental approach to transformation needs to be explored by considering traditional (disciplinary) and transitional (interdisciplinary) OBE as well. A direct move towards transformational OBE would have catastrophic implications for education. The new structure should reflect a shift towards transformational OBE that is underpinned by critical cross-fields and Spady's life performance roles (hereafter referred to as life roles). In other words, educators need to manage the continuum for systemic change in order to achieve the ideal of transformational OBE.

The concepts discussed in this chapter will be used to form the basis for the conceptual framework for qualification design in Chapter 5.1.

CHAPTER 5

A CONCEPTUAL FRAMEWORK AND DESIGN OF A QUALIFICATION IN MUSIC TECHNOLOGY

The purpose of this chapter is to develop a conceptual framework that identifies key concepts, draws relationships, and highlights meaningful interactions between the concepts that have emerged from the literature in preceding chapters. The conceptual framework will provide a foundation for the design of a new qualification (a certificate in Music Technology at NQF Level 5 in this case) and could also be used to critique other qualification designs in Music Technology. The qualification design in Music Technology will be positioned within a curriculum development model in order to show the relationship between the three levels of curriculum design, namely the design of a qualification, and the development and implementation of a learning programme.

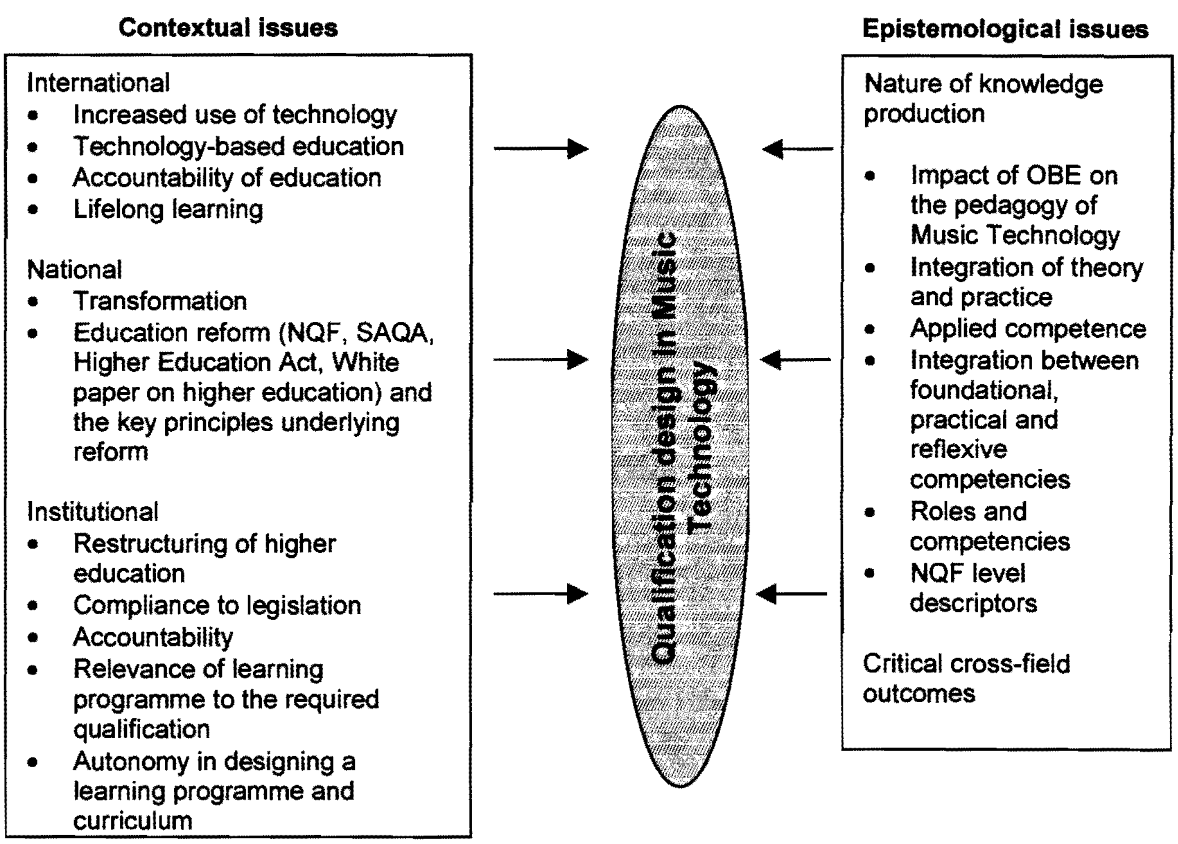
This chapter highlights the contributions of the study to education research by:

- Firstly, attempting to contextualize global trends in Music Technology to the South African socio-political and transformational conditions. This is sought through dealing with the challenges of designing a qualification in Music Technology that meets international trends whilst at the same time addressing the transformational agenda of accountability, redress and equity;
- Secondly, conceptually relating key concepts identified in the field of Music Technology and education policy that should guide the design of a qualification in Music Technology.
- Thirdly, in attempting to locate qualification design in Music Technology within a curriculum development framework, this study develops a holistic curriculum development model that includes three levels, namely the design of a qualification, and the development and implementation of a learning programme (for teaching, learning and assessment); and
- Finally, constructing an exemplar of a certificate qualification in Music Technology at NQF Level 5.

5.1 A conceptual framework

The concepts identified in Chapters 2, 3 and 4 relating to policy and the field of study of Music Technology have been grouped into two broad areas: contextual and epistemological issues (nature of knowledge and knowledge production). Only a selection of the key concepts that influence the design of the qualification in Music Technology will be discussed in the section that follows (see Appendix D for a complete list of concepts). These concepts and trends were extracted from the review of literature in Music Technology and education policy and initially assembled together, after which they were separated along the lines of contextual and epistemological issues. The justification for the separation was to indicate the changing contexts in which education finds itself globally as well as nationally and to highlight the dynamics of the field of Music Technology. The contextual and epistemological issues are therefore influential in constructing a new qualification. Their impact on qualification design is illustrated in Figure 5.1.

Figure 5.1: Illustration of the conceptual framework highlighting the concepts and issues that will inform qualification design in Music Technology



The interplay of the concepts relating to contextual and epistemological issues will now be examined in relation to the study.

5.1.1 Contextual issues

The contextual issues describe the international context and examine its influence on the national and institutional context in South Africa, with the focus on the design of a qualification in Music Technology. The demands made by socio-economic, cultural and philosophical factors globally pressurize higher education to transform. South African national education policy integrates these international pressures with the South African needs to transform society. Current education policies therefore, require institutions of higher learning to be accountable, relevant and to meet the needs of society (see Chapter 1.1).

5.1.1.1 International context

Global trends show an increased usage of technology. The rapid developments in technology in the latter part of the twentieth century, particularly with regard to the Internet, have demanded that education systems globally take cognisance of this trend. Technology in education has required education systems to create mechanisms for the inclusion of technology-based education programmes. This can be deduced, for example, from Tim Berners-Lee at CERN (European Particle Physics Laboratory), who already in 1989 facilitated the collaboration among scientists to work together on high-energy physics research using a specific Internet protocol (world-wide web or WWW) (Curtin *et al* 1998: 6). The ever-increasing technology-based programmes globally justify this phenomenon (Chapter 3.1). The impact of technology on the various disciplines as discussed in Chapter 3.1 (Design, Education and Biology) and in Music in Chapter 3.2 is a clear indication that disciplinary knowledge as well a pedagogy is being reshaped by current technology.

Apart from the technology explosion, higher education institutions internationally are being required to be accountable for the programmes they offer. In recent years there have been increasing calls in Western society for greater attention to be focussed on the outcomes of education. This phenomenon resulted from the public's calls for accountability, in that they wanted return on investments in education, which could be evaluated. Several countries (including the USA and the UK) responded to these calls of accountability in the 1980s (Killen 1998:4).

Coupled with education accountability is the issue of lifelong learning (see Chapter 4.2.3). This is discernable in the adoption of OBE in Australasia, countries in Europe, the Pacific rim and North America (SAQA 2000c: 2) in which two approaches to OBE are identified: the learners' mastery of some traditional academic outcomes and some cross-discipline outcomes (for example, working co-operatively) and the emphasis on outcomes that are related to learners' future life roles (Killen 1998:4). All of these global trends impact on qualification design in Music Technology.

5.1.1.2 National context

Within the national policy context, the South African Ministry of Education responds to these global trends (Chapter 4.1.2), by taking cognisance of the issues of technology education, accountability and lifelong learning. These trends are enshrined in current education policy documents (see Chapter 1.6.5).

Transformation of the education system in South Africa, however, was instituted to address the imbalances created through the previous education system under the apartheid government prior to 1994 (Chapter 4.1). The NQF was instituted to bring about systemic and curricula change to the South African education landscape (Chapter 4.1.2). The primary reason behind the development of the NQF is to develop a single unified qualifications framework. Some of the objectives of the NQF are to have an integrated national framework for learning, facilitate access and mobility within education training and career paths, address the issues of redress and equity, and contribute to the full personal development of the learner. The design of a Music Technology qualification will therefore have to take into account all of these objectives of the NQF in order for the qualification to qualify as being transformational.

In order to ensure the development of the NQF, the SAQA Act of 1995 was passed to enable South Africa to develop this framework. SAQA'a purpose is therefore to implement the NQF through: the registration of bodies responsible for establishing education and training standards/qualifications, and the accreditation of bodies responsible for monitoring and auditing achievements in terms of such standards and achievements (SAQA 1997: 2-4). The Higher Education Act 101 of 1997 requires the establishing of the Council on Higher Education, a body whose responsibility it is to manage transformation in the higher education sector. A subsidiary of this body is the Higher Education Quality Committee, a quality assurance body that monitors the quality of learning programmes and teaching, learning and assessment of learning programmes towards meeting the purpose and competencies of the qualification. The White paper on Higher Education provides guidelines as to how higher education in South Africa needs to transform in terms of its structures, learning programmes and curriculum in order to realize the vision of national education policy. The Music Technology qualification will therefore have to subscribe to the expectations of the NQF and SAQA and ensure that it takes cognisance of the Higher Education Act 101 of 1997 and the transformational requirements enshrined in the White paper on education.

5.1.1.3 Institutional context

There are a number of limitations regarding Music Technology curricula offered by South African higher education institutions (Chapter 3.4). Although some of the South African Music Technology programmes reflect international trends (Chapter 3.4), they do not, however, take cognisance of the needs of the national job market and the expectations of national education policy. Several of the South African programmes are designed according to international curriculum trends and not particularly national ones. This raises concerns with regard to the issues of accountability, restructuring of higher education, compliance to legislation, relevance of learning programmes and autonomy in learner programmes design and curriculum.

The issue of accountability is central to all aspects within the institutional context. In terms of an institutions management structures, all decision making in terms of curriculum, teaching, learning and assessment is to involve the participation of all stakeholders and be structured in terms of the legislative requirements. The legislative requirements are the nationally registered learning achievements on the NQF. However, in the case of Music Technology this does not exist as yet.

Policy demands that institutions address the needs of society, the community and lifelong learning of its learners. This requires institutions to realign its existing structures and curricula to the principles of transformational OBE underpinned by critical cross-field outcomes. The re-structuring of higher education is vital to the transformation process, in that the learning programmes offered are to be made accessible to all learners in addressing the issues of access, redress and equity. Institutions, therefore, need to put in place mechanisms that will ensure mobility and transferability of knowledge, skills and values within the institution as well as between institutions.

Since all qualifications have to be registered on the NQF, qualifications, learning programmes, teaching, learning and assessment that are offered and/or take place within the institutional context have to take into account the qualification exit level outcomes. This is to ensure national standards are maintained. All learning programmes and assessment criteria need, therefore, to be designed against these exit level outcomes. The critical cross-field outcomes, which contribute towards lifelong learning, are in most cases embedded in the exit level outcomes and assessment criteria of the qualification. For the sake of relevance with regards to national socio-economic, employment and education needs, the exit level outcomes and critical cross-field outcomes of the qualification underpins all institutional teaching, learning, assessment and the design of learning programmes. Currently, learning programmes are restricted to the specific institution at which the learning programme is offered, rather than responding to any national standards in Music Technology.

A part of this diversity in learning programmes could be attributed to the differing notions surrounding the issue of autonomy. Autonomy within the higher education sector is a highly contentious issue, as I have discovered in my capacity as Chair of the Higher Education and Training SGB for Music. Higher education institutions are required by legislation to conform to the transformational agenda of national education policy. The autonomy of these institutions would therefore lie in the domain of the learning programme and curriculum, which each institution chooses to offer, and not with regard to nationally registered learning achievements. It is therefore clear that in the case of the Music Technology, institutions will need to generate learning programmes and assessment criteria based on the exit level outcomes of this qualification in Music Technology.

The international, national and institutional context all impact on the design of a qualification in Music Technology.

5.1.2 Epistemological issues

The role of knowledge production is a highly contentious one, especially in view of the transformational agenda of policy. Since knowledge is central to the process of qualification design, the issue of knowledge production will be examined in this section, initially through three questions and thereafter through critical discourse.

5.1.2.1 How is knowledge produced?

The differing perceptions of knowledge production held by the state, labour, business, providers of education and training, critical interest groups, the community and learners produce a tension with regards to how knowledge is produced. Current South African education policy requires knowledge to be socially constructed by different stakeholders reaching consensus (Chapter 4.1). This is in sharp contrast to the institutional view on knowledge production (Chapter 2.1.4). Up to now knowledge production at education institutions internationally as well as in South Africa has been the domain of academics. Traditionally, academics decided what knowledge is to be included in the curriculum (an exclusive process). The issue of knowledge production within the proposed qualification in this study, will have to take into account the social construction of knowledge, which ultimately will need to be reflected in the design of the qualification.

5.1.2.2 Who produces knowledge?

Academics who view themselves as custodians of disciplinary knowledge and who have up to now monopolized knowledge production are reluctant participants in the transformation process because education policy requires knowledge production to be a socially constructed, inclusive process. The fear that arises amongst academics with regard to the social construction of knowledge is the shift from "high standards" of the disciplinary nature of knowledge. Ironically, I have observed through my experience as chairperson of the SGB for Higher Education and Training that the voices of academia and business still dominate the standards generation process whereas certain voices (critical interest groups, the community and learners) are lost or unheard through stakeholder participation. This implies that academics still have the major influence on what knowledge is included in the qualification design, despite transformational expectations of policy with regard to broad consultation on issues of knowledge production.

5.1.2.3 What knowledge is selected for the qualification in Music Technology?

Due to the long process in forming an SGB and designing qualifications in which knowledge issues are discussed, this study had identified and selected knowledge to be included in Music Technology qualifications (Chapters 2 and 3). This knowledge is embedded in the roles and competencies identified later in this chapter (see Chapter 5.1.2.8). Although this is a limitation of the study, an attempt is nevertheless made to provide a knowledge foundation that impacts on the conceptual framework and which serves to guide the SGB in the standards generation process.

5.1.2.4 The impact of OBE on the pedagogy of Music Technology

The different forms of OBE (Chapter 4.2) identified in this study also impact on how a qualification is designed. The generic use of the term OBE by the South African Ministry of Education and providers of education, has led to a perception that as long as the curricula are designed with learning outcomes, they conform to national policy requirements. This, however, is misleading and is not what South African policy dictates. The NQF as a key education policy requires a transformational OBE approach whereby the outcomes and criteria for assessment are underpinned by critical outcomes (Chapter 4.2.4). However, the data in Table 3.6 suggest that current education practices in South Africa at institutions offering Music conform to traditional and in a few cases transitional OBE where the focus is on the learners' mastery of some traditional academic outcomes and some cross-discipline outcomes. The shift in OBE approach at these Music institutions in South Africa (Chapter 3.4) occurs between traditional and transitional OBE, rather than transformational OBE.

The transformational OBE philosophy requires a high level of ownership, integration, synthesis, and functional application of prior learning (referred to later as recognition of prior learning or RPL) because learners need to respond to the complexities of real life (Spady 1994: 19). These transformational outcomes reflect a particular orientation to knowledge and to meeting the future needs of learners and of society in general.

5.1.2.5 The integration of theory and practice

The transformational OBE approach offers a dialogue between learners and the curriculum, where the learners interact with sources of knowledge, reconstruct knowledge and take responsibility for their own learning outcomes. In order to promote the skills required to enhance South Africa's education and economic competitiveness and help the convergence of general and vocational education, the transformational approach to OBE has to inform qualification design. The qualification design, therefore, needs to show an integration of theory and practice. Policy emphasizes what learners should know and be able to do. Currently most academic institutions still focus on the theoretical aspects of learning. These aspects are still highly valued, especially in university contexts. The application of this theoretical knowledge has not been fully exploited at such institutions of higher learning. Qualification design needs to show an integration of the theoretical and vocational (practical) aspects of learning in order to meet the transformational agenda of policy (for example, understanding the principles of signal processing and applying this knowledge to a studio/ live context).

5.1.2.6 Applied competence

Policy requires qualification design to take cognisance of the world of work and the world of professional practice (see Figure 4.1). The competencies required in the worlds of work and professional practice would enable future learners to make a contribution to themselves, their community, society, their country and the world. Therefore the knowledge component, which is to a large degree extracted from the requirements of the worlds of work and professional practice, needs to be manifested in the world of curriculum. By doing so, institutions of higher learning will be accountable to all stakeholders in education. The applied competence of learners is therefore vital to qualification design in that learners must demonstrate the knowledge and skills in a real, simulated and/or authentic context.

5.1.2.7 Integration between foundational, practical and reflexive competencies

One of the design features of a transformational OBE qualification is the integration of foundational (knowledge), practical (skills) and reflexive (evaluation/reflection) competencies. In the case of foundational competencies the learner will need to demonstrate an understanding of the knowledge and thinking which underpins the actions taken to solve problems, use technology, organize his/her work, work together with others, seek knowledge of his/her peers, and the like. The practical competencies require the learner to demonstrate the ability, in an authentic context, to consider a range of possibilities for action, make considered decisions about which possibilities to follow, and to perform the chosen action. The capacity of the learner to demonstrate the ability to integrate or connect performance and decision making with understanding and with the ability to adapt to change and unforeseen circumstances and explain the reason behind these actions will underlie the reflexive competencies. All three competencies underpin a Music Technologist's primary role and therefore impact on the design of a qualification in Music Technology.

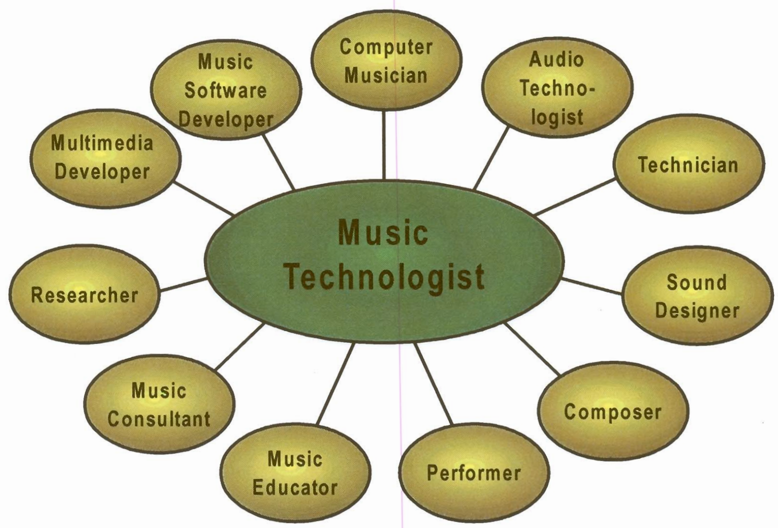
5.1.2.8 Identifying key roles and competencies

The selection of knowledge to be required in any qualification in Music Technology will be dependent on the expected roles and competencies of a Music Technologist. The overview presented in Chapter 3.3.3 indicates that most jobs in Music and Industry are influenced either entirely by, or by a core component of, Music Technology. Due to the newness of Music Technology as a field of study, the role and career path of a Music Technologist, both internationally as well as nationally, is at this point not clearly definable. It needs to be mentioned, however, that the Music Educators National Conference (MENC) in the USA (MENC 2001) has identified certain roles of the Music Technologist. Compared to the international roles, the MENC roles are limited, in that its focus is on three primary areas: Multimedia Publishing, Sound and Video Editing, and Technology-based Music Instruction Design. The other areas of employability are considered merely supplementary to the above three areas and not regarded as areas of specialization.

With regard to the ten core components of Music Technology offered internationally (see Chapter 3.3.1), it is apparent that most of these components already manifest themselves as career specializations within the existing Music Industry. Some of these career specializations are very recent developments. I used the data presented in Chapter 3.3 to identify the eleven primary areas of career specialization (see Figure 5.2). All of these eleven areas focus on the core components that underpin the field of Music Technology. In order to clearly define the roles and competencies needed for a qualification in Music Technology, I set out to identify the vital career paths that impact on the Music Technologist, together with their job descriptions. Other career paths (Music Business, Retail and

Copyright, and the like) also influence Music Technology, but to a lesser degree. These therefore, will not be elaborated upon in this thesis.

Figure 5.2: Primary career specializations for the Music Technologist



The primary career specializations provide key indicators for the roles and competencies expected of the Music Technologist. The Music Technologist's roles and competencies will need to integrate theory and practice, show applied competence, and integrate the foundational, practical and reflexive competencies. A brief description of the above-mentioned roles and competencies that follows, provides insight into the complexity of the work of the Music Technologist.

5.1.2.8.1 Computer Musician

A person who uses the computer to create, notate, record and manipulate music and sound in environments such as the entertainment and educational field, film industry and media or other kinds of multimedia products.

5.1.2.8.2 Audio Technologist

A person who has the knowledge and ability to apply well-established audio principles and techniques to audio problem-solving and audio engineering (such as recording, mixing, reinforcement and sound enhancement).

5.1.2.8.3 Technician

A person who provides technical support for music equipment and computer users. Such a person will install, analyse, service, trouble-shoot and configure music equipment, computer systems and networks, provide technical advice, and diagnose and correct music equipment and computer-related problems when they occur.

5.1.2.8.4 Sound Designer

A person responsible for the creation of a coherent and consistent overall sound style for a project utilizing moving images (video and film), as well as the recording, creation and/or transformation of sounds to this end.

5.1.2.8.5 Composer

A person who creates instrumental and/or vocal pieces, either to stand alone or to be combined with lyrics for a variety of mediums (film, jingles, video, and so forth), using a diversity of musical tools.

5.1.2.8.6 Performer

A person who specializes in the performance of music, either original, historical or cover-version material. Such a person's marketability is determined by his or her music skills. His/her work may involve solo playing, accompanying other musicians, or performing as part of a group.

5.1.2.8.7 Music Educator

A person involved in educating in Music at state-aided or independent education establishments and/or privately. Music educators' duties are governed by the level at which they educate, but for the most part they introduce learners to different aspects of music, the music industry and varying degrees of skill study pertaining to music.

5.1.2.8.8 Music Consultant

A person who provides direct support to customers of the Music Technology industry. Such persons are involved in sales, answer questions relating to music equipment, computer hardware and software, maintaining and setting up music instructional laboratories, and provide support in areas of Music Technology and Music.

5.1.2.8.9 Researcher

A person who has primary responsibility for the timely and accurate production of statistical analyses, technical reports and research papers. Such a person serves as an expert on research methodology and the structuring, managing and carrying out of research.

5.1.2.8.10 Multimedia Developer

A person who works with the latest advances in desktop computer technology. Such a person draws on the skills of the computer programmer and the visual artist to integrate graphics, text, digital audio and video.

5.1.2.8.11 Music Software Developer

A person involved in creating, modifying and testing software programmes. These programmes can be either newly written or combined with or adapted from existing programmes.

5.1.2.8.12 Summary of a Music Technologist's role

Due to the diversity of roles that a Music Technologist is required to fulfil, educating in Music Technology will need to focus on several competency areas simultaneously, rather than specializing in a particular aspect of Music Technology as described above. The role of a Music Technologist would therefore be more one of a generalist than a specialist, where the Technologist requires a general knowledge and skills of all of the above-mentioned roles.

Music Technology can therefore be regarded as a field of study that coordinates and synthesizes various independent areas of technology, both traditional specializations (older technologies, for example those related to audio recording and mixing) and contemporary specializations (present technologies, for example those integrating Computer Music into the Games Industry and Multimedia), into a single coherent field of study. The knowledge that needs to be considered for a qualification in Music Technology therefore includes theoretical knowledge and practical skills, as well as applied competence in the field. The selection of knowledge for the qualification in Music Technology is therefore dependent on the roles and competencies identified in this section.

5.1.2.9 Determining the level descriptors

Having established the roles and competencies (knowledge, skills and values) in the previous section, it is imperative to have these competencies pegged (located) at the appropriate level on the NQF. The pegging of these competencies, using the level descriptors, will indicate depth and breadth of knowledge and skills that are necessary to include in the design of the qualification in Music Technology.

Level descriptors attempt to describe the nature of learning achievement, its complexity and relative demand at each level of a qualifications framework. These level descriptors are broad, generic, qualitative statements against which specific learning outcomes can be compared and located. Thus, sets of level descriptors can be used in a general way to determine the pegging of qualifications on a framework. According to SAQA (2001: 2), these descriptors "describe learning across domains, disciplines, fields and learning pathways ... and are very general and highly abstract".

In this research the design of the qualification in Music Technology is targeted at a certificate at NQF Level 5 (120 credits). In order to peg the Certificate at NQF Level 5, it is appropriate for standards generators to view NQF level descriptors at NQF Level 4 (Further Education and Training Certificate), which describes the learning assumed to be in place prior to the commencement of this qualification, and NQF Level 6 (Bachelor's degree), which articulates the progression of learning beyond NQF Level 5. The NQF level descriptors (SAQA 2002: 39-41) stipulate the following applied competencies and autonomy of learners at Levels 4, 5 and 6. The qualification proposed in this study is located at NQF Level 5.

Table 5.1: Revised level descriptors for the NQF Levels 4 to 6 (SAQA 2002: 39-41)[*sic*]

NQF Level	Applied competence	Autonomy of learning
Typically, a learning programme leading to the award of a qualification or unit standard at this level should develop learners who demonstrate:		
4 (FETC)	. A fundamental knowledge base of the most important areas of one or more fields or disciplines, in addition to the fundamental areas of study, an informed understanding of the key terms, rules, concepts, established principles and theories in one or more fields or disciplines. . An understanding of the organization or operating environment as a system within a wider context. . An ability to apply essential methods, procedures and techniques of the field or discipline; an ability to apply and carry out actions by interpreting information from text and operational symbols or representations. . An ability to use their knowledge to solve common problems within a familiar context; an ability to adjust an application of a common solution within relevant parameters to meet the needs of small changes in the problem or operating context; an ability to motivate the change using relevant evidence. . A basic ability in gathering relevant information, analysis and evaluation skills. An ability to communicate and present information reliably and accurately in writing and verbally.	. A capacity to take responsibility for their own learning within a supervised environment. . Take decisions about and responsibility for actions. . Evaluate their own performance against given criteria. . A capacity to take the initiatives to address any shortcomings they find.
5	. A fundamental knowledge base of the main areas of one or more fields or disciplines; an informed understanding of the important terms, rules, concepts, principles and theories in one or more fields or disciplines. . An understanding of the organization or operating environment as a system within a wider context and in relation to society. . An ability to effectively apply essential methods, procedures and techniques of the field or discipline; an ability to interpret, convert and evaluate text and operational symbols or representations. . An ability to use their knowledge to solve well-defined problems both routine and unfamiliar within a familiar context; an ability to adjust an application of a solution within relevant parameters to meet the needs of changes in the problem or operating context; an ability to evaluate the change using relevant evidence.	. A capacity to take responsibility for their own learning within a supervised environment. . Take decisions about and responsibility for actions. . Evaluate their own performance against given criteria.

continued overleaf

Table 5.1. Revised level descriptors for the NQF Levels 4 to 6 (SAQA 2002: 39-41)[*sic*] (continued)

NQF Level	Applied competence	Autonomy of learning
Typically, a learning programme leading to the award of a qualification or unit standard at this level should develop learners who demonstrate:		
5	. Efficient information-gathering, analysis and synthesis, and evaluation skills. Presentation skills using appropriate technological skills; an ability to communicate information coherently using basic conventions of an academic/professional discourse reliably in writing and verbally.	
6	. A solid knowledge base in at least one discipline/field. . A sound understanding of one or more discipline/field's key terms, rules, concepts, established principles and theories; some awareness of how the discipline/field relates to cognate areas. . Effective selection and application of the central procedures, operations and techniques of a discipline/field. . An ability to solve well-defined but unfamiliar problems using correct procedures and appropriate evidence. . A critical analysis and synthesis of information; presentation of information using basic information technology. An ability to present and communicate information reliably and coherently, using academic/professional discourse conventions and formats appropriately.	. A capacity to evaluate their own learning and identify their learning needs within a structured learning environment. . A capacity to take the initiative to address these needs. . A capacity to assist others with identifying learning needs.

The level descriptors should be understood as cumulative, that is each level subsumes the levels of learning achievement below it. Therefore the difference between Levels 4, 5 and 6 shows a progression of thinking (cognition), learning, and the role of the learner in relation to the educator from dependence on other-regulation towards full self-regulation and from close supervision to creative, self-directed learning.

5.1.3 The role of the critical cross-field outcomes on qualification design

The final epistemological issue deals with the relationship between critical cross-field outcomes (Chapter 4.2.4) and the nature of Music Technology (Chapter 2.4 and 3.7). In critical cross-field outcomes and in the nature of Music Technology, there is a suggestion that their roles complement each other, in that they both function as a tool and an enabler (Chapter 2.3, 2.7 and 4.2.4). The critical cross-field outcomes contribute towards lifelong learning by empowering learners with knowledge, competencies, attitudes and values that will allow them to contribute to their own success, as well as to the success of their family, community and nation as a whole.

The primary focus, therefore, within transformational OBE is on the desired end results of education, with the emphasis on outcomes that are related to learners' future life roles through critical cross-field outcomes. These critical cross-field outcomes are seen by the NQF as tools that enable the flexibility and transferability of knowledge, competencies, attitudes and values from one context or problem situation to another. Embedded in these critical cross-field outcomes are the seeds for cultivating lifelong learning. The outcomes of qualification design in Music Technology need therefore to marry the outcomes of the field with the critical cross-field outcomes.

Using the concepts mentioned in the contextual and epistemological issues, the metaphor of marriage will be used to show the relationship between the design of a qualification, field of study (Music Technology) and current South African education policy. It is apparent from the contextual and epistemological issues discussed in Chapters 5.1.1 and 5.1.2 that an arranged marriage has been identified. Within this arranged marriage scenario, three possibilities exist. Firstly, within the education framework there is equal respect between both partners, where the expectations of the field of study and policy complement each other in qualification design. This would be the ideal case. In the second possibility, one partner dominates the other, thereby subduing the identity of the other. There is a danger that policy could dominate the field of study in qualification design. The third possibility could be a mismatch that results in an incompatible relationship, where policy and the field of study move in separate directions unrelated to each other. The present study proposes a qualification design that shows complementarity between the field of study and policy.

5.2 Curriculum development model

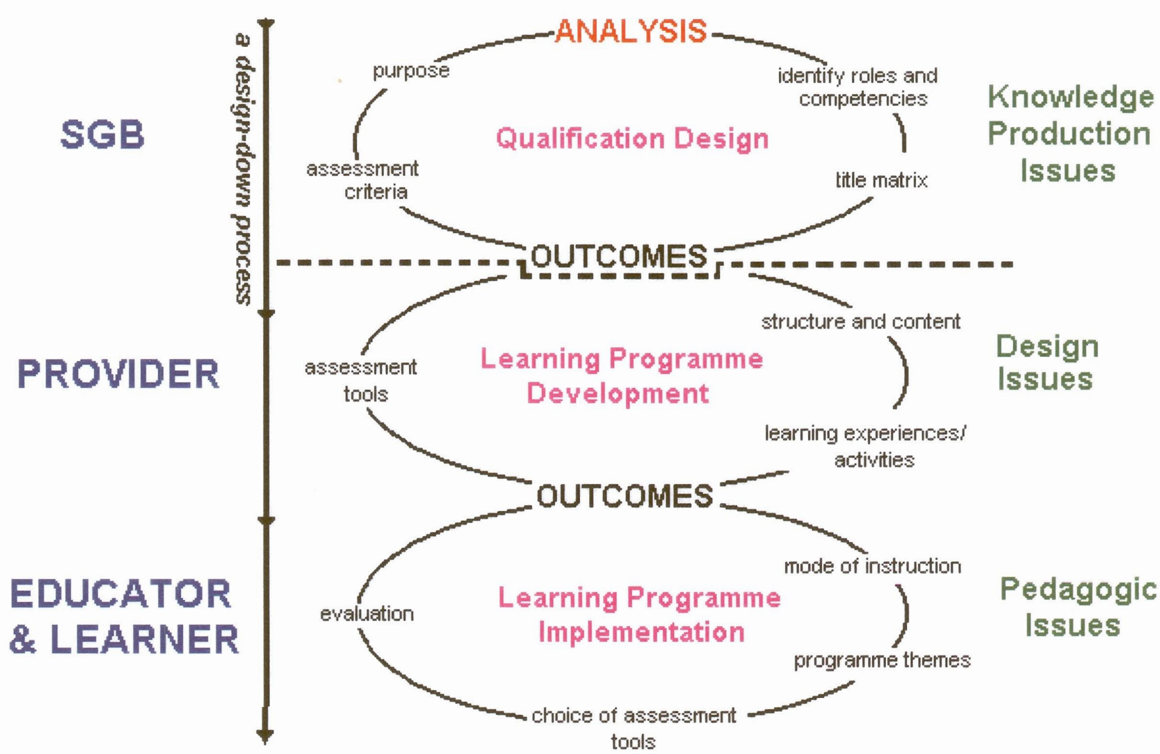
Qualification design is located within a curriculum development model. The proposed conceptual framework discussed in Chapter 5.1 through to Chapter 5.1.2.7 forms the main pillars of the design of a qualification in Music Technology. The concepts mentioned thus far need to be organized into some sort of system. This is reflected in the proposed model presented in Figure 5.3 by the author.

Existing curriculum development models (see Dixon 1998: 24-30) focus on design and pedagogical issues. The model proposed in this section adopts a holistic approach that includes two levels of curriculum development:

- Planning, Design and Development; and
- Implementation.

The third level (Evaluation) occurs once implementation of the qualification has taken place. Since this is an iterative process, review (basic evaluation) will occur at each stage and level. These three levels show the link between knowledge production issues, learning programme design and pedagogical (teaching/learning and assessment) issues. All three levels have to be considered in the design of a qualification, because the exit level outcomes of the qualification impacts on the entire curriculum development process.

Figure 5.3: A proposed curriculum development model



The model in Figure 5.3 has three cyclic units. The first cyclic unit is the level where the qualification is designed by the **SGB** for Music in the Higher Education and Training Band (HET) for NSB 02 Arts and Culture. Since the transformational OBE approach to curriculum development is a design-down[23] process, this study is located at the first level of the qualification design phase (the area above the dotted line). One cannot proceed to any of the other cyclic units if the first cyclic unit is not realized.

The second cyclic unit relates to the development of the learning programme that involves the **providers** of education, that is, course designers or planners. The final cyclic unit addresses the issues of teaching, learning and assessment. Since outcomes are central to the new education framework and tie the entire curriculum development process together, the exit level outcomes that are illustrated between the first (qualification design) and second (learning programme development) cyclic units (see "outcomes" in Figure 5.3) have been re-illustrated between cyclic units two and three (learning programme implementation). This is to emphasize that all aspects of the curriculum development process need to take cognisance of the exit level outcomes established by the SGB. The above model reflects the key principle of the OBE approach, that is the design down principle. In the design down principle, the outcomes of learning against the backdrop of the critical cross-field outcomes need to be established first. These outcomes will thereafter need to be used to develop learning programmes. All teaching and learning that follow have to be assessed against these learning outcomes.

During the qualifications design phase, an analysis of trends (both international and local) was undertaken, together with a review of international curricula, coupled with the examination of learner and industry needs (Chapter 3.3, 3.4 and 3.5). The next step in the process will be to identify key roles and competencies associated with careers (see Chapter 5.1.2.8). The analysis of these roles highlighted the knowledge, skills and values necessary for the qualification. Following these key roles, a title matrix (see Chapter 1.9 and 5.3.1) will be formulated that will be used as basis for the formulation of learning outcomes and criteria to be used to assess these outcomes. Once the learning outcomes have been identified, the purpose of the qualification will be clarified. This level of the qualification appears to be prescriptive, because the outcomes identified at this level affect national qualifications.

[23] Also referred to as a build-back approach where the curriculum design starts with abilities, skills, knowledge and attitudes that learners will have to demonstrate. It ensures that assessment is focussed on what the learners have achieved in relation to learning outcomes.

5.3 Qualification design process

The qualifications design process is a clearly structured process that follows certain key steps. An overview of the steps is as follows:

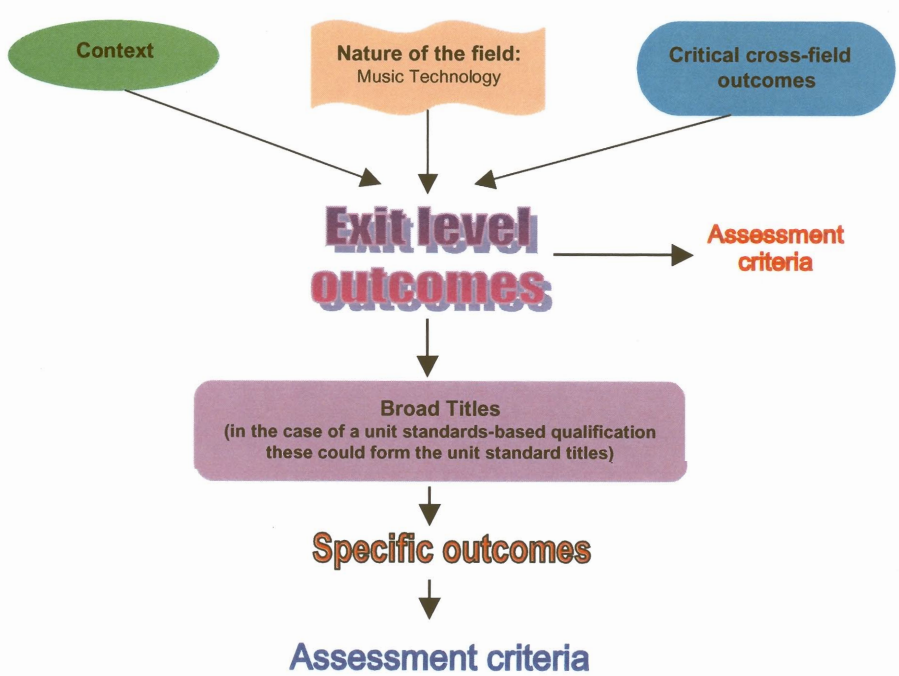
- Identifying key roles and competencies (see Chapter 5.1.2.8);
- Determining the descriptive statements of knowledge, skills and values that will guide the scope of knowledge, skills and values (see Chapter 5.1.2.9); and
- Constructing the proposed Certificate in Music Technology (see Chapter 5.3.1).

Since the steps dealing with key roles and competencies and the determining of the level descriptors have already been dealt with in Chapter 5.1.2.8 and 5.1.2.9 respectively, I shall now proceed with the construction of the whole qualification.

5.3.1 Constructing the proposed Certificate in Music Technology

The parameters provided by SAQA (2000a: 35-90) will be used as a guide in the construction of the Certificate in Music Technology. Figure 5.4 below provides an outline of the construction process.

Figure 5.4: Construction of the Certificate in Music Technology



The context, critical cross-field outcomes and nature of the field (in this case Music Technology) will be used to determine the exit level outcomes and assessment criteria for the qualification.

The SAQA parameters that will be used in this qualification are the three categories of learning competencies: Fundamental, Core and Elective (discussed in Chapter 4.1.4.5). This study focuses on the Core competencies. Fundamental competencies underpin the qualification, but these will not be discussed because learners would need to be proficient in these areas prior to gaining access to the qualification. The Elective competencies are optional modules from the broader Music/other disciplinary sector towards a general study in the discipline of Music/other discipline. To prevent duplication of these standards and outcomes, the competencies of the electives will not be elaborated upon in this study. The outcomes relating to electives will be generated under a generic Music/other qualification.

In order to engage in a study of Music Technology, it is imperative to first have a sound music background, since this forms the basis for the implementation of technology. Core Music competencies form the integral component in most Music qualifications. This Certificate in Music Technology will focus exclusively on the following Music Technology core competencies that have already been identified in Chapter 2.2, 3.3.1, 3.4 and 5.1.2.1. The core competencies will form the broad titles of a matrix around which exit level outcomes will be generated:

- Electronic Musical Instruments (EMI);
- MIDI Sequencing (MS);
- Music Notation (MN);
- Computer-based Education (CBE);
- Computer, Information Systems and Lab Management (CISLM);
- Multimedia and Digitized Media (MDM);
- Computer Music (CM);
- Audio Technology (AT); and
- Research (R).

Each broad title in this matrix will be used to generate exit level outcomes (ELOs) for the Certificate in Music Technology. The exit level outcomes form the core of this qualification.

In Table 5.2, I tabulate these exit level outcomes and the composition, requirements and elective options that are available to learners for the Certificate in Music Technology. The abbreviations (in brackets) correlate the exit level outcomes with the core competencies (stated above). The core competencies form the basis of the Certificate in Music Technology.

The specific outcomes for the core competency Internet and Telecommunications will be generated by the SGB for Physical, Mathematical, Computer and Life Sciences (NSB 10). In order to avoid duplication, these have not been generated in this certificate. However, since Internet and Telecommunications have been deemed compulsory by the National Department of Education (DoE 1997), this core competency has been categorized under Fundamental learning.

Table 5.2: Qualification construction for the Certificate in Music Technology

Fundamental learning
Language, Literacy and Communication
Basic Mathematic Literacy
Computer Literacy
Internet and Telecommunications (IT)

+

Core learning (exit level outcomes)
Perform musical works, process music data, synthesize and edit music timbres using **electronic musical instruments (EMI)**.
Sequence **(MS)**, write[24] **(MN)** and perform **(CBE)** musical works using MIDI related hardware and software.
Operate basic **computer information systems (CISLM)** to enable the integration of music and technology.
Create and produce musical products by applying **multimedia** packaging techniques and **digital recording** principles and techniques **(MDM)**.
Compose original music products using computer-based hardware and software and fundamental programming skills **(CM)**.
Engineer and produce audio products using **audio technology (AT).**
Collect, analyse, organize and critically evaluate information in Music Technology **(R).**

+

continued overleaf

[24] The term "write" is preferred as opposed to "notate" because the former includes the music composition/creation process as well.

Table 5.2: Qualification construction for the Certificate in Music Technology (continued)

Elective learning
Music Industry, Business and Marketing
Music Copyright
Music Education
Informatics
Human Computer Interaction
Computer Programming
Music Librarianship
Instructional Design
Core Music Disciplines (Performance, Theory, Style and Genre, Composition, Harmony and Form, Orchestration and Arranging, Acoustics and Psycho-acoustics)

Fundamental + Core + Elective(s) = Certificate in Music Technology

Therefore, the Fundamental together with the Core and some of the Elective learning constitute the Certificate in Music Technology.

5.3.1.1 Title of qualification

Certificate in Music Technology

5.3.1.2 Rationale

Post-secondary institutions in South Africa are entrusted with a new skills development initiative to meet the needs of the individual, education, industry and society. This qualification in Music Technology is designed to produce key players in the music industry, as well as contribute to the diversification of the sector. The qualification attempts to facilitate the process of skills development and knowledge transfer by opening access to Music Technology to all learners who are interested in a career in Music Technology and historically disadvantaged learners who have the potential to succeed in Music Technology.

5.3.1.3 Purpose of the qualification

Learners who have achieved this qualification will have generic competence in Music Technology in applying established music fundamentals, principles and methods to use existing technologies in the field of music to compose, write, arrange, orchestrate, perform, engineer, synthesize, publish, reflect, operate, explain, identify and to solve technology related problems. Such a qualification:

- Provides the learner with a basis for further learning and development in the field of Music Technology;
- Provides career and leaning opportunities for historically disadvantaged learners, who have been denied access to Music Technology;
- Satisfies the national needs of education transformation as required by civil society by affirming and integrating indigenous music knowledge systems;
- Addresses economic needs within the music industry in the form of the potential for employability, improved productivity and entrepreneurial skills; and
- Fulfils an academic need by broadening the structured music education framework.

5.3.1.4 Level

National Qualifications Framework Level 5.

5.3.1.5 Credits

A total of 120 credits will be assigned to the whole qualification. In order to accommodate prior learning, a minimum of 72 credits will have to be attained at NQF Level 5 with the remaining 48 credits at NQF Levels 4. This allocation will allow the majority of the adult learners, who are without formal qualifications and located in the Further Education and Training Band, access to this qualification.

5.3.1.6 Access to the qualification

All learners with a qualification at NQF Level 4 with Music as a major or who have the potential to pursue a study in Music, will be allowed access to the qualification. Learners who have acquired music knowledge and skills in non-formal and informal contexts at NQF Level 4 will have their prior learning recognized (RPL).

5.3.1.7 Organizing Field and Sub-Field for the qualification

Field: Culture and Arts (NSB 02)
Sub-Field: Music.

5.3.1.8 Learning assumed to be in place

The following competencies in terms of knowledge, skills and values are assumed to be in place at NQF Level 4:

- Language, Literacy and Communication;
- Basic Mathematic Literacy and Computer Literacy;
- Core music study areas (Music Performance, Music Theory, Music Composition).

5.3.1.9 International comparability

In order to check outcomes and assessment criteria, level of complexity and notional learning time, the learning outcomes of the Certificate in Music Technology will be compared with the following international qualifications to match the level of complexity in terms of knowledge, skills and values:

- Certificate in Music Technology Level 1 by the Technology Institute for Music Educators, US;
- National Certificate in Audio Visual Technology: Sound Technology by the Scottish Qualifications Authority;
- National Certificate in Music Technology (Level 5) by the New Zealand Qualifications Authority.

5.3.1.10 Integrated assessment

A combination of classroom work, essays, major projects, demonstrations and presentations need to be used to determine learner competence. This assessment is a continuous process undertaken throughout the programme. Assessors should also develop and conduct their own integrated assessment, pertaining to the specific and critical outcomes, in a manner which takes account of established assessment principles and makes use of a range of formative and summative assessment methods.

5.3.1.11 Recognition of prior learning (RPL)

The qualification can be achieved in part or completely through the recognition of prior learning. It will be the providers of education who will need to establish a policy and set in motion procedures for the recognition of prior learning.

5.3.1.12 Moderation

Moderation must include both internal and external moderation of assessment at the exit point of the qualification, unless ETQA policies specify otherwise. Internal moderation will take place by the programme manager. External moderation of coursework needs to be undertaken by academics or persons in the music industry that have a minimum qualification at NQF Level 6 in the Music Technology field. Alternatively, and especially with regard to the current lack of qualified moderators in South Africa, recognition of prior learning at an equivalent of NQF Level 6 should be allowed. Any institution offering learning that will enable the achievement of this qualification should be accredited as a provider with the relevant ETQA.

5.4 Outcomes

The outcomes of learning that are embodied in the exit level outcomes are the important milestones of achievement towards the completion of the qualification.

5.4.1 Exit level outcomes and assessment criteria

These exit level outcomes identified in this section represent the knowledge, competencies, attitudes and values which are flexible and transferable between contexts or problem situations. For ease of reference in cross checking the exit level outcomes and range statements against the assessment criteria, I have listed them in Table 5.3.

Table 5.3: Exit level outcomes and assessment criteria for the Certificate in Music Technology

Exit level outcomes	Assessment criteria ***The learner should provide evidence of the following knowledge, skills and values in order to be declared competent:***
Perform musical works, process music data, synthesize and edit music timbres using **electronic musical instruments (EMI)**.	• Connection of two or more music devices correctly to communicate with each other, taking into account one's own safety, the safety of others and the environment. • Performance of a melodic, rhythmic and/or accompaniment part using electronic musical instruments individually or with peers in a group demonstrating creativity and originality. • Improvisation of a melody, rhythm and/or harmonic progression in a diversity of music genres alone or in a group. • Creation of various tunings taking into account western, indigenous and other cultural musical temperaments. • Creation, synthesis and editing of timbres following systematically the principles of acoustics and sound design. • Identification of strengths, weaknesses and gaps in performance, processing, synthesis and editing and provide possible strategies to improve further practice/performance.
Sequence **(MS)**, write **(MN)** and perform **(CBE)** musical works using MIDI related hardware and software.	• Composition of musical works embodying the principles of music composition, theory and harmony according to a logical process of data input, using MIDI hardware and software. The compositions will reflect a diversity of music styles and differing cultural genres. • Publish a printed music text using music notation software showing music notation design principles. • Performance of a diversity of musical arrangements, alone or in a group using music software in combination with other musical instruments. • Reflect critically on the process and product of sequencing, writing and performing identifying strengths, weaknesses and gaps and providing strategies for improving future actions.
Operate basic **computer information systems (CISLM)** to enable the integration of music and technology.	• Operation of basic information systems in terms of procedures such as the correct connection, installation, un-installation, exporting, importing, creating, editing and saving of data, use of Music Technology equipment, software and using standard hardware and software manual procedures. • Identification of possible problems in the operation and provide logical strategies to solve these problems heeding the safety of the individual and environment. • Explanation of the possibilities of correctly connecting different hardware devices to Music Technology devices and taking into account one's own safety and the safety of others.

continued overleaf

Table 5.3 (continued)

Exit level outcomes	Assessment criteria
	The learner should provide evidence of the following knowledge, skills and values in order to be declared competent:
Create and produce musical products by applying **multimedia** packaging techniques and **digital recording** principles and techniques **(MDM)**.	• Creation of multimedia presentation in a group demonstrating the relationship of music to the arts and other disciplines, and taking cognisance of the different cultural genres. • Explanation of the processes involved in multimedia design and provision of alternative approaches. • Production of digital audio recordings according to the set systematic procedures for digital signal processing, storage, compression and decompression of audio data. • Critical reflection on the procedures followed in multimedia packaging as well as digital audio production providing strategies for improving future processes and products.
Compose original music products, create and synthesize new instrumental timbres using computer-based hardware and software and fundamental programming skills **(CM)**.	• Composition of an original work using algorithmic composition software. • Creation, synthesis and editing of new patches/instrumental timbres using computer software. • Integration of new patches/instrumental timbres appropriately within an algorithmic composition environment to generate new compositions. • Evaluation of one's own composition and instrumental timbres and those of one's peers in terms of standard music composition criteria, principles of sound synthesis, alternate composition paths and setting new frontiers in the field.
Engineer and produce audio products using **audio technology (AT).**	• Engineer an audio performance within a "live" and studio context correctly in terms of signal flow, principles of acoustics, sound reproduction and enhancement and taking into account the safety of the audience and the environment. • Explanation of the logical procedures and processes followed in sound recording, mixing, processing and mastering. • Identification of possible problems associated with differing acoustic environments, audio equipment and providing appropriate alternative strategies for engineering of the performance. • Production of a complete audio product following the principles of tracking, overdubbing, mixing, processing and mastering and considering the safety of the performer(s) as well as recording engineer(s). • Reflect on the engineering and production process and products by identifying strengths, weaknesses and gaps and concisely providing strategies for improving future actions and products.

continued overleaf

Table 5.3 (continued)

Exit level outcomes	Assessment criteria
	The learner should provide evidence of the following knowledge, skills and values in order to be declared competent:
Collect, analyse, organize and critically evaluate information in Music Technology **(R)**.	• Definition of a problem in Music Technology clearly taking into consideration the issues of relevance, and differing global, national, regional or local needs. • Writing of a research proposal clearly indicating the purpose, hypothesis, critical questions, research methodology, data collection procedures and issues of validity and reliability of data with regard to the research. • Explanation of the different approaches in research in Music Technology and identification of the appropriate approach within a given context.

In order for a qualification to be awarded, the learner has to meet the requirements stipulated by the exit level outcomes. The assessment criteria provide the mechanism for testing whether the exit level outcomes have been met.

5.4.2 Critical cross-field outcomes

The Certificate in Music Technology addresses the following critical cross-field outcomes (CCO) that contribute towards lifelong learning and are embedded in the exit level outcomes and assessment criteria for the qualification:

CCO 1 Identify and solve problems relating to the connection and selection of Music Technology equipment and software.

CCO 2 Work effectively with others as a member of a team, group, organization, or community.

CCO 3 Organize and manage oneself and one's activities responsibly and effectively to maintain a logical working framework.

CCO 4 Collect, analyse, organize and critically evaluate information acquired towards achieving a specific task(s).

CCO 6 Use science and technology effectively and critically in the Music Technology environment, through the careful selection of electronic analogue/digital equipment and show responsibility toward the environment and others.

CCO 8 Contribute to the full development of the learner and the social and economic development of the society at large, by making individuals aware of the importance of:

i. Reflecting on and exploring a variety of strategies to learn more effectively;
ii. Participating as a responsible citizen in the life of local, national and global communities;
iii. Being culturally and aesthetically sensitive across a range of social contexts; and
iv. Exploring education and career opportunities, and developing entrepreneurial opportunities within the Music Technology industry.

Providers of education will be guided by these exit level outcomes and assessment criteria towards designing learning programmes. Although the content of these learning programmes will differ, all evaluation will be conducted against the exit level outcomes and assessment criteria. Once the exit level outcomes have been met, the qualification may be awarded.

With reference to the proposed curriculum development model presented in Figure 5.1 for SGBs in qualification design, all five phases have been completed, namely:

- Analysis (Chapter 3.2, 3.3, 3.4 and 3.5),
- Identifying roles and competencies (Chapter 5.1.2.8),
- Title matrix (Chapter 5.3.1),
- Outcomes and assessment criteria (Chapter 5.4.1), and
- Purpose (Chapter 5.3.1.3).

This concludes the design of a Certificate qualification in Music Technology at NQF Level 5 based on the transformation requirements[24] of South African education policy. The credit allocation (minimum of 72 credits) for the exit level outcomes will have to be established by the providers according to their learning programmes and weighting of the exit level outcomes.

5.5 Summary

The generation of new qualifications within the transformational OBE paradigm requires an arranged marriage between policy and the field of study. It is clear that national education policy does affect the pedagogy of the field of Music Technology. This is discernable from policy expectations that are met in the exit level outcomes, RPL, access to historically disadvantaged learners, and the qualification being relevant to the demands of industry, fulfilling the needs of lifelong learning.

As illustrated in this chapter, the concepts relating to contextual as well as epistemological issues formed the basis of the conceptual framework that impacted on the qualification design in Music Technology. The new qualification had to then be located within the curriculum development process. This was achieved through the three-tier holistic curriculum development model in which the qualification design phase formed the first component. Using the design down process by taking cognisance of the study field, as well as transformational concerns as highlighted by national policy, the Certificate qualification in Music Technology was designed.

[24] In order to establish the transformational OBE approach one would need to compare this to the traditional approach so as to notice the difference. This qualification is transformational in that it:

- Integrates the worlds of curriculum, work and professional practice (see purpose of the qualification Chapter 5.3.1.3) and highlights the issues of relevance.
- Prepares the leaner to be employable, and enriches social upliftment.
- Adopts the transformational OBE approach that is rooted in critical cross-field outcomes.
- Prepares the learner for lifelong learning.
- Takes into account indigenous knowledge systems.
- Recognizes prior learning (for music this is vital).
- Provides access to learners in the informal and non-formal sector.

The process followed in this study shifted the standards generation process from being a mere technicist exercise towards an approach that is grounded in critical discourse which eventually produced a theory, by means of the conceptual framework for the future design of qualifications. The qualification design process adopted in this chapter, therefore, can be applied to any field of study that is located within a similar policy context.

CHAPTER 6
CONCLUSIONS AND RECOMMENDATIONS

The final chapter provides the conclusions that have emerged, as a result of answering the research questions. Recommendations relating to these findings are suggested together with a final comment.

6.1 Findings

The answer to the main research question, which follows, has emerged as a result of the answers to the two research sub-questions below.

6.1.1 Main research question: How does the nature of the field of Music Technology and current South African education policy contribute to the development of a conceptual framework that informs the design of a qualification in Music Technology?

During this study, recurring concepts and issues that relate to the nature of the field of Music Technology and current South African education policy were identified. The concepts and issues were then grouped into themes that related to contextual issues (Chapter 5.1.1) and epistemological issues (Chapter 5.1.2).

Emerging from the nature of the field of Music Technology internationally, key roles and competencies were identified (Chapter 5.1.2.8). These roles and competencies were then applied to the national (South African) context, which is currently in a process of transformation, in order to guide curriculum designers, service providers and standards writers. The national context in turn helps map the career directions and underlying competencies that are necessary for institutions to use in the design of their learning programmes to meet national needs and standards.

The construction and nature of knowledge (epistemological issues) is vital to this process, in that all stakeholders need to make an input. Current South African education policy contributes by putting mechanisms in place, such as the NQF (Chapter 4.1.2) and a guiding education philosophy, such as transformational OBE (Chapter 4.2.3) that helps transform the pedagogy of the field in meeting the needs of the learner, community and society. The concepts and issues relating to both the field and current education policy formed the conceptual framework (Chapter 5.1). Since qualification design is located within the curriculum development process, the conceptual framework needed to be located within a holistic curriculum development model, which contributed towards the design of a certificate qualification in Music Technology (Chapter 5.3.1).

6.1.2 Sub-question 1: What is the current nature of Music Technology internationally and as an emerging field of study in South Africa?

The construction of knowledge in Music Technology is constantly changing to accommodate new innovations and technologies (Chapter 2.2) in the field. Since the field is dynamic, it broadens the existing boundaries of knowledge production by extending these boundaries in most traditional disciplines, like Music. Music Technology creates potential for the integration of indigenous knowledge (knowledge specific to the South African context, such as traditional African music and local contemporary commercial music), which has been marginalized in current Music Education programmes (Chapter 2.5).

Internationally, Music Technology operates primarily through application, in that problems are not set within a disciplinary framework (Chapter 3.3.2 and 3.7). Technological development, which has given birth to this field of study (Chapter 2.2), locates Music Technology within an interdisciplinary context. By being interdisciplinary in nature, Music Technology blurs the boundaries that existed between the traditional disciplines of Music and Technology. Knowledge production in Music Technology operates, therefore, within this context.

Owing to the vastness of the field of Music Technology (Chapter 2.1.2 and 2.2) the responses by music institutions in South Africa, with regard to their curriculum and the exit level outcomes of their Music Technology programmes, have differed (Chapter 3.4). There exists no national consensus with regard to exit level outcomes of South African Music Technology programmes. Such disparities in learning programme outcomes place institutional needs above national education expectations, and this is contrary to the requirements of national education policy.

Music Technology is a vast field that is dynamic in nature. Internationally as well as in South Africa, the interdisciplinary nature of knowledge production in Music Technology as a field of study extends the boundaries of traditional disciplines.

6.1.3 Sub-question 2: What are the implications of current South African education policy for transformational qualification design?

South African education policy requires qualifications to adopt an outcomes-based approach, that is, qualifications having learning outcomes as the measurable outputs of learning (Chapter 4.2). These learning outcomes should be underpinned by critical outcomes (Chapter 4.2.4) which describe the competencies in terms of knowledge, skills and values which learners will need in order to be lifelong learners (Chapter 4.2.4). Qualification outcomes therefore are the sum total of knowledge, skills and values. The critical outcomes help to shape the construction of a qualification.

The contribution to the full personal development of each learner and the social and economic development of the nation at large (Chapter 4.1) need to be addressed in qualifications through generating outcomes and unit standards that are rooted in the critical outcomes (Chapter 4.2.4). These critical outcomes express the intended results of education and training in a broad and macro sense as they are integrated with personal and national goals and aims. They are generic and cross-curricular and are linked to all areas of education, as well as all spheres of life.

Access to, mobility and progression within education, training and career paths need to be facilitated (Chapter 4.1). Access should be made available through allowing the recognition of prior learning that occurs within the non-formal and informal sectors of society so that learners will be allowed to progress within the education framework (Chapter 5.3.1.6). The measuring of competence against learning outcomes (Chapter 5.4.1), rather than exclusively disciplinary knowledge, allows for mobility and progression within the education system between institutions and changing career paths.

The most significant aspects of the qualification are the purpose, outcomes and assessment criteria. This study focussed on these aspects and illustrates how South African education policy informs the construction of a proposed Certificate in Music Technology.

The purpose of the qualification, according to education policy, should specify the target population by indicating for whom the qualification is intended. It should also describe the performance achievements to be measured, that is, the key competencies and the context in which the qualification can be used (Chapter 5.3.1.3). In the case of Music Technology, the learners that are targeted are provided with a basis for further learning and development in the field. The qualification needs to fulfil an economic need in the form of occupational relevance with a potential for employability, improved productivity and entrepreneurial skills (Chapter 5.3.1.3).

Learners should be assessed against these exit level outcomes, and will be allowed mobility and transferability (Chapter 4.1) of knowledge and skills to other institutions and career paths. In writing exit level outcomes, the broad competencies required in the field need to be identified. These broad competencies need to be combined with the critical outcomes to generate core competencies and applied performance for the level at which the qualification is located (the word "pegged" instead of "located" is used in SAQA literature). Using such an outcomes generation process, eleven exit level outcomes have been identified for the qualification "Certificate in Music Technology" pegged at NQF Level 5 (Chapter 5.3.1.4). In generating the exit level outcomes for the Certificate in Music Technology, the critical outcomes and objectives of the NQF with regard to integration of knowledge, skills and values were used.

The assessment criteria that need to be used in order to evaluate whether the learner achieves the intended outcomes are closely aligned to the learning outcomes. The assessment criteria identify the essential evidence the assessor requires of a learner to prove that an outcome has been achieved. They are used to discriminate competent performance from that which is not yet competent. Education policy requires both the process and the product to be assessed. These assessment criteria need to be transparent, so that learners are also empowered by being able to evaluate their own performances. The transparency of assessment criteria also places a high level of accountability (Chapter 4.1.2) on the part of the providers of education.

In order to enhance the quality of education and training (Chapter 4.1), qualifications need to be measured against similar qualifications internationally (Chapter 5.3.1.9). International comparability with regard to trends and developments within a field ensures that South African qualifications are at the forefront of education.

The task facing South African education is to accomplish redress of the past unfair discrimination in education, training and employment opportunities (Chapter 4.1) without compromising quality (Chapter 5.3.1.12). The issue of redress needs to be built into the purpose of the qualification (Chapter 5.3.1.3), access (Chapter 5.3.1.6), recognition of prior learning (Chapter 5.3.1.11) and the exit level outcomes (Chapter 5.4.1).

Risks to be guarded against when subscribing to education policy include:

- The adoption of a technicist approach to standards generation, which will result in the field of study acquiring a secondary status to policy;
- The vocationalizing of the field where everything is measured in terms of outcomes, resulting in work outputs taking precedence over the theoretical foundation of the field; and
- The emphasis being placed exclusively on the assessment of outcomes that could be measured, where reflexive competencies are undervalued, for example in knowledge based on creativity, as in the case of music composition, MIDI sequencing and graphic notation.

The challenge to educators and standards writers therefore lies in translating the transformational principles into institutional programmatic realities.

6.2 Recommendations

The recommendations of this study are divided into sub-sections. The first two recommendations pertain to the findings in Chapter 6.1 that deal with standards generation (Chapter 6.2.1) and the general writing of learning outcomes (Chapter 6.2.2). The third is a general recommendation, and finally recommendations follow relating to further research.

6.2.1 Standards generation

The immediate priority for standards generators in Music Technology is to construct complete qualifications at the levels of certificates, diplomas and first degrees. In constructing whole qualifications, standards generators need to standardize transformational learning outcomes and assessment criteria that will be underpinned by the objectives of the NQF at each exit level of a certificate, diploma and degree.

The next priority would be to generate elective standards at NQF Level 4 (Grade 12) that are necessary to provide access to the majority of adult learners in industry with formal qualifications. These standards will allow prior learning to be recognized (RPL) and provide a basis for new learners to access Music Technology at NQF Level 5.

Finally, a consensual approach that involves the democratic participation of all stakeholders is vital to the standards generating process. The advantage of such an approach, apart from being legitimate, is that the standards that are generated are relevant to all sectors of the population and will allow for flexibility in the whole qualification. This will enable post-secondary institutions to develop learning programmes that will allow the reality of the context and resources (both physical and human) to be taken into account.

6.2.2 Writing transformational learning outcomes

When writing outcomes, one has to examine the underlying assumptions that SGBs are making about the nature of knowledge. Knowledge as in the case of Music Technology, which has been highlighted in Chapter 5.1.2, is relative, whereas traditional disciplinary knowledge that is still the basis of instruction at most post-secondary institutions is viewed as absolute or fixed. Therefore the challenge in writing learning outcomes lies in shifting the traditional assumption that knowledge is absolute, towards knowledge as being relative and dynamic in context.

Central to the writing of transformational outcomes are the critical outcomes. These critical outcomes underpin the writing of learning outcomes and proposers of unit standards and qualifications will need to show how these are developed within each unit standard/ qualification. The critical outcomes are vital in standards generation in that they provide the broad, general knowledge, skills, attitudes and values necessary for a learner to cope with lifelong learning.

In standards generation (see Chapter 6.2.1) there must be an integration of theory and practice; whereby a balance between these aspects within the qualification will need to be maintained. Theory that is acquired will need to be applied in relevant contexts. Therefore the assessment criteria that support the learning outcomes should be reflexive and allow learners to evaluate themselves and the work of their peers, apart from being assessed by educators/moderators. This ensures accountability on the part of all educators and learners.

The standards generation process (see Chapter 6.2.1) should be focused on fostering lifelong learning, whereby learners at any stage in their learning career are allowed to pick up learning at the point where they left off. Learning does not stop when one finishes formal education; everyone should keep adding to their skills and knowledge throughout their lifetime. The recognition of prior learning is designed to encourage the formal acknowledgement of learning which took place previously.

The danger that exists with the writing of learning outcomes is that one could easily write job outputs (tasks) instead of learning outcomes. The focus needs to be on the actual learning and not the tasks.

The risk that education in South Africa faces is that education institutions could very easily “dress-up” existing education programmes in SAQA jargon and pass these programmes off as meeting the transformational policies of government. This results from the ambiguities (different perceptions about OBE) that surround policy.

SAQA policy could be simpler; as identified in this study three issues are vital in addressing the new education paradigm, namely the objectives of the NQF, transformational OBE and the critical outcomes.

6.2.3 Further research

Three recommendations for further research are proposed.

- Firstly, the Music Technology qualification designed in Chapter 5.3.1 needs to be field-tested. This is necessary in order to examine whether the stated purpose, exit level outcomes, assessment criteria and relevant content in the Certificate in Music Technology are achieved through its actual implementation in the institutional context.

- Secondly, the issue of knowledge production in the standards generation process need to be examined for the sake of legitimacy, to establish which voices dominate in the SGB process, and which voices have a valid claim towards knowledge production.
- Finally, the development of a theory for standards generation in the South African context through a qualitative study of the process of standards writing in different fields is needed. This allows for future qualifications to be grounded in education theory and discourse rather than being a technicist response to policy requirements.

6.3 Conclusions

With regard to the main research question and three sub-questions posed at the outset of this study, the following conclusions are drawn:

- Music Technology is a dynamic, interdisciplinary body of knowledge that is socially constructed and market driven. Music Technology is therefore dependent on various contexts (social, economic, cultural, institutional) and conforms to Mode 2 knowledge production (see Chapter 3.2.8), which is largely application-based.
- Current education policy supports technology-based instruction, which positions Music Technology ideally despite the fact that arts-based disciplines in the upper education sector (above Grade 9) are being marginalized. Besides, the nature of Music Technology allows the field of study to spearhead the transformation process in education because it is current, relevant, provides access to all learners interested in this field, is outcomes-driven and is rooted in life roles and lifelong learning.
- This study has proved, in the case of the third research sub-question (see Chapter 6.1.3), that it is possible to let policy issues correspond with an emerging field of study. However, certain compromises need to be made (Chapter 5.1). This study did not simply accept education policy as being merely symbolic

statements, encapsulated in national policy documents (Chapters 1.6.5, 4.1 and 4.2), but strived towards realistic implementation challenges in the mainstream of education. In doing so, this study provides a theory that could be used for qualification design by education practitioners and standards writers, based not only on education policy documentation (Chapter 4.1 and 4.2), but also on critical discourse (Chapters 2, 3, 5.1 and 5.2).

Finally, the challenges facing Music Technology pedagogy would be to:

- Implement this Certificate in Music Technology;
- Design a learning programme based on the exit level outcomes of this qualification; and
- Implement the learning programme taking into account the pedagogical issues at the provider and learner level within the curriculum development process.

On a more general level, prior to meeting the above-mentioned challenges, the institutional and organizational changes that are required include:

- A restructuring of present systems;
- Aligning systems to yield outcomes;
- Focus on quality management and accountability;
- Training and support; capacity building of staff;
- The development of a research culture; and
- Finally, a critical discourse in standards generation.

6.4 Closing comment

As a supporter of education transformation within the South African context, a researcher, a believer in technology-based education and a musician, I would like to state that it is important to remember that technology is not an end in itself; it is a tool through which one can transmit one's ideas, search for information, gain access to the world's information resources, and improve scholarship. Technology itself is not the end. The end lies in good scholarship. In the same way the network itself is not the end, but a network of learners is. Technology should enhance the opportunity for greater scholarship and community.

APPENDIX A:

Questionnaire: Music Technology

Questionnaire – Music Technology

Telephonically administered by the researcher to all post-secondary institutions offering music in South Africa – 11 June 2001

1. What type of institution are you attached to?
   a. University
   b. Technikon
   c. College
   d. Community college
   e. Other, specify ______________________________

2. What is the total enrolment at your post-secondary institution majoring in music?
   ____

3. Do you offer Music Technology as a field of study?
   a. Yes
   b. No

4. If yes, indicate to what extent
   a. Course (1 semester course/module)
   b. Course (2 semester course)
   c. Certificate
   d. Diploma
   e. Degree
   f. Major in Music Technology
   g. Other, specify___________________________________

5. When was Music Technology introduced as a component/programme at your institution? ____years ago.

6. What is your current enrolment for Music Technology? ______students.

7. How many undergraduate____and postgraduate_______ students do you have?

8. How many hours of instruction do they receive per week?_____________

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9. What core components of Music Technology do you offer?
    a. Electronic Musical Instruments
    b. Midi Sequencing
    c. Music Notation
    d. Computer-based training
    e. Multimedia and Digitized media
    f. Internet and Telecommunications
    g. Computers, Information systems and Lab management
    h. Computer Music
    i. Audio Technology
    j. Research
    k. Other, please specify___________________________________

10. What background and training does the instructor have in Music Technology?
    a. Degree (Bachelor's, Honours, Master's or Doctrate)
    b. Short course
    c. Certificate
    f. Self study
    e. None
    f. Other, specify _____________

11. Is your programme currently in line with Outcomes-Based Educational criteria?
    a. Yes
    b. No
    c. Unsure

12. If yes, which of the following:
    a. Traditional
    b. Transitional
    c. Transformational
    d. Unsure

13. What would you say is the purpose of your programme?
    a. Educational (for teaching purposes)
    b. Industry requirement
    c. Offer an elective
    d. Other, specify__________________________

14. Have you had non-music students taking your programme at any stage?
    a. Yes
    b. No

15. Do you feel that there is a need for national standards in Music Technology?
    a. Yes
    b. No

APPENDIX B:

Follow-up questionnaire

Follow-up questionnaire

Telephonic interviews were conducted with a sub-sample of six educators engaged in teaching Music Technology at post-secondary institutions in South Africa. Interviews were conducted on 30 June 2001. The following ten questions were asked of all six educators:

1. What are your perceptions of Music Technology in South Africa?

2. How does your Music Technology programme fit into the overall music curricula at your institution?

3. Is your Music Technology programme accessible to all students, music students, or students specializing in a component of music?

4. What is the purpose of your Music Technology programme?

5. How did you construct the curriculum for your Music Technology programme?

6. Why did you develop a Music Technology programme at your institution?

7. Did you use international Music Technology programmes as a model in designing your programme?

8. How is your Music Technology programme evaluated? (External, internal or international moderation.)

9. Does your programme have any mechanism for evaluating recognition of prior learning?

10. Do you see national standards in Music Technology as having a positive or negative impact on your programme?

In all cases educators who articulated vague or ambiguous responses were asked to elaborate on their answers.

C Devroop June 2001

APPENDIX C:

The South African Music Industry Directory: Category list

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

2001 THE SOUTH AFRICAN MUSIC INDUSTRY DIRECTORY

A co-project of MUSIC AFRICA · MIDI Music Industry Development Initiative

CATEGORY LIST

Please select your applicable category/ies and enter code/s into SECTION 2 on entry form

Education and Training

A1. Adjudicator
A2. Clinics
A3. Colleges
A4. Educators
A5. In-Service Training for Classical Music Teachers
A6. International Examination Board (Music)
A7. Lecturers
A8. Music Schools
A9. School Drumming
A10. School Music and Instruments
A11. Teachers
A12. Technikons
A13. Universities
A14. Workshops

Financial/Legal Services

B1. Financial Services
B2. Legal Representatives and Services

Live Events

C1. Booking Agents
C2. Catering and Bar Services
C3. Cultural Activities
C4. Event Production and Services
C5. Promoters
C6. Security
C7. Festival Co-ordinators
C8. Festivals and Exhibitions
C9. MCs
C10. Music Industry Events
C11. Profiles and Personalities
C12. Ticketing
C13. Tour Managers and Services
C14. Transport and Travel
C15. Venue Booking Service
C16. Venues

Management/Marketing

D1. Advertising Agencies
D2. Artist Management
D3. Banners
D4. Corporate and Promotional Clothing
D5. Design- Posters, CDs, Cassettes
D6. Merchandising
D7. Music Licensing
D8. Music Sponsorship Consultancy
D9. Posters- Distribution
D10. Printing- Posters, CDs, Cassettes
D11. Publicity and Promotion

Media

E1. Radio Stations
E2. Interactive Media
E3. Internet/Online Services
E4. Media Monitoring
E5. National Radio Stations
E6. Newspapers
E7. Photographers
E8. Publications
E9. Radio Broadcast Consultancies
E10. Television Stations

Music Publishers and Songwriters

F1. Commercial Music Publishers
F2. Composers
F3. Jingles
F4. Library Music Publishers
F5. Lyricists
F6. Music for Films, TV, and Corporates
F7. Production Music/Mood Music/Music Library
F8. Publishers
F9. Sheet Music Publishers
F10. Songwriters

Public/Private Industry Organisations

G1. Arts Development
G2. Bargaining Councils
G3. Collection Societies (music rights)
G4. Consultants and Special Services
G5. Funding Organisations
G6. Government: National
G7. Government: Provincial
G8. Information
G9. Music Archives
G10. Researcher
G11. Resources

Record Companies

H1. Manufacturers- CD/Cassette/Record
H2. Music Distributors
H3. Music Wholesalers
H4. Record Companies
H5. Record Labels

Retail

J1. Audio Visual- Sales
J2. Audio- Sales
J3. Case Suppliers
J4. Gifts and Novelties for Music Lovers
J5. Internet Music Sites (please indicate genre)
J6. Lighting- Sales
J7. Musical Instruments- Acoustic
J8. Musical Instruments- African Drums
J9. Musical Instruments- Electric Guitars and Accessories
J10. Musical Instruments- Electronic
J11. Musical Instruments- Electronic Keyboards and Accessories
J12. Musical Instruments- General
J13. Musical Instruments- Pianos and Organs
J14. Paddi Bags- Protective Covers
J15. Sheet Music

Studio/Production

K1. Arranger
K2. Audio Duplications
K3. Audio Mastering
K4. Audio Suppliers- Tape
K5. CD-R Burning
K6. Demo Studios
K7. Mastering Engineer
K8. Mastering Studios
K9. MIDI Software
K10. Mobile Studios
K11. Mobile Studios Equipment
K12. Music Video- Directors
K13. Music Video- Post Production Facilities
K14. Music Video- Producers
K15. Music Video- Production Facilities
K16. Music Producers
K17. Programmers
K18. Recording Studio Equipment
K19. Recording Studios
K20. Rehearsal Facilities
K21. Samplers
K22. Studio Design and Acoustics
K23. Studio Engineers
K24. Synths/Sound Modification/ Accessories
K25. Voice Overs

Technical Services

L1. Audio Visual- Hire
L2. Audio Design and Accoustics
L3. Audio- Hire
L4. Backline Equipment
L5. Backline Technician
L6. Cable Accessories
L7. Cable Design and Manufacture
L8. Crew/Crewing
L9. Disco/Mobile Disco Equipment- Hire
L10. Electronic Equipment- Repairs
L11. Generator Hire
L12. Karaoke- Hire
L13. Lighting- Design
L14. Lighting Engineer
L15. Lighting- Hire
L16. Microphones and Cabling
L17. Musical Instruments- Hire
L18. Musical Instruments- Manufacturers and Makers
L19. Musical Instruments- Repairs
L20. Piano Tuning
L21. Public Address System Design Consultants
L22. Pyrotechnics
L23. Radio Station Equipment
L24. Rigging
L25. Rigging- Hire
L26. Searchlights
L27. Set Building
L28. Set Design
L29. Sound Engineers- Live
L30. Special Effects
L31. Staging- Design
L32. Staging- Hire
L33. Technicians

APPENDIX D:

List of concepts emerging from this study

List of concepts emerging from this study

	Trends in Music Technology	National Education Policy
Contextual issues	• Global • National • Institutional • Music Technology a field of study	• Global trends • Music Technology as an emerging field of study • Democratization (systemic change, NQF, SAQA, Policy documents)
Epistemological issues	• Knowledge is disciplinary • Traditional OBE • Transitional OBE • Technology as a tool • Technology as enabler • Nature of knowledge • Nature of knowledge production • National relevance • Duplication - standardization • Need for transferability • Need for consultation • Access only to privileged institutions but to all learners • Little mobility • Institutional accountability • Curriculum reform • Transformation of current educational practices • Mode 2 - shift • Inter-disciplinary study - Music Technology • Key roles and competencies • Market related • No consensus with standards	• Knowledge a social construct • Transformational OBE and critical cross-fields • Technology prominence • Relevance • Minimal duplication • Transferability • Consultation • Access • Innovation • Broad focus • Mobility • Accountability • Curriculum impact – global, socio-economic, political and philosophical • Mode 1 and 2 encouraged • Promotes interdisciplinary study • Applied competence • Foundational, practical and reflexive competencies • Cognisance of worlds of work and professional practice • Learning outcomes • Exit level outcomes, unit standards • Integration between theory and practice • National standards and NQF level descriptors

REFERENCE LIST

ADAMS, R.T. 1992. *Electronic music composition for beginners*. Dubuque: Brown and Benchmark.

ALBRIGHT, M.J. & GRAF, D.L. N.d. Teaching in the information age: the role of educational technology. *New Directions for Teaching and Learning*, 51: 7-16.

ANAND, P.G. & ZAIMI, A. 2000. Computer-managed instruction: Evaluation of alternative methods of technology integration in higher education. *Educational Technology and Society*, 3(1) [online]. Available from: http://ifets.ieee.org/periodical/vol1 2000/anand.html [Accessed 20 February 2001].

ASMAL, K. 2000a. *Music in Schools Symposium*. Address by the Minister of Education to music educators. Airport Holiday Inn, Johannesburg. 19-20 May 2000.

ASMAL, K. 2000b. Fads come and go, but OBE is here to stay. *Sunday Times*, 2 July 2000 [online]. Available from: http://www.suntimes.co.za/2000/07/02/insignt/in08.htm [Accessed 24 July 2000].

ASMAL, K. 2000c. Preface. *Higher education lecture series 2000*. Pretoria: Ministry of Education.

ANDERTON, C. 1988. 20 great achievements in 20 years of musical electronics 1968-1988. *Electronic Musician,* 4(7): 28-30.

AUSTRALIAN CAPITAL TERRITORY: DEPARTMENT OF EDUCATION AND TRAINING. 2001. *Technology Curriculum Framework* [online]. Available from: http://www.decs.act.gov.au/publicat/pdf/tech.pdf (page 3) [Accessed 20 February 2001].

BAGGI, D.L. 1991. Computer Generated Music. *IEEE Computer,* 24(7): 6-8.

BAGGI, D.L. 1998. *The role of computer technology in music and musicology* [online]. Available from: http://www.lim.dsi.unimi.it/eventi/ctama/baggi.htm [Accessed 1 October 2001].

BARNARD, J. 1999. Computers in FE biology – a study of how teacher's classroom practice can be affected by different types of software. *Educational Technology and Society,* 2(4) [online]. Available from: http://ifets.ieee.org/periodical/vol 4 99/jane barnard.html [Accessed 20 February 2001].

BARNICLE, S. 1992. *Intermediate course in electronic music and sound technology*. Simsbury, CT: Simsbury High School.

BASH, L. 1990. Visions warning: you may be replaced. *The Music and Computer Educator*, 1(5): 7-8.

BENNETT, A. 2001. *Unit standards in Music: guidelines for non-specialist teachers in training in Botswana and the SADC region.* Unpublished DMus thesis, University of Pretoria, Pretoria.

BERR, B. 2000. MTNA and Music Technology. *American Music Teacher*, 49: 28-29.

BERNSTEIN, B. 1971. On the classification and framing of educational knowledge. In M.F.D. Young (ed.), *Knowledge and control: new directions for the sociology of education.* London: Collier-Macmillan.

BERZ, W.L. 1994. Multimedia for music teachers. *Paper presented at the New York State School Music Convention.* Kiamesha Lake, New York.

BERZ, W.L. & BOWMAN, J. 1984. *Applications on instructional technology in music education.* Reston, VA: MENC.

BERZ, W.L. & BOWMAN, J. 1995. An historical perspective on research cycles in music computer-based technology. *Bulletin of the Council for Research in Music education*, 126: 21.

BISSELL, P.M. 1998. Tune in to technology. *Music Educators Journal*, 85(2): 36-40.

BLACK, P. & ATKIN, J.M. (eds.) 1996. *Changing the subject. Innovations in science, mathematics and technology education.* Organisation for Economic Co-operation & Development (OEOD). London/Paris: Routledge.

BOODY, C.G. 1990. *Tips: technology for music educators.* Reston, VA: Music Educators National Conference.

BOODY, C.G. 1992. New tools for music education. *Music Educators Journal*, 79(3): 26-29.

BOSMAN, R. 2001. *Unit standards for Aerophones in a Postmodern South Africa.* Unpublished DMus thesis, University of Pretoria, Pretoria.

BRASSWELL, R. 1994. The top five reasons not to use multimedia. *Computers in the Schools*, 10(3-4): 281-284.

BRAUT, C. 1994. *The musician's guide to Midi.* California: Sybex.

BROPHY, T.S. 1996. Building music literacy with guided composition. *Music Educators Journal*, 83(3): 15-18.

BROWN, A.R. 1997a. Changing technologies, changing minds: taking account of music technologies in the curriculum. *Exploding Art Online Journal*, 1(2) [online]. Available from: http://www.explodingart.com/XartJournal/XAOJ32.htm [Accessed 3 April 2001].

BROWN, A.R. 1997b. The internet and music research in education. *Exploding Art Online Journal*, 2(1) [online]. Available from: http://www.explodingart.com/XartJournal/XAOJ32.htm [Accessed 13 April 2001].

BROWN, A.R. 1997c. Histories and directions of music technology. *Exploding Art Online Journal*, 3(2) [online]. Available from: http://www.explodingart.com/XartJournal/XAOJ32.htm [Accessed 3 April 2001].

BROWN, A.R. 1998. An introduction to music analysis with computer. *Exploding Art Online Journal*, 4(1) [online]. Available from: http://www.explodingart.com/XartJournal/XAOJ32.htm [Accessed 3 April 2001].

BROWN, A.R. 1999a. *Where is music: beyond representation with music technology* [online]. Available from: http://www.academy.qut.edu.au/music/browna/ABPub.htm [Accessed 3 April 2001].

BROWN, A.R. 1999b. *Tools and outcomes: computer music systems and music directions* [online]. Proceedings of the ACME conference held in Wellington, New Zealand. 7 July 1999. Available from: http://www.academy.qut.edu.au/music/browna/Documents/ACMA99.html [Accessed 3 April 2001]

BROWN, A.R. 2000. The computer or digital appliance? *Exploding Art Online Journal*, 6(2) [online]. Available from: http://www.academy.qut.edu.au/music/browna/ABPub.htm [Accessed 3 April 2001].

BROWN, S. & McINTYRE, D. 1993. *Making sense of teaching.* Buckingham: Open University.

BRUN, H. 1971. *Über Musik und zum Computer.* Karlsruhe: G. Braun.

BUDIN, H.R. 1981. Technology and the teacher's role. *Computers in the Schools*, 8(1/2/3): 15-26.

CAGNÉ, R.M. 1985. *The conditions of learning and the theory of instruction.* 4th edition. New York: CBS Publishing.

CAHILL, T. 1906. The generation and distribution of music by means of alternators. *Electrical World*, 67: 519.

CAMP, V. 1997. *Making music on your PC.* Miami, FL: Abacus.

CENTRE FOR LEARNING ASSESSMENT (South Africa). N.d. *Postgraduate certificate – tertiary level teaching. Module: the systems approach to curriculum development* [online]. Available from: http://www.rgu.ac.uk/subj/eds/pgcert/systems/sys1.htm Accessed 3 April 2001].

CHADABE, J. 1997. *Electric Sound: The Past and Promise of Electronic Music.* Upper Saddle River, NJ: Prentice-Hall.

CHADABE, J. 2000. The Electronic Century. Parts 1-4. *Electronic Musician* [online]. Available from: http://industryclick.com//magazinearticle.asp? [Accessed 16 June 2001].

CHUNG, B. 2000. The ones that got away. Cited in: Music teaching in the new Millennium. *American Music Teacher*, 49(6): 25-26.

COMBS, A.W. 1982. A perceptual view of the adequate personality. In *Perceiving, Behaving, Becoming*. Yearbook. Alexandria: Association for Supervision and Curriculum Development.

COMMITTEE FOR DEVELOPMENT WORK ON THE NQF (South Africa). 1996. *Lifelong learning through a National Qualification Framework*. Report of the Ministerial Committee for development work on the NQF. Discussion document. Pretoria: Department of Education.

CONSTAS, M.A. 1998. The changing nature of educational research and a critique of postmodernism. *Educational Researcher*, 27(2): 26-33.

COTEP (COMMITTEE ON TEACHER EDUCATION POLICY). 1996. *Norms and standards and governance structures for teacher education*. Pretoria: Department of Education.

CURTIN, D.P., FOLEY, K., SEN, K. & MORIN, C. 1998. *Information Technology. The breaking wave.* Singapore: McGraw-Hill.

DE BONO, E. 1990. *Lateral thinking*. London: Penguin Books.

DE BONO, E. 2000. *New thinking for the new millennium*. London: Penguin Books.

DEAL, J.J. & TAYLOR, J.A. 1997. Technology standards for college music degrees. *Music Educators Journal*, 84(1): 17-23.

DEVROOP, C. 2001a. *The Status of Music Technology in South Africa.* Telephonic questionnaires administered to pedagogues teaching Music Technology at all South African post-secondary institutions. 11 June 2001.

DEVROOP, C. 2001b. *The Status of Music Technology in South Africa.* Telephonic interviews undertaken with a sub-sample of six pedagogues teaching Music Technology at South African post-secondary institutions. 30 June 2001.

DEWEY, J. 1938. *Experience and education.* New York: Collier Books.

DISLEY, A. N.d. *Music technology, past, present and future: a personal perspective* [online]. Available from: http://www-users.york.ac.uk/~acd114/mustech/mt.htm [Accessed 27 July 2001].

DIXON, E. 1998. *Developing of a learning programme for the learning area Technology at Colleges of Education*. Unpublished PhD thesis, University of Pretoria, Pretoria.

DoE (DEPARTMENT OF EDUCATION - South Africa). 1996. *Structures for the development of national policy regarding curriculum and related issues*. Report from the Consultative forum on Curriculum, Pretoria.

DoE (DEPARTMENT OF EDUCATION - South Africa). 1997. *Curriculum 2005. Lifelong learning for the 2lst century* [online]. Available from: http://www.polity.org.za/govdocs/misc/curr2005.html [Accessed 12 February 2000].

DOOLEY, L.M., METCALF, T. & MARTINEZ, A. 1999. A study of the adoption of computer technology by teachers. *Educational Technology and Society,* 2(4) [online]. Available from: http://ifets.ieee.org/periodical/vol_4_99/ldooley.html [Accessed 20 February 2001].

DRUCKER, P.F. 1994. The Age of Social Transformation. *Atlantic Monthly* [online]. November 1994. Available from: http://www.theatlantic.com/politics/ecbig/soctrans.htm. [Accessed 16 November 2001]

EDUCATIONAL & STAFF DEVELOPMENT SECTION (Great Britain). 2001. *Tertiary level teaching: systems approach to curriculum development* [online]. Centre for Learning & Assessment. Available from: http://www.rgu.ac.uk/subj/eds/pgcert/systems/sys1.htm. [Accessed 9 February 2001].

EGAN, K. 1978. What is curriculum? *Curriculum Inquiry*, 8(1): 65-72.

EICHE, J.F. 1987. *What's a synthesizer?* Milwaukee, WI: Hal Leonard.

ELECTRONIC MUSICAL INSTRUMENT. 1998. *120 Years of Electronic Music* [online]. Available from: http://www.obsolete.com/120_years [Accessed 27 July 2001].

ELLIOT, D.J. 1995. *Music matters: a new philosophy of music education.* New York: Oxford University.

ENCYCLOPEDIA BRITANNICA 98. 1998. [CDROM] New York, Microsoft Corp.

ERICKSON, L.H. 1998. *Concept-based curriculum and instruction: teaching beyond the facts.* Thousand Oaks, California: Corwin Press.

EVEREST, F.A. 1994. *The master handbook of acoustics.* 3rd edition. Singapore: McGraw Hill.

FÁBREGAS, E. 1992. *Designing and implementing an electronic music program in a community music school in New York City.* Unpublished DEd thesis, Teachers College, Columbia University, New York.

FARINA, A. 1998. Acoustic characteristics of virtual musical instruments. *Journal of New Music Research*, 27(4): 359-79.

FAULK, H.R. 1978. *A curriculum guide designed to teach a basic knowledge of electronic music to undergraduate music education students.* Unpublished DA thesis, Carnegie-Mellon University, Pittsburgh, Pennsylvania.

FIELDS, K. 2001. *Computer Music.* Personal email (ken@create.ucsb.edu) 13 August 2001 to C. Devroop (cdevroop@postinio.up.ac.za).

GIBBONS, M., LIMOGES, C., NOWOTNY, H., SCHWARTZMAN, S., SCOTT, P. & TROW, M. 1997. *The new production of knowledge.* London: The Society for Research into Higher Education and Open University Press.

GIBSON, B. 1996. *The audio pro home recording course*. Emeryville, CA: MixBooks.

GLIDDEN, R. 1997. *Modem technology in the American university* [online]. Available from: http://www.ohiou.edu/president/reports/Berlinlect.html [Accessed 20 July 2001].

GOVE, P.B. (ed.) 1976. *Webster's third new international dictionary of the English language unabridged*. Springfield: G&C Merriam.

GREEN PAPER (South Africa): Department of Arts, Culture, Science and Technology. N.d. *Preparing for the 21st century* [online]. Available from: http://www.sn.apc.org/sangonet/technology/stgreen/toc.htm [Accessed 3 April 2001].

GRIJALVA, F.J. 1986. *Factors influencing computer use by music educators in California independent elementary and secondary schools.* Unpublished DEd thesis, University of San Francisco, California.

GROVÉ, J.P. 2001. *Music Education Unit Standards for Southern Africa: A Model and its application in a General Music Appraisal Programme.* Unpublished DMus thesis, University of Pretoria, Pretoria.

HALL, G.E., WALLACE, R.C. & DOSSETT, W.A. 1973. A developmental conceptualization of the adoption process within educational institutions. *Research and Development Center for Teacher Education.* Austin, TX: University of Texas.

HALL, R.A. 1978. On knowing and knowing how to. In R.A. Hall and N. Smith (eds.), *History of technology*. Third annual volume. London: Mansell.

HAUPTFLEISCH, S.J. 1993. *Effective music education in South Africa: main report.* Pretoria: HSRC.

HAUPTFLEISCH, S.J. 1997. *Transforming South African music education: a systems view*. Unpublished DMus thesis, University of Pretoria, Pretoria.

HEIDEGGER, M. 1978. The end of philosophy and the task of thinking. In D.F. Krell (ed.), *Martin Heidegger: basic writings.* London: Routledge.

HERMANSON, C. 1994. Technology assisted teaching. Is it getting results? *American Music Teacher*, 43(6): 20-23.

HINDLE, B. 1966. *Technology in early America*. Chapel Hill, NC: University of North Carolina Press.

HOEK, A. 2001. *South African unit standards for a General Music Appraisal Programme at NQF Levels 2-4, with special reference to Ensemble specialization for available instruments.* Unpublished DMus thesis, University of Pretoria, Pretoria.

HOLMAN, L. 2000. Teacher morale has improved. *Pretoria News,* 22 August 2000 in Letters to the Editor.

HOOKER, M. 2001. *The Transformation of higher education* [online]. Available from: http://horizon.unc.edu/projects/seminars/Hooker.asp [Accessed 25 July 2001].

HSRC (HUMAN SCIENCES RESEARCH COUNCIL - South Africa). 1981. *Education provision in the RSA.* Report of the main committee of the investigation of the HSRC Investigation into Education. Pretoria: HSRC.

HUNT, A. & KIRK, R. 1999. *Digital sound processing for music and multimedia.* Oxford: Focal Press.

IEEE, CS. N.d. *Technical Committee on Computer Generated Music of the Society of the Institute of Electric and Electronic Engineers (IEEE CS TC on CGM)* [online]. Available from: http://www.computer.org/tab/cgm/tc_cgm.htm [Accessed 5 October 2001].

ILLICH, I. 1973. *Tools for Conviviality.* New York: Harper and Row.

JAESCHKE III, F.G. 1996. *Creating music using electronic music technology: curriculum materials and strategies for educators.* Unpublished DEd thesis, Teachers College, Columbia University, New York.

JOHNSON, D. laMont. 1997. Integrating technology in the classroom: the time has come. *Computers in the Schools,* 13(1-2): 1-5.

JONES INTERNATIONAL. 1999. *Audio recording: History and development* [online]. Available from: http://www.digitalcentury.com/encyclo/update/audiohd.html [Accessed 4 August 2001].

KACHELHOFFER, P.M. 1987. *Kurrikulumontwikkeling in geneeskundige opleiding.* Unpublished PhD thesis, University of Pretoria, Pretoria.

KAHN, M.J. & VOLMINK, J.D. 1997. *A position paper on technology education in South Africa.* Commissioned by the Development Bank of South Africa. Houghton: Edunet Consultants.

KANPOL, B. 1995. Outcomes-based education and democratic commitment: hopes and possibilities. *Educational Policy,* 9(4): 359-374.

KEANE. D. 1980. *Tape music composition.* London: Dent.

KILLEN, R. 1998. *Outcomes-based education: Some issues to consider in the South African context.* Paper presented at Vista University and ML Sultan Technikon as part of the AUSAID funded Australia-South Africa Institutional Links Project No. 2-007. Durban.

KRAAK, A. 1998. *Competing education and training policies - a 'systematic' versus 'unit standards' approach.* Pretoria: HSRC Publishers.

LANSKY, P. 2001. *Music Technology Perspective.* Personal email (paul@princeton.edu) 14 August 2001 to C. Devroop (cdevroop@postino.up.ac.za).

LEHRMAN, P.D. 1996. *Getting into digital recording.* Milwaukee, WI: Hal Leonard.

LEWY, A. 1991. *National and school based development.* Unesco. Paris: Gauthier-Villars.

LLOYD, W. & TERRY, P. 1994. *Music in sequence - a complete guide to Midi sequencing.* London: Musonix Publishing.

LUBISI, C., PARKER, B. & WEDEKIND, V. 1998. *Understanding outcomes-based education: teaching and assessment in South Africa.* Cape Town: South African Institute for Distance Education and Oxford University Press.

LUCIA, C.E. (ed.) 1986. *Music education in contemporary South Africa: proceedings of the first national music educators' conference.* Durban: University of Natal.

MACHOVER, W. 2000. The challenges of creating music in the twenty-first century. *American Music Teacher*, 49(6): 48-50.

MAJOR, A. 2000. Curriculum assessment. *Music Teacher*, 79(1): 17-19.

MANDELA, N. 1999. Message from the President: Nelson Mandela. *Education Africa Forum.* 3rd edition. Pinegowrie, South Africa: Education Africa.

MARIS, B.E. 2000. Music teaching in the new millennium. *American Music Teacher*, 49(6): 21.

MASH, D.S. 1996. *Computers and the music educator.* New York: SoundTree.

MASH, D.S. 1998a. *Musicians and the internet.* Miami, FL: Warner Brothers Publication.

MASH, D.S. 1998b. *Musicians and multimedia.* Miami, FL: Warner Brothers Publication.

MASH, D.S. 1999. *Historical development of music technology.* Personal email (dmash@berklee.edu) 20 February 1999 to C. Devroop (cdevroop@postino.up.ac.za).

MAURICIO, D. & ADAMS, S. 1994. *Fundamentals of Music Technology - a course of study for secondary schools.* California: Consultant Help software.

McDONALD, S. 1983. Technology beyond machines. In S. McDonald, *The trouble with technology.* London: Frances Pinter.

McGINN, R.E. 1978. What is technology? *Research in Philosophy and Technology,* 1: 179-197.

McLAREN, P. & HAMMER, R. 1989. Critical pedagogy and the postmodern challenge. *Educational Foundations,* Fall (Autumn): 29-60.

MENC (MUSIC EDUCATORS NATIONAL CONFERENCE). 1972. *Guidelines in music education: supportive requirements.* Reston, VA: MENC.

MENC (MUSIC EDUCATORS NATIONAL CONFERENCE). 1986. *The school music program: description and standards.* Reston, VA: MENC.

MENC (MUSIC EDUCATORS NATIONAL CONFERENCE). 1994a. *Opportunity-to-learn standards for music instruction grades PreK-12* [online]. Available from: http://www.menc.org/publication/books/standards.htm [Accessed 10 April 2001].

MENC (MUSIC EDUCATORS NATIONAL CONFERENCE). 1994b. *The school music program: a new vision.* Reston, VA: MENC.

MENC (MUSIC EDUCATORS NATIONAL CONFERENCE). 2001. Careers in music, [online]. Available from: http://www.menc.org/teachers/careers.htm [Accessed 20 May 2001].

MERRIAM-WEBSTER. 2001. *Your Dictionary.com* [online]. Available from: http://www.yourdictionary.com/cgi-bion/mw.cgi [Accessed 20 June 2001].

MIRANDA, E.R. 1998. *Computer sound for the electronic musician.* Oxford: Focal Press.

MONARE, M. 1999. Asmal: education system not ready for next century. *Pretoria News,* 22 November 1999.

MOORE, B. 1992. Future technology working for education. *Music Educators Journal,* 79(3): 30-32.

MORITA, A. 1986. *Made in Japan: Akio Morita and Sony / Akio Morita with Edwin M. Reingold and Mitsuko Shimomura.* New York: Dutton.

MURO, D. 1998. *Sequencing basics.* Miami: Warner Brothers Publication.

MISH, F.C. & MERRIAM-WEBSTER. 1995. *New collegiate dictionary.* Springfield, MA: Merriam-Webster.

NACCCE (NATIONAL ADVISORY COMMITTEE ON CREATIVE AND CULTURAL EDUCATION - UK). 1999. *All our futures: creativity, culture and education.* Suffolk, UK: DfEE Publication.

NICHOLL, M. 1993. *Introduction to music/synthesis.* Miami: CPP/Belwin.

OLIVA, P.F. 1992. *Developing the curriculum.* 3rd edition. New York: Harper-Collins.

OLIVIER, C. N.d. *Let's educate, train and learn outcomes-based.* Clubview: Design Book.

OLIVIER, C. 1997. *Outcomes-based education and training programmes*. Ifafi, South Africa: OBET Pro.

OLSEN, G.J. 1997. *Getting started in multimedia design*. Cincinnati, OH: North Light Books.

ORAM, D. 1972. *An individual note*. London: Galliard.

ORNSTEIN, A.C. & HUNKINS, F. 1998. *Curriculum: foundations, principles and theory.* 3rd edition. Needham Heights: Allyn & Bacon.

PAPERT, S. 1987. Information Technology and education: Computer criticism vs. technocentric thinking. *Educational Researcher*, 16(1): 22-30.

PARAYIL, G. 1991. Technological knowledge and technological change. *Technology and Society,* 13(2): 237-249.

PERSONAL COMMUNICATION. 2001. *Structure of study for qualification design for Music Technology and questionnaire design.* Personal email (frolichh@unt.edu; cheskyk@unt.edu and devroopk@unt.edu) 14-17 August 2001 to C. Devroop (cdevroop@postino.up.ac.za).

PRATT, D. 1994. *Curriculum planning: a handbook for professionals.* Florida: Harcourt Brace College Publishers.

PR NEWSWIRE ASSOCIATION. 1992. Survey published in the *Financial News*, August 1992. New York: United Business Media.

RAMALHO, H. 1998. An artificially intelligent jazz performer. *Journal of New Music Research*, 28(2): 105.

REESE, S. 1994. Music technology: Tools for extending and sharing minds. *American Music Teacher*, 43(6): 12-13, 90.

REGENMORTER, M.V. 1998. *Integrating technology into the music curriculum of a California community college.* Unpublished MA thesis in Humanities, California State University, Dominguez Hills.

REID, M.S. 2000. Towards Effective Technology Education in New Zealand. *Journal of Technology Education,* 11(2) Spring [online]. Available from: http://scholar.lib.vt.edu/ejournals/JTE/v11n2/reid.html [Accessed 20 February 2001].

REIMER, B. 1989. Music education as aesthetic education: toward the future. *Music Educators Journal*, 75(7): 26-32.

ROADS, C. 1985. *Composers and the computer.* Middleton, WI: A-R Editions.

ROGERS, E.M. 1983. *Diffusion of innovations.* New York: The Free Press.

ROSSING, T.D. 1990. *The science of sound.* Reading, MA: Addison-Wesley.

RÖSCHER, A. 2001. *Music Standards for the Foundation Phase and Teacher Training in South Africa.* Unpublished DMus thesis, University of Pretoria, Pretoria.

RSA (REPUBLIC OF SOUTH AFRICA). 1995. South African Qualifications Authority Act (Act no. 58 of 1995). *Government Gazette* No. 1521 (4 October). Pretoria: Government Printer.

RUDOLPH, T.E. 1996. *Teaching music with technology*. Illinois: GIA Publications.

RUDOLPH, T.E., RICHMOND, F., MASH, D.S. & WILLIAMS, D. 1997. *Technology strategies for music education*. Wyncote, PA: Technology Institute for Music Educators.

SANDERS, W.H. 1980. *The effect of computer-based instructional materials in a programme for visual diagnostic skills training of instrumental education students,* Unpublished PhD in Education, University of Illinois at Urbana-Champaign.

SAQA (SOUTH AFRICAN QUALIFICATIONS AUTHORITY). 1997. The emergence of the NQF and SAQA. *SAQA Bulletin* 1(1): 2-4, 15-16. Pretoria: SAQA.

SAQA (SOUTH AFRICAN QUALIFICATIONS AUTHORITY). 2000a. *Standards generating body manual - Fourth draft, May 2000.* SGB Manual for public comment. SAQA 1230/00. Pretoria: SAQA.

SAQA (SOUTH AFRICAN QUALIFICATIONS AUTHORITY). 2000b. *Criteria for the general evaluation of Qualifications and Standards within the National Qualification Framework.* Policy Document. SAQA 1430/00. Pretoria: SAQA.

SAQA (SOUTH AFRICAN QUALIFICATIONS AUTHORITY). 2000c. *A SAQA position paper: the NQF and Curriculum 2005* [online]. Available from: www.saqa.org.za/html/nqf/docs/curricul2005.html [Accessed 20 February 2000].

SAQA (SOUTH AFRICAN QUALIFICATIONS AUTHORITY). 2000d. South African Qualifications Authority Tables of Level Descriptors. *SAQA Bulletin,* 4(1): 9. Pretoria: SAQA.

SAQA (SOUTH AFRICAN QUALIFICATIONS AUTHORITY). 2002. *Revised level descriptors for the NQF*. Pretoria: SAQA.

SCHMIDT, C.P. 1988. An investigation of undergraduate music education curriculum content. *Council for Research in Music education Bulletin*, 99: 42-56.

SCHOENHERR, S.E. 2001. *Recording technology history* [online]. Available from: http://history.acusd.edu/gen/recording/notes.html [Accessed 30 July 2001].

SCIENCECENTRAL & THE AMERICAN INSTITUTE OF PHYSICS. 1999. *Transistorized* [online]. http://www.pbs.org/transistor/album1/index.html [Accessed 12 June 2001].

SMIT, E. & HAUPTFLEISCH, S. 1993. *Effective Music Education in South Africa. Music Education Policy.* Pretoria: HSRC Publishers.

SPADY, W.G. 1994. *Outcomes based education: critical issues and answers.* Arlington, VA: American Association for School Administrators.

SPECTOR, B.S. 1993. Order out of chaos: restructuring schooling to reflect society's paradigm shift. *School science and mathematics,* 93(1): 9-19.

SPOTTS, T.H. & BOWMAN, M.A. 1995. Faculty use of instructional technologies in higher education. *Educational Technology*, 35(2): 56-64.

STANFILL, D. 1994. High tech today. *American Music Teacher*, 43(6): 8-11, 89-90.

STENHOUSE, L. 1989. *Introduction to curriculum research and development.* London: Heinemann.

SYLLABUSWEB. 1997. *News, resources, and trends* [online]. Syllabus Oct 1997:10. Available from: http://www.syllabus.com/news/ntr_archive99.cfm [Accessed 19 February 2001].

TEACHER EDUCATION COMMITTEE. 1996. *Technology 2005: The HEDCOM Technology Education project. Broad parameters for teacher education.* Pietermaritzburg: Teacher Education Committee.

TECHNICAL COMMITTEE (TECHNICAL COMMITTEE ON THE REVISION OF NORMS AND STANDARDS FOR TEACHER EDUCATION - South Africa). 1997. *Discussion document: norms and standards for teacher education, training and development. 31 November 1997.* Pretoria: Department of Education.

TREDWAY, C.B. 1994. *A curriculum for the study of audio, video, computer, and electronic music technology for undergraduate music education majors based on a survey among members of the Florida Music Educators Association.* Unpublished PhD thesis, University of Southern Mississippi, Hattiesburg, Louisiana.

TRUBITT, D.R. 1993. *Making music with your computer.* Milwaukee, WI: Hal Leonard.

TRUBITT, D.R. 1997. *Live sound for musicians.* Milwaukee, WI: Hal Leonard.

UNIVERSITY OF YORK. 2002. *Music Technology Group. Introduction* [online]. Available from: http://www.york.ac.uk/inst/mustech/gsp/course_struct.html#intro [Accessed 20 May 2002].

UNWIN, D. 1978. Educational Technology. *The Encyclopedia of Educational Media Communications and Technology.* Westport: Greenwood Press.

USZLER, M. 1994. A byte out of the future. *American Music Teacher*, 43(6): 24-29, 90-91.

VAN LOGGERENBERG, A. 2000. *Implementing a problem-based learning model in the training of teachers for an outcomes-based technology curriculum.* Unpublished PhD thesis, University of Pretoria, Pretoria.

VAN ROOY, M.P. 1996. The curriculum. In W.J. Fraser *et al. Didactics for the undergraduate student.* Johannesburg: Heinemann.

VINCENT, M.C. & MERRION, M. 1996. Teaching music in the year 2050. *Music Educators Journal*, 82(6): 38-42.

VINCENTI, W.G. 1984. Technological knowledge without science: The innovation of flush riveting in American airplanes, ca. 1930 - ca. 1950. *Technology and Culture, 25* (3): 540-576.

WATERS, B. 1999. Ideas for effective Web-based instruction. *Music Educators Journal*, 85(4): 13-17, 47.

WAUGH, I. 1997. *Making music with digital audio direct to disk recording on the PC.* London: PC Publishing.

WEBSTER, P.R. 1994. Beyond drill and practice. *American Music Teacher*, 43(6): 16-19.

WELLS, R. 1997. Designing curricula based on the standards. *Music Educators Journal*, 84(1): 34-39.

WHEELRIGHT, P.E. 1996. *The Presocratics*. New York: Odyssey Press.

WHITE, I. 1997. *Audio made easy*. Milwaukee, WI: Hal Leonard.

WHITE PAPER ON EDUCATION AND TRAINING (South Africa): Republic of South Africa, Notice 196 of 1995 (15 March) Government Gazette No. 16312 [online]. Available from: http://www.polity.org.za/govdocs/white_papers/educ1.html. [accessed on 12 April 2001]

WILLIAMS, D.B. 1992. Viewports to technology and teacher training. *Music Educators Journal*, 79(2): 26-30.

WILLIAMS, D.B. & WEBSTER, P.R. 1996. *Experiencing Music Technology: software, data, and hardware.* 1st edition. New York: Schirmer Books.

WILLIAMS, D.B. & WEBSTER, P.R. 1999. *Experiencing Music Technology: software, data, and hardware.* 2nd edition. New York: Schirmer Books.

WILLIS, J. 1993. Educational technology: issues and innovations. What conditions encourage technology use? It depends on the context. *Computers in the Schools*, 9(4): 13-32.

WILLOUGHBY, K.W. 1990. *Technology choice: a critique of the appropriate technology movement*. Boulder and San Francisco: Westview Press.

WILLMAN, F. 1992a. Music and computers: Coming of age. *Music Educators Journal*, 79(3): 21-25, 63.

WILLMAN, F. 1992b. New solutions to curricular problems. *Music Educators Journal*, 79(3): 34.

WOLFF, U.L. 2001. *Choral Unit Standards and support material for Primary Schools in South Africa.* Unpublished DMus thesis, University of Pretoria, Pretoria.