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The instructional design of a training program for audiometricians

by

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To my husband, Derek de Clercq, and

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ABSTRACT

This study focused on designing a training programme for audiometricians, using the principles of instructional design. Instructional design is the continuing, systematic development of instructional specifications, utilizing researched strategies and principles to create detailed outcomes for the development, implementation, evaluation and maintenance of training programmes. An audiometrician is defined by SANS (10083:2004), as a person registered with the *Health Professions Council of South Africa* as an audiometrician, hearing aid acoustician or someone trained in audiometry. Audiometricians are adult learners. Therefore, in addition to instructional design principles, the principles of adult learning were also incorporated in the training programme. The successful training of audiometricians may ensure that noise induced hearing loss is significantly reduced when audiometric monitoring is appropriately implemented as part of a hearing conservation programme. Training for audiometricians is critical in this process as incorrect audiometric monitoring may negatively influence the outcomes of a hearing conservation programme.

This study followed a descriptive research design where the results were described in a quantitative manner. Data was collected by means of electronically mailed questionnaires. All participants were practicing audiometricians at the time of the study and were registered with the *South African Society for Occupational Health Nursing*. All participants had an audiometric certificate as qualification.

For the analysis of data, 181 completed questionnaires were used. The results were analyzed and described in terms of the respondents' own experience regarding audiometry; their opinions regarding the topics they have been taught in audiometry; the duration of their own training programmes and their opinions regarding a future training programme for audiometricians. Based on the results of the above analysis, the instructional design programme for audiometricians was developed. The obtained results were used to determine what the topics, content, duration, learning outcomes and learner evaluation methods should be in the development of a training programme for audiometricians.

This research study developed a training programme for audiometricians in order to ensure that all future audiometricians have the necessary knowledge to perform comprehensive hearing evaluations, interpret audiometric findings and thereby assist in reducing noise induced hearing loss in the industrial sector through hearing conservation programmes.

Keywords: adult learner; adult learning; audiometrician; audiometry; evaluation; hearing conservation programme (HCP); hearing protective device (HPD); instructional design; noise induced hearing loss (NIHL); training programme.

ABSTRAK

Hierdie studie is toegespits op die ontwerp van ‘n onderrigprogram vir oudiometriste waarin die beginsels van onderrigontwerp toegepas is. Onderrigontwerp behels die deurlopende en stelselmatige ontwikkeling van onderrigspesifikasies deur gebruik te maak van nagevorsde strategieë en beginsels om gedetailleerde uitkomste vir die ontwikkeing, evaluering en onderhoud van opleidingsprogramme daar te stel. ‘n Oudiometris word gedefinieer deur wetgewing (SANS 10083:2004) as ‘n person wat geregistreer is by die *Health Professions Council of South Africa* as ‘n oudiometris, gehoorapparaat akoestikus of iemand wat opgelei is in oudiometrie. Oudiometriste is volwasse leerders. Om hierdie rede is nie net die beginsels van onderrigontwerp nie, maar ook die beginsels van volwasse leer in die onderrigprogram geïnkorporeer. Suksesvolle onderrig van oudiometriste kan verseker dat die voorkoms van geraas-geïnduseerde gehoorverlies verminder, mits oudiometriese monitering toepaslik as deel van ‘n program vir gehoorkonservering geïntegreer word. Opleiding vir oudiometriste is krities belangrik in hierdie proses want indien oudiometriese monitering verkeerd gedoen word, kan dit die gehoorkonserveringsprogram in totaliteit negatief beïnvloed.

‘n Beskrywende navorsingsontwerp is in hierdie studie gebruik en die resultate is kwantitatief beskryf. Data is deur middel van vraelyste wat elektronies versend is, versamel. Al die deelnemers was ten tye van die studie praktiserende oudiometriste wat by die *South African Society for Occupational Health Nursing* geregistreer was. Elkeen was in besit van ‘n oudiometriese sertifikaat as kwalfikasie.

Vir data-ontleding is 181 voltooide vraelyste gebruik. Die data was geanaliseer en beskryf in terme van die respondente se eie ervaring ten opsigte van oudiometrie; hul mening omtrent die temas wat by hul opleiding ingesluit was; die duur van hul opleidingsprogramme en hul idees omtrent ‘n toekomstige opleidingsprogram vir oudiometriste. Die onderrigontwerp-program is op grond van die resultate van bognoemde analise ontwikkel. Die resultate wat verkry is, is gebruik om die temas, inhoud, duur, leeruitkomste en evalueringsmetodes in die ontwikkeling van ‘n opleidingsprogram vir oudiometriste te bepaal.

Hierdie studie is gerig op die ontwikkeling van ‘n opleidingsprogram vir oudiometriste met die doel om te verseker dat hulle oor die nodige kennis beskik om omvattende gehoorevaluerings uit te voer, om oudiometriese bevindinge te interpreteer en daardeur, in gesondheidssorgprogramme, by te dra tot die vermindering van geraas-geïnduseerde gehoorverlies in die industriële sektor.

Sleutelwoorde: evaluering; gehoorkonservering-program; geraasbeskermers; geraas-geïnduseerde gehoorverlies; onderrigontwerp; onderrigprogram; oudiometrie; oudiometris; volwasse leer; volwasse leerder.

CHAPTER 1
THEORETICAL BACKGROUND

1.1 Introduction

This study focused on designing a training programme for audiometricians according to the principles of instructional design and adult learning. A properly trained audiometric technician is essential for the successful prevention of occupational hearing loss. Accurate hearing assessments identify early signs of noise induced hearing loss (NIHL) in order to be able to take preventive measures (Occupational Health and Safety [OHS] Regulation Section 7, 2005).

Hearing loss due to exposure to occupational noise is the most prevalent disorder in the industrial sector, and recognized since the Industrial Revolution in the 19th century (Sataloff & Sataloff, 2006:1). In this sector there are millions of employees with occupational hearing loss and this results in human and economic consequences that affect virtually every household in industrialized countries (Sataloff & Sataloff, 2006:1). Premature hearing loss in industrial workers is a well known outcome of exposure to noise at work (Duan, Laurell & Olofsson, 2004:1).

The learners in the training programme for audiometricians will be adults and as such the principles of adult learning are applicable in this study. The learners will remain the focal point of the programme by ensuring that lifelong learning takes place according to adult learning principles (Knowles, Holton & Swanson, 2005:1). The main goal of instructional design is therefore to ensure competent performance by the learners at the end of instruction (Morrison, Ross & Kemp, 2001:2). In addition to enhancing the learning experience, effective instructional design for training purposes shows achievement of the programme objectives by the learners as well as learners' ability to use these acquired skills and knowledge in their work environment (Morrison et al., 2001:11).

Audiometricians require training in the skills and knowledge that are necessary for conducting effective and accurate hearing screening evaluations in industrial settings. For the purposes of this study, an audiometrician is defined as a person who have a degree in nursing and conduct audiometric testing in the mining industry, or as a person who do not have any other qualification and is only registered as an audiometrician and who conducts hearing screening in

the mining industry. Audiometricians typically conduct hearing screening evaluations in mines and industries on employees with possible NIHL. NIHL is an irreversible, but preventable, condition. For the purposes of this study 'noise' refers to any unwanted sound (De Koker, 2003:4). According to the South African National Standard (SANS) 10083:2004 exposure to noise of more than 85dB SPL (decibel sound pressure level) can cause a hearing loss if exposure is longer than eight hours per day. The most appropriate exposure measurement for occupational noise is the A-weighted decibel (dB), usually averaged over an 8-hour working day ($L_{Aeq,8h}$) (World Health Organization, 2004:12). Industrial or occupational noise is widely accepted as a health hazard but is frequently taken for granted and the measures employed to deal with it are often inadequate (Leinster, Buam & Whitehead, 1994:125). The responsibility of protecting hearing is often placed on the employer and not on the employee, making the employee only a passive receiver of the surrounding noise. For this reason, hearing conservation programmes (HCP) should be put in place to enable the employee as well as the employer to know their rights and responsibilities regarding noise and NIHL (Project Health 809, 2004:24). According to the Occupational Health and Safety Act (OHSA) a HCP is designed to protect employees with significant occupational noise exposure from hearing loss even if they are subject to such noise exposure over their entire working lifetimes (OHSA 3074, 2002:7).

According to the Mine Health and Safety Act (MHSA), HCPs are implemented to identify hazards and assess risks regarding noise exposure according to the requirements of legislation (MHSA, 1996:9). Furthermore, measures to eliminate, control, minimize and monitor risks for NIHL should be implemented. Part of the HCP is medical surveillance, including hearing tests (MHSA, 1996:12). The SANS (10083:2004) specifies the different hearing tests, procedures and equipment calibration requirements that should be conducted for medical surveillance as part of the HCP.

Exposure to noise exceeding 85dB SPL also makes it mandatory to implement a HCP, have a code of practice, have occupational hygiene monitored and conduct medical surveillance. Mine operators need to record and store the results of occupational medical monitoring and make it available to authorities as needed or on an annual basis (SANS 10083:2004). Noise exposure can be limited with properly implemented hearing conservation programmes (Sataloff & Sataloff, 2006:403).

The above regulations make it clear that NIHL can be controlled, and to a great extent be prevented, if all of the legal requirements are implemented. Unfortunately, this is not always the case; the national prevalence of NIHL increases every year in spite of HCPs being implemented. According to Kay (2008), 12 to 14 percent of all disease and injury claims in South Africa in 2008 have been for NIHL. These claims cost the industry millions of rand each year. The Rand Mutual Association (RMA) has settled claims for NIHL of between 76 and 110 million rand since 1998 (Kay, 2008). These amounts do not even include the cost of hearing assessments, specialist referrals and transport – not to mention loss of productivity due to time off work for the necessary testing procedures. It can therefore be concluded that NIHL has a significant financial and human resource impact on the industry.

The financial and human resource implication for NIHL can be lessened by conducting effective medical surveillance as part of the required HCP. According to Royster and Royster (1990:1), the purpose of a HCP is to prevent employees from developing NIHL while working. HCPs consist of noise control measurements, engineering and administrative controls, medical surveillance (audiometric testing) and hearing protective devices (HPDs). Medical surveillance includes audiometry and the process begins with hearing screening evaluations. Legislation requires that otoscopic examinations be done prior to hearing screening and that hearing screening tests then be conducted at the frequencies of 500 Hz, 1000 Hz, 2000 Hz, 3000 Hz, 4000 Hz, 6000 Hz and 8000 Hz (SANS 10083:2004). According to SANS (10083:2004) it is required that these tests be conducted by an audiologist or an audiometrician. An audiometrician is defined by SANS (10083:2004), as a person registered with the Health Professions Council of South Africa (HPCSA) as an audiometrician or a hearing aid acoustician, or one of the following persons:

- A medical specialist in otorhinolaryngology;
- A graduate in speech therapy and audiology;
- A person who holds a certificate in audiometry issued by an institution recognized and approved by the Department of Labour or by the Department of Minerals and Energy as relevant;
- An occupational medical practitioner;

- A person qualified in audiometric techniques from an institution registered with the South African Qualifications Authority (SAQA) or any of its structures in terms of the SAQA Act, 1995 (Act No. 58 of 1995), and registered with the South African Society for Occupational Health Nursing (SASOHN).

The above definition of an audiometrician could possibly indicate that the training received by the different groups described as 'audiometricians' differs greatly. A medical specialist, audiologist and occupational medical practitioner all have a four to six year degree from a university, whereas the person with a certificate in audiometry has only undergone training for anything from four days to two weeks (www.hpcsa.co.za). This constitutes a vast difference in training and experience that may greatly influence the type of service delivered in terms of hearing testing. As previously mentioned, for the purpose of this study, an audiometrician is defined as a person without a degree in any field except Occupational Health Nursing.

1.2 Problem statement

According to Michell (2010), a person requiring registration as an audiometrician with the South African Society for Occupational Health Nursing (SASOHN), needs only to provide proof of a completed training course in audiometry. Since SASOHN is not a policing body and as such only acts as a registering body for all audiometricians, it does not verify the specific type or quality of training of audiometricians, but only that a training course in audiometry was indeed completed. Prior to 2004 it was compulsory for all audiometricians to register with the Department of Labour (Michell, 2010). All training programmes in South Africa must be registered with the South African Qualifications Authority (SAQA) and have a SAQA registration number. SAQA is the body responsible for overseeing the development and implementation of the National Qualifications Framework (NQF), established in terms of the SAQA Act no. 58 of 1996. Furthermore, all programmes must have unit standards complying with the requirements of SAQA. A unit standard is a registered statement of desired education and training outcomes and its associated assessment criteria together with administrative and other information as specified in the regulations of the programme (SAQA, 2010).

The only unit standard the Department of Labour was willing to approve was one where understanding and interpreting the hearing test results were not part of the requirements (Michell,

2010). This implied that the person conducting the hearing screening was not required to have any understanding of testing procedure or of the results, but only had to be able to physically conduct the testing procedure (Michell, 2010; De Koker, 2009). This defied the purpose of training audiometricians, as the person conducting the test was considered a technician and not a professional with skills and knowledge regarding NIHL and/or the referral process (Michell, 2010). Consequently, when training an audiometrician to comply with the Department of Labour's unit standard only, it can be assumed that the audiometrician will not necessarily have understanding of the conducted procedures and not be able to interpret the test results or to make an informed decision regarding referral for further testing (Michell, 2010). In 2008 this unit standard was eventually approved and registered with the South African Nursing Council (SANC) and SAQA and it contained only the minimum requirements for an audiometrician regarding how to conduct the hearing screening test and report the results of the test only, and not any requirements regarding understanding or interpretation of results according to the SAQA registration list (www.saqa.org.za) . The purpose of a unit standard is to have minimum requirements for any given training programme or procedure to ensure equal and standardized training (www.saqa.org.za). Unfortunately, the governing body that should enforce this unit standard for audiometry, i.e. the Department of Labour, does not have the capacity or work force to enforce these regulations (Michell, 2010). Consequently, any person can develop and present a training course in audiometry; and as long as the training is certified by SAQA and the person who has undergone the training may then conduct industrial hearing screening (Michell, 2010).

According to SASOHN, the only requirement for a person to be registered as an audiometrician, is to have a certificate for an audiometric course with a recognized body – it does not matter who the registered body or what the content of the course is. After 2003 it was required by SASOHN that audiometricians already registered with SASOHN had to undergo a refresher course that incorporated the new Workmen's Compensation Commissioner (WCC) Instruction 171 (2001). SASOHN has no rules regarding who are able to provide the training or what the content of the training should be since SASOHN is only a registering body (Michell, 2010). From the above it is clear that a comprehensive, practical and standardized audiometric programme is currently not available. This highlights the immediate importance of ensuring that all audiometricians do have the necessary knowledge and training to be able to do hearing screening competently (De Koker, 2009).

Insufficient training of audiometricians may have severe and long-lasting consequences for both the employee being tested and for the employer's business as a whole. The worst case scenario being where the employee is not informed of his/her test results. Should a person present with an ear or hearing pathology, it is critical that he/she should be informed about the diagnosis and be provided with options for treatment or referral to the appropriate specialist/s (SANS 10083:2004). An untreated hearing loss and/or medical pathology of the ear can have a profound effect on a person's life. It may have physical, emotional and psychological consequences, all of which have a negative impact on the social, communicative and vocational areas of the affected person's life (Arlinger, 2003:18). According to Swanepoel, Olusanya and Mars (2010:1) hearing loss is the most prevalent chronic disability and a major contributor to the global burden of disease. It is, to some degree, present in almost 10% of the global population and affects one in every four individuals over the age of 45 years. More than 80% of people with hearing loss reside in developing countries such as the South African sub-continent where services are either totally absent or very limited (Swanepoel et al., 2010a:1). Only two countries in Africa train hearing health care specialists, namely South Africa and Egypt (Swanepoel et al. 2010a:1). Current global health care efforts are clearly inadequate in terms of reaching the vast majority of people with hearing loss (Swanepoel et al., 2010a:2). Consequences of hearing loss (such as vocational limitations) are even more serious in Sub-Saharan Africa due to the vicious cycle of poverty that predisposes hearing loss while hearing loss predisposes poverty (Swanepoel et al., 2010a:1). Hearing loss can be adequately identified and referred to the appropriate health care professional by implementing HCPs where the audiometrician is adequately trained to correctly identify the employee with a hearing loss. An important part of monitoring a HCP's effectiveness is therefore through correct and effective hearing testing.

The effects of an incorrect diagnosis of hearing loss have severe consequences for the employer as well. An employee may exaggerate an existing hearing loss or pretend to have a hearing loss without it being noticed by the insufficiently trained audiometrician. If the audiometrician has been sufficiently trained and is experienced in hearing testing, he/she should be able to identify false or overstated results and refer accordingly. Should an employee be incorrectly diagnosed with a hearing loss, which he/she actually does not have, it costs the company money, time and loss in production (De Koker, 2003:1). The employee has to be referred for diagnostic testing which has financial implications, as the employer has to pay for the test itself, the transport to

and from the audiologist's practice, the employer also has a loss of income because the employee cannot do his/her work for the day and there is a disruption in the work schedule for the other employees (De Koker, 2003:3). Wrongly diagnosed hearing loss can also result in claims for NIHL that further costs the company money and additional paperwork (De Koker, 2003:3).

Claims for NIHL are one of the main concerns for the mining industry as a whole because it is something that can be completely avoided (De Koker, 2009). In order to control and ultimately prevent NIHL it is essential that adequate and effective audiometric testing is conducted at all sites that have a noise level of 85dB SPL or more (SANS 10083:2004). This can be achieved by training audiometricians to use a correct, legally prescribed, testing protocol when conducting hearing evaluations as part of the HCP's medical surveillance.

Currently, according to the SASOHN Database, there are 2049 audiometricians registered with SASOHN of which 1746 (85.2%) are currently practicing audiometricians and 303 (14.8%) are inactive audiometricians. A currently practicing audiometrician is defined as any audiometrician who is currently practicing audiometry and has paid his/her bi-annual registration fee to SASOHN. Inactive audiometricians can be defined as those audiometricians that are not currently practicing audiometry, have received their qualification before 2003 when the legislation changed and have not done the refresher course to update their knowledge of the new legislation, or have not paid their bi-annual registration fees. Only currently practicing audiometricians registered with SASOHN was incorporated in this study; they all have received their qualification from various companies/training facilities (SASOHN Database, 2010). Table 1.1 presents the different training facilities for audiometricians in South Africa and also indicate the percentage of audiometricians registered with each training facility.

Table 1.1: Different training facilities for audiometricians in South Africa

Training facility	Number of audiometricians (n = 1746)	Percentage
Audiometric Calibration & Training Services (ACTS)	595	34.1%
(Occupational Care South Africa (OCSA)	125	7.2%
Durban University of Technology (DUT)	226	12.9%
Cape Pennisula University of Technology (CPUT)	147	8.5%
Tswane University of Technology (TUT)	120	6.9%
University of Johannesburg (UJ)	80	4.5%
VDH Industrial Hygiene	48	2.8%
Concept Safety Systems (CSS)	357	20.4%
OccuTech	48	2.7%

Table 1.1 indicates that the majority of currently practicing audiometricians have received their training at ACTS (34.1%). All these different training programmes have different content and evaluation methods and no two programmes are the same (Michell, 2010). There is no set of regulations other than the unit standard as to what should be taught to audiometricians or included in a training programme (Michell, 2010).

1.3 Proposed solution

The training programme designed in this study can be used as a standardized programme for all audiometricians working in South Africa. The majority of audiometricians working in the fields of industry and mining are unable to conduct all the required evaluations regarding hearing screening (De Koker, 2009). Some audiometricians undergo only a short, on-site training session that does not include all the necessary background information, audiometric testing procedures or knowledge of hearing disorders that is needed to effectively conduct hearing screening (De

Koker, 2009). If hearing screening testing is not done correctly and thoroughly, negative and incorrect results may occur, including wrongful compensation that will cost the mining industry even more money, time and resources. It is therefore necessary to develop a training programme for all audiometricians that will train them to conduct professional, effective and comprehensive hearing screening in compliance with legislation. In order to develop such a training programme, it is necessary to conduct research as to which objectives should be included in such a programme that will contribute to reducing occupational hearing loss in industries in South Africa.

1.4 Aim of the study

The aim of this study is to develop a training programme for audiometricians using the principles of instructional design and adult learning. This will ensure that audiometricians are able to perform the correct and required testing procedures effectively and efficiently when conducting a hearing evaluation.

1.5 Clarification of terminology

The following key terms which are frequently used in this study, are defined below:

Adult education:

Activities designed for the purpose of bringing about learning among those whose age, social roles and perception of self define them as adults (Nafukho, Amutabi & Otunga, 2005:2).

Adult learner:

A term used to describe any person socially accepted as an adult who is in a learning process, whether it is formal education, informal learning or corporate sponsored learning. The process is voluntary, goal orientated and based on experience (Fogarty & Pete, 2004:14).

dB SPL:

The dB or decibel is a logarithmic unit for measuring the ratio between two numbers. The abbreviation ‘SPL’ stands for ‘sound pressure level’. SPL measures are taken with respect to the minimum threshold for human hearing. A 10dB difference in SPL therefore represents a ratio of 10:1 in sound pressure (Vanderheiden, 2010:1)

Evaluation:

'Evaluation' refers to the process or tool integrated into the instructional activity, innovation or programme designed to improve the quality of instruction and the resulting learning outcomes. A process used to determine whether the design and delivery of instruction were effective and if the proposed outcomes were met (Caffarella, 2005:225).

Hearing conservation programme (HCP):

A programme that is established when employees are exposed to noise exceeding 85dB SPL. The programme should include noise surveys, audiometric testing, hearing protective devices, training and recordkeeping according to the current South African legislative requirements (Franz, 2003:12).

Hearing protective device (HPD):

Devices worn in or on the ears to reduce exposure to noise. May include disposable earplugs, reusable earplugs (banded and corded), or earmuffs (De Koker, 2003:14).

Instructional designer:

A person who applies a systematic methodology based on instructional theory to create content for learning events (Fogarty & Pete, 2004:18).

Instructional design:

Instructional design is a field of study concerned with improving learner learning. It is the practice of arranging media and content to help learners and teachers transfer knowledge in the most effective way. The process, broadly speaking, consists of determining the current state of learner understanding, defining the end goal of instruction and creating some media based intervention to assist in the transition (Tennyson, Schott, Seel & Dijkstra, 1997:1).

Learning:

Learning is the act or process by which behavioural change, knowledge, skills and attitudes are acquired. It emphasizes the person in whom the change occurs, or is expected to occur (Knowles et al., 2005:10).

Learning programme:

A set of policies, procedures, materials and people organized around specific learning objectives. Learning programmes vary in their levels of information and skills to be taught as the participants and coordinators differ in their roles and come from various backgrounds (Caffarella, 2005:3).

Learning objectives:

The outcomes expected of the learners at the end of the instruction in terms of content acquisition, terminal behaviours, directions of growth and skills demonstrated (Knowles et al., 2005:267).

Noise induced hearing loss (NIHL):

Noise-induced hearing loss is a sensory neural hearing loss caused by noise exposure. A decrease in hearing is typically seen first in the frequency range from 3000 to 6000 Hz. Hearing loss is usually symmetrical (De Koker, 2003:11).

Purpose of adult learning:

The goals and purposes of adult learning serve to shape and mould the learning experience. The purposes of adult learning are to facilitate change in society and support and maintain good social order and to enhance personal growth (Knowles et al., 2005:150).

1.6 Outline of the study

Chapter 1: Theoretical background

This chapter explains the rationale, problem statement, proposed solution and the aim of the study. It also defines the key terminology used in the study and gives an outline of the chapters in the study.

Chapter 2: Theoretical concepts

This chapter presents a detailed description of the two main theoretical concepts of this study, namely instructional design and adult learning.

Chapter 3: Methodology

This chapter explains the research methods in terms of the main aim, sub-aims, research design, ethical considerations, participant selection criteria and procedure, material and apparatus used during the study, data collection and data analysis procedures as well as the ethical considerations of the study.

Chapter 4: Results of the needs analysis

This chapter presents the results of the data collection as well as a discussion of the results. It also outlines the macro and micro strategies used to design and develop the training programme, evaluation methods, learning outcomes and course content.

Chapter 5: Conclusions and recommendations

This chapter provides a summary of the designing of the training programme, the strengths and limitations of the study as well as recommendations for further research.

1.7 Summary

Hearing loss in industries is a well known result of noise exposure at work. In order to reduce such exposure it is important to implement a hearing conservation programme that will reduce the number of employees suffering from NIHL. HCPs aim to reduce NIHL by implementing noise reduction measures and audiometric evaluations.

Hearing screening testing can be conducted by audiometricians who have been trained according to certain standards. If, however, the audiometrician has not been trained correctly or comprehensively enough, audiometric testing as part of a HCP will not constitute an effective way of monitoring an employee's hearing thresholds while working in noise.

Training programmes for audiometricians in South Africa are not regulated and consequently any person can present a training programme as long as they have a SAQA registration number. This often leads to audiometricians not being trained correctly and effectively.

If an audiometrician is not able to monitor an employee's hearing threshold correctly over time, NIHL will continue to be an immense problem in mines and other industries. Incorrect diagnosis

of a hearing loss has far-reaching effects on the employee with NIHL, his/her family, his/her employer as well as on the economy as a whole.

This study aims at designing a training programme for audiometricians that can be used as a standardized programme in order to ensure that audiometricians are trained correctly and comprehensively, thereby reducing NIHL in the industries and mines by implementing effective HCPs.

CHAPTER 2
THEORETICAL CONCEPTS

2.1 Introduction

In developing a training programme for audiometricians, the goal is to ensure lifelong learning in the adult learner. It is therefore important to discuss the two concepts that form the foundation of this training programme, namely instructional design and adult learning. Instructional design is an umbrella term for the analysis, design, development, implementation and evaluation of a training programme. It is the framework for developing training programmes that increase and/or enhance the possibility of learning and encourage the engagement of learners so that they may learn faster and gain deeper levels of understanding (Clark, 2004:8). The programme designed in this study also included the principles of adult learning, as this is a process that creates change within the adult individual and also infuses change into an organization as part of the art and science of helping adults to learn (Knowles, 1990:48).

The aim of this chapter is to discuss the two main theoretical concepts of this study, namely instructional design and adult learning, in more detail. The discussion takes place against the background of the audiometrician's responsibilities and skills with regard to hearing testing in the industrial and mining sector.

2.2 Instructional design

'Instructional design' of the training programme for audiometricians refers to the systematic process that is employed in developing education and training programmes (Reiser & Dempsey, 2002:16). It encompasses five basic phases, namely the analysis, design, development, implementation and evaluation phase of the training programme. There are many different models of instructional design and most of these models incorporates the five basic phases of instructional design (Reiser & Dempsey, 2002:16). In order to have a deeper understanding of instructional design, the definitions, principles, model and process will be discussed in more detail.

2.2.1 Definitions of instructional design

The Applied Research Laboratory at Pennsylvania State University has developed a four-part definition of instructional design that views it as a process, a discipline, a science and a reality (Brown & Green, 2006:7):

2.2.1.1 Instructional design as a process:

Instructional design is the systematic development of instructional specifications using learning and instructional theory to ensure the quality of instruction. It is the entire process of analysis of learning needs and goals and the development of a delivery system to meet these needs. It includes the development of instructional materials and activities, as well as evaluation of all instruction and learner activities (Brown & Green, 2006:7).

2.2.1.2 Instructional design as a discipline:

Instructional design is the branch of knowledge concerned with research and theory about instructional strategies and the process of developing and implementing these strategies (Brown & Green, 2006:7).

2.2.1.3 Instructional design as a science:

Instructional design is the science of creating detailed specifications for the development, implementation, evaluation and maintenance of situations that facilitate the learning of both macro and micro units of subject matter at all levels of complexity (Brown & Green, 2006:7).

2.2.1.4 Instructional design as a reality:

Instructional design can start at any point in the design process. Often only a basic idea develops, revealing the core of an instruction situation. By the time the entire process is completed the designer can reflect on the process to ensure that all parts of the ‘science’ have been taken into account. Finally, the entire process is written up as if it occurred in a systematic fashion (Brown & Green, 2006:7).

When integrating this four-part definition, the instructional design of the training programme can be defined as the continuing, systematic development of instructional specifications using researched strategies and principles to create detailed outcomes for the development, implementation, evaluation and maintenance of the training programme.

2.2.2 Principles of instructional design

Merrill (2009:1) stated that there are core principles that apply to instruction regardless of the instructional programme prescribed by any given model or theory. Also, if an instructional designer fails to implement these principles in the process of educating learners, there will be a decrement in learning and performance (Merrill, 2009:1). In the instructional design of the training programme for audiometricians, Merrill's first principles were incorporated as part of the instructional methods that were used in the training of audiometricians. These principles were:

2.2.2.1 Task-centred principle

Learning is facilitated when learners are engaged in solving real world problems and are shown the tasks they will be able to perform and the problems they will be able to solve as a result of completing the training. Problems should be authentic, real world and personal (Merrill 2009:5). In the training programme for audiometricians, learners should be taught how to conduct effective and accurate hearing screening complying with the South African National Standard (SANS 10083:2004). They should participate in practical sessions to practice the knowledge and skills they have learned throughout the training programme and should be required to interpret real life examples of audiograms and test results. This problem solving approach is more effective than teaching the learners only abstract learning objectives (Merrill, 2009:6). According to Merrill (2009:6) "learning to solve a problem involves four levels of instruction: the problem, the tasks required to solve the problem, the operations that comprise the tasks and the actions that comprise the operations". The training programme for audiometricians should engage the learners on all four of these levels, namely: the problem level, the task level, the operation level and the level of action. These four levels of the training programme for audiometricians should be implemented when learners conduct complete hearing screening evaluations. This includes the different procedures, namely case history, otoscopic examination, hearing screening and interpreting the results, a step-by-step guide on how to perform these procedures and the actual physical conduction of procedures, interpretation of results and referral to other professionals.

2.2.2.2: Activation principle

Learning is facilitated when relevant previous experience is activated and integrated as part of the learning process. Learners may provide relevant experience that may form a foundation for the new knowledge (Merrill 2009:6). The training programme for audiometricians should start with general previous knowledge on hearing, noise and the consequences of noise in places of work. This should establish the said foundation for the training programme and enable learners to identify with the main target of the training programme, namely hearing screening in industries. Activation not only tests prerequisite knowledge, but also activates the mental models that incorporate the new knowledge into existing knowledge. These mental models can be modified to enable the learners to incorporate the new knowledge with existing information (Merrill, 2009:7). Coaching should be very prominent at the beginning of the training programme and should then be gradually withdrawn until the learners have mastered the required set of knowledge and skills. Learners should be able to observe each other, enabling them to master the skills more rapidly (Merrill 2009:7).

2.2.2.3: Demonstration principle

Learning is facilitated when the content and skills to be learned are demonstrated rather than merely providing information about what is to be learned (Merrill, 2009:7). Learning in the training programme for audiometricians should be enhanced by the instructor conducting an actual hearing screening test. Otoscopes, audiometers and audiograms should be readily available and used to demonstrate and model the required behaviour of learners. The learners should first be shown how to conduct these procedures, after which they should be afforded the opportunity to conduct these procedures themselves in smaller groups. The procedures should be frequently repeated and compared in order to enhance the learners' knowledge and skills. Information provided in the training programme should be specific and examples should be provided rather than only presented orally. The information should be consistent with the learning goal, namely hearing screening in industries. The instructor should focus the learners' attention on the relevant information and should direct them to important references and additional reading materials. Demonstrations should include media presentations as a mode of delivery to bring learning material to the learner. In the training programme for audiometricians

visual media should be used to highlight important information and to focus the learners' attention on this information (Merrill, 2009:7).

2.2.2.4: Application principle

Learning is facilitated when learners are required to use new knowledge or skills to solve problems. The application and practice of new skills and knowledge should be guided by appropriate feedback and coaching, including error detection and correction (Merrill, 2009:8). In the training programme for audiometricians the practical session should include hearing screening guided by the instructor while these procedures are practiced by the learners. Coaching should gradually be withdrawn as the learners progress in their ability to conduct tests independently. Practical sessions should involve a series of procedures in which the learners take turns to practice each procedure in order to avoid loss of concentration. Errors in conducting the procedures should be identified early and learners should be taught how to rectify and learn from these errors (Merrill, 2009:8).

2.2.2.5: Integration principle

Learning is facilitated when learners are encouraged to integrate new knowledge or skills into their everyday life and when they are able to reflect on and discuss this new knowledge and skills. It is also facilitated when learners can create, invent and explore new and personal ways of applying their new knowledge and skills (Merrill, 2009: 8).

These first principles of instruction ensure effective instruction and highlight the characteristics of instructional design (Merrill, 2009:14).

2.2.3 Characteristics of instructional design

The characteristics of instructional design according to Reiser and Dempsey (2002: 21-22) can be summarized as in Table 2.1:

Table 2.1: Characteristics of instructional design (Reiser & Dempsey, 2002:21-22)

Characteristic of instructional design	**Implementation of the characteristics in a training programme for audiometricians**
Learner centred	A training programme that is learner centred focuses on the learner whilst the form of teaching is only the means to this end. The focus should therefore be on the development of the abilities of the learners to conduct hearing screening and on the interpretation of the results of the tests, regardless of the time or effort it takes to accomplish.
Goal orientated	A training programme that is goal orientated has well defined aims that the learner can use as a guide to enable him/her to complete the instruction successfully. These goals are designed to optimize the learners' expectation of the instruction and to serve as guidelines for successful implementation of the knowledge and skills learned.
Real world performance	A training programme should provide opportunity for the learners to apply their acquired knowledge and skills to actual practical sessions during instruction.
Outcomes	The outcomes of a training programme for audiometricians should be measurable in a reliable and valid way by using an evaluation form and should provide the learners with the criteria that are used to measure successful completion of the outcomes.
Empirical	A training programme should implement empirical data collection and analysis procedures to guide the selection of the content and strategies that will be used to develop and design the programme.
Team effort	An effective training programme for audiometricians should involve different role players, namely the instructional designer, the instructor, the learners and the administrative personnel. All the team members should work together to ensure effective and comprehensive instruction.

According to Merrill (2009:14), the instruction will be effective if the first principles and characteristics (Table 2.1) of instructional design are implemented, regardless of the theory or model that prescribes the instruction. In this study, the ADDIE model is followed (where the acronym represents *analyze*, *design*, *develop*, *implement* and *evaluate)*, because it implements all five basic phases of instructional design (Culatta, 2008:2).

2.2.4 Model of instructional design

No matter what model of instructional design is followed, all have the same five basic and generic phases, namely analysis, design, development, implementation and evaluation which can be seen as a dynamic and flexible guideline for developing intentional facilitation of effective training (Culatta, 2008:2). Although there are many models of instructional design, all are based on, or incorporate, the ADDIE process. The ADDIE model contains the generic steps that were followed in the development of this training programme for audiometricians as it is a step-by-

step framework which ensures that course development and learning do not occur in a haphazard and unstructured way (Castagnolo, 2008:3). This model of the design process was used to ensure that the learners achieve the goals of the course and that their needs was determined. Furthermore, this model is used as rationale for the design and development of training materials and for evaluating the effectiveness of a training programme for audiometricians using specific and measurable outcomes.

As the ADDIE model is one of the most commonly used descriptions of instructional design, this process was used to develop a training programme for audiometricians (Brown & Green, 2006:11). This is actually the means of describing *any* instructional design model as it is an illustration of the core elements of the instructional design/development process (Brown & Green, 2006:12). Figure 2.1 illustrates the core elements of the ADDIE programme as it can be applied to any instructional design model/process.

Figure 2.1: Core phases of the ADDIE process (Branch, 2009:15)

As illustrated in Figure 2.1, there are five phases to the ADDIE model. These different phases of the ADDIE process are more comprehensively discussed below.

Phase 1: Analysis

In the analysis phase the instructional problem is identified and clarified. The instructional goals and objectives are established and the learning environment as well as the learner's existing knowledge and skills are determined as completely as possible (Culatta, 2008:2).

The trainer as instructional designer must initially be able to identify and clarify the problem that has to be addressed according to the needs analysis that was conducted in the field of audiometry, since this study focuses on providing a solution for the need of a training programme for audiometricians. The training needs of the practicing audiometricians as well as the needs of the learners for whom this programme was designed had to be clarified as thoroughly as possible in order to develop an effective and useful training programme. This was done through data collection from currently practicing audiometricians to determine their opinions regarding what the content of a training programme for future audiometricians should be.

The aspects that was defined and investigated in the analysis phase include:

- Learning outcomes and goals;
- The manner of instruction necessary to achieve these outcomes;
- The order of instruction that should be followed in order to achieve these outcomes.

When designing an instructional training programme, one of the keys to success is to begin with a clear goal in terms of the desired end result. The instructional designer must have a thorough understanding of what the objectives of the programme should be and how they will enhance the learning process for the learners (Sievers, 2003:3).

The learners' characteristics and needs are important aspects of successful instructional design. The learners are the key to the training and if the instructional designer is able to identify their needs and learning experiences, the likelihood of the training being successful will be greatly improved.

The results of the analysis phase formed the basis of the design phase.

Phase 2: Design

The design phase deals with the development of learning objectives, assessment instruments, exercises, content, subject matter analysis, lesson planning and media selection. This phase should be systematic and specific, where 'systematic' means a logical, orderly method of identifying, developing and evaluating a set of planned strategies targeted for attaining the project goals and 'specific' means that each element of the instructional design plan needs to be executed with attention to details (Culatta, 2008:3). In the development of a training programme for audiometricians these steps were followed in the design phase:

- Designing the learning outcomes;
- Designing the organizational structure of the course content and instruction;
- Designing the selection of visual and graphic material that will be used;
- Designing the assessment criteria.

The first step in designing specific learning outcomes is to define the scope of the project. This study aims to design a training programme for audiometricians and the main topics of instruction should be developed accordingly. These topics became clear on completion of the data analysis.

Learning outcomes should be based on performance, which means that the learner must be able to demonstrate the acquired knowledge and skills by performing specific tasks. In this study the instructional designer aims to identify the specific skills and knowledge, as well as the method of assessing these skills on the basis of the data analysis. Once developed, these learning outcomes should be included in the course syllabus. For the learners, this will specify exactly what is required of them and also inform them how these skills and knowledge should be displayed (Sievers, 2003:3).

The results of this phase formed the basis of the development phase.

Phase 3: Development

In the development phase the instructional designer creates and assembles the content assets that were identified in the design phase (Branch, 2009:21). The course content for the training programme for audiometricians should be developed in this phase by following these steps:

- Reviewing and revising the proposed programme to control the accuracy and completeness of the content;
- The composing of the specific study material;
- The development of a trial product.

Upon completion of this phase, a trial run must be executed in order to evaluate the programme and make any required changes before the implementation phase is commenced. The trail run of the training programme should be performed by the instructional designer or a qualified audiometrician who will be able to give feedback and make suggestions at the end of the programme to ensure that relevant changes are made before the programme is implemented.

Phase 4: Implementation

In this phase the training programme is implemented. This phase consists of the actual instruction and training of the learners with overall effectiveness as its the goal. This phase should improve the learner's knowledge of the instructional content, support the learner's ability to master the required skills and ensure that the skills and knowledge learned are carried over to the learner's vocational setting (Merrill, 2009:14).

Implementation can be defined as "to put something into effect or action" (Smith & Ragan, 2005:304). The result of an engaging instructional design programme is typically an innovation, something new, a new idea, a new way to solve a learning problem. However, the actual implementation of the training programme for audiometricians did not form part of the scope of this study.

Phase 5: Evaluation

The evaluation phase consists of two methods of evaluation: formative evaluation and summative evaluation. Formative evaluation has the purpose of improving the training programme and is present in each stage of the ADDIE process. Summative evaluation consists of tests designed for domain specific criterion related referenced items and providing opportunities for feedback from the users (Brown & Green, 2006:230). Although the evaluation of the training programme was not part of the scope of this study, a brief summary of the two methods of evaluation is provided below.

According to Brown and Green (2006:235) formative and summative evaluation can be summarized as shown in Table 2.2.

Table 2.2: Comparison between formative and summative evaluation (Brown & Green, 2006:235)

Criterion	Formative evaluation	Summative evaluation
Purpose	To determine the value or quantity of a set of data	To determine the value or quantity of a set of data
Use	To improve a programme or instruction	To make decisions about the future adaptation of the instructional programme
Audience	Programme administrators and staff	Programme administrators and potential consumer or funding agency
Evaluators	Primarily internal evaluators, supported by external evaluators	External evaluators, supported by internal evaluators in unique cases
Major characteristics	Provides feedback to enable programme personnel to improve the instruction	Provides information to enable programme personnel to decide whether to continue the instruction
Design constraints	To determine the information needed at each stage	To determine the necessary evidence for major decisions
Purpose of data collection	Diagnostic	Judgmental
Measures	Sometimes informal	Valid and reliable
Frequency of data collection	Frequent	Infrequent
Sample size	Generally small	Usually large
Questions asked	What is working? What needs to be improved? How can it be improved?	What results occur? With whom? Under what conditions? With what training? At what cost?

As is clear from Table 2.2, both formative and summative evaluation is necessary for a comprehensive evaluation of any training programme. When designing evaluation, the designer should plan an approach that will determine the type of changes that may need to be made to the instructional components. All materials used should enable the learner to acquire the required set of skills and knowledge (Sievers, 2003:4). If the training material is adequate, the instruction will be effective. Continuous evaluation of the training material is important to ensure the effectiveness of training. Evaluation of the training programme for audiometricians was not part of the scope of this study.

The instructional design procedures determine the goals of the training programme. The training programme for audiometricians should contain instructional design principles that will enable the

learners to conduct correct hearing screening. The learners in the training programme for audiometricians are adults and must therefore be taught according to the theories and principles of adult learning. This will ensure an honest attempt to focus on the learner, since adults have different learning styles than children (Knowles et al., 2005:1).

2.3 Adult learning

When designing an instructional design training programme the process should ideally be grounded in adult learning principles and theories. The learners targeted in this process will be adults who have different learning styles and experiences than younger learners. Adulthood is viewed as a status, involving certain responsibilities when the learner entered into this specific stage. People are considered to be adults because of their age and are expected to behave in a mature manner (Jarvis, 2004:45). In South Africa the Constitution and the South African Charter on the Rights and Welfare of the Child define a child as any person under the age of 18 years. Any person less than 18 years of age, unless married or emancipated by court order, is a child, whilst any person 18 years or older is an adult (South African Constitution and the SA Charter on the Rights and Welfare of the Child. Section 28:3). To be considered for the training programme for audiometricians all applicants must have at least a high school diploma which is almost always received after a person turns 18. This will ensure that all learners are adults and the principles and theories of adult learning should apply. This section focused on the theoretical concepts surrounding adult learning, the principles of adult learning, the different models of adult learning and the implementation of these principles.

There are many different adult learning theories, but there is not complete consensus amongst them as to what exactly should form part of these theories. Overall, it seems that the theory of adult learning can be broken down into two elements: a process that creates change within the adult individual and a process that infuse change into an organization (Jarvis, 2004:27). Malcolm Knowles's concept of andragogy was used in this study as the basis for adult learning because it explains how the adult learner differs from the child learner and also describes the principles of adult learning (Jarvis, 2004:27). These principles were used as the basis for designing an instructional training programme for adult audiometricians.

2.3.1 Andragogy

Malcolm Knowles might well be considered the founding father of adult learning (Jarvis, Holford & Griffin, 2003:94). He contrasted the concept of andragogy, meaning the art and science of helping adults learn, with pedagogy, the art and science of helping children learn. Knowles's original studies and writings arose from the assumption that there are significant, identifiable differences between adult learners and learners under the age of 18. Primarily, these differences, according to Knowles, relate to an adult learner being more self directing, having a repertoire of experience, and being internally motivated to learn subject matter that can be applied immediately in the learner's social or vocational role (Jarvis et al., 2003:95).

According to Knowles, andragogy is based on the following six assumptions of the adult learner that differs from the pedagogical model (Knowles et al., 2005:64-66). These assumptions are:

- *The need to know:* Adults need to know why they need to learn something before undertaking to learn it (Knowles et al., 2005:64). In the training programme for audiometricians, the learners should be taught how to conduct hearing screening that are used in the mining industries on a regular basis. The audiometricians should be able to use these skills on a daily basis as part of their work requirements. The learners should therefore know beforehand why they should learn to be able to conduct reliable and effective hearing screening in the industrial setting, as they will be required do this on a daily basis in their workplace.
- *The learners' self concept:* Adults have a self concept of being responsible for their own decisions and their own lives (Knowles et al., 2005:64). The instructional designer needs to make an effort to create learning experiences in which adults are helped to make the transition from dependent to self-directed learners. The audiometricians should be responsible for their own learning and should be encouraged to do further reading on subject content.
- *The role of the learners' experiences:* Adults draw upon their experiences of the past to aid their learning (Knowles et al., 2005:65). The richest resources of learning may reside in the adult learners themselves and therefore it is important to keep in mind that they will enter into the learning situation with their own set of experiences and ideas.

- *Readiness to learn:* Adults show a readiness to learn those things they need to know and be able to do in order to cope effectively with their real life situations (Knowles et al., 2005:65). The learners who will enrol for the training programme for audiometricians should do so out of their own desire and/or because of a requirement of the employer.
- *Orientation to learning:* Adults are life centred in their orientation to learning. They are motivated to learn to the extent that they perceive that learning will help them perform tasks or deal with problems that confront them in real life situations. When adults learn new knowledge and skills, they want to immediately apply it to problem solving exercises (Knowles et al., 2005:66). In the development of a training programme for audiometricians this principle should be kept in mind and the learners should be given the opportunity to practice their skills and apply their knowledge to both practical and theoretical assessment.
- *Motivation:* For the most part, adults respond to internal motivational factors or pressures, more so than to external motivational factors. The learners will enrol in order to learn something they can use in their everyday work environment and therefore they will be highly motivated to learn (Knowles et al., 2005:66).

The six assumptions above created a lot of thought and consequently theories from other instructional designers. Eventually three keys to transformational learning were identified, namely experience, critical reflection and development (Merriam & Caffarella, 1999:325).

The *experience* of the adult learner is important because the learning opportunity needs to be relevant and applicable to a person's set of experiences. Experience is an important factor in an adult's ability to create, retain and transfer knowledge.

Critical reflection and analysis form the second key to the transformation of adult learners. They need time to contemplate the scope of practice of audiometricians and the ramifications of the training and relate them to their own experiences, responsibilities and vocational demands. Any training programme should provide time for the learners to do self-study and ask any questions they might have regarding the material taught.

The last key to transformational adult learning is *personal development*. The ability to think critically is developmental in itself (Merriam & Cafferella 1999:330). Effective adult learning

opportunities should be created as part of the training programme for audiometricians in order to provide the learner with time to reflect and think critically and this may facilitate personal development.

Adult learners are considered to be people who behave in adult ways and believe themselves to be adults and therefore they should be treated as adults (Knowles, 1978:85). According to Knowles (1978:85), adult learning is unique in a number of ways:

- Adult learners have a great deal of experience which they bring to the learning environment and educators can use this as a resource;
- Active participation of learners should be encouraged in the design an implementation of educational programmes;
- Adults need to be able to know how the newly acquired information can be applied in everyday life;
- Adult learners expect to have a high degree of influence on how learning will be evaluated;
- Adults expect their responses to be acted upon when asked for feedback on the progress of the programme.

Adult learning is therefore learner-centred, experience-based and problem-orientated (Burns, 1995:233). Andragogy differs from pedagogy in terms of training as shown in Table 2.3 (adapted from Isenberg, 2007:18):

Table 2.3: A comparison between andragogical and pedagogical training (Isenberg, 2007:18)

Andragogy	**Pedagogy**
Learners have an independent learning style	Learners have a dependent learning style
Objectives are flexible to ensure optimal learning	Objectives are inflexible and predetermined
It is assumed that learners have experience to contribute to the learning process	It is assumed that learners are inexperienced and/or uninformed
Active training methods are used, e.g. real life experiences and practical sessions	Passive training methods are used, e.g lectures
Learners influence the time and pace of training in this learner centred method of training	Trainer controls the time and pace of instruction
Learner involvement is vital to success	Learners contribute very little to the success of the training
Learning is real life and problem centred	Learning is content centred

According to Table 2.3 adult learning must implement active training methods, allow learners to influence the timing and pace of the training, get learners involved in the process of training and include real life experiences and problems to be solved. These principles of adult learning are of great importance when developing instruction for adults and were used in the development of the training programme for audiometricians in this study.

2.3.2 Implementing adult learning principles

In order to succeed instruction has to be implemented according to the principles of adult learning (Isenberg, 2007:17). There are six principles or assumptions of adult learning as identified by Knowles (Isenberg, 2007:15). The following section identifies these principles and explains how they should be implemented in the training programme for audiometricians.

2.3.2.1 Adults are internally motivated and self-directed

Adult learners resist learning when they feel others are imposing information, ideas or actions on them. The role of the trainer is to design a programme that will assist the learner in moving from a dependent to a self-directed learner. In order to achieve this the instructional designer of a programme for audiometricians should do the following (Isenberg, 2007:15):

- Set up a *graded learning programme* that moves from more to less structure, from less to more responsibility and from more to less direct supervision at an appropriate pace that is challenging yet not overloading the learners;
- *Develop rapport* with the learners to optimize approachability and encourage asking of questions and exploration of concepts;
- *Show interest* in the learners' thoughts and opinions. The trainer should actively and carefully listen to any questions asked and answer it to the best of his/her ability.
- *Lead the learners toward inquiry* before providing them with too many facts;
- Provide *regular constructive and specific feedback* (both positive and negative);
- *Review goals* and *acknowledge the achievement of these goals;*
- *Encourage the use of resources* such as libraries, journals and correspondence with supervisors in the working environment;
- *Set projects or tasks* for the learner which they must complete and that *reflects their interests*.

2.3.2.2 Adults bring life experiences and knowledge to learning experiences

Adults prefer to be given the opportunity to use their existing knowledge base and life experiences, and apply them to their new learning experiences. The audiometricians' trainer should apply this principle as follows (Isenberg, 2007:15):

- *Find out more about the learners* - their interests and past experiences (personal, work and study related);
- *Assist them to draw on their previous knowledge and experiences* when solving problem, reflecting and applying clinical reasoning processes;
- *Facilitate reflective learning opportunities* which may also assist the learner to examine existing biases or habits based on life experiences and move toward a new understanding of the information presented.

2.3.2.3 Adults are goal-orientated

Adult learners experience a need to learn when they are confronted with real life tasks or problems. In a training programme for audiometricians this principle should be implemented through the following (Isenberg, 2007:16):

- *Providing meaningful learning experiences* that are *clearly linked* to personal, client and fieldwork goals as well as assessment and future life goals;
- *Providing real case studies;*
- *Asking questions* that motivate reflection, inquiry and further research.

2.3.2.4 Adults are relevancy orientated

Adult learners want to know the relevance of what they are learning for what they want to achieve. The trainer should therefore provide training relevance through (Isenberg, 2007:17):

- *Asking the learners to do some reflection* on what they expect to learn prior to the experience, on what they have learned after the experience, and how they might apply this knowledge in future, or how it will help them to meet their learning goals;
- *Providing them with a choice* in a fieldwork project by providing two or more options where learning is more likely to reflect the learner's interests.

2.3.2.5 Adults are practical

Through practical fieldwork experiences interacting with real clients and their real life situations learners move from the classroom and textbook mode to hands-on problem solving where they can experience firsthand how their learning material applies to real life situations and the work context. The training programme for audiometricians should have a practical component including the following (Isenberg, 2007: 17):

- *The trainer should clearly explain the clinical reasoning* when making choices about assessments, interventions and when prioritizing a client's clinical needs;
- *The trainer should be explicit* about how the skills and knowledge that the learners acquire are applied to the job and client group they will eventually be working with;
- *The trainer should promote active participation* by allowing learners to practice new skills rather than to observe only. The trainer should furthermore provide plenty of practice opportunities in assessment, interviewing and intervention with frequent repetition in order to promote development of skill, confidence and competence.

2.3.2.6 Adult learners want to be respected

Respect should be demonstrated to the learner in the training programme for audiometricians through (Isenberg, 2007: 17)

- *Taking interest* in the learners;
- *Acknowledging the wealth of experiences* that the learner brings to the training situation;
- *Regarding them as colleagues* who are equal in terms of life experience;
- *Encouraging expression* of ideas, reasoning and feedback at every opportunity.

2.3.3 Adult learning in the South African context

South African education emphasizes social responsibility, job orientation, political participation and spiritual and moral values (Nafukho et al., 2005:27). The South African context is unique in the fact that is truly a rainbow nation in terms of the languages spoken, different cultures and the different religious beliefs of the people living in it (Nafukho et al., 2005:25). Learning in South Africa refers to a process through which an individual gains knowledge, skills and attitudes

through some form of learning experience in terms of their individual cultural, linguistic and religious orientation. It could also refer to a method of being taught and then applying the outcomes to daily life (Fasokun, Katahoire & Akpovire, 2005:34-35). Learning in South Africa largely involves interaction between a source of knowledge, skills or change in attitude, the process of transfer and the learner as it relates to each learners unique cultural background (Fasokun et al., 2005:35). South African adults learn through experience in enabling conditions that facilitate the development of knowledge, skills, attitudes, aptitudes, values and interests as a large number of South African adult learners' cultural and religious belief enables this experienced-based learning process. This approach enhances problem solving performance, brings about change and/or solves practical problems (Fasokun et al., 2005:36). South African adult learners rely on structured forms of observation for achieving the goals of learning (Fasokun et al., 2005:36).

According to Fasokun et al. (2005:40), the following principles should be adhered to within the South African context specifically due to the nation's wide cultural and linguistic differences in the learning environments:

- Learning must be problem centred;
- Learning must be experience-centred;
- Learning must be meaningful to the adult learner;
- Learning must be interesting and engaging.

These principles should also be incorporated in a training programme for audiometricians in the following ways (Nafukho et al., 2005:31):

- Learning is achieved through observing and doing. Learners must be given ample opportunity to observe the desired outcomes and to practice it themselves;
- Joint and communal custody of knowledge and information is essential to South African adult learners. In a training programme, it should not be expected of the learners to acquire all the training outcomes by themselves, but they should engage in group activities where learning is facilitated by communal efforts;
- Equity, mutuality and respect among members of society should be present in the use and sharing of knowledge. No one learner is superior to the others and all should be respected and awarded equal opportunity to learn;

- Development and improvement of intellectual skills should be based on needs and desires. The outcomes of the training programme should be designed in such a manner that the learners will want to learn because it will improve their vocational abilities;
- Sharing and joint use of all types of resources, including the time and equipment available to practice the skills and knowledge taught should be encouraged;
- The instructional designer must focus his/her teaching skills on relaying information in such a way that it is practical, context-based and enables learners to get to the answer in their own way and time-frame.

Understanding, appreciating and promoting the cultural heritage of communities by relating the information taught to the cultural background of the learners to the highest possible degree is very important in the South African context as one can expect the adult learners to come from different cultural, religious, academic and linguistic backgrounds. This will enhance the instructional process and enable learner to retain information better and be more motivated to learn.

Adult learners must be motivated to learn (Fasokun et al., 2005:42). In training audiometricians, this can be achieved by the following techniques that are specifically aimed at the South African adult learners (Fasokun et al., 2005:42):

- Learning activities should be preceded by a warm-up activity that aims to get everyone in the mood for learning;
- Goal setting should precede every learning session. This should be done in collaboration with the learners in terms of the amount of work to be covered and the time frame for the specific lesson;
- Learning must be reinforced through feedback. Adults need to be aware of their progress in order to understand how to focus their learning efforts;
- Pacing and non-competitive approaches should be used by not subjecting everybody to unnecessary time pressures for the completion of tasks;
- The facilitator in the training programme for audiometricians should break down the body of knowledge and skills into small, logically arranged and manageable parts;
- Practical application of the learned knowledge and skills should be built into the training sessions to further facilitate learning;

- A relationship of trust should be built into the training programme for audiometricians by providing information promptly and comprehensively during training and also by communicating with the learners in an informal manner over tea and in break times.

In training adults in the South African context, it is important that the instructional designer keeps in mind that adult learning in Africa has existed long before the introduction of formal education and that South Africans have had ways of transferring knowledge, skills and attitudes from one generation to the next (Fasokun et al., 2005:34). It should be endeavoured to incorporate these principles of adult learning in a training programme for audiometricians in order to have a successful learner based programme.

2.4 Summary

The two most important theoretical concepts for this study are 'instructional design' and 'adult learning'. Instructional design can be defined as a continuing, systematic development of instructional specifications using researched strategies and principles to create detailed outcomes for the development, implementation, evaluation and maintenance of the training programme. The first principles of instructional design are the task-centered, integration, activation, application and demonstration of learning principles. Instructional design is centred on the learner, is goal orientated and has real world applications, measurable outcomes and empirical data; furthermore, it is a team effort.

The ADDIE model is used to describe the instructional design process incorporating analysis, design, development, implementation and evaluation. Instructional design procedures determine the goals of training audiometricians. Effective learning must take place in order to achieve these goals.

Adult learning as the second theoretical concept can, according to Knowles, be defined as the art and science of helping adults learn (Jarvis, 2004:28). This is based on the assumptions that adults need to know why they are learning; that they have a self-concept of being responsible for their own learning; that they come into the learning environment with their own experiences and that they are ready to learn; they are orientated to learning and motivated to learn. Adult learning

principles must be implemented in a training programme in order for the training to be successful.

South Africa has a very unique cultural and social orientation (Fasokun et al., 2005:42). When training South Africans learning should be problem-orientated, experience centred, meaningful, interesting and engaging. In the South African context, one is dealing with a unique population in terms of the work environment of the audiometricians as well as the cultural, linguistical and religious background of the adult learners. All aspects of adult learning as a whole and specifically for the South African context should be implemented if a training programme for audiometricians is to be effective (Fasokun et al., 2005:15).

CHAPTER 3
METHODOLOGY

3.1 Introduction

The main aim of this study is to develop a training programme for audiometricians by following the principles and phases of instructional design as explained in Chapter 2, i.e. analysis, design, development, implementation and evaluation of the programme (Branch, 2009:17). The analysis, design and development phases that form part of the methodology of this study.

Needs analysis

The instructional problem is identified and clarified in this first and fundamental phase. The instructional goals and objectives are established and the learning environment as well as the learner's existing knowledge and skills are identified as comprehensively as possible (Branch, 2009:18).

According to Branch (2009:18) the trainer as instructional designer should firstly identify and clarify the problem and address it according to the needs analysis that was done in the field of audiometry. This study focused on providing a solution for the need of a training programme for audiometricians. It is clear that a comprehensive, practical and standardized audiometric programme is currently not available. This highlights the immediate importance of ensuring that all audiometricians do have the necessary knowledge and training to be able to do hearing screening competently (De Koker, 2009). The needs of the current audiometricians, as well as those of the learners for whom this programme was designed, should be clarified as thoroughly as possible in order to develop an effective and comprehensive training programme.

The aspects that were defined and investigated in this phase include:

- Needs analysis;
- Learning outcomes and goals are developed according to the needs analysis;
- The manner of instruction as identified through the need analysis;
- The order of instruction.

In the analysis phase a complete description of the situation was developed and the results of this phase formed the basis of the instructional design phase.

3.2 Aims of the study

In order to conduct this study the following aims were identified and described.

3.2.1 Main aim

The main aim of the study is the instructional design of a training programme for audiometricians.

3.2.2 Sub aims

In order to realize the main aim, two sub-aims have been identified that will enable the researcher to develop the training programme.

3.2.2.1 Conducting a needs analysis;

3.2.2.2 Designing and developing a training programme for audiometricians.

3.3 Research approach and design

This study followed a quantitative research approach where a descriptive research design was used and the results were described in a qualitative manner. The focus of descriptive research is on the situation as it is (Cormack, 2000:213). The reason why a descriptive research design was followed is because the purpose of this design is to describe characteristics and phenomena observed by the researcher, in this case to determine what, according to practicing audiometricians, should be included in a training programme for future audiometricians (Thyer, 2010:120). The primary task of descriptive research is aimed at describing a social phenomenon when it is relatively new or needs to be described (Thyer, 2010:121). In this study, the type of training audiometricians need to be able to conduct effective and correct audiometric testing procedures as part of a hearing conservation programme, was described. This study used one type of descriptive research, namely survey research (Thyer, 2010:121). A survey describes a population and its size and also describes ‘what is out there’, in this study, currently practising audiometricians’ opinion regarding their own training as well as their perceptions as to what the training of future audiometricians should entail (Sapsford, 2007:3). First, a needs analysis had to be conducted in order to identify the need as to what should be included in a training programme for audiometricians.

3.3.1 Purpose of the needs analysis

The needs analysis was used in order to identify what should be included in a training programme for audiometricians within the South African context. To accomplish this, specific information was gathered and then used to determine how to carry out the rest of the instructional design process (Brown & Green, 2006:88-89). The important role that assessment of needs played was to provide information to the instructional designer about what knowledge and skills current audiometricians have or do not have. Conducting a needs analysis early in the instructional design process helps the instructional designer to identify the problem at hand. In this study the problem is that not all audiometricians are effectively trained to be able to conduct effective hearing screening in the industry, interpret the results of the hearing screening, refer appropriately, be able to develop a hearing conservation programme and/or to implement the programme (De Koker, 2009; Michell, 2010). A needs assessment is a systematic process of determining the goals of developing a training programme for audiometricians, identifying discrepancies between these goals and the current situation and establishing priorities for action. In respect to education a needs assessment is a process for determining what should be taught in order to close the learning gap that exists between the current condition and the desired condition (Gupta, 2007:13). In this study a needs assessment was conducted by utilizing a questionnaire as data collection tool to gather data in order to determine whether currently practising audiometricians feel a need for future audiometricians to be trained more effectively. The role players (currently practising audiometricians) were consulted in order to determine the different topics that they recommend to be included in the training programme that will be developed. A need is present when there is a discrepancy or gap between the way things ‘ought to be’ and the way they ‘are’. Thus, a normative need is a discrepancy between the individual or group’s present state and a given norm or standard (Brown & Green, 2006:90).

3.4 Participants

The criteria and procedure for participant selection as well as the description of the participants are discussed below:

3.4.1 Criteria for the selection of participants

The criteria for the selection of participants were carefully considered in order to eliminate as many variables as possible and thereby increasing the validity of the study. The criteria for participant selection were as follows:

3.4.1.1 Participants had to be currently practicing audiometricians

All participants had to be currently practicing as audiometricians as defined by the South African National Standard (10083:2004) and be registered with SASOHN at the time of the study. This ensured that all participants could legally practice in South Africa and should have the knowledge and training in audiometry to be able to make a worthwhile contribution to the study. According to the South African National Standard (SANS 10083:2004) the definition of an audiometrician is:

A person registered with the Health Professions Council of South Africa as an audiometrician or a hearing aid acoustician, or one of the following persons:

- A medical specialist in otorhinolaryngology;
- A graduate in speech therapy and audiology;
- A person who holds a certificate in audiometry issued by an institution recognized and approved by the Department of Labour or by the Department of Minerals and Energy, as relevant;
- An occupational medical practitioner;
- A person qualified in audiometric techniques from an institution registered with the South African Qualification Authority or any of its structures in terms of the South African Qualifications Authority Act, 1995 (Act No. 58 of 1995), and registered with SASOHN.

3.4.1.2 Experience

Participants must have had at least six months working experience in audiometry in South Africa. This ensured that they had the necessary knowledge and skills to work as audiometricians in the industry and were able to perform industrial hearing screening. Consequently they were also able to contribute significantly to the needs analysis that determined the content and

structure of the training programme. There was no limit to the maximum number of years of experience in practicing audiometry.

3.4.1.3 Location

The researcher distributed all the questionnaires electronically. This enabled the researcher to conduct the study countrywide as no personal interviews had to be conducted and more prospective participants were reached. Thus the researcher was not aware of where any of the respondents resided. Only participants who gave their informed consent was included in the study.

3.4.2 Participant selection procedure

A list of all audiometricians registered with SASOHN was obtained directly from the SASOHN office and all audiometricians who had valid contact details were contacted via electronic mail. Some audiometricians did not have any contact details listed or the contact details were no longer correct or in use and could not be verified. These audiometricians were not contacted to participate in this study.

3.4.3 Description of participants:

A total of 181 audiometricians participated in this research study. As specified in the selection criteria, all the participants were currently practicing audiometricians. In compliance with the set criteria, all participants (181/100%) had a valid audiometric certification.

All the participants (181/100%) had at least six months working experience and therefore complied with the corresponding criterion. The average number of years of experience of all the participants is 9.87 years, ranging from six months to 25 years experience (n = 181).

Participants had a wide-ranging age distribution that varied from 21 years old to 66 years old. The average age of all the participants was 46.55 years old (n = 181).

The participants have practiced audiometry in different environments as shown in Figure 3.2.

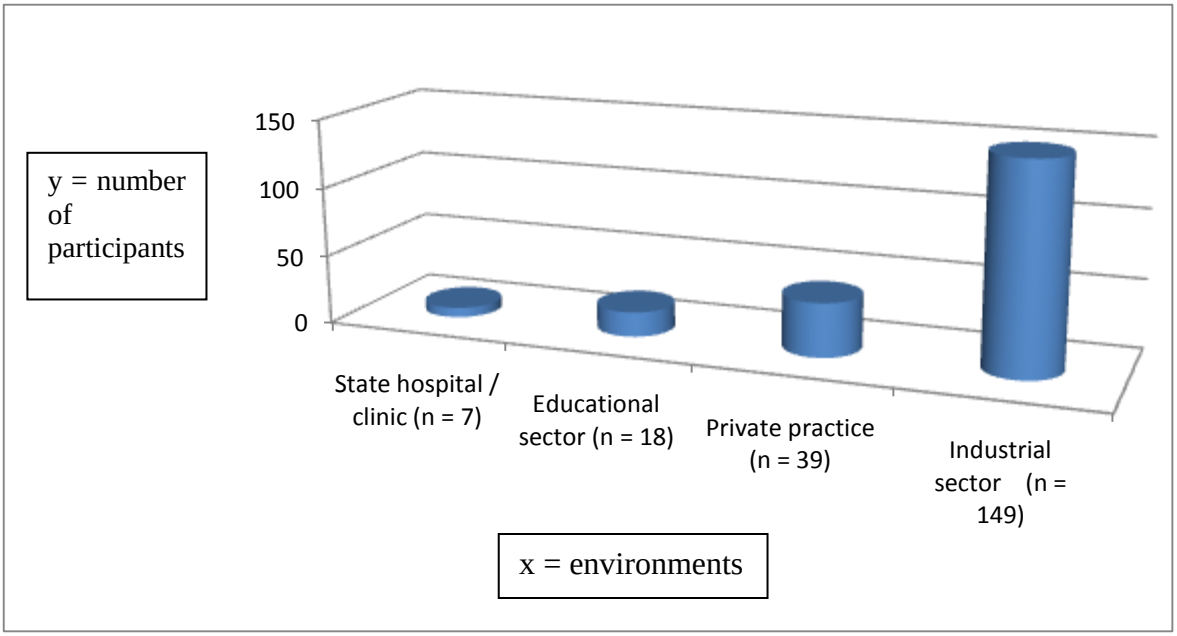

Figure 3.1: Environments in which participants have practiced audiometry (n = 181)

Audiometry can be practiced in various environments as can be seen in Figure 3.1. The participants have not necessarily practiced in one environment only. This is to be expected, since one audiometrician can perform audiometric testing in a variety of different settings. The most common environment where hearing screening testing is done is in the mining industry (De Koker, 2003:12). The majority of the participants (149/82.3%) were, at the time of the study, practicing audiometry in the industrial sector, which includes the mining industry.

Some participants have received additional training in audiometry beyond their audiometric certificate as is shown in Figure 3.2.

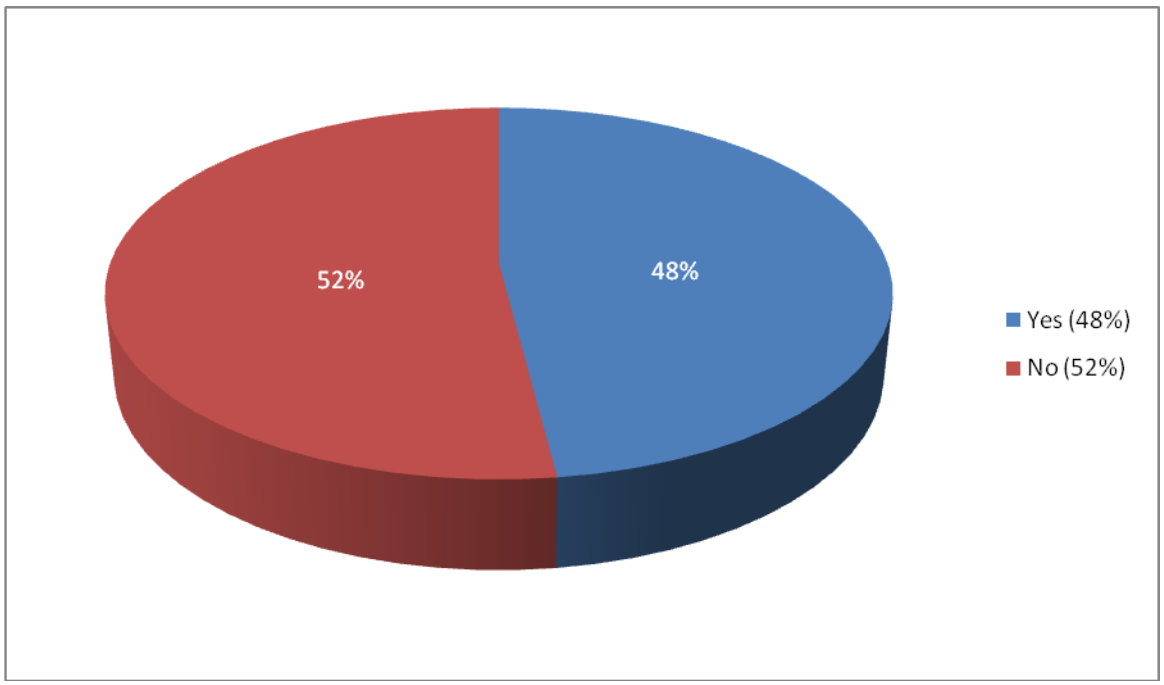

Figure 3.2: Participants with additional training in audiometry (n = 181)

Of all the participants, only 48% (87) have received additional audiometry training (n = 181). These participants then indicated what type of additional training they have received. The types of additional training is reflected in Figure 3.3 below:

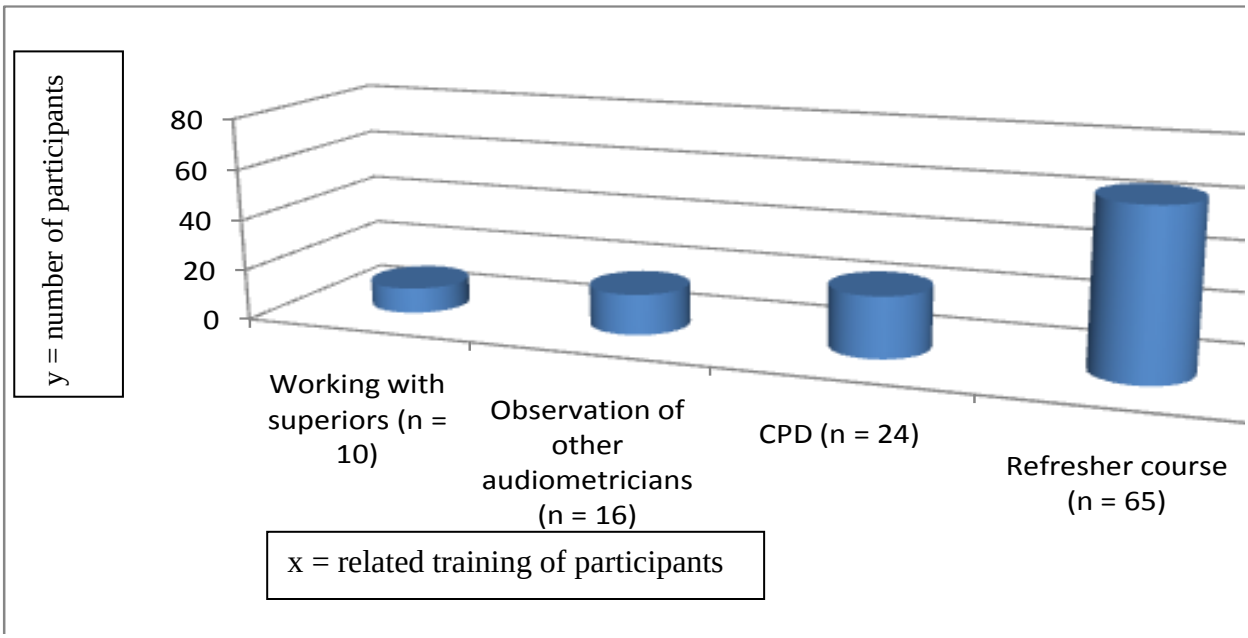

Figure 3.3: Additional training of participants (n = 181)

Of all the participants who have received additional audiometric training, the majority (65/74.7%) attended the *Refresher Course in Audiometry*, which is a one day course on the current South African legislation as the legislation has changed since 2003 (n = 87). When the legislation changed after November 2003, audiometricians who had already completed their training programme had to do this course in order to acquaint themselves with the new legislation (Michell, 2010; De Koker, 2009).

3.5 Material and apparatus

The following material and apparatus were used for the collection, recording and analysis of data:

3.5.1 Material for data collection

Before conducting the research, ethical clearance was gained from the Ethical Research Committee of the Department of Communication Pathology and the Research Ethics Committee of the Faculty of Humanities of the University of Pretoria (Appendix A).

The letters providing information regarding the study and requesting informed consent (Appendix B & C), the questionnaire (Appendix D & E) and the ethical clearance certificate from the University of Pretoria (Appendix A) were used as material for data collection.

In this study, data was collected using survey research, specifically by means of questionnaires. Questionnaires are survey instruments containing questions that can be completed by the respondents without the assistance of the researcher (Schutt, 2006:249). Questionnaires were used specifically because the participants were able to complete the questionnaires at their own time without the researcher being present for administration (Schutt, 2006:249). A questionnaire is defined as "a set of questions for obtaining statistically useful or personal information from individuals" (Wrenn, Loudon & Stevens, 2003:139). Questionnaires should be well designed in order to minimize the possibility of participants giving inaccurate answers. The reliability and validity of survey results are dependent on the way the specific questions are planned, constructed and executed (Wrenn et al., 2003:139). A questionnaire should be designed in such a way that it will provide the researcher with the required data. In this study, the aim was mainly to

determine the perceptions of practicing audiometricians on what should be included in a training programme for audiometricians as well as the participants' opinions on the training they themselves have received regarding audiometry.

Questionnaires should be designed to minimize, but not eliminate, dishonest and careless reporting (Dörnyei, 2003:16). In order to design a questionnaire effectively, certain steps should be taken as proposed by Dörnyei (2003:16-17). These steps are:

- Deciding on the general features of the questionnaire;
- Questionnaire design;
- Questionnaire content;
- Writing appropriate questions;
- Distributing the questionnaire.

How these steps were integrated in the design of the questionnaire used in this study, is explained in more detail below.

Step 1: Deciding on the general features of the questionnaire

This includes paying attention to the maximum length of time it will take to complete the questionnaire, the layout of the questionnaire and issues of confidentiality.

- Length

A questionnaire should not exceed the four to six page limit or the 30 minutes time limit to complete (Dörnyei, 2003:18-19). As the participants in this study were adult professionals, the questionnaire was therefore designed in such a manner to obtain the maximum amount of information in the shortest period of time. The questionnaires were mailed electronically to the participants and they could complete it at any time that was convenient to them. The questionnaire used in this study should have taken no more than 20 minutes to complete.

- Layout

In surveys where questionnaires are used, the main interface between the researcher and the participant is the actual questionnaire. The format and graphic layout carry a special significance and have an important impact on the responses. Some key factors that were kept in mind in the planning of the layout of the questionnaire for this study was that the questionnaire must appear concise, have the relevant information on a page without looking crowded and must be orderly and clearly marked in sections and questions (Dörnyei, 2003:19-21).

- Confidentiality

The main argument regarding confidentiality is that participants are more likely to give accurate or honest answers when they know that they cannot be identified (Dörnyei, 2003:24). In this study all questionnaires were mailed electronically, therefore complete anonymity was not achieved. However, on completion of the questionnaires, all questionnaires were randomly numbered and no actual names were used in the collection and analysis of the data. For all following purposes only these numbers were used. In this manner, confidentiality was maintained. The assurance of confidentiality was also communicated to the participants in the letter requesting informed consent (Appendices B & C).

Step 2: Questionnaire design

The main components of a questionnaire include the title, instructions (general and specific), questionnaire items (clearly separated from the instructions), additional information and the final expression of appreciation (Dörnyei, 2003:25-30). All of these components contributed to a questionnaire that was easy to read and had a clear layout so that all the components were grouped in a logical manner. By conducting a pilot study, the researcher ensured that no question included in the questionnaire, was repeated and that no question was ambiguous (Dörnyei, 2003: 30).

Step 3: Determining the content of the questionnaire

The contents of the questionnaire were designed in such a manner as not to threaten the reliability and validity of the study. Appropriate sampling of the content must specifically be considered at this stage of designing the questionnaire, as one cannot analyze what one does not

measure. It is therefore often recommended that the questionnaire design phase be preceded by a pilot study (Dörnyei, 2003:31). A pilot study was therefore conducted in this study. The pilot study will be explained in more detail in 3.5.2.

Step 4: Writing appropriate questions

There are two types of questions that are most frequently used in questionnaires, namely open ended and closed ended questions (Dörnyei, 2003:35):

- Closed-ended questions

These items do not require the participants to express their own opinion; instead, they are to choose amongst one of several alternatives, regardless of whether their preferred answer is amongst those provided or not (Dörnyei, 2003:35). In this study, the majority of questions were closed ended. According to Babbie and Mouton (2001:35), the advantages of closed-ended questions include the following:

- It saves time if the participant is familiar with the question subject;
- It increases the amount of information that is collected because participants usually understand these questions better than open-ended questions;
- The degree and validity of the participant's knowledge can be effectively determined.

A disadvantage is that important information might be lost if not all possible options were included (Babbie & Mouton, 2001: 36).

- Open-ended questions

These are questions that are not followed by response options for the participant to choose from, but rather by a blank space for the participant to write his/her own viewpoint on the matter at hand (Dörnyei, 2003:47). Advantages of open ended questions include the following (Babbie & Mouton, 2001: 36):

- If questions are well-formulated very specific and useful information may be gathered;
- The participant may provide additional information that might not have been elicited through closed ended questions.

Disadvantages of open ended questions are that they increase the time it takes to complete the questionnaire and are more difficult to analyze (Babbie & Mouton, 2001:36). For these reasons, only a few open ended questions were used in this study to elicit the additional information required from the respondents when needed.

3.5.1.1 Content of the questionnaire

The questionnaire's content will now be discussed according to these five logical sections:

- Demographic information / description of participants;
- Respondents' own experience regarding audiometry;
- Respondents' opinions regarding their own training programme;
- Duration of respondents' own training program;
- Respondents' opinions regarding a future training programme for audiometricians.

Demographic information / description of participants

The first seven questions of the questionnaire (Appendix D & E) focused on the demographic information of the respondents as well as the description of the respondents' qualifications. This gave the researcher an overview of the age (Question 1) and gender (Question 2) of the respondents. Furthermore, one of the selection criteria of the respondents is that every respondent must have a certification in audiometry and Questions three to seven focused on the respondents' qualifications.

Respondents' own experience regarding audiometry

Several different questions in the questionnaire (Appendix D & E) focused on the respondents' own experience regarding audiometry in terms of the environments in which they have conducted hearing screening (Questions 12 & 13), whether they work as part of a hearing health care team (Question 14) and indicating who is part of their team (Question 15). This section also included a question inquiring about the type of testing programmes the respondents used (Question 16) and the respondents' opinions regarding education of their clients in terms of NIHL (Questions 17 & 18). The respondents' knowledge regarding the current legislation was

also assessed (Questions 22 – 24). This section's information provided the researcher with background information against which the development of a future training program for audiometricians could have been evaluated. Recent literature on adult learning and instructional design assisted this process.

Respondents' opinions regarding their own training programme

This section of the questionnaire (Appendix D & E) elicited information of the respondents' own training program and provided the researcher with information to evaluate current training programmes for audiometricians against this study's proposed training program for audiometricians. The section included questions regarding the main topic(s) or theme(s) the respondents' own training programmes consisted of and the different audiometric procedures that was taught in these training programmes (Questions 8, 19 & 20). It also focussed on the type of audiometric testing procedures the respondents use when conducting hearing evaluations (Question 11). This information was contrasted against existing literature in the development of this training programme for audiometricians.

Duration of respondents' own training program

The information gathered from Questions nine and 10 of the questionnaire (Appendix D & E) determined what the duration of the respondents' own training programmes was. This information was used in the development of the proposed training program for audiometricians.

Respondents' opinions regarding a future training programme for audiometricians

This section of the questionnaire (Appendix D & E) was critical for the development of a training programme for audiometricians in that it provided the researcher with important information on the respondents' opinions regarding a future training programme for audiometricians. The respondents' opinions of the duration of a future training program (Question 21), the type of training audiometricians should receive (Questions 25 & 27); the evaluation methods for future audiometricians completing a training programme (Question 26); the content of such a future training programme (Question 29) and their opinions regarding the coordinator of such a training programme (Question 28) were gathered. The respondents also gave their opinion regarding the necessity of continuing professional development (CPD) points

(Questions 30 – 32) which was taken into account in the development of the proposed training programme for audiometricians.

3.5.2 Material and apparatus for data analysis

Data capturing was done using a *Microsoft Office Excel* software programme. The data of the questionnaires was captured on a spreadsheet and then sent for analysis to the University of Pretoria's Department of Statistics. The analyzed data was sent back to the researcher where all data was grouped in frequency tables to correspond with each question in the questionnaire. All data was used for data analysis purposes and no questionnaire was captured if it was not complete (n = 181).

3.6 Procedure of data gathering and analysis

The procedures for data gathering and data analysis are discussed below:

3.6.1 Data gathering procedure

The researcher contacted the SASOHN administrative office and was supplied with the contact information, specifically electronic mail addresses, of all the current practicing audiometricians on the SASOHN Database. The researcher contacted the audiometricians by electronic mail and every audiometrician who was willing to participate received an informed consent form (Appendix B & C) and a questionnaire (Appendix D & E) to complete and return either by electronic mail or by fax. Additionally, the researcher attended the monthly SASOHN meeting in the Gauteng and Pretoria areas in order to verify electronic mail addresses of attending audiometricians. These addresses were then used to distribute questionnaires to audiometricians who have attended the meetings.

Data collection was utilized by electronically mailed questionnaires. According to (Dörnyei, 2003:8) this method of data collection have several advantages but also some disadvantages:

Advantages of electronically mailed questionnaires:

- *Cost effective:* The cost involved in sending out electronic mail was very low as the researcher already had access to an electronic mail address as well as internet access. There was no setup cost involved and it was not required of the researcher to deliver the

mail to any fixed location such as a post office as would have been the case with hard copy questionnaires.

- *Speed:* An electronically mailed questionnaire can be sent and delivered in a matter of minutes and can also collect thousands of responses within a few days, depending on the number of people it was sent to.

- *Novelty:* The novelty element of an electronically mailed questionnaire often stimulates higher response levels than ordinary hard copy questionnaires.

- *All in a day's work:* Most professionals use electronic mail on a daily basis and the time and trouble it takes to complete the questionnaire are much less than having to complete a hard copy and mail it back to the researcher.

Disadvantages of electronically mailed questionnaires (Dörnyei, 2003:8):

- *Access:* The researcher as well as the participants must have access to and be in possession of an electronic mail address.

- *Control:* Some respondents may complete a questionnaire several times or send it to friends or family to complete and the researcher will have no control over who answers the questionnaire or the number of times one person sends a completed questionnaire back to the researcher. This could cause a duplication of data, but to the researcher's knowledge this did not happen.

- *Generalization:* When conducting an electronically mailed survey the results cannot necessarily be generalized to the whole population as people who use electronic mail are different from those who do not, even with matching demographic characteristics. Although the use of electronic mail is growing very rapidly, it is far from universal. Most people over 40 years of age do not use electronic mail and this can influence the results of the research study when only electronically mailed questionnaires are used. At this point in time electronically mailed questionnaires are best used within a corporate environment where the target population is known to have and use electronic mail. The questionnaires were sent to everyone on SASOHN's Database who indicated that they had an electronic mail address.

In this study the use of electronic mail surveys was not a barrier as the researcher, as well as the participants, had effortless access to electronic mail. All the participants were professionals and it was therefore assumed that all had experience in using electronic mail.

The only potential disadvantages of using electronic mail surveys were controlling who completed the questionnaire and what could be done if one respondent completed and sent more than one questionnaire. This problem was minimized by filing the responses received and the electronic mail addresses were checked to avoid duplicate responses.

3.6.2 Pilot study

An integral part of questionnaire construction is field testing or conducting a pilot study. This is an important phase of questionnaire design since a lot depends on the actual wording of the questionnaire. These trial runs allow the researcher to collect feedback on the effectiveness of the instrument as to whether it performs the function it has been designed to perform. Based on this information, changes can be made before conducting the final data collection (Dörnyei, 2003:63).

A pilot study could be defined as a small scale experiment designed to test the logistics of collecting information in order to improve the main study's quality and efficiency (Ruxton & Colegrave, 2006:2). A pilot study can reveal shortcomings in the design of the proposed study or procedure and these can be addressed before time and resources are spent on the main study (Ruxton & Colegrave, 2006:4). A pilot study is especially important when using a questionnaire to gather data, as it determines if the participants understand the questions correctly, determines the actual duration of time it takes to complete the questionnaire and also determines if the required data could in fact be obtained by using this tool (Meriwether, 2001:12)

According to Meriwether (2001: 12) reasons for conducting a pilot study include the following:

- It permits preliminary testing of the hypotheses that leads to testing more precise hypotheses in the main study. It may lead to changing some hypotheses or developing new hypotheses;
- It often provides the researcher with ideas, approaches and clues which may not have been foreseen before conducting the pilot study. This can increase the chances of getting better results when conducting the main study;

- It permits a thorough check of the planned statistical an analytical procedures, giving the researcher an opportunity to evaluate the usefulness of the data. If needed, changes can be made;
- It can greatly reduce the number of unanticipated problems because the researcher can redesign some of the methods to overcome difficulties that the pilot study reveals;
- It may save a significant amount of time and money. Should the research design not provide enough or the correct type of data, the study can be stopped or modified in order to ensure its effectiveness.

3.6.2.1 Pilot study procedure

The researcher distributed eight questionnaires to audiometricians practicing in the mining industry for more than two years. All eight selected audiometricians adhered to the selection criteria (as specified in 3.3) and completed the questionnaire. After conducting the pilot study the researcher contacted the participating audiometricians to determine if they had any ideas on improving the questionnaire.

3.6.2.2 Results of the pilot study

After conducting the pilot study only two changes to the questionnaire were recommended. Both changes were minor in the sense that it only served to clarify the questions the eight participants felt were unclear. These two questions were Question 6 and Question 8. Question 6 was changed from "Have you had any other training?" to "Have you had any other training (not mentioned in question 5)?". Question 8 was changed from "What was the main topic(s)/theme(s) of the training as mentioned above?" to "What was the main topic(s)/theme(s) of the training as mentioned in question 5?" No other changes were made and the questionnaires were distributed for the main study.

3.6.3 Data analysis procedure

The goal of data analysis is to classify, organize, summarize and generalize data obtained through data collection, in order to allow for convenient numerical evaluation of the available data (Maxwell & Satake, 2006:24). Appropriate statistical methods were applied to analyze and interpret the data obtained: namely descriptive statistics and content analysis. "Descriptive statistics are used to describe the basic features of the data in a study" (Maxwell & Satake,

2006:25). In descriptive statistics, the sample and the measures are summarized and form the basis of most quantitative analysis of data (Maxwell & Satake, 2006:30). According to Leedy and Ormrod (2010:45), content analysis is used to identify patterns by thorough and systematic examination of the contents of the data used in a study.

By identifying the clinical characteristics, the findings were related to the original research question. Comparisons were made between the original objectives of the study and the actual outcomes. The results obtained in this study were then compared to those of similar studies. The results either confirm or contradict the outcomes of previous research. New research questions may also arise. The practical as well as the statistical significance of the findings were determined and the limitations of the study were identified (Leedy & Ormrod, 2010:30).

In this study, the data was gathered by means of questionnaires, consisting of 32 questions per questionnaire. Only the information of the questionnaires that were completed in full was tabulated on to a single *Microsoft Office Excel* spreadsheet. The spreadsheet consisted of multiple rows using a number assigned to each respondent and a column for each question of the questionnaire. Closed-ended questions were indicated using binary values where “0” indicated a negative response and “1” a positive response. This data was used in a quantitative manner and the data was summarized in frequency tables and graphically represented in bar and pie charts. Open-ended questions were tabulated where each answer of the respondents were used for qualitative description.

3.7 Ethical considerations

In order to conduct research that is fair to all participants and do not cause any harm, ethical considerations need to be taken into account. Research ethics also determines legally and morally acceptable behaviour when conducting a research project (Neuman, 2006:43). In this study, three ethical considerations were taken into account, namely informed consent, ethical clearance and confidentiality. These are discussed in more detail in the following section.

3.7.1 Informed consent

It is important that the research participants were given the choice of withdrawing from the study at any given point without any harmful or negative consequences. In this research study,

withdrawing from the project would not have had a negative impact on the professional's name, work environment or his/her ability to conduct hearing screening.

Each participant received letters providing information (Appendix B & C) and explaining the research study. In case the participant had any questions regarding the letter content, he/she was encouraged to contact the researcher in this regard. Each participant was able to contact the researcher. In the correspondence between the researcher and the participants the researcher's contact details, including the telephone number and electronic mail address of the researcher, were made available to them.

3.7.2 Ethical clearance

Ethical clearance was obtained from the University of Pretoria's Research Ethics Committee (Faculty of Humanities) and the Research Committee of the Department of Communication Pathology (Appendix A) in order to ensure compliance with the requirements of these bodies. Data collection only commenced after this clearance was obtained.

3.7.3 Confidentiality

The main argument to ensure confidentiality is that participants are more likely to give accurate or honest answers when they know that they cannot be identified (Dörnyei, 2003:24). In this study, all questionnaires were mailed electronically to the participants. The researcher numbered the completed questionnaires in order to ensure anonymity and confidentiality. Participants' identifying information was not at any stage used as part of the data analysis or description of results. As the collected data was numbered, only the numbers were used in the analysis and description of the results.

The following steps were also taken to ensure confidentiality:

- The names and personal information of the participants have not been published in any written documentation;
- The participants were not required to disclose any personal information or identify themselves in the questionnaire.

- No participant has in any way been harmed through participating in the study;
- All participants have been made aware of the relevance of this study with regard to their contribution to the profession.

3.7.4 Validity and reliability

While reliability and validity of you measurements are important in clinical research, even more so it is essential in questionnaire research (Leedy & Ormrod, 2010: 28). Reliability refers to how precise the measurement is and can be assessed by determining how consistent a measuring instrument is. Validity is to what extent the information can be generalized and whether the measuring instrument measures what it intends to measure. Validity refers to the extent to which an empirical measurement accurately reflects the concept it is intended to measure (Leedy & Ormrod, 2010:27). Validity is determined by internal and external validity. These are two different but very related dimensions (Leedy & Ormrod, 2010:28).

The degree to which the research design allows the researcher to make inferences about relationships within the data, is known as *internal validity* (Leedy & Ormrod, 2010:34). According to Leedy and Ormrod (2010:35) internal validity is especially important in experimental designs, but should still be considered in any research study. As this particular study does not make use of variables and is not aimed at determining cause-and-effect relationships, it is not an experimental study. Several strategies, one of which is known as triangulation, can be used to ensure that the study is internally valid. Triangulation was used to increase the probability that the results described are representative of the information obtained from the questionnaires as well as the clinical files of the subjects. In this study common themes, which appear in the data collected were identified (Leedy & Ormrod, 2010:38).

The extent to which the results of the study represent the larger population and can be generalised to other contexts is referred to as *external validity* (Leedy & Ormrod, 2010:30). In this study, only 181 audiometricians participated in the study and can thus not be seen as respresentative of audiometricians in the entire South African population.

The completeness of data collection is referred to as *content validity*. This refers to how well the data collected represents the specified population (Leedy & Ormrod, 2010:42). This highlights

the importance of selecting the correct questions to be included in the questionnaire. By ensuring that the questionnaire contained questions concerning the established as well as other possible training and educational factors, the aim was to achieve high content validity.

Validity of this study was ensured by the following:

- Previous studies and a variety of recent literature were used in compiling the questionnaire to ensure that the appropriate data was collected to answer the research question. This ensured content validity;
- The validity of this study was increased by the fact that a pilot study was carried out. This ensured that the measurements made truly measure the concept that it intended to measure and that the questions asked in the questionnaire were valid and clear. This increased the comprehensibility of the questionnaire.

The extent to which errors occur in the study is reflected by both the validity and reliability of the study. Reliability refers to the consistency and stability of the data collection instrument, in other words whether or not the results are replicable (Shipley & McAfee, 2004:10). There are various types of reliability. The type that is of primary concern to this study is commonly referred to as *rater reliability.*

Rater reliability can be divided into two categories; when one individual administers the same test on more than one occasion and the results obtained are consistent, *intra-rater reliability* is attained (Shipley & McAfee, 2004:12).

The second category of rater reliability is referred to as *inter-rater reliability*. This is determined when two or more individuals conducting the same test obtain the same results (Shipley & McAfee, 2004:15). As a questionnaire was sent electronically to each participant, the researcher was not present while the subject completed the questionnaire. The data obtained will therefore remain consistent, regardless of who conducts the research.

As the outcome of this study was dependent on the questionnaires' answers, the questionnaire needed to be as objective as possible. To ensure that the results remain as objective as possible,

the questionnaire was set up in such a manner to reduce subjectivity, using a majority of closed ended questions.

Reliability in this study was ensured by the following:

- Inter-rater reliability was ensured as the researchers were not involved in the completion of the questionnaire;
- Questions on the subjective opinions of subjects were avoided to ensure reliable, objective answers;
- Prior to the onset of the study, the researchers had had no personal contact with any of the subjects in the study, ensuring the researchers' objectivity;
- Sufficient explanations in the cover letter ensured that subjects understood the aims and implications of the study as far as possible.

3.8 Summary

The main aim of this study is to design a training programme for audiometricians using the principles of instructional design. In order to achieve this aim a needs analysis was conducted and a training programme was designed and developed. This study followed a descriptive research design where data was quantitatively gathered and results were described in a qualitative manner. Questionnaires were designed and then used as data collection apparatus. Participants received and returned the questionnaires electronically. Participant selection criteria were determined in terms of the participants' experience, location and qualifications.

The validity and reliability of the study was discussed as well as the ethical considerations and confidentiality. Respondents were fully informed of the expectations of the researcher and no harm was done to any respondents.

This chapter outlined the methodology of the study that was followed in order to obtain the data that was used to develop the training programme for audiometricians. These research results will be discussed in the next chapter.

CHAPTER 4

RESULTS OF THE NEEDS ANALYSIS

4.1 Introduction

The aim of this chapter is to present, discuss and interpret the research results and to evaluate these against the framework of the body of knowledge set out in the discussion of the theoretical concepts. The main focus was to use the obtained information to design a training programme for audiometricians.

4.2 Results of data collection

A total of 181 completed questionnaires were received and used for data analysis. The audiometricians who participated in the study are henceforth referred to as *respondents*. The results of responses to Question 1 to Questions 7 (demographic information) were already discussed as part of the description of the respondents in Chapter 3. Responses to the remaining questions (Question 8 to Question 32) are discussed in the pertaining sections below.

Respondents' own experiences and knowledge with regard to audiometry as well as their experiences and opinions regarding the training they received in audiometry, were used to determine the need for a comprehensive training programme for future audiometricians and to design such a training programme. The results of the data collection were divided into four sections based on a logical grouping of themes. These sections are presented below:

4.2.1 Respondents' own experience regarding audiometry

The respondents' own experience regarding audiometry includes the environment in which they conduct hearing screening evaluations, mainly industrial settings. Industrial audiometry mainly focuses on NIHL. For the purposes of this study, henceforth the term 'employee' will be used to refer to any person whose hearing is tested in the industrial setting as part of a HCP, e.g. mineworkers.

The *National Institute for Occupational Safety and Health* (NIOSH, 1998) calculates that a lifetime's exposure to excessive noise above 85dB SPL will cause an excess risk of 15% of those employees suffering from such a disabling hearing loss. The purpose of a hearing conservation

programme (HCP) is to prevent employees from developing NIHL at any time during their working career (Royster & Royster, 1990:1). Effective HCPs hold benefits for both the employer and the employee in terms of time, money and quality of life (Royster & Royster, 1990:4). The five key roles of a HCP is sound survey, engineering and administrative controls, education, hearing protection and audiometric monitoring. In terms of audiometric monitoring, audiometric testing is done on all employees in any environment where the noise exceeds 85dB SPL. These environments can range from the mining industry to factories or industries where production takes place. According to the responses on Question 13 of the questionnaire, respondents indicated that, collectively, they have experience of industrial hearing screening in all these environments. These results are illustrated in Figure 4.1.

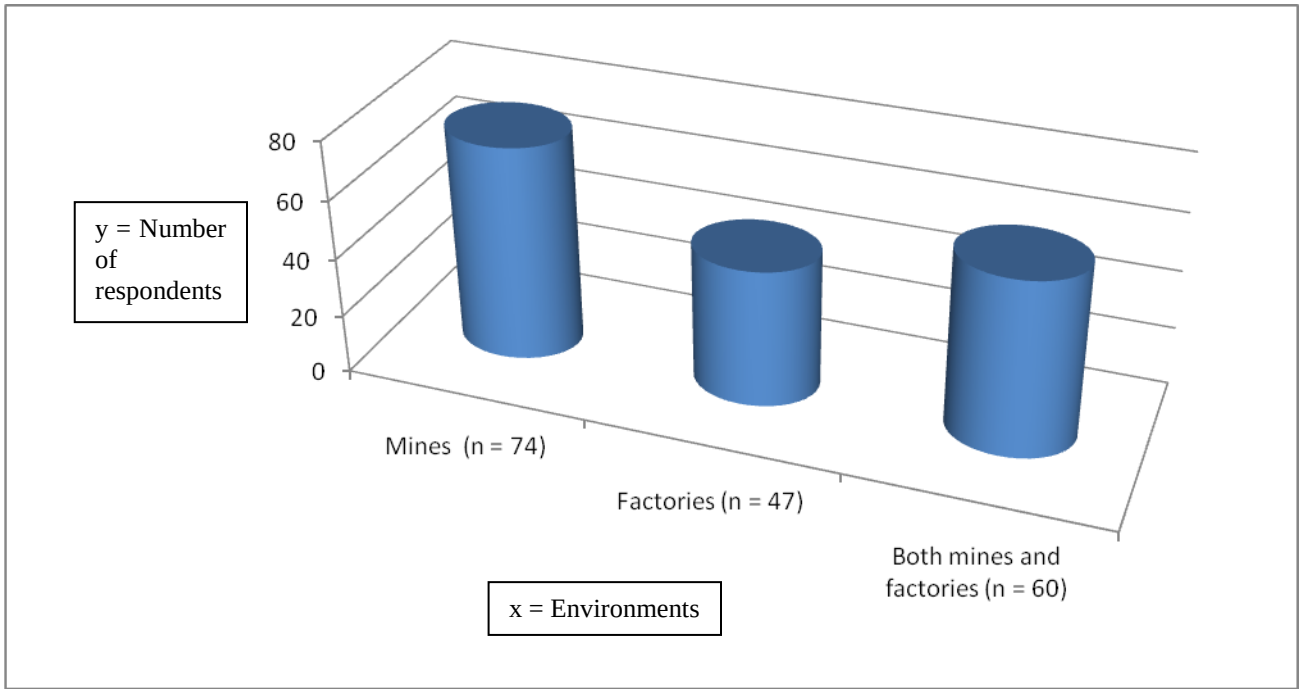

Figure 4.1: Environments in which respondents conducted hearing screening tests (n = 181)

As illustrated in Figure 4.1, hearing testing was mainly done in three environments. Seventy four respondents (40.9%) conducted hearing screening tests only in mines, 60 respondents (33.2%) have conducted hearing screening test in both mines and factories and the minority of the respondents (47/26%) have conducted hearing screening tests in factories only (n = 181). Therefore, the majority of the respondents, namely 134 (74%) have conducted hearing tests in mines (n = 181). There are two specific pathologies that are unique to the mining environment

where they also have a high prevalence, namely barotrauma and middle ear pathologies (Habig & De Koker, 2004:1). According to Habig and De Koker (2004:1) mineworkers show a high prevalence of outer and middle ear abnormalities due to unhygienic and overcrowded living and working conditions. A combination of these unfavourable environmental and socio-economic factors may pose a potential health risk to a significant portion of South Africa's population (Habig & De Koker, 2004:1). Furthermore, mineworkers may be subjected to the risk of middle ear damage from explosions or from sudden changes in atmospheric pressure which may lead to barotrauma (Workmen's Compensation Commissioner Instruction 171, 2001). Barotrauma can be defined as tissue damage that occurs when pressure in a gas-filled space (e.g. the middle ear cavity) is not equalized to changing ambient pressure (Habig & De Koker, 2004:2). The focus of the training programme for audiometricians should therefore be directed to specific environmental factors that are unique to this specific industry. In the mining industry, for instance, it would be necessary to focus on audiometricians' ability identify middle ear pathology and to make the necessary and appropriate referrals as this is where most of the respondents have had experience with regard to audiometry.

According to Habig and De Koker (2004:1), otoscopy identified 49.7% of the 181 employees they have tested as having an active or previous middle ear problem. This emphasizes the need for otoscopic examination to identify outer and/or middle ear pathologies as these pathologies may have a negative impact on pure tone screening results (Habig & De Koker, 2004:2). The second evident pathology in the mining industry is barotrauma. The mine Occupational Health personnel in the study done by Habig and De Koker (2004:2) were found to have insufficient knowledge regarding middle ear barotrauma. This implies that audiometricians testing in the mining industry should be adequately familiar with barotrauma in order to make appropriate decisions regarding referral and further assessment of affected workers. Adequate information regarding the predisposing factors which may increase the risk of barotrauma should therefore be included in the training course for audiometricians in order to ensure that the correct course of action is taken when these risk factors are identified during a hearing screening testing procedure. Legislation (Workmen's Compensation Commissioner Instruction 168, 1995) stipulating compulsory annual hearing screening tests as part of a hearing conservation programme was put in place in South Africa in 1994 (Clark, 2004:20). Since then audiometricians have been employed by mines in order to comply with this regulation (Clark,

2004:21). Hearing screening testing should include otoscopic examination in order to determine if any outer ear pathologies are present at the time of testing (SANS 10083:2004).

In South Africa there are two additional pathologies that are unique to the mining industry, namely the high prevalence of HIV/AIDS and pulmonary tuberculosis (TB). Researchers at the University of Oxford, Brown Universities, the University of California, San Francisco and the London School of Hygiene and Tropical Medicine estimate that the mining industry in Africa may be implicated in as many as 760,000 new cases of tuberculosis each year. This is mainly due to factors such as silica dust in mines, crowded working and living conditions, and the spread of HIV (Science Daily, 2010:1). Tuberculosis has been on the rise in Sub-Saharan Africa over the past 20 years with a doubling in the annual incidence from 173 to 351 per 100,000 people between 1990 and 2007. These rises are largely the result of the growing HIV epidemic, but the data also shows that HIV is only one of several factors involved in the spread of TB in the region (ScienceDaily, 2010:1). The factors mentioned above need to be taken into account when training audiometricians on how to conduct a hearing test on employees, as it increases the likelihood of middle ear infections and in effect can influence the results of a pure tone screening test. Incorrect testing may have a negative influence on the employee and also increase the costs involved in assessing the employee, as the test should be repeated at a later date, involving more costs to the industry. Another problem in the mining sector is infection control and the manpower to enforce infection control which again increases costs to the company. Industries may also have to pay compensation to miners with a hearing loss, which may not be due to noise but rather due to or exacerbated by middle ear infections, again increasing costs. A training programme for audiometricians should therefore focus on all types of hearing loss, and how to differentiate between, for example, a NIHL and other types of hearing loss, or a combination of types of hearing loss. This can aid in reducing costs to the company as only the employees who should rightly be compensated will then be compensated.

As industries and corporations continue to cut back on expenses, medical departments are usually among the first to feel the effects of these cutbacks in the form of staff downsizing (Sataloff & Sataloff, 2006:761). As a result, hearing testing is often not done timeously. One solution for this predicament is to hire a mobile hearing testing service to perform the hearing testing (Sataloff & Sataloff, 2006:761). Thus, industrial hearing screening can also be done in a

mobile unit. According to the responses from the respondents to Question 12 of the questionnaire, the majority of respondents had not previously tested hearing in a mobile unit as illustrated in Figure 4.2.

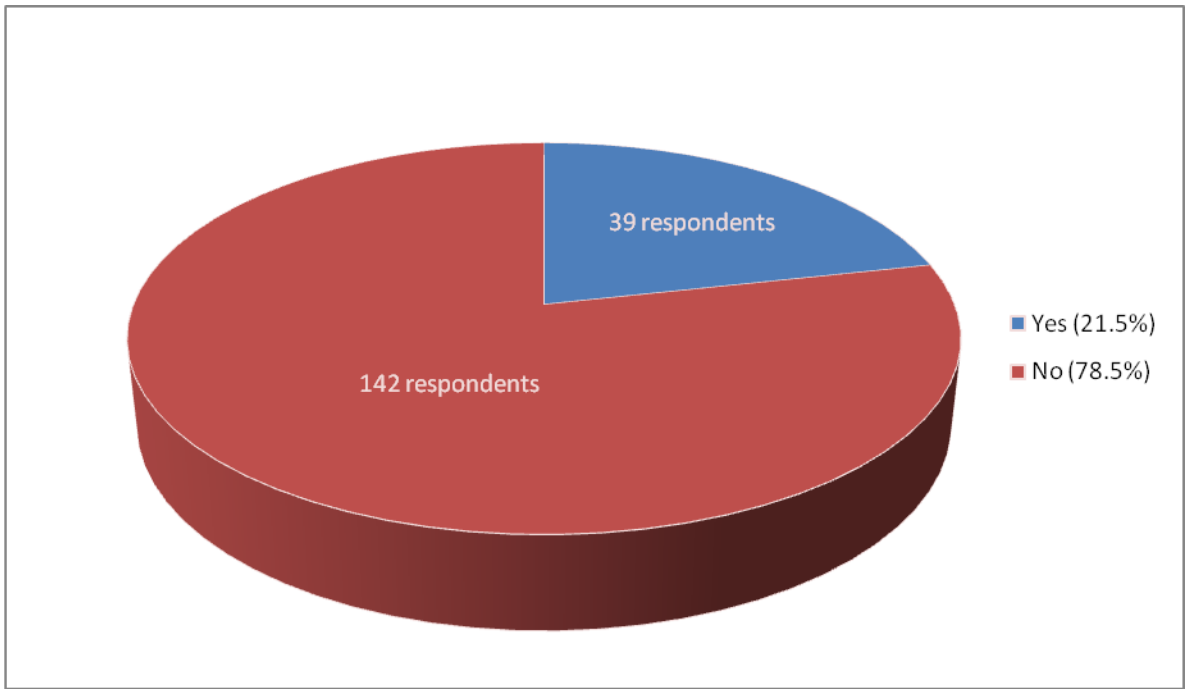

Figure 4.2: Hearing tests conducted by audiometricians in a mobile unit (n = 181)

According to Figure 4.2 above, the minority of the respondents (39/21.5%) have utilized mobile facilities to conduct hearing screening tests (n = 181). Company management will find it easier to have all of their employees' hearing tested if the person/s delivering these services can conduct the tests at the workplace (Berger, Royster, Driscoll & Layne, 2003:464). Mobile testing units are an alternative to staffing and equipping an in-house audiometric facility (Berger et al., 2003:460). By using a mobile hearing testing facilities the company does not need to employ permanent staff to be available for conducting these tests on a daily basis. The majority of the respondents (142/78.5%) have never done hearing tests in mobile facilities and therefore it is assumed that they have done the testing only at an in-house audiometric facility. In-house audiometry facilities are probably more convenient for employees since testing can usually be done during any workday and is not a service that is only offered on certain days and times, as would be the case when an outsourced company does the testing in a mobile testing unit (Berger et al., 2003:465). Whether testing is done at an in-house facility or in a mobile testing unit, the focus of the training should still be on the testing procedure and referral process to other health care professionals, regardless the place of testing. Therefore, audiometricians should be trained

to use different types of audiometers, be able to conduct hearing tests in different environments and be able to apply the relevant legislation (SANS 10083:2004) specifically for mobile testing facilities, with or without the support of a hearing health care team.

According to responses obtained on Question 14 of the questionnaire, the majority of the respondents (136/75%) work as part of a hearing health care team as depicted in Figure 4.3.

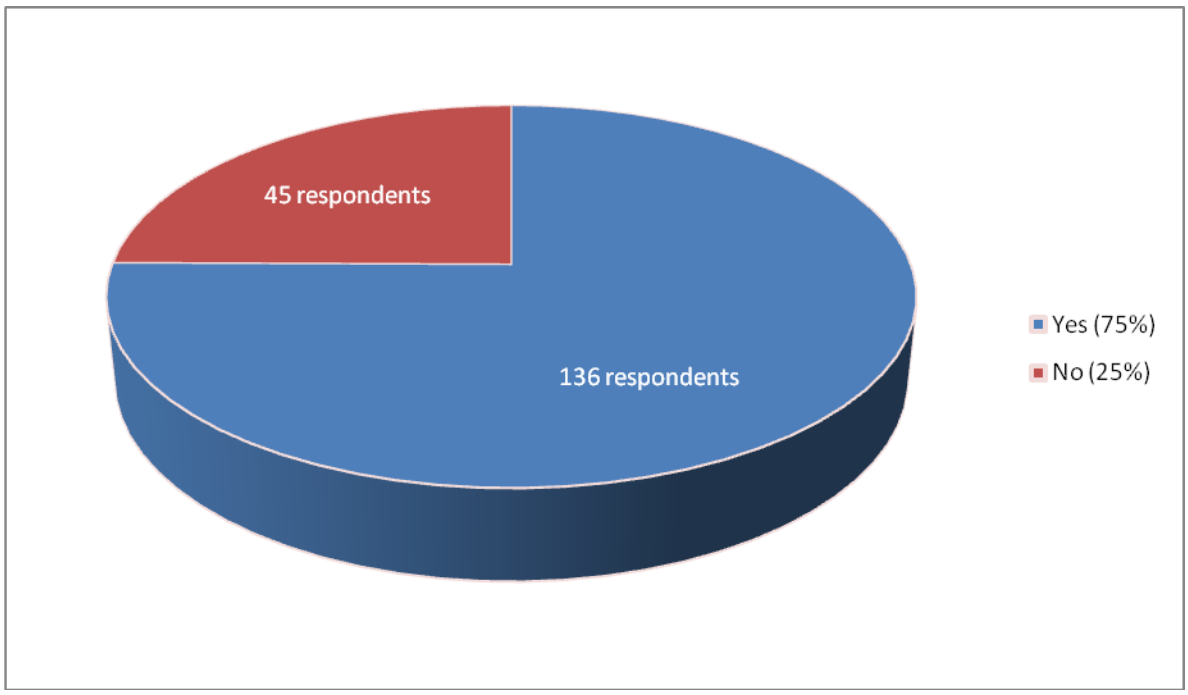

Figure 4.3: Respondents who have indicated to be part of a hearing health care team (n = 181)

As illustrated in Figure 4.3, 136 respondents (75%) indicated that they do work as part of a hearing health care team. According to the respondents, this team may consist of several different professionals, including ear, nose and throat specialists (ENT), general practitioners (GPs), audiologists, other audiometricians, occupational health nurses (OHN), occupational medical practitioners (OMP) and general ward nurses. Depending on the type of referral needed, an employee with a hearing loss should be referred to one or more of these professionals. Each member of the team is uniquely equipped to deal with the different treatments an employee with a hearing loss may require, depending on the type, severity and cause of the hearing loss. Without a comprehensive perspective on hearing loss through a team approach, it is possible that an incorrect diagnosis may be made and that treatment may not be effective (Hosford-Dunn, Roeser & Valente, 2008:66). The aim of a HCP is effective hearing testing within a HCP and

ineffective teamwork can influence a HCP negatively. Therefore, specific training should be given to audiometricians regarding the individual role and importance of each team member.

Considering the importance of a hearing health care team, Figure 4.4 indicates the members of the hearing health care team of which respondents form part (data obtained from Question 15 of the questionnaire):

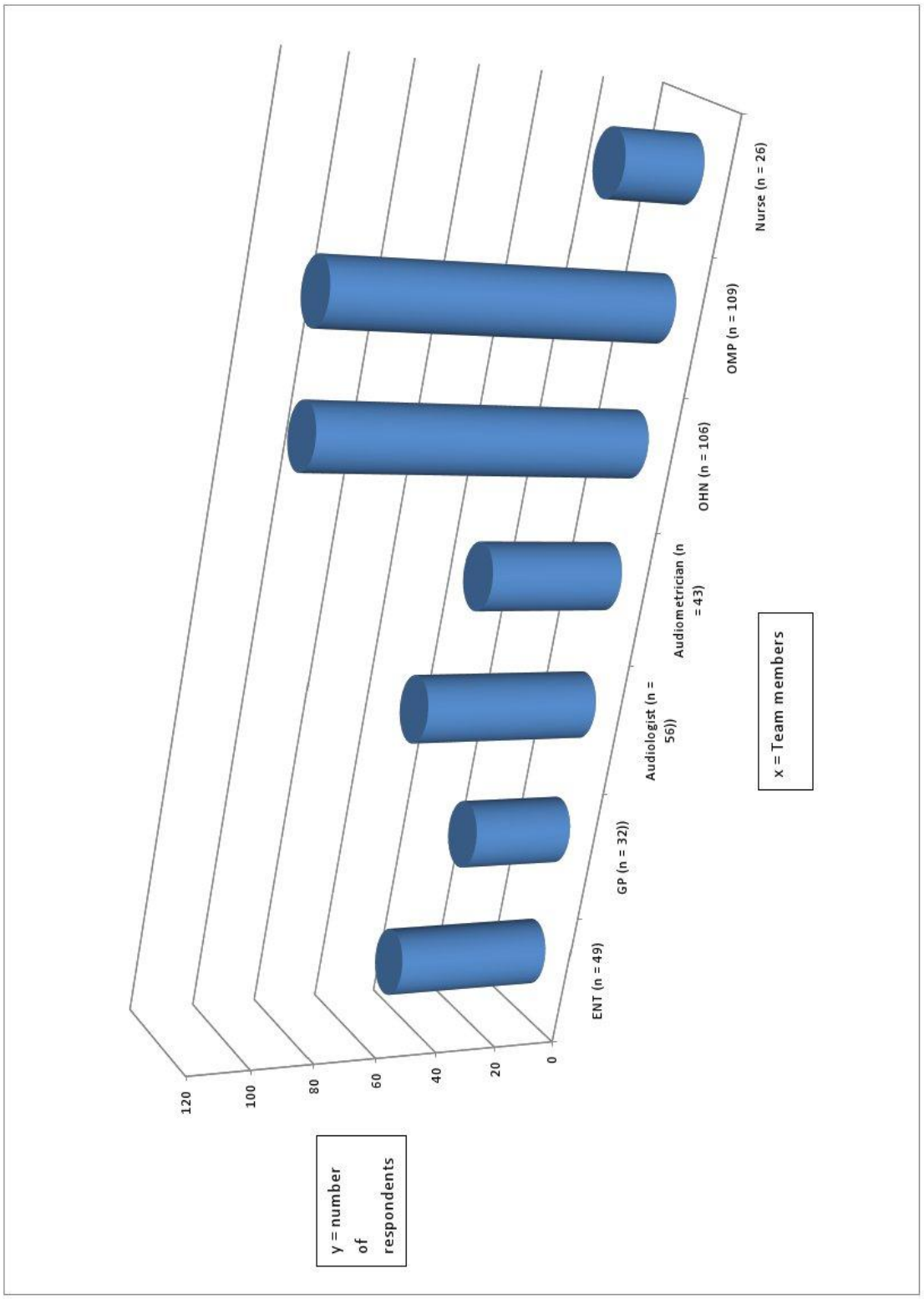

Figure 4.4: Members of a hearing health care team which respondents form part of (n = 136)

Figure 4.4 illustrates that of the 136 respondents who have indicated that they work as part of a hearing health care team, the majority (109/80.1%) worked with an occupation medical practitioner (OMP) and 106/78% with an occupational health nurse (OHN) (n = 136). Only 56 respondents (41.2%) indicated that their team also included an audiologist. It is unclear why less than half of the respondents' hearing health care team included an audiologist since an audiologist would be the preferred professional to conduct a diagnostic hearing evaluation on an employee (Roeser, Valente, Hosford-Dunn, 2007:14).

When an employee is referred for a compensation claim, the documentation that should accompany the claim should include a medical report from the OMP and a diagnostic audiogram from the audiologist, otherwise the claim would not be processed (RMA Guideline, 2008:5). SANS (10083:2004) requires that an employee with a hearing threshold shift or percentage loss of hearing (PLH) of more than 10% has to be referred to an audiologist for a diagnostic hearing evaluation. Such a diagnostic evaluation consists of several tests, including otoacoustic emissions (OAEs), air and bone conduction thresholds, speech reception and discrimination thresholds and immittance measurements; these may only be conducted by an audiologist (SANS 10083:2004). For this reason it is important to have an OMP and an audiologist on a hearing health care team (De Koker, 2009). Each team member has a specific role and responsibility when a person with a hearing loss is involved. A training programme for audiometricians should therefore focus on the different team members that should be included in a hearing health care team as well as each team member's unique function.

It is important to refer to other team members, thereby enhancing the probability of an accurate diagnosis and in this way the overall effectiveness of the HCP may be improved. In response to Question 15 of the questionnaire only six (4.4%) of the 136 respondents who does work as part of a health care team, indicated that they refer, when necessary, to all the health care members involved in the treatment and/or diagnosis of a person with a hearing disability. This may indicate that the management of a client still takes place in isolation and that, when it comes to hearing health care, there is not yet an established sense of team work in the mining industry. Different team members may have different professional opinions regarding the same case because each team member's primary focus should be on a different aspect of the case and as such a more holistic and comprehensive approach may come about (Roeser et al., 2007:16). The focus of the training programme for audiometricians should therefore not solely be on the

hearing testing procedure, but should also include the different referral criteria in order to facilitate a holistic approach to treatment and the role of the different team members in this process should be recognized. This may facilitate a more comprehensive approach to hearing health care in the mining industry.

As part of a comprehensive approach to hearing health, a hearing test should also be conducted. The results of this hearing test may be obtained by using either manual testing procedures or computer based programmes that test the employee's hearing automatically, without the audiometrician having to test each frequency manually. Automation of healthcare services is becoming increasingly important in the light of the global shortage of specialized healthcare personnel (Swanepoel, Mngemane, Molemong, Mkwanazi & Tutshini, 2010:1). For conducting computer based hearing tests, several different software programmes are available that can conduct and store the hearing test results. These programmes have different features and operating techniques, but they are all able to generate a print-out of the employee's hearing test results after the test have been completed. Automated audiometers do not require an audiometrician or any other health care worker to physically conduct the testing procedure at each test frequency because signal presentation levels are under software control (Stach, 2003:35). The advantage of using an automatic testing method is that it is quick and simple and does not require the audiometrician to effectively search for thresholds. However, the disadvantage of automatic systems is that it removes the audiometrician's control over the testing speed and the intervals of testing and it can be more easily manipulated by the employee (De Koker, 2009). Therefore, the audiometrician needs to be comprehensively trained to be able to conduct accurate hearing testing and interpret the results of the test rendered by either manual or automated audiometers. The importance of manual testing is evident when considering the unique population of the mining industry. According to De Koker (2003:19) pseudohypacusis (the feigning or exaggeration of a hearing loss), plays a significant role in a population with a high prevalence of NIHL, such as the mining industry. It is therefore important to consider the impact that pseudohypacusis may have on pure tone screening procedures. Using automated testing procedures does not always take pseudohypacusis into account and as such can be less effective than manual testing procedures where the person conducting the test has more control over the testing procedure and environment (De Koker, 2003:34). If the person conducting the test has sufficient knowledge of the testing procedure, as well as the signs and risk factors for

pseudohypacusis, manual testing may be more accurate than automated testing. The main focus of the training programme for audiometricians should therefore be on the testing procedure itself, understanding the risk factors and signs of pseudohypacusis and also on training the learners how to optimally control the testing procedure and environment in order to obtain reliable results despite the prevalence of pseudohypacusis.

Automated testing procedures are used in various mines and other industries and therefore Question 16 asked the respondents who indicated that they use automated testing programmes which testing programme they used. Their responses are reflected in **Figure 4.5.**

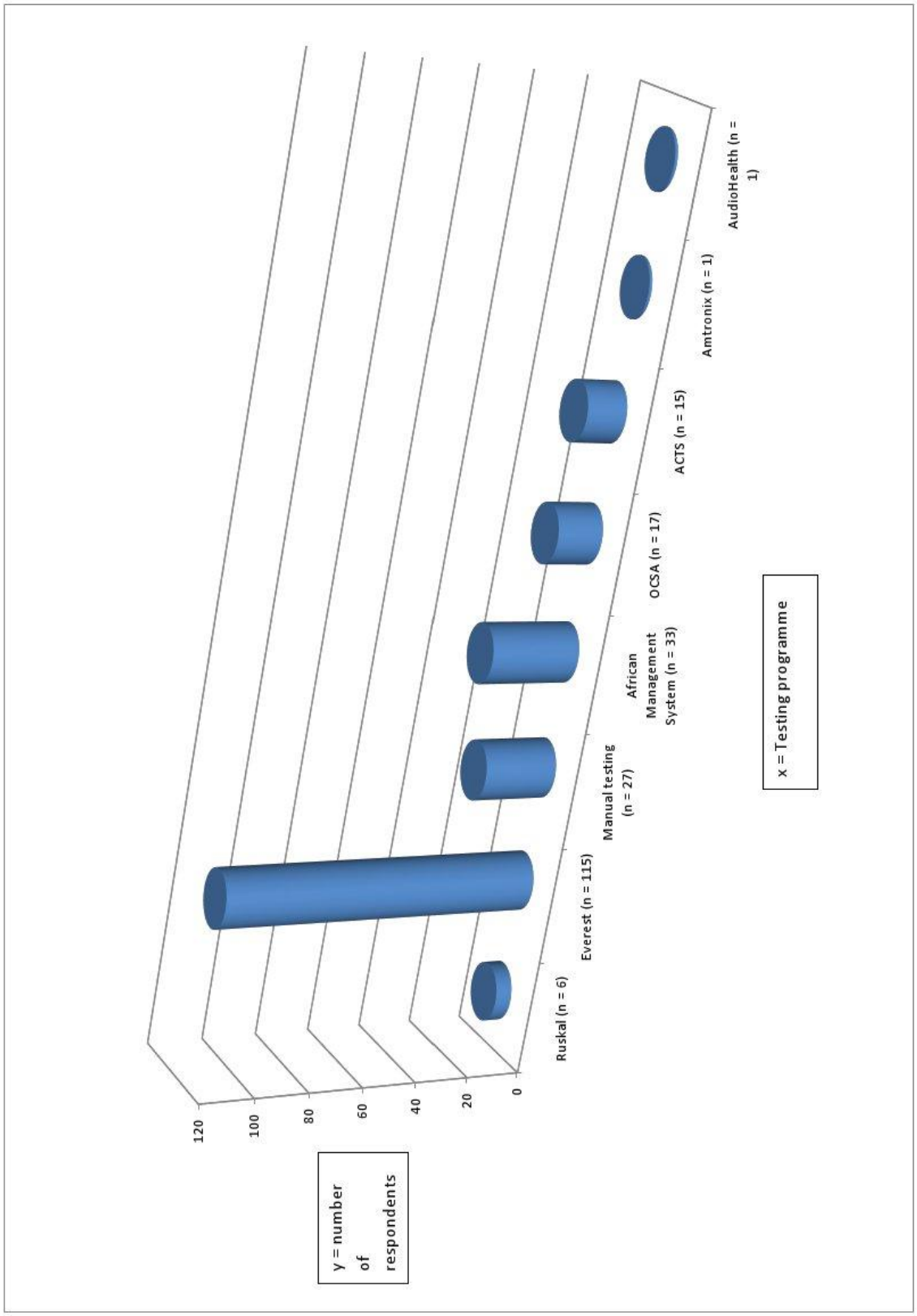

Figure 4.5: Type of testing programmes used by respondents (n = 181)

According to the data obtained through Question 16 of the questionnaire, the majority of the respondents (115/63.5%) used *Everest* as indicated in Figure 4.5. *Everest* is one of the available automatic testing programmes and it is not clear why this specific software programme is so popular among mining companies, or which features are unique to this programme. Automated audiometry is a tool that has the potential to increase accuracy and decrease costs associated with routine hearing testing (Margolis, 2005:3). Automated audiometry first came into widespread use in the industry and the military (Ho, Hildreth & Lindsey, 2009:5). Numerous attempts have been made to validate automated audiometers but there is still a need for audiologists to perform manual pure tone testing on selected employees, such a people with syndromes, special needs or people showing signs of pseudohypacusis (Ho et al., 2009:5). However, automated audiometry is a quick and effective way of pure tone hearing screening for most employees. It helps to streamline day-to-day hearing screening by speeding up the testing procedure and storing the results in one central database for easy retrieval. When used for the proper application it was designed for, computer-assisted audiometry is an excellent clinical tool, although it will never replace the clinical judgment of a trained audiometrician or audiologist (Ho et al., 2009:6).

The focus of the training programme for audiometricians should be on the testing procedure and ensuring that the learners understand the process in order to minimize the negative impact pseudohypacusis or an uncooperative employee may have on the test results. When conducting hearing tests in a unique environment such as the mining or industrial environment, part of the testing procedure would be to provide information to the employee regarding the testing procedures, the desired outcomes of these procedures and further treatment options based on the testing results. This is also done to ensure cooperation of the employee and to try and eliminate false testing results as far as possible. Providing the employee with this information (educating the employee) is especially important for employees who are at risk for, or already suffers from, NIHL.

Education of employees in this environment would therefore entail the process of engagement between two people, both of whom are bound to change through the educational venture (Flasher & Fogle, 2004:3). Educating employees in the industrial setting, may be defined as an applied social science and a caring, interpersonal relationship in which the clinician’s intention is to assist an employee in understanding a hearing disorder and ways of preventing, managing, adjusting to and coping with this disorder. The clinician’s intention is to assist the employee

(Flasher & Fogle, 2004:5). Educating employees regarding NIHL, middle ear pathologies, pseudohypacusis and HPDs, is a constant and ongoing process that should take place with each employee that is evaluated. Education is also an important part of the relevant legislation (SANS 10083:2004) as it compels the health care provider to provide the employee with the necessary information. The importance of employee education was addressed in Question 17 of the questionnaire. Respondents' answers are depicted in Figure 4.6:

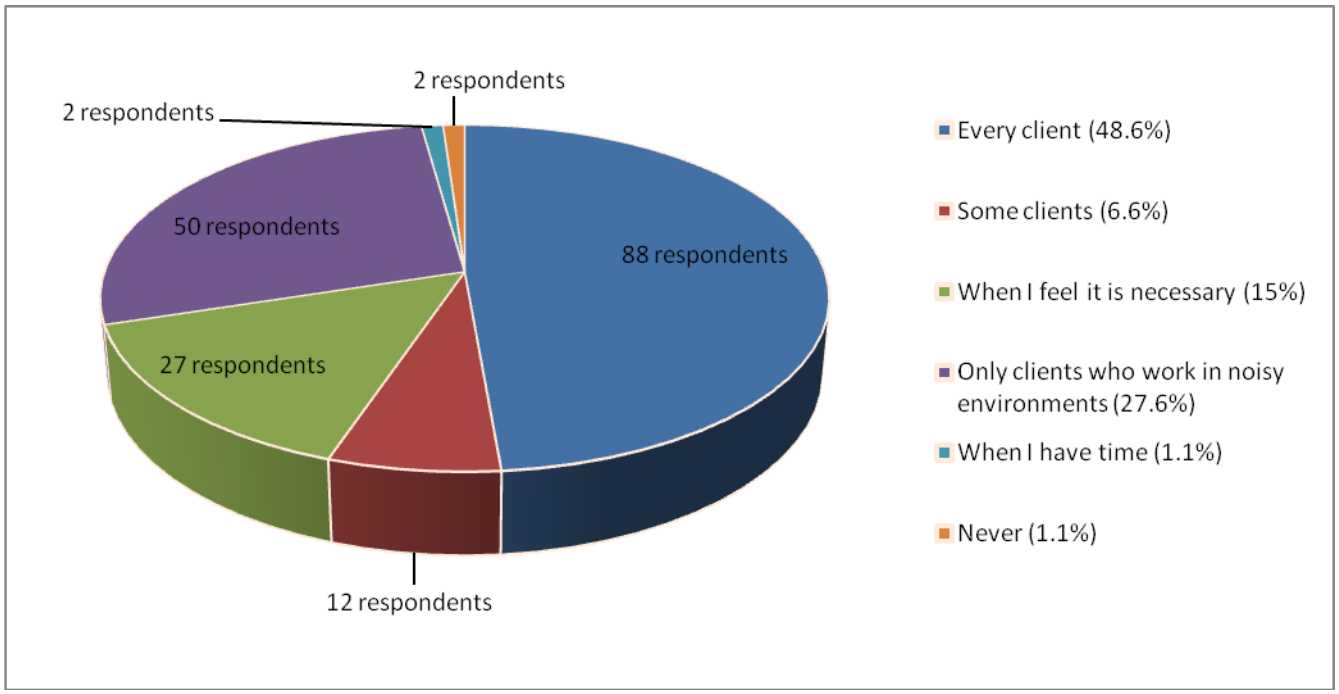

Figure 4.6: Respondents' education of employees regarding NIHL (n = 181)

As illustrated in Figure 4.6, 48.6%/88 of the respondents indicated that they educate every employee regarding NIHL and hearing protective devices (HPDs) (n = 181). The majority (91/50.3%), indicated that they only provide information as and when they see fit or if they have time to educate the employee. Two respondents (1.1%) indicated they never educate employees regarding NIHL and/or hearing protection. Education of employees is compulsory in the industrial setting (SANS 10083:2004) and if audiometricians do not provide this education, as indicated by the results of this question, it may have a negative impact on the goal of reducing NIHL in the mining industry. Education is aimed at reducing NIHL by providing information to the employees regarding the need for accurate testing results and the positive outcome that correct testing results may have, not only for the employee that is tested, but also for the course

the referral process will take after testing (Habig & De Koker, 2004:6). Incorrect referral or lack of referral due to incorrect results can mean that the employee does not receive the correct treatment, or is not compensated for his/her occupational hearing loss, even if he/she is eligible for compensation. Education also provides information regarding hearing protection and the importance of wearing hearing protective devices (HPDs) in order to reduce the negative effect of noise on the auditory system and to improve the overall effectiveness of the HCP (SANS 10083:2004). Information on educating employees as well as its importance in the prevention of NIHL should be included in the training programme for audiometricians and should also increase the more effective use of HPDs in the mining and industrial settings.

Wearing HPDs is part of conserving hearing and part of the education of employees within the HCP (Greenberg, 2003:698). The respondents who did indicate that they educated employees at least when they have time (all but two), expressed different opinions as to what should be included in such an educational programme for employees. This information was gained from the responses to Question 18, which are reflected in Figure 4.7.

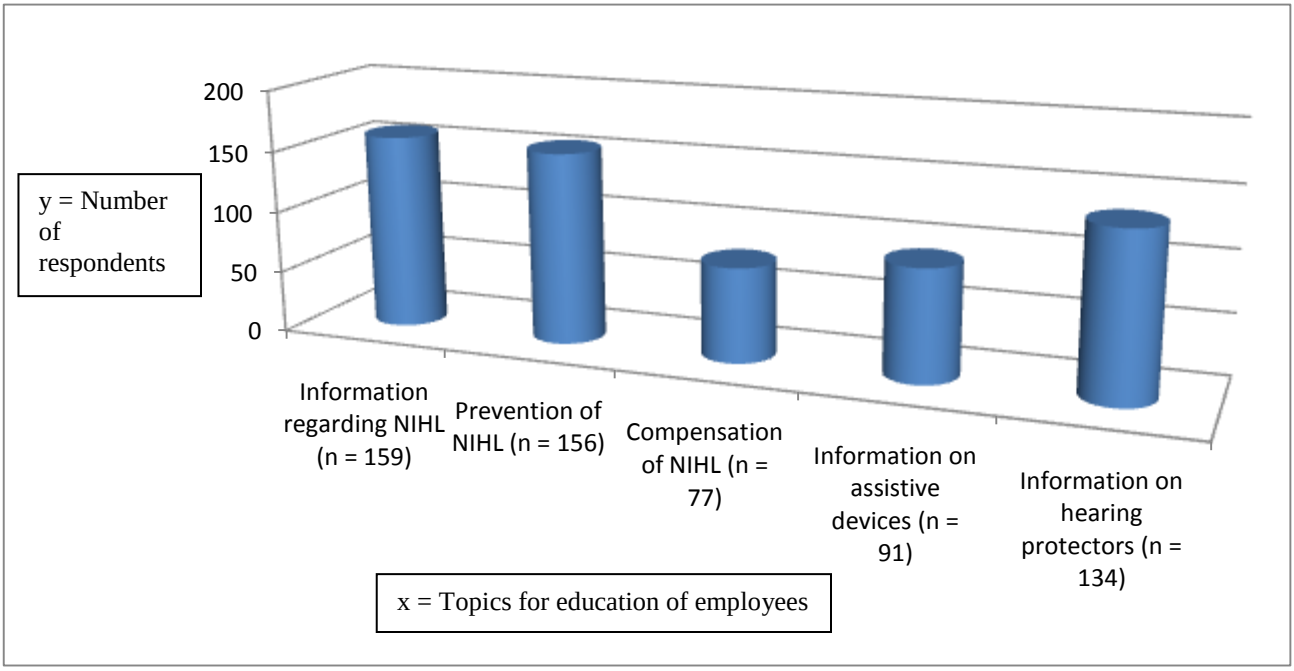

Figure 4.7: Topics that should be included in the educational programme for employees (n = 179)

Figure 4.7 indicates the different topics according to the respondents, that should be included in an educational programme for employees. In this question, the respondents could have chosen more than one answer as to which topics they would include in their own educational programmes. Of the 179 respondents who do educate employees as part of their testing protocol, 159 (88.3%) provided them with information regarding NIHL; 156 (86.6%) educated employees on the prevention of NIHL and 77 (42.7%) explained compensation for NIHL to employees (n = 179). Only 91 (50.5%) indicated that they provide the employee with information on assistive listening devices such as hearing aids and 134 (74.4%) indicated that they provide information on hearing protective devices (n = 179). Of all the respondents, only 49 (27.4%) indicated that they included all the topics mentioned in the questionnaire as part of their educational programme for employees (n = 179). Educational programmes also serve as an important opportunity to provide employees with more information, not only on NIHL, but also on the practical administrative process of claiming for a compensable occupational disease (SANS 10083:2004).

In the light of the above, the training of audiometricians should focus on which topics to include when educating employees. Topics should include information regarding NIHL, prevention of NIHL, choosing, wearing and caring for HPDs, information on assistive listening devices such as hearing aids as well as compensation for NIHL (SANS 10083:2004).

NIHL is legally a compensable occupational disease (Workmen's Compensation Commissioner Instruction 171, 2001). Questions 22 and 23 of the questionnaire dealt with the respondents' knowledge of the South African legislation (SANS 10083:2004 and Instruction 168 and Instruction 171 of the Workmen's Compensation Commissioner, 1995 & 2001) regarding the importance of a HCP. It includes the testing procedure when dealing with an employee with NIHL, the interpretation of the results of this testing procedure, the referral process after testing has been done as well as the compensation for NIHL. The results of responses to Question 22 are illustrated in Figure 4.8.

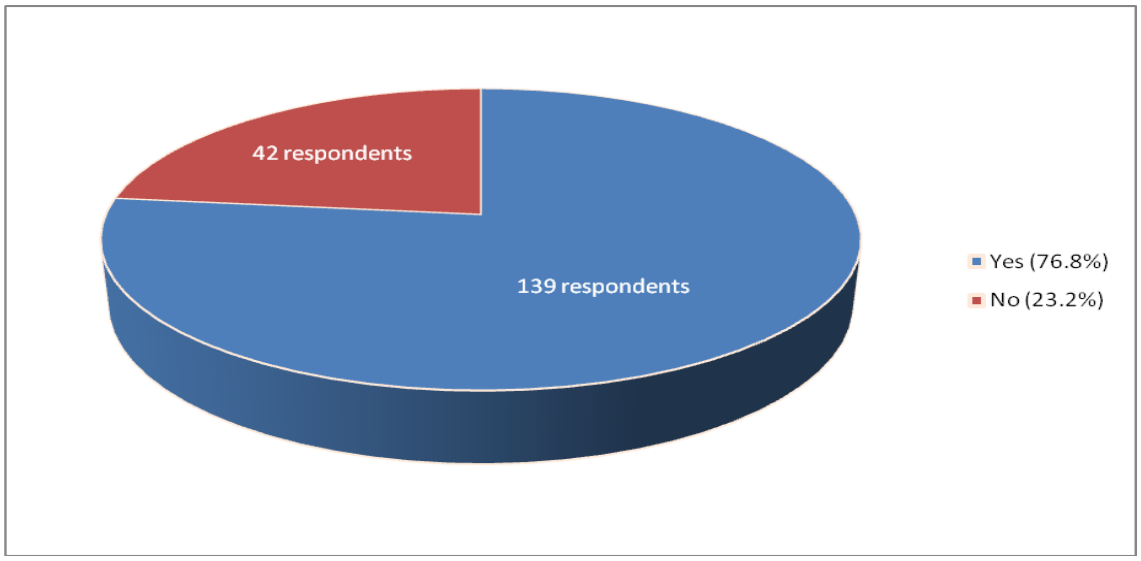

Figure 4.8: Respondents' knowledge of the South African legislation regarding NIHL (n = 181)

Although 139 respondents (76.8%) indicated that they are familiar with the legislation regarding NIHL (SANS 10083:2004 and Instructions 168 and 171 of the Workmen's Compensation Commissioner, 1995 & 2001) it is still, according to Figure 4.8, unacceptable that 42 of the 181 respondents (23.3%) are working in an industrial setting without sufficient knowledge of the legislation surrounding NIHL. Of the 139 respondents (77%) who indicated that they are familiar with the legislation, only the minority of those respondents (42 of 139) were able to name the specific legislation of documentation they claim to know. Knowledge of the legislative requirements regarding NIHL and claiming for NIHL is important in order to conduct hearing testing and implement an HCP effectively. Relevant legislative documents include the *Mine Health and Safety Act (MHSA) 1996*; *Compensation for Occupational Injuries and Disease Act (COIDA) 1995*; *Department of Labour Instruction 168 and Instruction 171 of the Workmen's Compensation Commissioner 1995 & 2001* and the *South African National Standard* (SANS) *10083:2004*. The respondents were asked in an open question to name all of the relevant documents they knew and only 42 respondents (30.1%) were able to name one, but not all of the documents (n = 136). The reason why the respondents indicated more legislative documents in the specific question, may be that more than one document is currently used in the mining industry to guide practice. This is a problem, because it may cause confusion and afford the possibility of conducting, interpreting and evaluating HCP and hearing evaluations differently. A training programme for audiometricians should therefore focus on training learners in terms of

one legislative document – the South African National Standard – as this is the standard for practice in South Africa.

Despite the fact that there are more than one legislative document currently in use, there were still some respondents (42/30.1%) who did not know the legislation – this was clearly revealed by the responses to Question 22 of the questionnaire, as indicated above. These respondents were asked a follow-up question (Question 23 of the questionnaire) to determine why they did not know the relevant legislation since it is such an important part of the HCP. The results of these responses are presented in Figure 4.9.

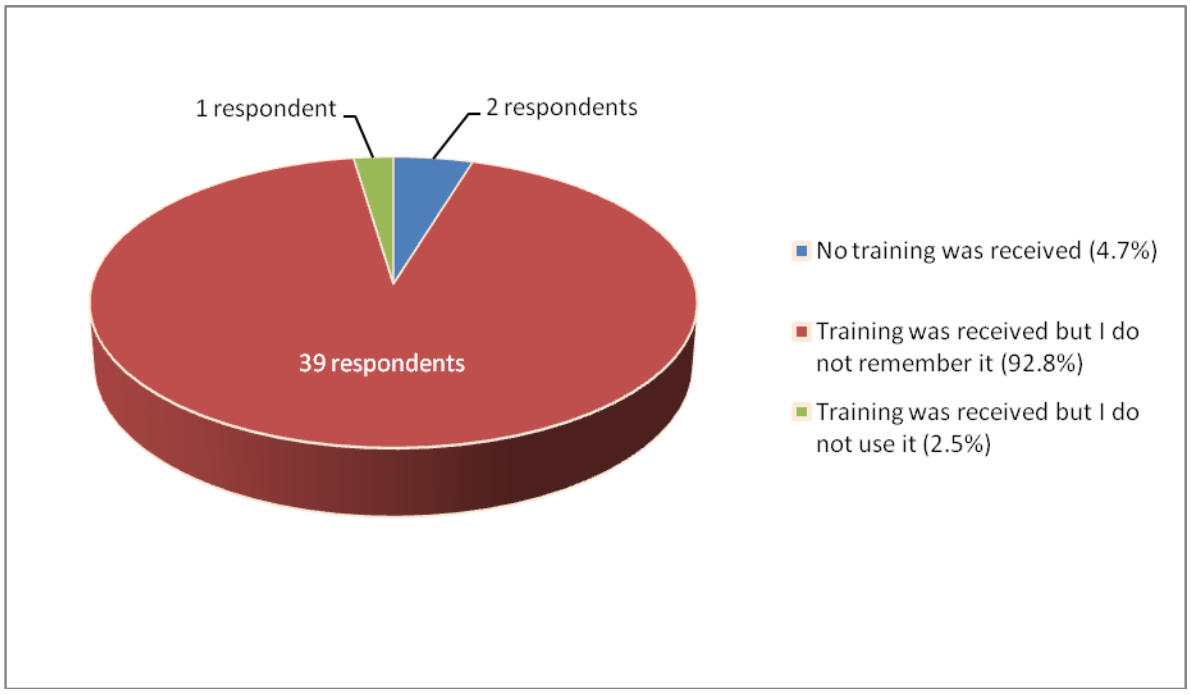

Figure 4.9: Respondents' reasons for not knowing the legislation (n = 42)

As illustrated in Figure 4.9, the majority of the 42 respondents (39/92.8%) indicated that they have received the necessary training in order to be familiar with the legislation, but they forgot the legislation after the training (n = 42). Only one respondent indicated that he/she does not to use the legislation and the remaining two respondents have not received any training in terms of the legislation. This indicates the need for comprehensive training and for training to be structured in such a way as to optimize retention of information as described by in the principles of adult learning. Adults are motivated to learn from being in situations in which they experience a need to learn. Consequently, adult learning should include topics that address the adult learners' current learning needs (Clawson, 2002:2).

4.2.2 Respondents' opinions regarding their own training programme

Adult learners' experience of a training programme also influences their retention of information (Clawson, 2002:3). Respondents were asked (Question 8 of the questionnaire), to indicate which topics were included in their own training programmes. Answers to this question included the following: legislation regarding NIHL; the anatomy of the ear; physics of sound and noise; how to perform an audiometric pure tone test; the impact of noise and medication on the ear; abnormalities of the ear; education of employees regarding NIHL and HPDs; calibration of equipment; otoscopic examination; interpretation of audiometric results.

When asked more specifically with a closed-ended question (Question 19 of the questionnaire) which topics were included in their training, the following results as shown in Figure 4.10 were obtained.

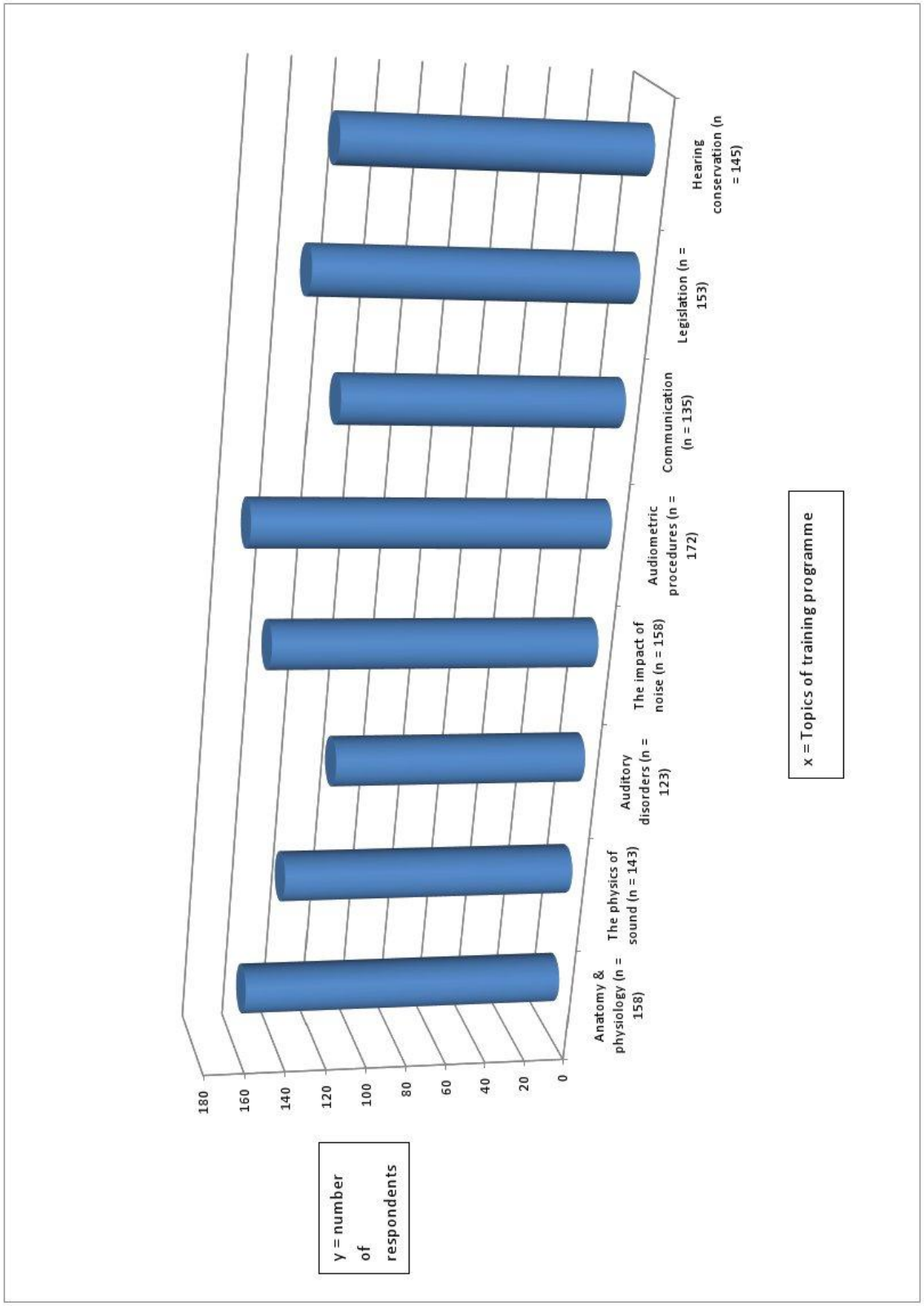

Figure 4.10: Topics included in the training programmes of respondents (n = 181)

All of the topics indicated were part of the respondents' training programmes as illustrated in Figure 4.10. Although 172 (95%) of the 181 respondents indicated that they were taught how to perform audiometric testing procedures, 5% indicated that they have not been taught how to conduct an audiometric test (n = 181). This is unacceptable because audiometric testing should be the main outcome of any training programme for audiometricians. In spite of this, not all respondents indicated that they were taught these procedures and it is not clear how they can be able to perform the testing without the necessary training. Of the respondents 95% (n = 172) indicated that they have been taught these procedures. Question 20 of the questionnaire aimed at gaining information on what exactly was taught to these respondents with regard to audiometry. Figure 4.11 reflects the results.

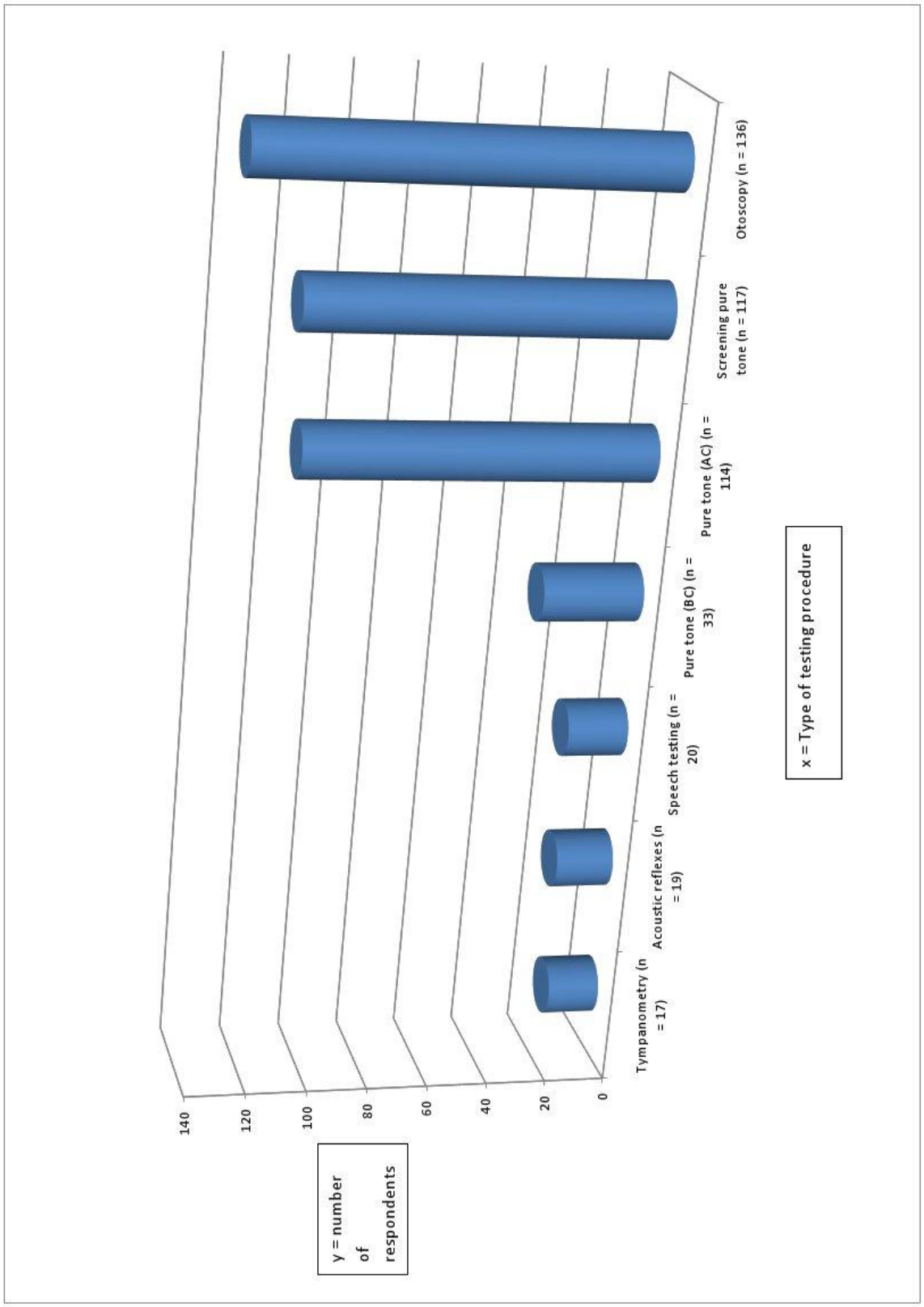

Figure 4.11 Audiometric testing procedures included in the respondents' own training programmes (n = 172)

As illustrated in Figure 4.11, different options regarding audiometric testing procedures were provided to the respondents in Question 20. Even though the majority of the respondents, 136 respondents (79%), indicated to have been taught how to conduct an otoscopic examination, this is still not an acceptable response (n = 179). All 181 respondents should have been taught how to conduct this procedure, since it is compulsory according to SANS (10083:2004) for audiometricians to perform an otoscopic examination during industrial hearing screening. If otoscopic examination is omitted, it could lead to incorrect referral and a wrong diagnosis; otoscopy is necessary to determine if an employee has normal outer and middle ears. In the mining industry, middle ear pathology has a very high incidence and highlights the need for otoscopic examination prior to conducting pure tone audiometry (Habig & De Koker, 2004:2). The only procedures audiometricians are required to perform when conducting industrial hearing screening, according to legislation (SANS 10083:2004), is otoscopy and pure tone air conduction (AC) testing or screening pure tone testing. In the questionnaire, both pure tone AC testing and screening pure tone testing was given as an option because there is some discrepancy regarding the terminology (Michell, 2009). Both of these terms, however, indicate pure tone testing at 500 Hz, 1000 Hz, 2000 Hz, 3000 Hz, 4000 Hz, 6000 Hz and 8000 Hz, as required by legislation (SANS 10083:2004). Thus, according to the results, of the 172 respondents who indicated they have been taught audiometric procedures, 100% of them indicated that they perform pure tone AC and/or screening pure tone testing. In a training programme for audiometricians, audiometric testing procedures should be the main focus of the training programme and should include in depth knowledge of pure tone AC or screening pure tone testing as well as an otoscopic examination and the interpretation of the results of these procedures, because these are the two testing procedures audiometricians are required to be able to perform (SANS 10083:2004). Others tests, such as pure tone bone conduction (BC), speech testing, acoustic reflexes and tympanometry, should not be taught in depth as these procedures do not fall within the scope of practice of audiometricians. These procedures should not be conducted by audiometricians and therefore Question 11 of the questionnaire aimed to determine which additional procedures respondents conduct when performing a hearing evaluation within the industrial setting. The results are shown in Figure 4.12.

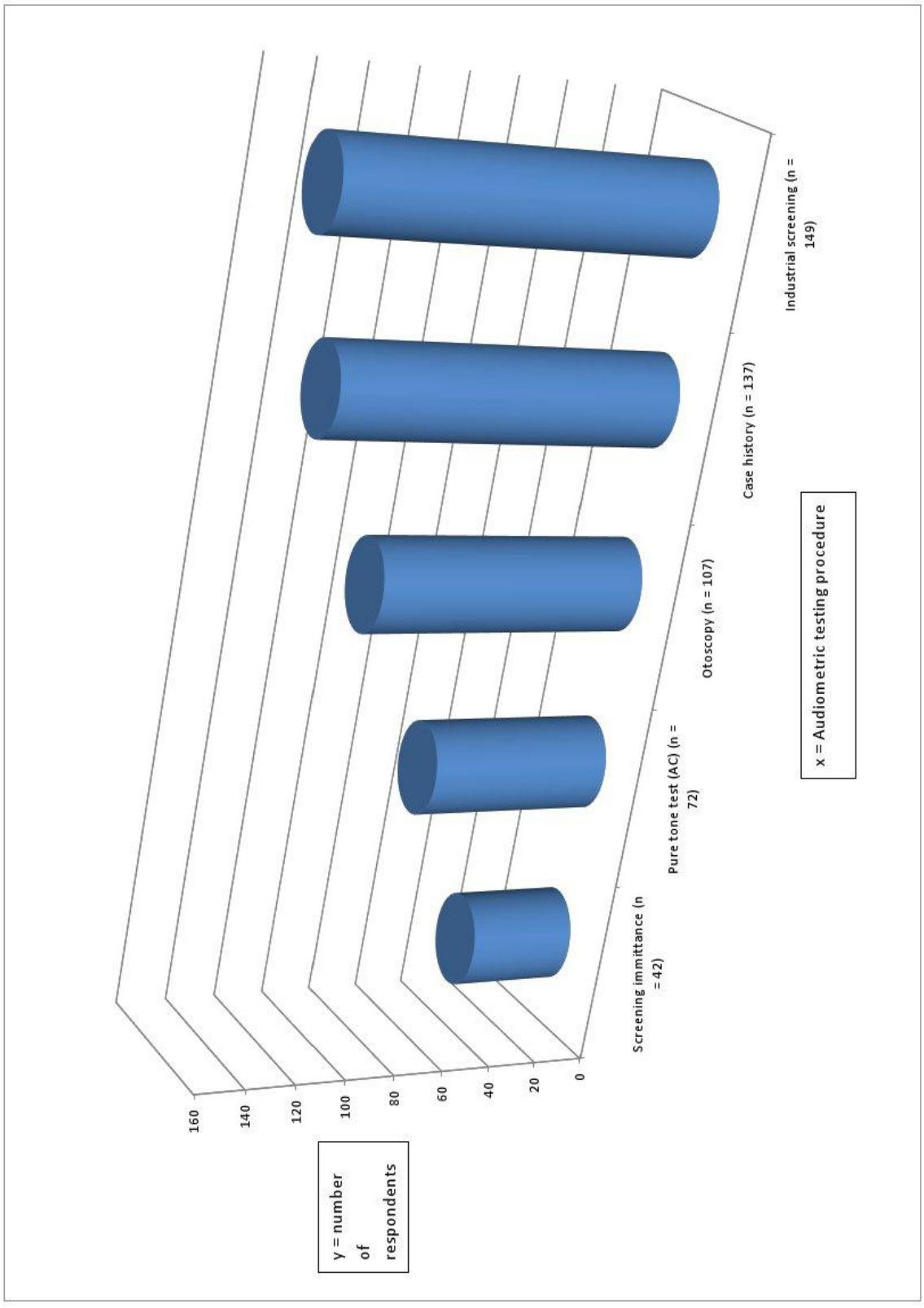

Figure 4.12: Procedures performed during audiometric evaluations by audiometricians (n = 181)

According to SANS (10083:2004), procedures to be administrated for hearing screening includes otoscopy and pure tone air conduction screening at frequencies of 500 Hz, 1000 Hz, 2000 Hz, 3000 Hz, 4000 Hz, 6000 Hz and 8000 Hz. No differentiation is made in this legislation (SANS 10083:2004) between industrial screening and pure tone screening, only that all seven frequencies should be tested when screening is done in the industrial setting. This lack of differentiation between the two terms may be confusing to some audiometricians and may also have had a negative impact on data collection. The question (Question 11 of the questionnaire) provided a choice of pure tone testing and industrial screening in order to eliminate the possibility that respondents may not answer the question if the name of the pure tone testing procedure they feel comfortable with, is not mentioned. Although 107 respondents (59.1%) indicated that they do actually conduct an otoscopic examination as part of their hearing screening procedures, it is unacceptable that the remaining 74 (40.9%) do not conduct otoscopic examinations (n = 181). An otoscopic examination is the visual examination of the employee's outer ear, ear canal and tympanic membrane (Williams & Wilkins, 2004:375). The purpose of this examination is to determine if there are any abnormalities present in the outer or middle ear. If there is, referral to the appropriate professional, usually an ear, nose and throat specialist should be made (Williams & Wilkens, 2004:375). Otoscopic examination is important for proper referral and diagnosis of an employee because it is necessary to determine if a client has any outer and/or middle ear pathologies, which could additionally influence the results of the test. Therefore, in training audiometricians, testing procedures that should be taught include a case history, otoscopic examination and pure tone testing (AC/industrial screening/pure tone screening) since SANS (10083:2004) requires an audiometrician to obtain a case history from the employee prior to conducting a hearing test.

Obtaining a case history from an employee prior to conducting the audiometric test is very important, since it may reveal possible causes of hearing loss, whether it may be previous noise exposure or other factors (Maltbly, 2005:96). This information may assist the audiometrician in the decision making process following audiogram analysis and interpretation (Maltby, 2005:96). As indicated in Figure 4.12, 75.7% of the respondents do conduct a case history as part of their evaluation (n = 181). However, people working in the mining industry can easily be assumed to have a hearing loss due to vocational noise exposure, but might very well have a hearing loss due, at least in part, to other causes such as a middle ear pathology, trauma or recreational noise

exposure, HIV, medication or drug use (De Koker, 2010). If a complete case history is not obtained it may have a negative impact on the interpretation of the test results because the audiometrician may assume the hearing loss to be noise induced when it might be due to or exaggerated by other causes.

Training for audiometricians should be extensive and effective enough to teach them all the necessary procedures and techniques needed to conduct hearing screening correctly and to gain all the necessary information for interpreting the results correctly and also to make appropriate referrals to determine the effectiveness of the HCP. Teaching audiometricians the required information takes time and as part of determining the need for a training programme, the duration of such a programme should also be taken into account.

4.2.3 Duration of respondents' own training programmes

In order to be able to teach future audiometricians all the necessary procedures for hearing screening and how to implement a hearing conservation programme sufficient, time should be allocated to training. Respondents were asked what the duration of their own training programmes was (Question 10 of the questionnaire). Their responses are reflected in Table 4.1.

Table 4.1: Duration of respondents' own training programmes (n = 181)

Duration	Number of respondents	Duration	Number of respondents
1 day	6 respondents (3.3%)	3 weeks	3 respondents (1.6%)
2 days	2 respondents (1.1%)	4 weeks	2 respondents (1.1%)
3 days	13 respondents (7.2%)	6 weeks	2 respondents (1.1%)
4 days	16 respondents (8.8%)	3 months	1 respondents (0.5%)
5 days	97 respondents (53.6%)	6 months	7 respondents (3.9%)
2 weeks	32 respondents (17.8%)	>6 months	0 respondents (0%)

As illustrated in Table 4.1, the majority of the respondents (97/53.6%) indicated that their own training programmes consisted of five days of training, followed by 32 respondents (17.8%) who indicated that their training programme was two weeks long. The duration of the intended training programme was determined by taking into account the information reflected in Table 4.1 and Table 4.2 as well as the outcomes that the training programme should achieve. Currently the

training of audiometrician seems not to be sufficient and therefore a training programme for audiometrician based on the principles of instructional design should be longer than the indicated programmes the respondents have undergone. The respondents also indicated where they attended this training. The responses to this question are summarized and presented in Figure 4.13.

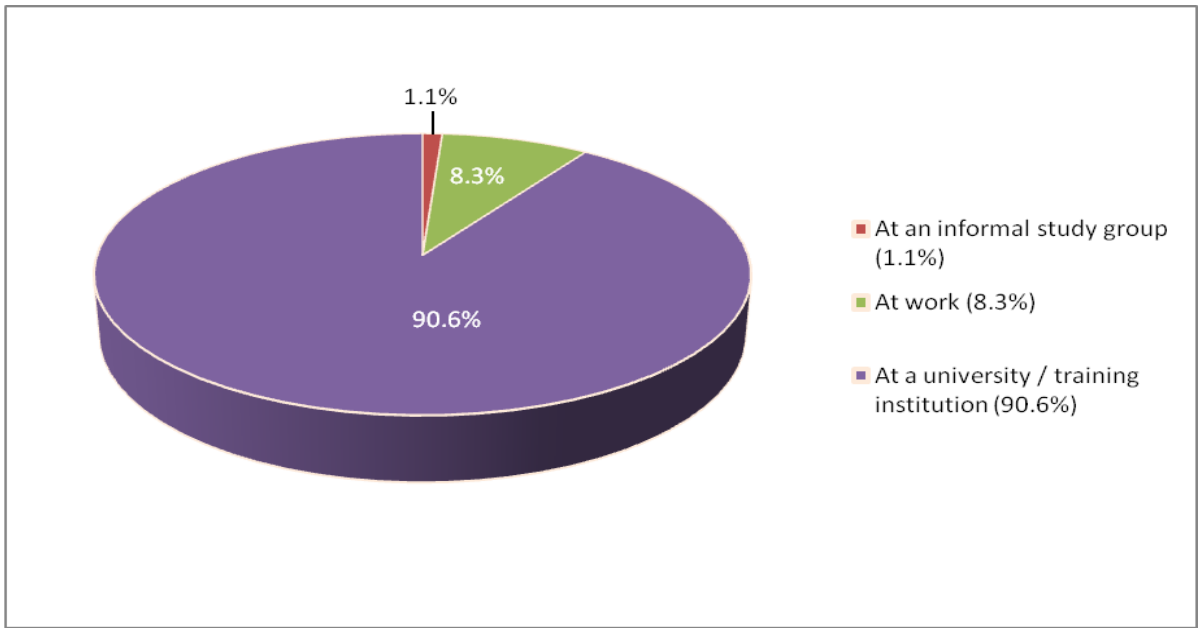

Figure 4.13: Training facilities of respondents' own training programmes (n = 181)

The majority of the respondents (164/90.6%) indicated that they received their training from a university or a formal training facility (n = 181). The remaining 9.4% (n = 17) of the respondents indicated that they attended the training at work or at an informal study group. None of the respondents indicated that they received training through any electronic media. According to this data the training programme for audiometricians should be presented at a formal training facility as indicated by the majority of the respondents (164/90.6%).

4.2.4 Respondents' opinions regarding a future training programme for audiometricians

This section will illustrate what the respondents' opinions were regarding a future training programme for audiometricians. Firstly (Question 21 of the questionnaire), they were asked what, in their opinion, the duration of the training should be. Respondents' suggestions are reflected in Table 4.2.

Table 4.2: Duration of a future training programme for audiometricians (n = 181)

Duration	Number of respondents	Duration	Number of respondents
1 day	1 respondent (0.5%)	4 weeks	2 respondents (1.1%)
2 days	2 respondents (1.1%)	1 month	7 respondents (3.9%)
3 days	7 respondents (3.9%)	2 months	2 respondents (1.1%)
4 days	3 respondents (1.7%)	3 months	2 respondents (1.1%)
5 days	87 respondents (48%)	6 months	7 respondents (3.9%)
2 weeks	55 respondents (30.4%)	1 year	2 respondents (1.1%)
3 weeks	3 respondents (1.7%)	2 years	1 respondent (0.5%)

As illustrated in Table 4.2, 87 respondents (48%) felt that the training programme should cover five days and 55 respondents (30.4%) that it should be two weeks (n = 181). The length of the training programme should be determined by the amount of academic content that is included in the programme as well as the availability of facilitators. In conjunction with the results indicated in Table 4.1, the respondents were of the opinion that a training programme for audiometricians should be between five days and two weeks long, as this is the amount of time the majority of the respondents felt is needed to complete the course. As current programmes did not achieve all the required outcomes, the training programme developed for audiometricians in this study, should be longer than indicated by the respondents, as there was a big difference in their opinions and also because of the need for more adequate training than that which the currently trained audiometricians received.

The type of training that should be provided is another important part of developing a training programme and therefore Question 25 of the questionnaire focussed on the respondents' opinions with regard to the type of training that should be provided for audiometricians. Their responses are depicted in Figure 4.14.

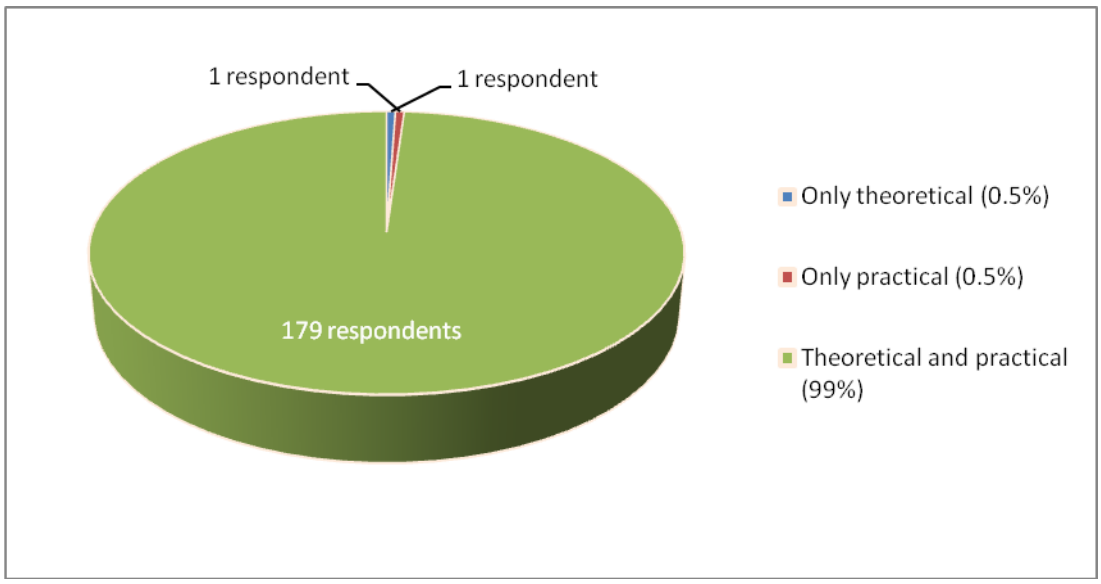

Figure 4.14: Type of training future audiometricians should receive (n = 181)

As illustrated in Figure 4.14, almost all of the respondents (179/99%) thought that training should include both theoretical and practical components (n = 181). Respondents indicated, in response to Question 27 of the questionnaire, from what type of training they themselves benefited most. Responses are presented in Figure 4.15.

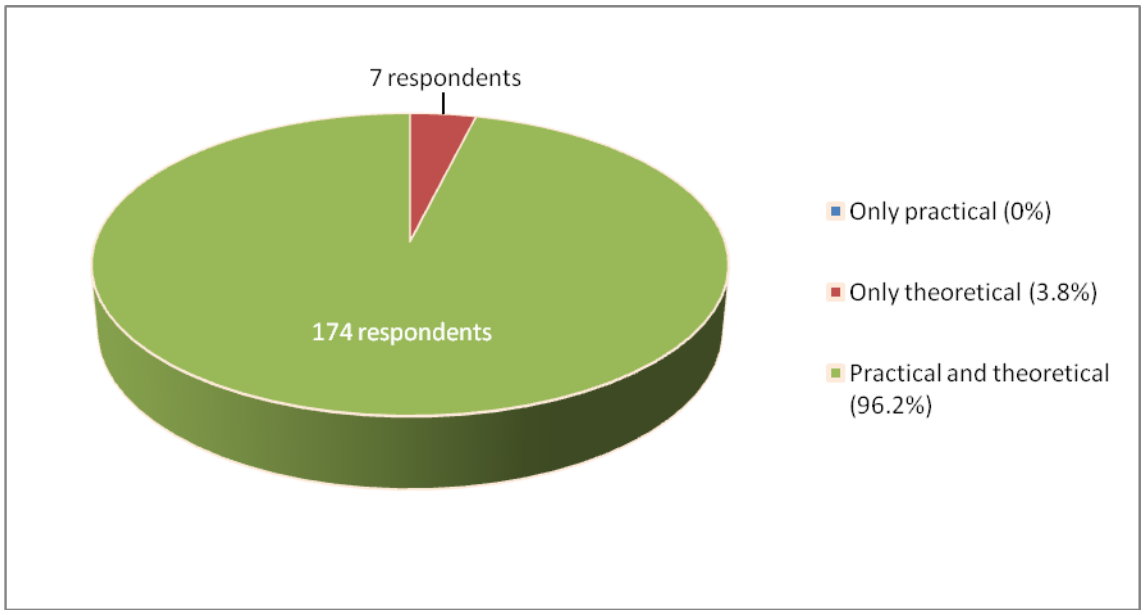

Figure 4.15: Type of training respondents benefited from most (n = 181)

According to Figure 4.15, the majority (174/96.2%) indicated that they benefited most from combined practical and theoretical training. This finding was taken into account when developing a new training programme for audiometricians. Adult learners are more self directed and, being internally motivated, they consider it important to learn subject matter that can be immediately applied to their social or vocational role (Jarvis et al., 2003:95). Thus, practical testing experiences are important to motivate and educate the adult learners to conduct hearing screening tests according to the theoretical basis they have been taught. Adults are life centred in their orientation to learning. They are motivated to learn to the extent that they perceive that learning will help them perform tasks or deal with problems that they confront in real life situations. As adults learn new knowledge and skills, they want to apply them immediately in problem solving exercises. In the development of a training programme for audiometricians this principle should be kept in mind and the learners should be given the opportunity to practice their skills and apply their knowledge in a practical situation (Knowles et al., 2005:66).

Not only must the type of training be considered when dealing with adult learning, but the facilitator of this learning process also plays an important role. The person who coordinates the training course should be knowledgeable in the field and as such should play a role in developing the training programme, as indicated in Figure 4.16.

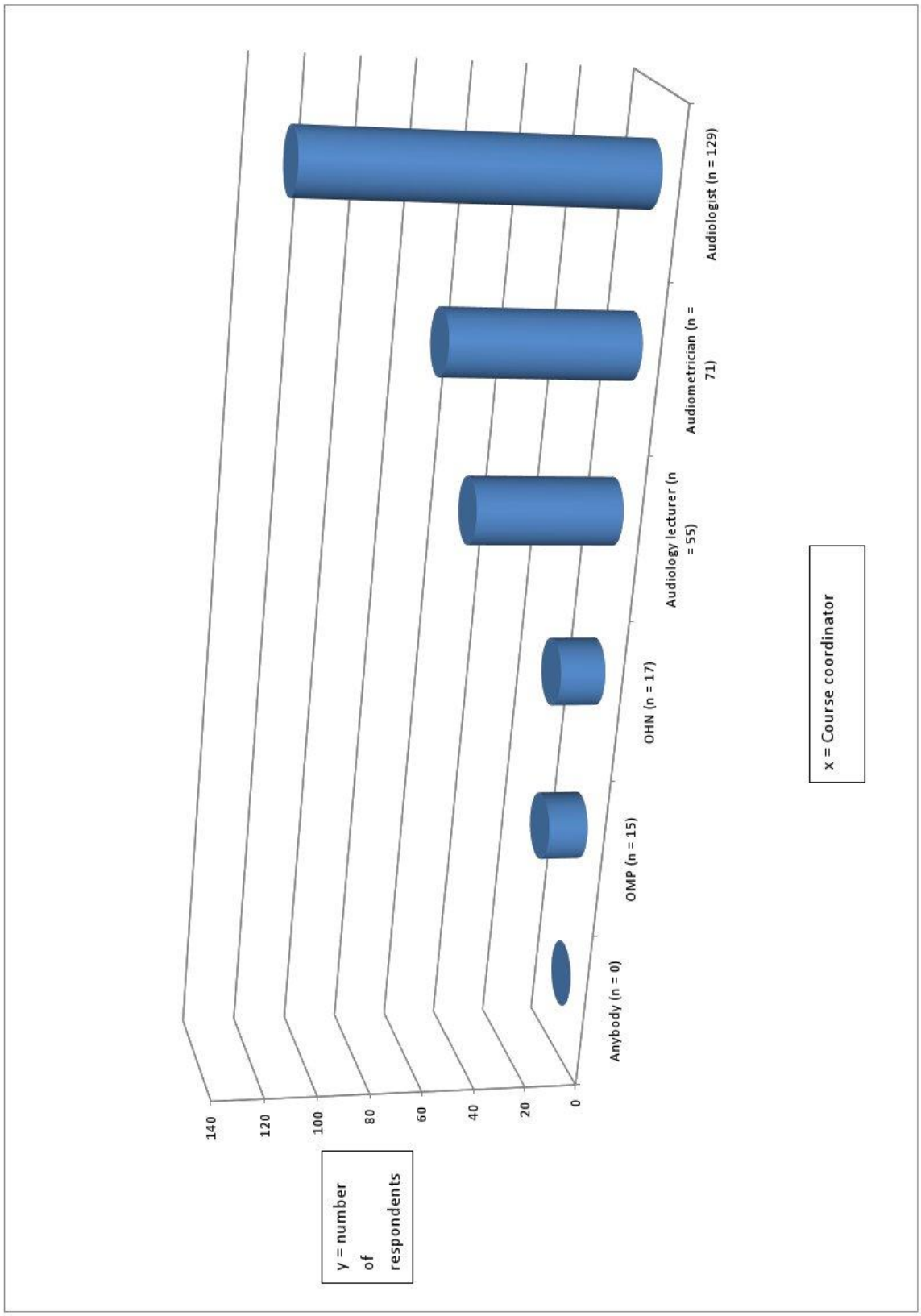

Figure 4.16 Coordinator of a training course for audiometricians (n = 181)

The majority of the respondents (129/71.2%) indicated in Question 28 of the questionnaire that an audiologist working in the field should coordinate the training course for audiometricians (n = 181). An audiologist has the knowledge and experience to be able to coordinate the training programme for audiometricians effectively as they have had at least four years of training in the field of hearing loss prevention, assessment and management (De Koker, 2010).

The training programme's topics play a role in its effectiveness and the scope of practice for audiometricians should be considered when determining these topics of training. Topics that should be included in the training programme for audiometricians, as recommended by the respondents (Question 29 of the questionnaire) are shown in Figure 4.17.

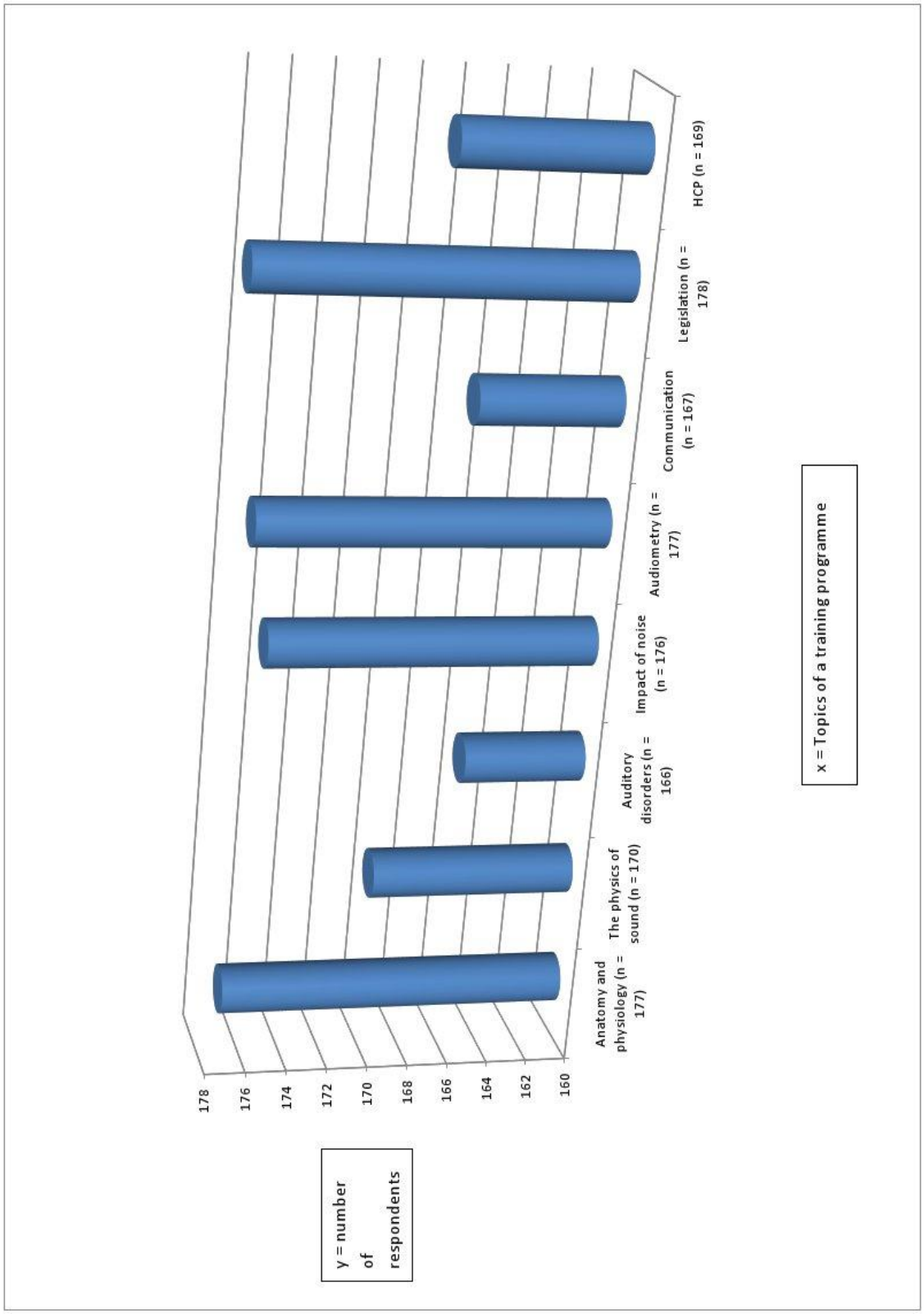

Figure 4.17: Topics to be included in a training programme for audiometricians (n = 181)

Topics that should be included according to the respondents are:

- Anatomy and physiology of the ear (177/97.8%);
- They physics of sound (170/94%);
- Disorders of the auditory system (166/91.7%);
- The impact of noise on the ear (176/97.2% /);
- Audiometric testing procedures (177/97.8%);
- Communication with clients (employees and employers) (167/92.2%);
- Legislation regarding NIHL (169/98.2%);
- Hearing conservation programmes (169/93.3%).

The data for this question (Question 29 of the questionnaire) was obtained through a closed-ended question where respondents were allowed to choose more than one option. The majority, 129 of the respondents (71.3%), indicated that *all* the suggested topics should be included in a future training programme for audiometricians (n = 181). Hundred and seventy-seven respondents (97.8%) indicated that audiometric testing procedures should be included in future training programmes. The remaining four respondents (2.2%) did not indicate why they felt that audiometric testing procedures should not be part of a training programme (n = 181).

By including all of these topics, it is possible to cover the entire scope of practice of the audiometrician and to ensure that they have extensive and sufficient knowledge regarding hearing, NIHL, hearing conservation and hearing testing. The acquisition of knowledge should be tested in order to verify that all of the learners have been sufficiently trained and skills should be assessed to determine if the desired outcomes have been reached. One method of assessing the learners' knowledge and skills is by means of a theoretical and practical examination. The respondents' opinions regarding ways of evaluating future learners are depicted in Figure 4.18.

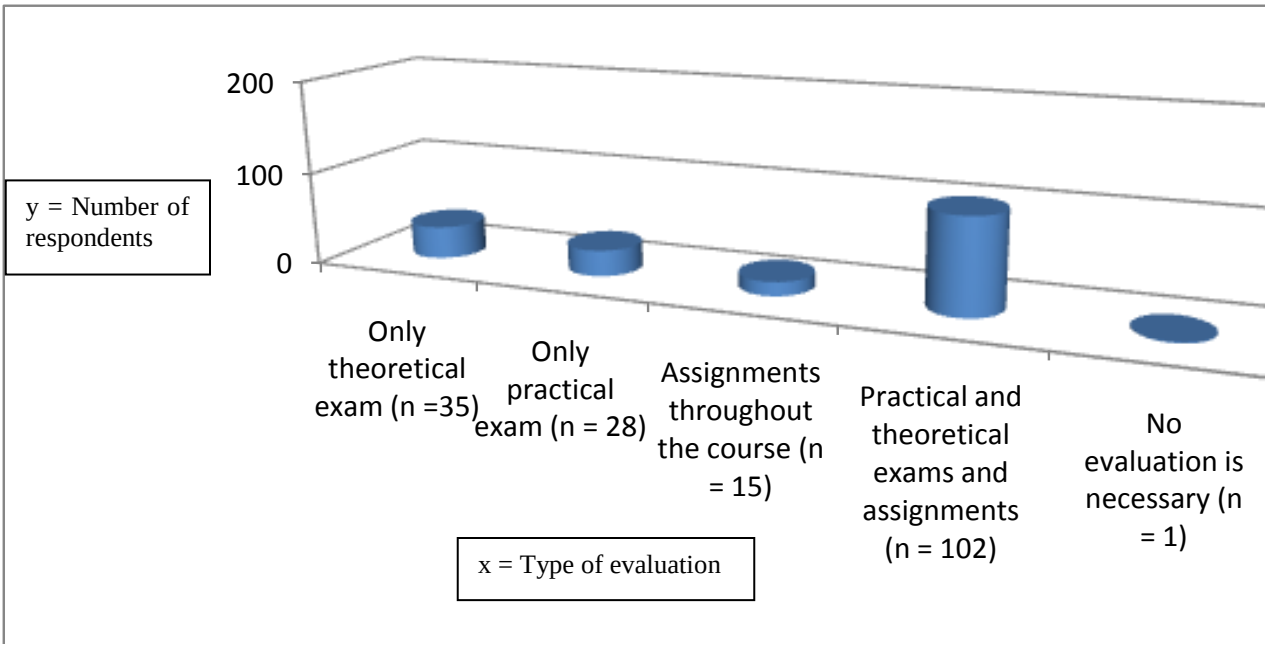

Figure 4.18: Evaluation of the learners (n = 181)

As illustrated in Figure 4.18, 35 of the respondents (19.3%) thought that only a theoretical examination is necessary; 28 respondents (15.4%) felt that only a practical examination is necessary and 15 respondents (8.4%) indicated that only assignments throughout the course is necessary to evaluate the learners (n = 181). Only one respondent (0.5%) felt that no evaluation is necessary. The majority, 102 of the respondents (56.4%), indicated that written examinations, practical examinations and assignments throughout the course were necessary to comprehensively assess the learners' knowledge (n = 181). Therefore, a training programme for audiometricians should be structured in such a way as to allow for all three types of assessment to be incorporated in the programme.

On completion of such a training programme, audiometricians should still stay informed regarding new developments in the field and therefore respondents' opinions regarding continuing education were probed in question 27 of the questionnaire. Respondents indicated whether they felt continuing professional development (CPD) activities and CPD points should be compulsory for audiometricians. Their responses are presented Figure 4.19.

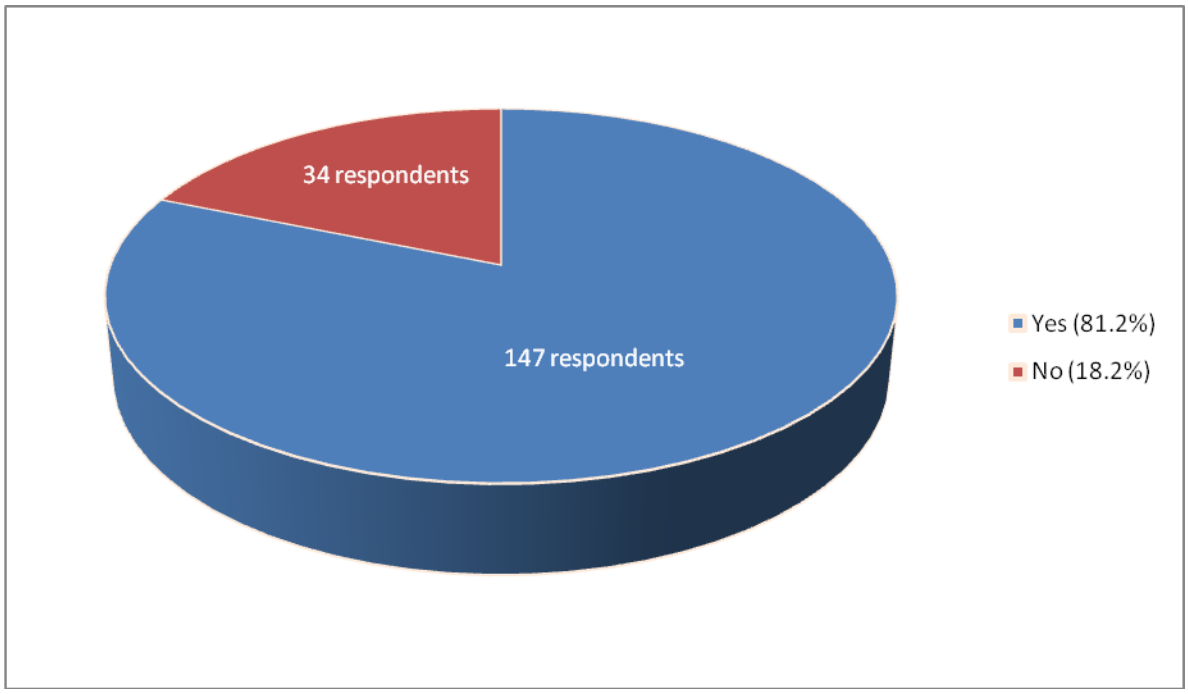

Figure 4.19: Responses regarding compulsory CPD points (n = 181)

As depicted in Figure 4.19, 147 respondents (81.2%) indicated that CPD points should be compulsory for audiometricians and 34 respondents (18.2%) did not feel the need for compulsory CPD activities (n = 181). The 147 respondents who indicated the need for compulsory CPD points also indicated (Question 31 of the questionnaire) how many points they think should be compulsory, where one point equals one hour of training. The average number of points, calculated by adding all the numbers indicated by the respondents and dividing it by 147, indicated that the respondents felt, on average, that 14 points per year should be sufficient in terms of CPD activities, ranging from one to 36 points per year, according to the respondents' answers. As the respondents' answers differed so widely, the researcher felt that eight CPD points per year should be adequate because this translates to one eight hour day's training or two half days per year; given the average audiometrician's work load, such an expectation seems reasonable. There are currently no official guidelines that can be taken into account specifically for audiometricians as to determine how many CPD points is recommended for the continuing development of audiometricians' professional skills and knowledge.

Of the 34 respondents (18.2%) who indicated that they do not think CPD points should be compulsory, reasons for their opinion were asked. Responses included difficulty to get time off

from work for training or workshops, difficulty to find available training workshops for audiometricians, and some respondents felt that once you were trained, you do not need any further information or training regarding audiometry.

4.3. Developing a training programme

Based on the results presented above, a training programme for audiometricians was developed, based on the principles of instructional design. These results, combined with the needs analysis, were used to determine what the learning outcomes should be in the development of a training programme for audiometricians.

4.3.1 Duration of the learning programme

According to the respondents' opinions as derived from Question 21 of the questionnaire, 87 of the respondents (48%) felt the course should run over five days, whilst 55 (30.4%) felt the course should be two weeks in duration (n = 181). This learning programme should therefore be between five days and two weeks as the majority of the respondents felt this should be sufficient time to complete the course. Existing programmes include two programmes of five days and one programme of two weeks (ten working days). The researcher recommends that eight to ten working days should be sufficient for completing the course and achieving the necessary outcomes. According to the principles of adult learning, adults have a self-concept of being responsible for their own learning. The instructional designer needs to make an effort to create learning experiences in which adults are helped to make the transition from dependent to self-directed learners. The audiometricians should be responsible for their own learning and should be encouraged to do further reading on subject content (Knowles et al., 2005:64). Each learner will learn at a different pace; therefore the training programme should aim to provide sufficient time for the majority of learners to master the course material.

4.3.2 Coordination of the learning programme

The main outcome of a learning programme for adults is to ensure the learners have a meaningful understanding of the content of the learning programme (Reighluth, 1994:80). Part of this outcome is to have the content that will be presented to the learners coordinated in such a manner and by such a person/s, that meaningful understanding is facilitated (Reighluth,

1994:80). Before the content of the learning programme is developed, the instructional designer should determine who should coordinate this learning programme for audiometricians. According to the data obtained through Question 28 of the questionnaire 128 of the respondents (71%) indicated that they felt that an audiologist working in the field should coordinate the training programme (n = 181). Only 71 of the respondents (39.2%) indicated that an audiometrician who has already completed the course should be the coordinator and 55 of the respondents (30.4%) felt that a university lecturer in Audiology should coordinate the programme (n = 181). According to the respondents, an audiologist working in the field would be the best person to coordinate a training course for audiometricians as he/she in-depth knowledge of the testing procedures used by audiometricians and the theoretical components surrounding the audiometrician's scope of practice. Adults do not only learn from the facilitator or coordinator, but they also draw upon their experiences of the past to aid the learning process. The richest resources for learning may reside in the adult learners themselves and therefore it is important to keep in mind that the learners will enter into the learning situation with their own set of experiences and ideas (Knowles et al., 2005:65). Adults are life centred in their orientation to learning. They are motivated to learn to the extent that they perceive that learning will help them perform tasks or deal with problems that they confront in real life situations. As adults learn new knowledge and skills, they want to immediately apply it in problem solving exercises. In the development of a training programme for audiometricians this principle should be kept in mind and the learners should be given the opportunity to practice their skills and apply their knowledge in a practical situations (Knowles et al., 2005:66). The coordinator of such a programme should integrate these adult learning principles into the programme.

4.3.3 Formulation of learning outcomes

The content of the training programme as well as the scope of practice of audiometricians as stipulated by the HPCSA, was determine by the outcomes of the training programme. According to the HPCSA (www.hpcsa.co.za), audiometricians' scope of practice is defined as:

- The determination and evaluation of the range, nature and degree of a person's hearing by means of electro-acoustic instrumentation and observation methods;

Combining this scope of practice for audiometricians and the respondents' opinions regarding the outcomes of a future training programme for audiometricians, the following topics that should be included in a training programme for audiometricians were identified, as indicated in Table 4.3.

Table 4.3: Topics and content of a proposed training programme for audiometricians

TOPIC	CONTENT	MOTIVATION FOR INCLUSION
Anatomy and physiology of the human ear	Anatomy and physiology of the human ear in terms of the outer, middle and inner ear	"Understanding the anatomy and the function of the auditory system and the ability to apply this knowledge, is essential for all clinicians who are involved in testing, diagnosis or treatment of disorders of the auditory system as this forms the basis of the diagnostic and treatment process" (Moller, 2006:1).
Physics of sound	The definitions and characteristics of sound, sound waves and the phases of sound waves	"One has to understand the mechanism of the travelling sound wave and the different properties of sound in order to understand how humans hear, the logarithmic scale and the functioning of an assistive hearing device. This knowledge has to be applied to the testing methods when conducting hearing evaluation" (Maltby, 2005:8)
Disorders of the auditory system	Disorders of the auditory systems in terms of the outer, middle and inner ear	"There are three general ways of classifying hearing loss (sensorineural, conductive and mixed) and each is worth understanding in order to be able to explain the symptoms of the client and plan the course of treatment" (Tanner, 2007:180).
Noise and its impact on the ear	The definition and characteristics of noise and its impact on the human ear in terms of physiological, physical and emotional effects	"The impact of noise-induced hearing loss on the employees' physiology, quality of life and their ability to earn a living is a matter of even greater concern, as the disease has socio-economic implications for the entire country and for the Southern African region as a whole" (Franz, 2003). "Audiological personnel who are consulting in the mining industry are tasked with quantifying the impact of noise on employees' hearing, not only for compensation purposes, but also as a means of determining employees' fitness for work and evaluating the effectiveness of the HCPs" (De Koker, 2003:14).
Communication with employees	The strategies and content of conducting an audiological interview or obtaining case history information as well as providing feedback regarding the test results	"For clients to feel respected, cared for and safe, the professional person must create environments that put them at ease, allowing revelation, understanding and mutual planning to facilitate assessment and treatment and to allow the clinician to elicit the information needed as part of the treatment process" (Sheldon, 2009:4).

TOPIC	CONTENT	MOTIVATION FOR INCLUSION
Audiometric testing procedures	Audiometric testing procedures for conducting a hearing screening evaluation as per SANS guidelines and the scope of practice for audiometricians according to the HPCSA	"The importance of correct and periodic audiometric monitoring in preventing NIHL cannot be overemphasized" (Rom, 2007:1302). This is the focus point of the scope of practice for audiometricians and as such should be the focus point of the training programme for audiometricians.
Audiometric equipment	Being competent in using different audiometers (manual and automatic) and be able to trouble shoot equipment. Should also know the requirements for when equipment should be calibrated.	"An inaccurate audiogram may be caused by several factors, chief of which may be the use of an audiometer that is not appropriately calibrated, causing the whole testing procedure to be skewed" (Wiet, 2006:12). The person conducting audiometric testing procedures should be able to determine any inconsistencies in the testing procedure and be able to determine whether it is due to faulty calibration. "OSHA has taken the position that a audiometrician who is not competent in the hearing testing procedures and equipment, won't be suitable to work as part of a hearing health care team" (Rimmer, 2001:3)
Legislation regarding NIHL	Legislation regarding NIHL and the criteria for compensation of a NIHL	"Legislation and regulations have been enacted that spell out guidelines for protecting employees, employers and medical professionals when conducting hearing tests. Without clear guidelines and without following these guidelines, one is open for legal and social consequences" (Leeds, 2010:80).
Hearing conservation and hearing protection	The different components of hearing conservation programmes and how to develop and implement such a programme; different types of hearing protectors and the characteristics of each.	"Conducting hearing tests without implementing and interpreting the results within the framework of a HCP has no value. HCPs can only be deemed relevant if the necessary knowledge regarding the programme's strengths and weaknesses are utilized to improve the programme for the protection of the employees, employers and hearing health care professionals" (WCC Instruction 171, 2001). According to the HPCSA guidelines, audiometricians should be able to instruct employees in the use of hearing devices (including hearing protective devices) and as such should have the relevant knowledge and understanding regarding these HPDs.

In order to critically evaluate the current study's data, the topics in indicated in Table 4.3 will henceforth be compared to the training programmes of the two current training facilities' in Table 4.4. Both of these companies' training manuals have been provided to the researcher for the purpose of comparison – the opinions reflected in Table 4.4 are that of the researcher.

Table 4.4: A comparison between existing training programmes for audiometricians

Proposed training programme's topics	ACTS training programme topics (current ACTS training manual)	CSS / OCSA training programme topics (current OCSA training manual)
Anatomy and physiology of the human ear.	This topic is included in the training programme in sufficient detail to ensure adequate understanding of the outer, middle and inner ear's anatomy and physiology.	This topic is included in the training programme in sufficient detail to enable the learner to understand the basic anatomy and physiology of the ear.
Physics of sound	This topic is included in the training programme with detail regarding frequency, amplitude, pitch, loudness and intensity. It does not include the pathway of sound in terms of the discussed anatomy and physiology of the human ear or how the human ear captures and conducts sound waves. More detail may be given to integrate the learner's knowledge.	This topic is included in the training programme, but very superficially, since it only offers brief descriptions of the nature of sound, decibels, frequency duration and sound level meter. There is no integration of how human ears hear sound or how sound is measured or the characteristics of sound in sufficient detail to enable the learner to understand these concepts. It also does not integrate the anatomy and physiology of the ear with the pathway of sound through the human hearing mechanism.
Disorders of the auditory system	This topic is included in the training programme and describes the different types of disorders associated with the outer, middle and inner ear as well as the effects that these disorders would have on a pure tone audiogram or a person's hearing ability.	This topic is included in the training programme but only in terms of NIHL and the auditory effects of noise on a person. It does not include sufficient detail regarding other disorders that can be associated with the outer, middle or inner ear. Some mention is made of what type of disorders would be associated with conductive, mixed and sensorineural hearing losses, but without detailed explanations of any.
Noise and its impact on the ear	This topic is not included in the training programme, except for a section on NIHL as part of the general disorders of the ear. It does not include adequate detail regarding the auditory and non-auditory effects of noise.	This topic is included in the training programme and presented with sufficient detail in order to understand the basic principles of the influence noise has on an individual (auditory and non-auditory).
Communication with employees	This was omitted from the training programme. No information was provided on the importance of obtaining the correct and desired information from a case history, or on how to conduct a case history.	This topic is not included in the training programme. Reference was only made to the case history and which types of questions should be asked to the employee. This is however incomplete. It is expected of the learner to establish a case history form on his/her own as no clear indication is given as to which questions should be asked to obtain the desired information.

Proposed training programme's topics	**ACTS training programme topics (current ACTS training manual)**	**CSS / OCSA training programme topics (current OCSA training manual)**
Audiometric testing procedures	Included in this training programme is both the otoscopic examination as well as the pure tone air conduction screening procedure. Interpretation of the audiogram is also included.	Included in this training programme is both the otoscopic examination as well as the pure tone air conduction screening procedure. Interpretation of the audiogram is also included.
Audiometric equipment	Included in this training programme is information regarding the basic components of an audiometer and the calibration (biologic and electro-acoustic calibration) of the audiometer.	This topic is included in the training programme in sufficient detail, including the types of available audiometers, mobile hearing facilities and also the calibration of equipment.
Legislation regarding NIHL	This is covered in the training programme but only superficially and mostly in terms of baseline testing only. It only refers to Compensation for Occupational Injury and Disease Act (COIDA) (1995) and no references are made to SANS 10083:2004 or any other legislative documents.	Applicable legislation is only summarized in this programme regarding NIHL, including the Occupational Health and Safety Act (OHSA) (2002), COIDA (1995), MHSA (1996), Instruction 171 of the WCC (2001) and SANS 10083:2004.
Hearing conservation and hearing protection	This topic is included in the training programme but only superficially, since it only refers to the need for HCPs and that HPDs should be worn. Additional information regarding all the aspects of HCPs or the different types of HPDs; how to take care of these HPDs or any motivation, education and training of employees and employers regarding HCPs and HPDs are not included.	This topic is included in the training programme, specifying the content of a HCP as well as the different HPDs that can be used. It also includes the approximate attenuation of each type of HPD.

As discussed in Table 4.3, the proposed training programme in this study seems to contain all the necessary topics, even when compared to two current training programmes (*ACTS* and *CSS / OCSA* programmes) in Table 4.4. There are no topics in these two current training programmes (*ACTS* and *CSS / OCSA* programmes) that are not included in this study's proposed training programme. However, some topics that are included in the proposed programme, such as communicating with clients or obtaining a complete case history, are not included in the current training programmes or covered in very little detail only. Each proposed topic should be covered in sufficient detail to ensure effective learning. In order to achieve this, any training programme for audiometricians should have specified learning outcomes. According to Miller (1990:25), curriculum planning, teaching and assessment of learners are in close relationship as depicted in Figure 4.20.

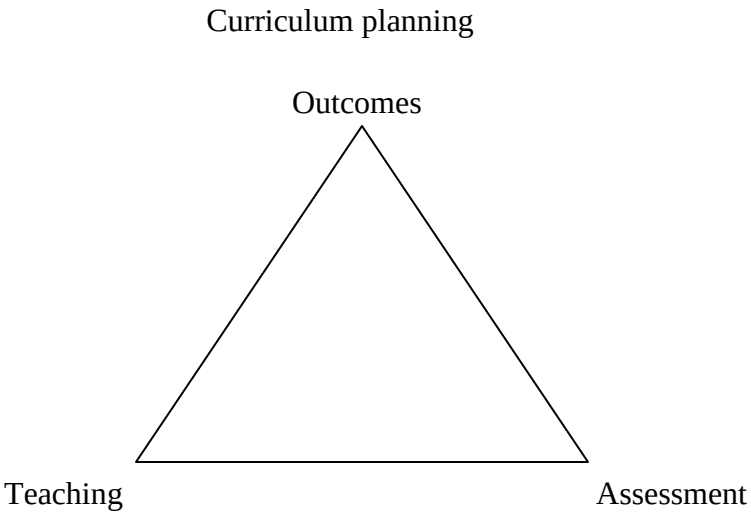

Figure 4.20: Curriculum planning, teaching and assessment

Figure 4.20 depicts the close relationship between the setting of the desired learning outcomes and the teaching and assessment methods implemented in a learning programme (Miller, 1990:25). Furthermore, simply knowing the facts is not enough to ensure competence; assessment is the process of determining how much each learner knows or can do and this principle of competence is depicted in Figure 4.21 (Miller, 1990:30).

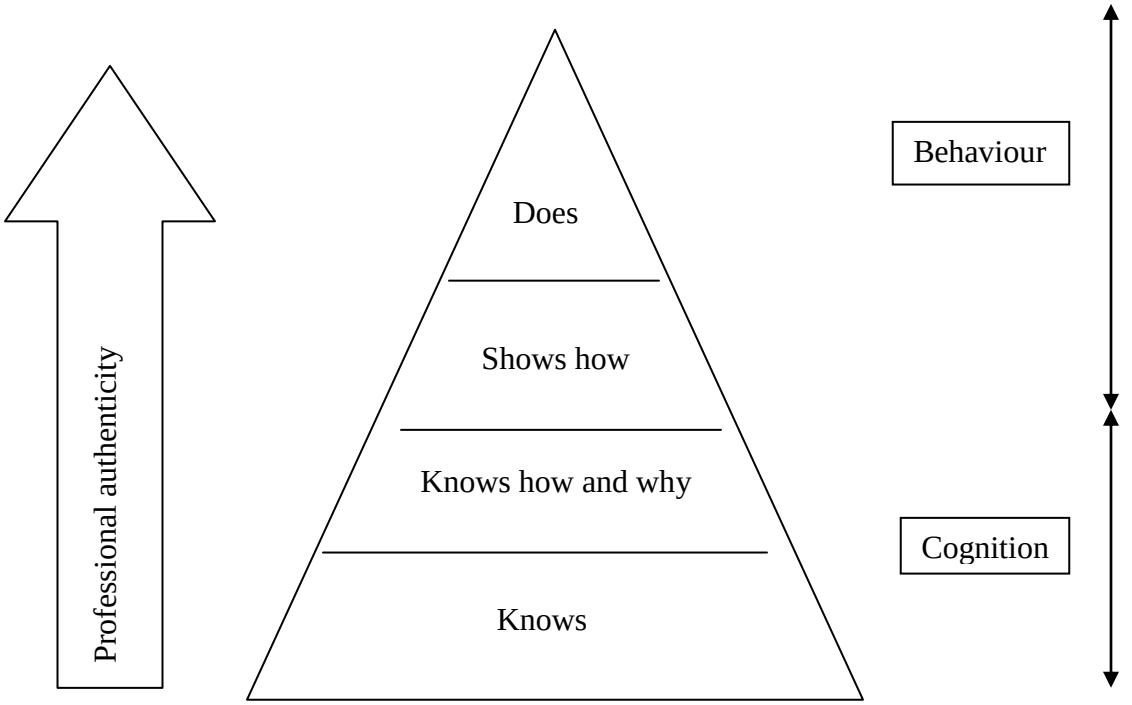

Figure 4.21 Miller's pyramid: a simple model of competence

The desired result of a training programme is thus for the learner to be able to achieve the required outcomes as illustrated in Figure 4.21. In order to achieve this modified behaviour the learning programme should be structured is such a way that the outcomes are formulated in order to evaluate the learner's ability to demonstrate and conduct the required testing procedures (Miller, 1990:30). These learning outcomes should be used as assessment criteria and are stipulated in Table 4.5.

Table 4.5: Specific learning outcomes for a training programme for audiometricians

Topic	Specific outcomes
Anatomy and physiology of the human ear	• Learners should be able to differentiate and explain the different structures of the outer, middle and inner ear as well as the functioning/physiology of each structure; • Learners should be able to reconstruct and summarize the different anatomical structures of the ear; • Learners should be able to integrate his/her knowledge of the anatomy and physiology of the ear in order to determine the site of lesion for each of the three different types of hearing losses; • The learners should be able to analyze, explain and distinguish different types of anatomical or physiological abnormalities and the type of hearing loss each specific abnormality would cause.
Physics of sound	• Learners should be able to identify and explain the different physical characteristics of waveforms; • Learners should be able to describe different waveforms and interpret and explain how these waveforms will interact when combined; • Learners should be able to illustrate and explain how sound travels through a medium from a sound source to a sound receiver; • Learners should be able to identify, describe and interpret a waveform's amplitude and frequency; • Learners should be able to describe the influence of abnormal anatomical or physiological features in a person's ear on the transmission of sound through the hearing pathways and be able to apply this knowledge to the hearing testing procedure; • Learners should be able to illustrate and describe how sound waves are received, modified and transmitted through the hearing pathways; • Learners should be able to describe the relationship between frequency and pitch as well as between amplitude and intensity and be able to apply this knowledge to conducting a hearing test and interpreting an audiogram.
Disorders of the human ear	• Learners should be able to differentiate and outline different disorders of the human ear; • Learners should be able to analyze how these different disorders will impact a pure tone screening test's results; • Learners should be able to compare and describe how specific disorders of the human ear would influence a person's hearing ability and be able to apply this knowledge to the hearing evaluation procedure;

Topic	Specific outcomes
	• Learners should be able to perform an otoscopic examination and be able to identify abnormalities.
Noise and its impact on the ear	• Learners should be able to explain how noise impacts human hearing in terms of the auditory as well as non-auditory effects; • Learners should be able to compare the duration of time allowed in different noise levels according to the decibel readings of the environments; • Learners should be able to compare and explain the characteristics of a NIHL to other types of hearing losses; • Learners should be able to identify a temporary threshold shift (TTS) and a permanent threshold shift (PTS) and illustrate on an audiogram the influence TTS and PTS will have on a pure tone hearing test; • Learners should be able to explain the impact of noise on the employer as well as on the employee; • Learners should be able to summarize the physical, emotional and social impact noise has on a person; • Learners should be able to demonstrate the effects of noise exposure on a person's pure tone thresholds in relation to the time of exposure by illustrating the results on an audiogram; • Learners should be able to explain and evaluate NIHL in depth, describing at least 20 different qualities, aspects or consequences of NIHL and illustrate how a typical NIHL would present on an audiogram.
Communication with employees	• Learners should be able to conduct a complete case history of employees; • Learners should be able to communicate effectively with employees and in such a manner that the employee understands the information conveyed to him/her; this should be done by performing an oral presentation of such a scenario; • Learners should be able to educate employees on the dangers of hazardous noise and wearing hearing protection. • Learners should be able to communicate the results of the otoscopic examination and the audiogram to employees in terms that the employee will understand; • Learners should be able to educate employees regarding the legislative requirements of noise zones, noise exposure, hearing protection and motivation to implement a HCP.
Audiometric testing and audiometric equipment	• Learners should be able to conduct a biological check on the audiometric equipment; • Learners should be able to operate the audiometric equipment and ensure it is calibrated regularly and determine when it is due for calibration; • Learners should be able to perform an otoscopic examination and interpret his/her findings on at least ten clients; • Learners should be able to conduct a hearing screening test on at least ten clients; • Learners should be able to record the audiometric results correctly on the audiogram; • Learners should be able to interpret all the audiometric results correctly; • Learners should be able to categorize the results of the hearing test in term of degree of hearing loss and compare it to previous results; • Learners should be able to refer a client appropriately.

Topic	Specific outcomes
Legislation regarding NIHL	• Learners should know and apply all the relevant legislative requirements for conducting a hearing test and a HCP in an industrial/mining environment; • Learners should be able to apply the relevant legislation to his/her vocational setting on completion of the learning programme; • Learners should be able to differentiate between the different criteria for conducting the different types of hearing tests (e.g. monitoring tests, exit tests, diagnostic tests) as stipulated in the relevant legislation.
Hearing conservation and hearing protection	• Learners should be able to explain how he/she would organize a HCP; • Learners should be able to define the role of the management, medical, safety, and other workers in a HCP; • Learners should be able to illustrate and describe the basic content that should be included in a HCP by drawing a diagram of the different aspects of a HCP; • Learners should be able to communicate the implementation of a HCP to all stakeholders; • Learners should be able to demonstrate in a class presentation how he/she would motivate employers and employees to implement and monitor a HCP; • Learners should be able to list the advantages and disadvantages of the different types of hearing protectors; • Learners should be able to advise employees and employers regarding hearing protection; • Learners should be able to educate the employees on inserting, cleaning and protecting his/her HPDs; • Learners should be able to demonstrate how he/she would motivate employees to wear and take care of their HPDs by means of a class presentation; • Learners should be able to evaluate the effectiveness and adequacy of each of the different HPDs that can be worn by employees by conducting regular audiometric evaluation and comparing the results of each test to determine a decline in hearing ability.

These learning outcomes in Table 4.5 should guide the course coordinator, course presenter/s as well as the learners as to what would be expected of them during the course of the training programme. Adults respond for the most part to internal motivational factors or pressures, more so than to external motivational factors. Adult learners attend a training course in order to learn something they can use in their everyday work environment and this will motivates them to learn (Knowles et al., 2005:66). The respondents indicated that the majority (174/96.2%) benefited most from both theoretical and practical training in their own training programmes (n = 181). Furthermore, 179 of the respondents (99%) felt that future training of audiometricians should include ample opportunity for training, both theoretical and practical (n = 181). The outcomes cited in Table 4.5 should therefore be structured in such a way that the practical, audiometric testing procedures are not only facilitated as a theoretical component, but are actually practiced during the course of the training programme. Adult learners need to know how the new

information that is learned can be applied to their everyday or vocational life. As such, practical demonstrations as well as adequate time for the learners to practice these techniques themselves are important when the learners are adults. .

These outcomes should also be used to assess the learners in order to determine if they have mastered the necessary outcomes.

4.3.4 Evaluation of the learners' knowledge

According to the majority of the respondents, the learners should be evaluated by means of a written and practical examination as well as by completing assignments throughout the course of the training programme. Using all three these methods of evaluation, the knowledge and skills the learners have acquired by the end of the training programme can be evaluated. If the learning has been successfully completed in terms of the learning outcomes, adequate modification and transformation in behaviour should be demonstrated by the learners at the end of the training programme. Critical reflection and analysis is key to transformation of adult learners. They need time to contemplate the scope of practice of audiometricians and ramifications of the training provided in relation to their own experiences and responsibilities. Any training programme should provide time for the learners to do self study and ask any questions they might have regarding the material taught. In a training programme for audiometricians, learners should reflect on the implications of the training they have received, by evaluating the training programme at the end of the training, relative to their own views regarding audiometry and all the related topics that have been taught. Assessing if the necessary transformation in the learners' knowledge and skills has been achieved is critical for determining if the learner shows the necessary competence at the completion of the training programme.

With reference to the obtained data, it is clear that the training programme for audiometricians should include three methods of evaluating the learners' competencies, namely: a written and practical examination on completion of the training programme and assignments to be completed throughout the training programme. First, there should be one written theoretical examination on the last day of the training programme. There should also be a practical examination on the last day of the training programme to ensure that the audiometric testing procedures that were taught through demonstration have been mastered. Finally, assignments should be devised in such a

manner as to test both the theoretical knowledge gained throughout the course, as well as the learner's ability to integrate this knowledge into real life practical scenarios. Learners should obtain a score of at least 70% per learner per assessment method, in order for the learner to be awarded a certificate stating that he/she is qualified as an audiometrician. Obtaining a score of 70% per learner per assessment method should indicate that the learner has sufficient knowledge and skills to be able to independently perform the necessary testing on completion of the training course.

On completion of the training programme, the learners should therefore be evaluated to determine their level of knowledge and skill regarding the training topics that were presented. The training programme should also be evaluated to determine if the objectives of instruction have been achieved.

4.4 Evaluating the programme

Although the scope of this study does not include the evaluation and maintenance of the training programme, the theoretical concepts of maintaining and evaluating such a programme will be discussed in order to give a more complete representation of this study and as a topic for a future research project.

4.4.1 Theoretical concepts

The evaluation of a group of learners' performance should indicate to the instructional designer whether or not the objectives of instruction have been reached in terms of the programme as a whole (Smith & Ragan, 2005:327).

In addition to this type of evaluation it is also critical for the instructional designer to evaluate the instructional materials. This evaluation occurs during two separate points in time in the instructional development process for two different purposes. Firstly, the designer evaluates the material to determine any weakness in the instruction so that revisions can be made to make it more effective and efficient, until the designer is satisfied that the material is sufficient to allow learners to receive optimal training (Smith & Ragan, 2005:327). This is called formative evaluation and is an ongoing process.

The second evaluation process occurs later, after the materials have been implemented in the instructional context, where the materials are evaluated in terms of their effectiveness in order to provide data for decisions regarding the continuing or aborting of the instruction. This is called summative evaluation and is also an ongoing process (Smith & Ragan, 2005:327)

4.4.2 Formative evaluation phase

The four stages of formative evaluation are design reviews, expert reviews, learner validation and ongoing evaluation. These are briefly discussed below according to Smith and Ragan (2005:328 - 329).

4.4.2.1 Design review

Each aspect of the analysis phase can be submitted to formative evaluation in order to make revisions prior to any bulk distribution of the materials. These reviews can be conducted on completion of each phase of the design because it serves to confirm the accuracy of the design process at each stage (Smith & Ragan, 2005:328).

- Goal review

Goal review confirms that the goals that have been established are representative of a real instructional need and congruent with the expectations of the relevant role players. This will ensure that there is an agreement on the purpose of instruction (Smith & Ragan, 2005:329).

- Environment and learner analysis review

The data obtained regarding the environment and the learner analysis must be reviewed to ensure their accuracy (Smith & Ragan, 2005:329). This can be done by utilizing survey research.

- Task analysis review

Task analysis can be confirmed using a number of techniques depending on the type of design and the designer's preference (Smith & Ragan, 2005:330).

4.4.2.2 Expert reviews

Before the material is used, it is often helpful to have different experts review the material and make suggestions to improve the material if necessary. These experts may include: content

experts, instructional design experts, content-specific education specialists and learner experts such as teachers (Smith & Ragan, 2005:329). This is a very important recommendation of this programme for future research studies.

4.4.2.3 Learner validation

Learner validation can be divided into three phases, one-to-one evaluation, small-group evaluations and field trials (Smith & Ragan, 2005:329).

- One-to-one evaluation

The designer pilots the instructional materials with two or three members of the target audience. The purpose of this stage is to determine and rectify any gross problems in the instruction. Learners may also complete a questionnaire on completion of the course regarding the course's content, relevance, logistic aspects and presentation. Positive feedback indicates a higher probability of learning.

- Small-group evaluation

The purpose of this stage is to check the efficacy of the revisions based on the one-to-one data to ascertain how well the instructional goals are implemented. The goal of small-group evaluation is to determine if the teaching material is complete enough on its own without the designer's constant explanations and clarifications (Smith & Ragan, 2005:329). This is usually recommended for a distance learning programme.

- Field trails

The purpose of field trails is to:

  - Determine the effectiveness of the revisions made during the small-group evaluation;
  - Ascertain any problems that might arise in the administration of the materials in a real instructional environment;
  - Validate the instruction with a large enough sample of the target audience to make a confident prediction of its effectiveness.

4.4.2.4 Ongoing evaluation

Data collection for the purpose of revision of instruction should not cease, even when the instruction has been implemented in the target systems. Materials can be revised more than once if a training programme has a long-term implementation period (Smith & Ragan, 2005:329).

4.4.3 Summative evaluation phase

The purpose of summative evaluation within the context of instructional design is to collect, analyze and summarize data to make a judgment call regarding the effectiveness, and perhaps the appeal and efficiency of the instruction (Smith & Ragan, 2005:342).

The steps in completing a goal-based summative evaluation are summarized (Smith & Ragan, 2005: 342 – 350):

- *Determine the goals of evaluation:* identify the objectives that should be determined as a result of the evaluation;
- *Select indicators for success:* determine which indicator to use as evidence of the impact of the instructional programme;
- *Select the benchmarks for success:* agree on the benchmarks that are most appropriate in answering the evaluation questions that will be used to determine the success of the programme;
- *Select the design of evaluation:* evaluation designs describe what data will be collected, when the data should be collected and under what conditions the data should be collected in order to answer the evaluation questions;
- *Design or select evaluation measures:* considerations involved in designing measures of learning outcomes;
- *Collect data:* a plan for data collection of all the outcomes and characteristics determined should be devised according to the programme's design;
- *Analyze data:* data should be analyzed in such a way that it is easy to see how the instructional programme affected the problem presented in the needs assessment; and
- *Report results:* results should be reported in an academic and concise manner including all the relevant components that were evaluated.

4.5 Summary

In this chapter the results of the needs analysis were presented and used to design the training programme for audiometricians. The results indicated that currently practicing audiometricians display a lack of knowledge regarding the legislation and also regarding some of the audiometric testing procedures. It also indicated that not all of the respondents have received the necessary training on the relevant testing procedures as part of their audiometric evaluation protocol, such as otoscopic evaluation, which some of the respondents indicated they do not perform. Furthermore, the majority of the respondents do not operate as part of a hearing health care team and this can have a negative impact on the quality of care an employee receives, since some pathology may be overlooked or misinterpreted in the absence of the appropriate professional team member. The data indicated that not all of the respondents where sufficiently familiar with the legislation regarding NIHL and not all of the respondents were able to name the required legislative documents.

All of these results were used to determine what should be included in a training programme for audiometricians to ensure they are trained as adequately as possible. The proposed training programme consists of different topics, each with a set of measurable outcomes to determine whether the learners have in fact mastered the required knowledge and skills. Training should also be conducted in such a way as to accommodate the adult learning principles as discussed in this study. On completion of the training programme, different evaluation methods are employed to further assess the learners' mastering of the required outcomes of the programme.

The evaluation of the training programme does not form part of the scope of this research study but an overview of the theoretical concepts of evaluation as well as the different phases of evaluation were included. This was done in order to provide a more complete representation of this research study and for planning purposes for future studies.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

NIHL is the most prevalent disorder in the industrial sector and has been recognized since the Industrial Revolution in the 19th century (Sataloff & Sataloff, 2006:1). In an attempt to try and reduce NIHL in the mining and industrial sector, legislation has been brought into place to guide the monitoring of noise zones, the testing of employees' hearing who are exposed to noise of 85dB SPL or louder and to guide the referral process (SANS 10083:2004). The responsibility of protecting hearing is often placed on the employer and not on the employee, making the worker only a passive reactor to the noise around him/her. For this reason, hearing conservation programmes (HCP) have been brought into place to enable the employee as well as the employer to know their rights and responsibilities regarding noise and NIHL (Project Health 809, 2004:24). According to the Mine Health and Safety Act (MHSA, 1996), HCPs are implemented to identify hazards and assess risks regarding noise exposure according to the legislative requirements. Furthermore, measures to eliminate, control or minimize existing risks and monitor risks should be implemented. Part of the HCP is medical surveillance which includes hearing tests (MHSA, 1996).

According to SANS (10083:2004) it is required that hearing testing be done by an audiologist or an audiometrician. An audiometrician is defined, according to SANS (10083:2004), as a person registered with the Health Professions Council of South Africa (HPCSA) as an audiometrician or a hearing aid acoustician or one of several other professional people who may conduct hearing screening tests as discussed in Chapter 1 of this study. This definition of an audiometrician indicates that the training received by the different groups described as 'audiometricians' differs greatly. The focus of this study was on designing a training programme for audiometricians according the principles and guidelines of instructional design. The learners was the focal point of the programme by ensuring that lifelong learning takes place according to the principles of adult learning (Knowles et al., 2005:1). Therefore, the main goal of instructional design is to ensure competent performance by the learners at the end of the instruction (Morrison et al., 2001:2). In addition to enhancing the learning experience, effective instructional design for training purposes shows attainment of the programme objectives by the learners as well as the

learners' ability to use these acquired skills and knowledge in their work environment (Morrison et al., 2001:11).

5.2 Research findings

The aim of this section is to summarize the research findings described in Chapter 4. These research findings have been divided into four sections based on a logical grouping of themes, namely:

5.2.1 Respondents' own experience regarding audiometry

5.2.2 Respondents' opinions regarding the topics they have been taught in audiometry

5.2.3 Duration of respondents' own training programme

5.2.4 Respondents' opinions regarding a future training programme for audiometricians

The results of these four sections will now be summarized as per Chapter 4's findings.

5.2.1 Respondents' own experience regarding audiometry

The majority of respondents have conducted hearing screening tests in the mines. The focus of the training programme should therefore be on the mining industry as this is where the majority of the respondents are working. This environment requires unique considerations that should be included in the training programme. These include a high incidence of middle ear pathology (Habig & De Koker, 2004:1), the presence of barotrauma (De Koker, 2003:8) as well as the high prevalence of pseudohypacusis and its potential negative influence on the test results and the referral process of these mine workers (De Koker, 2003:5). Conducting hearing tests on employees exposed to noise should be done according to the SANS guidelines (SANS 10083:2004) and although the training programme may include mobile testing guidelines, it does not need to be the main focus as the majority of respondents conducts hearing tests in an in-house facility. Audiometricians should be trained to conduct hearing screening on the different types of audiometers and should have knowledge on the advantages and disadvantages of each type.

One of the benefits of conducting hearing tests in an in-house facility in the mine or industrial setting, is that it is easier to refer to other specialists who are also based in the same mine or

company. However, not all the respondents indicated that they were in fact working as part of a hearing health care team. The need for and importance of team work should be emphasized in the proposed training programme for audiometricians, as well as the appropriate referral processes, since each team member is uniquely equipped to deal with the different treatments a person with a hearing loss may need (Hosford-Dunn et al., 2008:66). The minority of the respondents indicated to have an audiologist as part of their hearing health care team. It is unclear why not even 50% of the respondents collaborates with an audiologist and this matter should also be addressed in the training of audiometricians because audiologists are specially equipped to conduct diagnostic hearing evaluations (Roeser et al., 2007:14). According to legislation (SANS 10083:2004) the audiometricians have a responsibility to refer to an audiologist in certain circumstances and as such should not work without an audiologist who can conduct diagnostic hearing tests.

Hearing tests can be conducted by audiometricians through either using manual or automatic methods and although automatic methods are widely used in the mining industry, manual testing procedures are preferred when dealing with a population with such a high prevalence of pseudohypacusis. The majority of the respondents used an automatic testing programme named *Everest* and although they are not using manual testing procedures, there is still a need for audiometricians to be trained to conduct a hearing testing procedure by using manual testing as this population is unique in the sense that it could be described as a difficult to test population. It is important to consider the impact pseudohypacusis may have on pure tone screening procedures. The main focus of the training programme for audiometricians should thus be on the testing procedure itself, understanding the risk factors and signs of pseudohypacusis and also on teaching the learners how to control the testing procedure as well as the testing environment in order to obtain reliable testing results as frequently as possible, despite the prevalence of pseudohypacusis.

Part of the process of achieving accurate results is to educate the client in such a way that he/she wants to give his/her cooperation in the testing procedures as well as in wearing HPDs. The majority of the respondents indicated that they only provide education to employees as and when they see fit or if they have time to do so. The training of audiometricians should focus on the importance of and need for education regarding NIHL and HPDs, as well as on the content of the

education as a tool that can be used to reduce the rising prevalence of NIHL in the mining industry.

Legislation was also put in place to attempt to curb the rising prevalence of NIHL in the mining industry. It is unacceptable that almost 25% of the respondents did not know the legislation and only 30% of those who did claim to know the legislation could name the relevant documentation. This should be an important part of the training programme for audiometricians as the legislation should form the basis of the audiometric testing procedure and as such serve as a guideline for clinical practice (SANS 10083:2004).

5.2.2 Respondents' opinions regarding the topics they have been taught in audiometry

The majority of the respondents (95%) have indicated that audiometric testing procedures were taught to them when they attended a training programme for audiometricians (n = 181). This is unacceptable, because it indicates that 5% of the respondents have not had any training in audiometric testing procedures and it is uncertain if they will be able to perform these procedures without the necessary training (n = 181). The respondents who have had training further indicated that all of them do conduct pure tone AC testing as part of a hearing evaluation but not all of the respondents indicated they conduct an otoscopic examination prior to AC testing. This is yet again unacceptable as it implies that some of the respondents do not conduct otoscopic examinations as part of their routine hearing testing procedure and this can have a negative impact on the results as well as the referral process of the clients. An otoscopic examination is compulsory as part of a hearing evaluation according to SANS (10083:2004). The training programme should therefore include training of the specified audiometric procedures, including performing otoscopic examinations.

5.2.3 Duration of respondents' own training programmes

In the needs analysis the respondents indicated which topics they considered to be important to include in a training programme for audiometricians. Another important factor derived from the needs analysis, is the recommended duration of such a training programme. A number of respondents indicated that their own training programme was five days long. This was taken into account when developing the training programme for future audiometricians. The researcher

concluded that due to the differences in opinions in the duration of a programme as well as the lack of training the respondents have received, a training programme should be eight to 10 working days long to ensure that all topics are sufficiently covered and the learners are sufficiently trained in audiometry.

5.2.4 Respondents' opinions regarding a future training programme for audiometricians

The type of training that should be provided to audiometricians was done according to the principles of adult learning, which state that learning should be practical and have a strong connection to the learner's everyday vocational life (Isenberg, 2007:15). Training consisting of theoretical and practical (hands-on) components were recommended by almost all of the respondents. The course coordinator will be an audiologist as the majority of the respondents felt that an audiologist would have adequate knowledge regarding audiometry in order to coordinate such a course effectively. The topics to include in the training programme as suggested by the respondents, are as follows:

- Anatomy and physiology of the ear;
- They physics of sound;
- Disorders of the auditory system;
- The impact of noise on the ear;
- Audiometric testing procedures;
- Communication with clients;
- Legislation regarding NIHL;
- Hearing conservation programmes.

On completion of the training programme, evaluation should be done by means of a written, theoretical examination, a practical examination, and assignments covering all the outcomes of the learning programme.

Continuing professional development (CPD) activities should be conducted annually after the course has been completed. The minority of the respondents who did not feel CPD activities on completion of studies are necessary, indicated the following reasons: problems getting time off work to go to these activities and problems in finding available CPD activities. Some respondents felt that once you have completed your training, no additional training is necessary. They felt the training programme should be developed in such a manner that no additional training should be needed on completion of the programme.

5.3 Developing the training programme

The training programme was developed according to the instructional design principles as set out in Chapter 2. The information obtained through the analysis phase, as well as through currently existing training programmes were used in the design of a training programme for audiometricians. The topics to be included in a training programme for audiometricians were discussed in Chapter 4 and are only summarized as follows:

- Anatomy and physiology of the human ear;
- Disorders of the auditory system;
- Noise and its impact on the ear;
- Communication with clients and the case history;
- Audiometric testing procedures and equipment;
- Legislation regarding NIHL;
- Hearing conservation and hearing protection.

Specific learning outcomes were identified for each of these topics. These learning outcomes should guide the learner as well as the facilitator as to what is expected of them during the course of the training programme (see Table 4.3). The outcomes should also be used to assess the learners in order to determine if they have a meaningful understanding of the content that they have been taught.

Evaluating the learners' knowledge should be done by means of a theoretical and practical examination on all of the programme's topics as well as an assignment that should be completed by each learner to assess their integration and understanding of the material that they have been taught. This should be done according to the adult learning principles as were discussed in the beginning of this research study.

5.4 Strengths and limitations of the study

This research study had some strengths and limitations. The study's strong points include:

- Instructional design principles and adult learning principles were used as basis for designing a training programme for audiometricians;
- Current training programmes for audiometricians were reviewed as part of the data collection from the respondents.

The limitations of this research study included:

- The sample size of the respondents used for data collection could have been bigger;
- The opinions of other role players, such as the management staff of mining companies, occupational health doctors and/or nurses and audiologists working in the mining industries could have been used as part of the data collection.

5.5 Recommendation for future research

This research study included only the first three of the five stages of the instructional design process, namely analysis, design and development. The last two stages, namely implementation and evaluation, were not within the scope of this study. These two phases may be included in future research. Further recommendations for future studies include**:**

- Consultation experts for additional input and recommendations for improving the training course for audiometricians;

- Including learner evaluation at the end of each training programme to determine the learners' opinion regarding the training course in terms of content, tempo, presentation and evaluation methods;

- Critical evaluation of the study suggest that the market research was sufficient to determine the design of a instructional programme for audiometricians, but it only included the opinions of current practicing audiometricians. Future studies may include other professionals' opinions as well, for example those of the employers of mining companies, occupational health doctors and nurses and audiologists working in the mining industry;

- Evaluation of audiometricians' (trained with this newly developed training programme) actual performance in the field.

5.6 Closing

This research study aimed at designing a training programme for audiometricians following the principles of instructional design. By following the instructional design principles the researcher was able to develop a proposed training program for audiometricians that may improve the future training of audiometricians and assist in the reduction of NIHL in South Africa through an effective HCP.

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APPENDIX A: ETHICAL CLEARANCE CERTIFICATE

Faculty of Humanities
Research Proposal and Ethics Committee

1 December 2008

Dear Dr Suer

Project:	**The instructional design of a training program for audiometricians**
Researcher:	**H Hoogendyk**
Supervisor:	**Dr ME Soer**
Department:	**Communication Pathology**
Reference number:	**22099621**

Thank you for the application you submitted to the Research Proposal and Ethics Committee, Faculty of Humanities.

I have pleasure in informing you that the Research Proposal and Ethics Committee formally **approved** the above study on 25 November 2008. The approval is subject to the candidate abiding by the principles and parameters set out in her application and research proposal in the actual execution of the research.

The Committee requests you to convey this approval to Ms Hoogendyk.

We wish you success with the project.

Sincerely

Prof. Brenda Louw
Chair: Research Proposal and Ethics Committee
Faculty of Humanities
UNIVERSITY OF PRETORIA
e-mail: brenda.louw@up.ac.za

APPENDIX B: INFORMED CONSENT AND INFORMATION LETTER (ENGLISH)

100
1908 - 2008

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Humanities
Department of Communication
Pathology

17 April 2009

INFORMED CONSENT TO PARTICIPATE IN A RESEARCH STUDY

TITEL OF THE STUDY: THE INSTRUCTIONAL DESIGN OF A TRAINING PROGRAM FOR AUDIOMETRICIANS

RESEARCHER: H. HOOGENDYK. CONTACT DETAILS: hhoogendyk@gmail.com

This study will consist of the development of a training program for audiometricians following the principles of instructional design. This program will be used to train audiometricians regarding industrial hearing screening and the associated legislation. If you wish to participate in this study, your input will be taken into account when developing this program.

You will be required to fill in a questionnaire consisting of 26 questions. It will take approximately 20 minutes to complete the questionnaire. All answers will be kept confidential and your honest opinion will be appreciated. There will be no risks involved by participating in this study. Participation is completely voluntary and participants can withdraw at any time should they wish to do so.

If you need any additional information or clarification, please feel free to contact me at the above mentioned electronic mail address.

By completing the questionnaire you give your informed consent to participate in the study.

Regards,

Hendrika Hoogendyk
Researcher

Dr. M. Soer
Supervisor

Prof. B. Louw
Head: Department of Communication Pathology, University of Pretoria

APPENDIX C: INFORMED CONSENT AND INFORMATION LETTER (AFRIKAANS)

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Fakulteit Geesteswetenskappe
Departement Kommunikasiepatologie

17 April 2009

INGELIGTE TOESTEMMING OM IN 'N NAVORSINGSSTUDIE DEEL TE NEEM

TITEL VAN DIE STUDIE: THE INSTRUCTIONAL DESIGN OF A TRAINING PROGRAM FOR AUDIOMETRICIANS

NAVORSER: H. HOOGENDYK

KONTAKBESONDERHEDE: hhoogendyk@gmail.com

Hierdie studie bestaan uit die ontwikkeling van 'n opleidingprogram vir oudiometriste deur die beginsels van instruksionele ontwerp te volg. Die program sal gebruik word om oudiometriste op te lei rakende industriële gehoorsifting, asook die gepaardgaande wetgewing. Indien u aan die studie wil deelneem, sal u mening en insette in ag geneem word tydens die ontwikkeling van die program.

Daar sal van u verwag word om 'n vraelys te voltooi wat uit 26 vrae bestaan. Dit sal ongeveer 20 minute neem om te voltooi. Alle antwoorde sal konfidensiëel gehou word en u eerlike opinie sal waardeer word. Daar is geen risikos verbonde aan deelname in hierdie studie nie. Deelname is heeltemal vrywillig en deelnemers kan ten enige tyd onttrek indien hulle dit so verkies.

Indien u enige verdure inligting benodig, voel vry om my te kontak by die bogenoemde elektroniese pos adres.

Deur die vraelys te voltooi, gee u u ingeligte toestemming tot deelname aan hierdie studie.

Groete,

Hendrika Hoogendyk
Navorser

Dr. M. Soer
Studieleier

V/R

Prof. B. Louw
Hoof: Departement Kommunikasiepatologie

APPENDIX D: QUESTIONNAIRE (ENGLISH)

INSTRUCTIONS

Please **complete all of the questions** below.
Mark the appropriate option/s with an "x" in the **box to the right**
or **fill in the information** in the space provided
Some questions can have **more than one answer**!

Thank you for your time, this questionnaire will only take approximately 20 minutes to complete.

Section A: Demographic information

1 How **old** are you in years?
_____ years

2 What is your **gender**?
2.1 Male
2.2 Female

3 For how many years have you been **practicing** audiometry?
_____ years

4 In which **environments** have you practised audiometry?
Please choose all the options you feel is necessary.
4.1 Private practice
4.2 State hospital / clinic
4.3 Educational sector
4.4 Industrial sector
4.5 Other: _____

5 What **qualifications** do you have with regards to audiometry?
Please choose all the options you feel is necessary.
5.1 Audiometry diploma
5.2 Audiometry certificate
5.3 Acoustician degree
5.4 Audiology degree
5.5 Other: _____

Section B: Training

6 Have you had any **other training (not mentioned in question 5)** regarding audiometry?

6.1 Yes ☐
6.2 No ☐

7 If yes to **question 6**, what **type** of training?
Please choose all the options you feel is necessary.

7.1 CPD (continuing professional development) activities ☐
7.2 Working with superiors ☐
7.3 Observation of other audiometrists ☐
7.4 Refresher course in audiometry ☐
7.5 Other: _____

8 What was the **main topic(s) / theme(s)** of the training as mentioned in **question 5**?

8.1 _____
8.2 _____
8.3 _____
8.4 _____
8.5 _____
8.6 _____
8.7 _____

9 Where did you **attend the training** as mentioned above?

9.1 At work ☐
9.2 At a university / training institution ☐
9.3 At an informal study group ☐
9.4 Over the internet ☐
9.5 Other: _____

10 How **long** was the training as mentioned above?

10.1 _____ days; or ☐
10.2 _____ weeks; or ☐
10.3 _____ months; or ☐
10.4 _____ years ☐

11 When performing a hearing evaluation, which of the following **procedures** do you use?
Please choose all the options you feel is necessary.

11.1 Case history ☐
11.2 Pure tone testing (air conduction) ☐
11.3 Industrial screening ☐

11.4 Screening immittance testing
11.5 Otoscopy
11.6 Other: _____

12 Do you conduct hearing testing in a **mobile unit**?
12.1 Yes, frequently
12.2 Yes, sometimes
12.3 Yes, seldomly
12.4 No

13 If you have done industrial screening testing, in which **environments**?
Please choose all the options you feel is necessary.
13.1 Mines
13.2 Industries
13.3 Factories
13.4 Other: _____

14 Are you working as part of a **hearing health care team**?
14.1 Yes
14.2 No

15 If yes to question 14, who is **part of your team**?
Please choose all the options you feel is necessary.
15.1 ENT
15.2 General practitioner
15.3 Audiologist
15.4 Audiometrist
15.5 Occupational health nurse
15.6 Occupational medical practitioner
15.7 Nurse
15.8 Other: _____

16 Which **testing program** do you use when doing screening audiometry?
Please choose all the options you feel is necessary.
16.1 Ruskal
16.2 Everest
16.3 Manual testing
16.4 African Management System
16.5 OCSA
16.6 ACTS
16.5 Other: _____

17 How often do you **educate** clients about NIHL (noise induced hearing loss)?

17.1	Every client	
17.2	Some clients	
17.3	When I feel it is necessary	
17.4	Only clients who work in noisy environments	
17.5	When I have time	
17.6	Never	

18 If you do counsel clients, what does the **education program** consist of?
Please choose all the options you feel is necessary.

18.1	Information regarding NIHL	
18.2	Prevention of NIHL	
18.3	Compensation of NIHL	
18.4	Information on assistive devices, e.g. hearing aids	
18.5	Information on hearing protectors	
18.6	Other: _____	

19 What did your **own training program** regarding hearing screening consist of?
Please choose all the options you feel is necessary.

19.1	Anatomy and physiology of the ear	
19.2	The physics of sound	
19.3	Disorders of the auditory system	
19.4	The impact of noise on the ear	
19.5	Audiometric testing	
19.6	Communication with patients	
19.7	Legislation regarding NIHL and industrial hearing testing	
19.8	Hearing conservation and protective devices	
19.9	Other: _____	

20 It **Audiometric testing** (question 19.5) was included in your own training program, what type of audiometric testing was taught?
Please choose all the options you feel is necessary.

20.1	Otoscopy	
20.2	Pure tone testing (air conduction)	
20.3	Pure tone testing (bone conduction)	
20.4	Screening pure tone testing	
20.5	Acoustic reflexes	
20.6	Tympanometry	
20.7	Speech testing	
20.8	Other: _____	

21 How **long** do you think someone's training should be for him / her to be able to do hearing screening?

21.1	_____ days; or	
21.2	_____ weeks; or	
21.3	_____ months; or	
21.4	_____ years	

22 Do you have knowledge on the **legislation** regarding audiometric testing in South Africa?

22.1	Yes	
22.2	No	

23 If yes to question 22, please state the **name of the legislation** you know / use:

_____

24 If no to question 22, **why not**?

24.1	No training was received	
24.2	It was covered in the training program but I do not remember it	
24.3	It was covered in the training program but I do not use it	
24.4	I forgot the legislation after it was taught in training	
24.4	Other:	

_____

25 What **type of training,** in your opinion, should someone receive regarding hearing screening?

25.1	Only theoretical	
25.2	Only practical	
25.3	Theoretical and practical	

26 How do you think should someone who has done the training be **evaluated** to determine if he / she has the necessary knowledge and skills? **Please choose all the options you feel is necessary**

26.1	Written exam	
26.2	Practical exam	
26.3	Assignments throughout the course	
26.4	No evaluation is necessary	
25.6	Other: _____	

27 From what **type of training** did you benefit the most?

27.1	Only theoretical	
27.2	Only practical	
27.3	Both theoretical and practical	

28 Who must **coordinate** such a training course?

28.1	Audiologist working in the field	
28.2	Occupational nurse	
28.3	Occupational doctor	
28.4	Audiometrician who has been trained and works in the field	
28.5	Audiology lecturer	
28.6	Anybody who is available to give lectures	
28.7	Other: _____	

29 What **topics** do you think should be included in a course to provide training to an audiometrician?

Please choose all the options you feel is necessary

29.1	Anatomy and physiology of the ear	
29.2	The physics of sound and soundwaves	
29.3	Disorders of the auditory system	
29.4	The impact of noise on the ear	
29.5	Audiometric testing	
29.6	Communication with patients and case history	
29.7	Legislation regarding NIHL and industrial hearing testing	
29.8	Hearing conservation and protective devices	
29.9	Other: _____	

30 Do you think it should be **compulsory** for audiometricians to obtain CPD (continuing professional development) points?

30.1	Yes	
30.2	No	

31 If yes to question 30, how **many points per year** (one point equals one hour of training)?.

_____ points

32 If no to question 30, **why not**?

_____

_____

THANK YOU FOR YOU PARTICIPATION!

APPENDIX E: QUESTIONNAIRE (AFRIKAANS)

INSTRUKSIES

Voltooi asseblief al die onderstaande vrae
Merk die gepaste opsie/s in die blokkie aan die regterkant
Sommige vrae kan meer as een antwoord he!

Dankie vir u tyd, hierdie vraelys behoort ongeveer 20 minute te neem om te voltooi.

Afdeling A: Demografiese inligting

1 Hoe **oud** is u in jare?
_____ jaar ☐

2 Watter **geslag** is u?
2.1 Manlik ☐
2.2 Vroulik ☐

3 Vir hoe lank **beoefen** u oudiometrie?
_____ jaar ☐

4 In watter **omgewings** beoefen u oudiometrie?
Kies asseblief al die opsies wat u voel is nodig.
2.1 Privaat praktyk ☐
2.2 Publieke hospitaal / kliniek ☐
2.3 Opvoedkundige sector ☐
2.4 Industriele sector ☐
2.5 Ander: _____

5 Watter **kwalifikasies** het u met betrekking to oudiometrie
Kies asseblief al die opsies wat u voel is nodig.
5.1 Oudiometriese diploma ☐
5.2 Oudiometriese sertifikaat ☐
5.3 Akoestikus grad ☐
5.4 Oudiologie grad ☐
5.5 Anders: _____ ☐

Afdeling B: Opleiding

6 Het u enige **ander opleidin**g (wat nie in vraag 5 genoem is nie)?

4.1	Ja	
4.2	Nee	

7 Indien ja tot vraag 6, watter **tipe** opleiding?

7.1	CPD (aanhoudende professionele opleiding) aktiwiteite	
7.2	Samewerking met seniors	
7.3	Audiometrie kursus	
7.4	Hersieningskursus in oudiometrie	
7.5	Ander: _____	

8 Wat was die **hooftemas / -onderwerpe** van die opleiding soos genoem in vraag 5?

_____
_____
_____
_____
_____
_____
_____

9 Waar het u die **opleiding ondergaan** soos genoem in vraag 5?

7.1	By die werk	
7.2	By 'n universiteit	
7.3	By 'n informele studiegroep	
7.4	Deur die internet	
7.5	Ander: _____	

10 Hoe **lank** was die opleiding soos genoem in vraag 5?

10.1	_____ dae; of	
10.2	_____ weke; of	
10.3	_____ maande; of	
10.4	_____ jare	

11 Wanneer u gehoor evalueer, van watter **prosedures** maak u gebruik?
Kies asseblief al die opsies wat u voel is nodig.

11.1	Gevalsgeskiedenis	
11.2	Suiwertoontoetsing (luggeleiding)	
11.3	Industriele siftingstoetse	
11.4	Siftingsimmittansie toetsing	
11.5	Otoskopie	

11.6 Ander: _____

12 Voer u gehoortoetse uit in 'n **mobiele eenheid**?

12.1	Ja, gereeld	
12.2	Ja, soms	
12.3	Ja, ongereeld	
12.4	Nee	

13 Indien u industriele gehoortoetsing gedoen het, in watter **omgewings** is dit gedoen?
Kies asseblief al die opsies wat u voel is nodig.

13.1	Myne	
13.2	Industrie	
13.3	Fabrieke	
13.4	Ander: _____	

14 Werk u as deel van 'n **gehoorgesondheidsspan**?

12.1	Ja	
12.2	Nee	

15 Indien ja tot vraag 14, wie is almal **deel van die span**?

13.1	ONK	
13.2	Algemene praktisyn	
13.3	Oudioloog	
13.4	Oudiometris	
13.5	Arbeidsgesondheidsverpleegster	
13.6	Arbeidsgeneesheer	
13.7	Verpleegster	
13.8	Ander: _____	

16 Watter **toetsprogram** gebruik u wanneer u gehoorsiftings doen?
Kies asseblief al die opsies wat u voel is nodig.

14.1	Ruskal	
14.2	Everest	
14.3	Konvensionele toetsing	
14.4	Ander: _____	

17 Hoe gereeld verskaf u **opleiding** aan kliente rakende geraasgeinduseerde gehoorverlies?

15.1	Daagliks	
15.2	Weekliks	
15.3	Maandeliks	
15.4	Soms	

15.5 Elke klient
15.6 Nooit

18 Indien u wel opleiding verskaf, waaruit bestaan u **opleidingsprogram**?
Kies asseblief al die opsies wat u voel is nodig.

16.1 Informasie rakende geraasgeinduseerde gehoorverlies
16.2 Voorkoming van geraasgeinduseerde gehoorverlies
16.3 Kompensasie van geraasgeinduseerde gehoorverlies
16.4 Informasie rakende aanvullende toestelle, gehoorapparate
16.5 Informasie rakende gehoorbeskermers
16.6 Ander: _____

19 Waaruit het u **eie opleidingsprogram** rakende gehoorsifting bestaan?
Kies asseblief al die opsies wat u voel is nodig.

19.1 Anatomie en fisiologie van die oor
19.2 Die fisika van klank
19.3 Afwykings van die ouditiewe sisteem
19.4 Die impak van geraas op die oor
19.5 Oudiometriese toetsing
19.6 Kommunikasie met pasiente
19.7 Wetgewing rakende geraasgeinduseerde gehoorverlies
19.8 Gehoorkonservering
19.9 Ander: _____

20 Indien ja tot vraag 19.5, watter **tipe oudiometriese** toetsing was behandel?
Kies asseblief al die opsies wat u voel is nodig.

20.1 Otoskopie
20.2 Suiwertoontoetsing (luggeleiding)
20.3 Suiwertoontoetsing (beengeleiding)
20.4 Suiwertoonsiftingstoetsing
20.5 Akoestiese reflekse
20.6 Timpanometrie
20.7 Spraaktoetsing
20.8 Ander: _____

21 Hoe **lank** dink u moet iemand se opleiding wees vir die persoon om effektiewe en korrekte gehoorsifitng te kan doen?

21.1 _____ dae; of
21.2 _____ weke; of
21.3 _____ maande; of
21.4 _____ jare

22 Het u enige kennis rakende die wetgewing oor oudiometriese toetsing in Suid-Afrika?

22.1	Ja	
22.2	Nee	

23 Indien ja, noem asseblief die **naam van die wetgewing(s)** wat u ken:

_____
_____
_____
_____
_____
_____

24 Indien nee, **hoekom nie**?

24.1 Geen opleiding was ontvang nie
24.2 Opleiding is ontvang maar ek het dit vergeet
24.3 Opleiding is ontvang maar ek gebruik dit nie
24.4 Ek het die wetgewing vergeet nadat dit behandel is
24.5 Ander: _____

25 In u opinie, watter **tipe opleiding** moet 'n persoon ontvang rakende gehoorsiftingstoetsing?

25.1	Slegs teoretiese opleiding	
25.2	Slegs praktiese opleiding	
25.3	Beide teoretiese en praktiese opleiding	

26 Hoe dink u moet iemand wat die opleiding ontvang het rakende gehoorsifting **geevalueer** word om te bepaal of hy / sy die nodige kennis en vaardighede het om korrekte toetsing uit te voer?
Kies asseblief al die opsies wat u voel is nodig.

26. 1	Geskrewe eksamen	
26.2	Praktiese eksamen	
26.3	Take regdeur die opleidingsprogram	
26. 4	Geen evaluasie is nodig nie	
26.5	Ander: _____	

27 Vanuit watter **tipe opleiding** het u die meeste baat gevind?

27.1	Teoretiese opleiding	
27.2	Praktiese opleiding	
27.3	Beide teoretiese en praktiese opleiding	

28 Wie moet so 'n opleidingskursus **koordineer**?

28.1	'n Oudioloog wat in die veld werk	
28.2	'n Arbeidsverpleegster	
28.3	'n Arbeidsdokter	
28.4	'n Oudiometris wat opgelei is en in die veld werk	
28.5	'n Oudiologie dosent	
28.6	Enige iemand wat beskikbaar is om lesings te gee	
28.7	Ander: _____	

29 Watter onderwerpe dink u moet ingesluit word in 'n opleidingsprogram vir oudiometriste?

Kies asseblief al die opsies wat u voel is nodig.

29.1	Otoskopie
29.2	Suiwertoontoetsing (luggeleiding)
29.3	Suiwertoontoetsing (beengeleiding)
29.4	Suiwertoonsiftingstoetsing
29.5	Akoestiese reflekse
29.6	Timpanometrie
29.7	Spraaktoetsing
29.8	Ander: _____

30 Dink u dit moet verpligtend wees vir oudiometriste om **CPD punte** (aanhoudende professionele ontwikkeling) op te bou?

30.1	Ja	
30.2	Nee	

31 Indien ja, **hoeveel punte** per jaar (een punt is gelykstaande aan een uur)?

_____ punte

32 Indien nee, **hoekom nie**?

_____

_____

DANKIE VIR U SAMEWERKING!