# Portability of Technical Skills Across Occupations

Joseph Siloka Mukuni

Dissertation submitted to the faculty of the Virginia Polytechnic Institute and State University in partial fulfillment of the requirements for the degree of

Doctor of Philosophy
In
Career and Technical Education

William T. Price

Konrad K. Eschenmann

Daisy L. Stewart

Josiah S. Tlou

March 23rd, 2012

Blacksburg, VA

**Key words**: Portable skills, Technical and vocational education and training, Multi-skilling, Apprenticeship, Competence

# Portability of Technical Skills Across Occupations

Joseph Siloka Mukuni

## Abstract

In the literature, much has been reported about skill shortages in the labor market and many solutions have been suggested but most of them do not appear to work well for developing countries. This study investigated the place of portable technical skills as an option for addressing skill shortages, particularly in developing countries. The objective of the study was to determine whether different occupations have portable technical skills, which graduates of workforce development programs can carry with them as they transfer from one occupation to another. Although in the literature the importance of portable skills has been recognized, research has tended to focus on the portability of soft skills such as communication and problem-solving. This study is unique in that in addition to soft skills, it explores the existence and usefulness of portable technical skills such as maintenance of equipment and use of hand tools.

The study methodology comprised analysis of documents followed by focus group discussions with instructors and employers. The researcher examined competency lists drawn from three different occupational clusters, taking three occupations in each cluster. Analysis of correlation between pairs of occupations in each cluster revealed the existence of portable technical skills within occupational clusters. For example, within the Mechanical Engineering cluster, there were 504 technical skills that Fitting and Machining had in common. Furthermore, the study discovered 152 technical skills that were portable across all the occupations in the sample.

According to an instructors' focus group, one of the pedagogical implications of the findings of this study was that training institutions could promote inter-disciplinary collaboration through joint preparation of syllabi and team-teaching.

An employers' focus group confirmed that portable technical skills have long been used effectively and efficiently in the Informal Micro-Enterprise sector and training providers should, therefore, promote the teaching of portable technical skills with special emphases on entrepreneurship development to make students more flexible in their career development.

In addition to policy recommendations for the promotion of portable technical skills, the study recommends that further studies should be done to determine the full extent of portable technical skills across a wider range of occupations.

## Dedication

I dedicate this work to my beloved wife, Felistus, and my children for the support and encouragement that I received while working on my studies. I recognize the huge sacrifice that my family made by allowing me to give up my job in order to attain my dream of reaching the highest possible rung on my scholarly ladder.

In addition, I wish to dedicate this work to my late father who inspired me to aim high when I took the first few steps on my educational ladder. He was confident that I could do it, even when as a little village boy school meant little to me.

**Acknowledgements**

As one of my professors said, no matter how skillfully one might work at producing a good dissertation, there is always something that could have been done better. One never really finishes writing and rewriting a dissertation; one simply stops. With that in mind, I take full responsibility for any holes that might still exist despite my earnest attempt to fill them all. However, I give full credit to the following individuals for all the good parts of this dissertation:

- My advisor and committee chairman, Dr. Bill Price, who gave me the opportunity to learn from him that a good master-craftsman does not only share knowledge with his apprentice; he shares himself as well by making himself available to his pupil and showing interest not only in the skill or knowledge but also in the life and well-being of the learner. I am grateful for his insights, patience, and kindness which inspired me as I worked on this study;
- My other committee members, Dr. Kurt Eschenmann, Dr. Daisy Stewart, and Dr. Josiah Tlou. I am most grateful to the committee members for their comments and suggestions which helped me to clarify my thoughts on this dissertation. I learned a lot about the art of academic writing from their comments and suggestions.
- Dr. Patrick O'Reilly, who helped me to narrow my research topic. Before he guided me, I had a very broad topic that would have taken me a decade to write about. He asked me to decide whether I wanted to solve all the world's problems affecting workforce development or to focus on one problem;
- Dr. Patrick K. Nkanza, Director General of the Technical Education, Vocational and Entrepreneurship Training Authority (TEVETA) and his senior management

for providing me with the curriculum documents on which this study was based; and

- The Principal of Kabwe Institute of Technology, Mr. Andrew Kasanda Sayila, who kindly agreed to facilitate focus group meetings with his staff and employers on my behalf because I was unable to travel to Zambia for the purpose. I am also greatly indebted to the Kabwe Institute of Technology staff and the employers who participated in the focus group meetings. I am especially grateful to Mr. Eneya Banda for producing the focus group minutes.

Finally, I acknowledge the divine hand that placed me at Virginia Tech and blessed me with a team of knowledgeable, dedicated and very caring instructors in all my courses. As stated in James 1:17: "Every good gift and every perfect gift is from above, and cometh down from the Father of lights, with whom is no variableness, neither shadow of turning."

## Table of Contents

## List of Figures

## List of Tables

## Abbreviations and Acronyms

| | |
|---|---|
| BOTA | Botswana Training Authority |
| Danida | Danish International Development Agency |
| ESM | Electronic Systems Maintenance |
| GTZ | Deutsche Gesellschaft für Internationale Zusammenarbeit |
| HEART | Human Employment and Resource Training Trust |
| ILO | International Labor Organization |
| IME | Informal Micro-Enterprise |
| IRB | Institutional Review Board |
| JUNAE | National Employment Board |
| KIT | Kabwe Institute of Technology |
| LIBES | Livingstone Institute for Business and Engineering Studies |
| LTTI | Lukashya Trades Training Institute |
| MSTVT | Ministry of Science, Technology and Vocational Training |
| NGO | No-Governmental Organization |
| NGT | Nominal Group Technique |
| NQF | National Qualification Framework |
| NTA | National Training Authority |
| PDG | Painting, Decoration, and Graphics |
| RORUM | Result Oriented, Result Utilization Management |
| SEFOR | National Secretariat of Training and Skills Development |
| SENCE | National Service of Training and Employment |
| SSDA | Sector Skills Development Agency |
| TESDA | Technical Education Skills Development Agency |

| | |
|---|---|
| TEVET | Technical Education, Vocational, and Entrepreneurship Training |
| TEVETA | Technical Education, Vocational, and Entrepreneurship Training Authority |
| TVE | Technical and Vocational Education |
| TVET | Technical, Vocational Education and Training |
| UNESCO | United Nations Educational, Scientific and Cultural Organization |
| VET | Vocational Education and Training |
| WfD | Workforce Development |

# CHAPTER 1- INTRODUCTION

In the last two decades, officials in many countries have been revitalizing their technical and vocational education and training (TVET) systems to make them more responsive to their socio-economic development. It is perceived that TVET is essential because, as Atchoarena and Delluc (2002) asserted, no country can achieve economic and social development without a skilled, productive labor force. One of the common trends in the reforms worldwide has been the strengthening of TVET coordination and governance structures through enhanced stakeholder participation. Training authorities or councils have been created in countries where they did not exist to ensure closer collaboration between government officials and their social partners (such as representatives of employers and workers) in the strategic management of TVET at all levels of workforce development systems. The rationale behind closer collaboration between public and private sector partners was to ensure increased relevance of TVET to the needs of the labor market. Another universal trend in TVET reforms over the last few decades has been the establishment of national qualification frameworks (NQFs) aimed at aligning qualifications to the needs of employers as well as facilitating linkages between training providers within countries and internationally. This trend began in the 1980s. According to Tuck (2007), the first countries to establish NQFs were Australia, New Zealand, Scotland, South Africa, and the United Kingdom (except Wales). These countries were followed by Ireland, Malaysia, Maldives, Mauritius, Mexico, Namibia, the Philippines, Singapore, Trinidad and Tobago, and Wales.

TVET reforms in developing countries have been largely financed through grants and loans from international organizations, such as the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ), Danish International Development Agency (DANIDA), and the World Bank, because these international agencies considered demand-driven TVET to be a critical

element of national policies for workforce development (Atchoarena & Delluch, 2001; Middleton, 1991; Middleton, Ziderman & Adams, 1991; Ziderman, 2001). Atchoarena and Delluch, in their report on an evaluation of TVET policies in Sub-Saharan Africa, noted that the goal of institutionalizing demand-driven training had not yet been fully achieved in most countries that have reformed their TVET systems. Atchoarena and Delluch's report confirmed what Castro (2000) had earlier observed: "Many countries still have not put the brakes to training offered without any concern for the employability of the graduates. The quest for demand-driven training is being heard but not everywhere" (p. 41).

An example of a country whose TVET reforms have not yet resulted in a successful shift from supply-driven training to demand-driven training is Zambia. In line with the world trend of revitalizing TVET systems, the Republic of Zambia had its second wave of TVET reforms in the mid 1990s, having had the first post-independence reforms in the late 1960s. According to the Ministry of Science, Technology and Vocational Training (MSTVT )(1996), the main objective of the reforms that began in 1994 was to develop a skills training system that would be demand-driven. Employers had been complaining that graduates of TVET programs did not have sufficient practical skills to match the demands of their occupations. Trainers acknowledged the insufficiency of the practical skills of their graduates and blamed it on the paucity of resources and inadequacy of facilities for practical, hands-on training. One option to ameliorate this challenge was to make student internships in industry a compulsory component of training. However, this option was affected by the economic downturn that hit the country in the early nineties, which led to shrinkage of the formal sector. Industry, therefore, did not have the capacity to provide learning experiences to students. Furthermore, the shrinkage of the formal sector through closure or downsizing of enterprises had resulted in an unexpected

emergence and growth of an informal sector characterized by poor goods and services. Informal sector operators needed business as well as practical technical skills, but TVET institutions lacked the experience and knowledge needed for an effective response to the informal sector skills gaps.

## Background of the Problem

Many nations in the world are facing the problem of mismatch between supply and demand for labor (Jelas & Azman, 2005; Leman, 2008; Siriwardene & Qureshi, 2009). Reflecting on this issue of skill mismatches, Atchoarena and Delluc (2002) suggested some of the major causal factors:

> …TVE [technical and vocational education] systems are everywhere facing challenges to prepare a sufficient number of people with the right skills to meet labour market demands. Matching skills, knowledge and attitudes to the needs of employment is increasingly challenging in the current context of globalization and rapid technological change due to constant transformation of occupations. A critical issue for TVE planners and mangers is how to train individuals for future jobs on the basis of information covering past and present labour markets. (p. 15)

In the literature, one of the suggestions for minimizing skill shortages is to enable mobility of workers across different jobs by teaching of portable skills (see for example Noue, 2010). The suggestion for providing portable skills as a way of reducing the mismatch between the supply and demand of labor skills may be of great interest to developing countries like Zambia. Because most developing countries lack sufficient resources to offer a comprehensive set of TVET program offerings, providing portable skills training at a much lower cost than

comprehensive programs could make a huge difference if, indeed, it would help reduce the mismatch.

The term "portable skills" refers to a set of skills that are not occupation-specific. Noue (2010) explained portable skills as follows: "As you move from job to job over the course of your career, there are some skills that you can take with you and apply to a wide range of roles and workplaces. These are called *portable skills* …" (p. 1). According to Buchanan, Briggs, Considine, Schofield, and McIntyre (2000), different authors have referred to these non-occupation-specific skills by different labels such as technical skills, foundation skills, key competencies, generic skills, soft skills, underpinning skills, cognitive skills, literacy and numeracy skills, and communication skills.

## Statement of the Problem

There are two principal causes of skill shortages in the labor market. The first cause is the changing nature of occupations arising, mainly, from globalization and technological advancements, as indicated above. Whereas this cause lies on the demand side of workforce development, the second cause is on the supply side of workforce development. It has to do with inadequate capacities of training providers. Taking Zambia as an example, training providers do not have the resources necessary for training the right quality and quantity of skills demanded by employers, as Results Oriented Result Utilization Management (RORUM) (2007) reported: "52.9% of the studied training institutions do not meet the demand of the industry because of poor infrastructure, lack of necessary equipment, and inadequate staffing" (p 15).

Under these circumstances, it would be advantageous for training providers to rationalize their limited resources by prioritizing the basic technical skills that are a common foundation among a wide range of technical occupations. Portable technical skills could then be

offered in a manner that would facilitate pooling of staff, equipment, materials, facilities, and time. The general objective of this study was to determine if there were any technical skills that could be found in more than one occupation. If the skills did exist, the researcher intended to identify them and assess their pedagogical implications.

## Objective of the Study and Research Questions

The objective of the study was to compare and contrast competency lists of nine different occupations to identify portable technical skills. Specifically, the study was intended to answer the following research questions:

1. What skills do the technical occupations listed below have in common within their occupational clusters?
    a. Construction Occupational Cluster
        i. Building Construction (i.e. Masonry)
        ii. Carpentry and Joinery
        iii. Painting, Decoration, and Graphics
    b. Electrical Engineering Occupational Cluster
        i. Electrical Craft
        ii. Electronic Systems Maintenance
        iii. Telecommunications repair
    c. Mechanical Engineering Occupational Cluster
        iv. Fitting
        v. Machining
        vi. Metal Fabrication

2. What skills do the selected technical occupations have in common across their occupational clusters?
3. What are occupational instructors' perceptions of the classroom implications of the identified portable technical skills?
4. From the point of view of employers, what are the labor market implications of the identified portable technical skills?

The results of the study comprised: (a) an outline of technical skills that were portable among three occupations within each of three occupational clusters and portable across the occupational clusters; (b) a description of instructors' perceptions of the classroom implications of the identified portable technical skills; (c) a description of employer representatives' perceptions of the labor market implications of portable technical skills; and (d) a description of the researcher's perceptions of what needs to be done to enhance local and national policies relating to technical and vocational education in Zambia with reference to portable technical skills.

## Importance of the Study

In the literature, a lot has been said about portable soft skills. However, very little mention has so far been made of portable technical skills despite their enormous potential contribution to the discussion on demand-driven training. Demand-driven training requires providers to expand their training portfolios by including all the different programs required by industry. For a developing country, with inadequate training resources, this option is unaffordable. What would be more affordable would be to identify and teach portable technical skills (such as maintenance of equipment, care and use of hand tools, and identification of engineering materials) which could be applicable to a range of occupational trades. This study

sought to determine whether such skills existed, and if they did exist, to identify them and then generate occupational competency lists for possible use in high school and technical college TVET programs. The teaching of portable technical skills would facilitate rationalization of training resources through pooling of TVET programs that have similar technical skills.

## Theoretical Framework of the Study

The theoretical framework for this study can be traced back to the debate between Charles Prosser and John Dewey. Prosser, following his mentor, David Snedden, believed that the principal aim of vocational education was to produce a workforce that would closely meet the skill needs of industry (Drost, 1977; Gordon, 2008). To make sure that vocational education effectively carried out its mandate of supplying industry with the required competencies, Prosser advocated for the establishment of specialized vocational schools that would provide occupational experiences better than the general education schools in existence at the time.

Dewey, on the other hand, believed that providing narrowly focused vocational training would inhibit innovation and limit people's capacity to change careers, if they so wished. He also believed that a narrowly focused vocational training program would perpetuate the social class system by treating schools as an agency for transferring the older division of labor and leisure, culture and service, mind and body, directed and directive class, into a society nominally democratic. He believed that knowledge and skills learned from a much broader education would not pigeon-hole individuals into one narrowly focused occupation, but rather allow one to move among occupations within a given social class and an opportunity to move up the social class ladder (Dewey, 1916).

A hybrid of both Prosser's and Dewey's philosophical tenets on education and training served as the underpinning theoretical framework for this study. Prosser's belief that vocational

training should closely meet the skill needs of industry is still relevant today, as can be seen in the demand-driven vocational curriculum movement. However, Dewey's belief that a broader set of knowledge and skills is more advantageous supports the portable skills concept that is also being promoted.

## Overview of Research Design

A combination of qualitative and quantitative research methodologies were used to conduct this study. The design of this study consisted of the following components in addition to a review of literature:

1. Selection of occupational competency lists from which to identify portable technical skills: Three occupational clusters were selected (namely Construction, Mechanical Engineering, and Electrical Engineering). From each cluster, three occupational areas were selected;

2. Analysis of competency lists from the selected occupations: The competency lists for the nine selected occupational areas were analyzed to identify portable technical skills within and across each of the selected occupational clusters;

3. Validation of the list of portable skills by instructors: The list of portable technical skills that the researcher generated from the analysis of competency lists was validated by instructors from a Zambian technical college, who were familiar with the competency lists; and

4. Determination of classroom implications: A focus group discussion using the nominal group technique (NGT) was conducted with instructors to determine the classroom implications of the identified portable technical skills; and

5. Determination of labor market implications of the identified portable technical skills: A focus group discussion using the NGT was conducted with employer representatives in

Zambia to determine the labor market implications of the identified portable technical skills. The employers were mainly from the Informal Micro-Enterprise (IME) sector because that is the sector employing the majority of TVET graduates in Zambia. According to Haan (2006), the IME sector contributes 78% to total non-agricultural employment in Africa.

## Delimitations

The background theme of this study (skilled labor shortages) is very broad. The scope of the study was therefore delimited to an investigation of engineering-related portable skills, excluding other factors that have an impact on labor shortages. Furthermore, the scope of the study was restricted to competency lists of nine different occupations.

## Limitations

Following are the limitations of the study:

1. Identification of portable technical skills was based on perceptions of a single researcher rather than a multi-disciplinary team of researchers. To minimize the impact of this limitation, instructors of occupations were consulted through focus group discussions to validate the competency lists of portable technical skills;

2. Because the data for this study was based on Zambian TVET competency lists, it was deemed beneficial to have the validation of the data done by Zambian users of the task lists and to determine the views of Zambian employers and instructors concerning the significance of the portable technical skills identified in the syllabuses. However, the researcher was not able to travel to Zambia to oversee the validation of the list of portable technical skills and to personally conduct the focus group sessions. For that reason, the researcher requested a principal of a TVET college in Zambia, who is an experienced facilitator and administrator with several years experience as a head of a technical college, to monitor the validation of the list, facilitate the

focus group sessions, and send the validated portable skills list and records of the sessions to the researcher for analysis. Through telephone and email communication, the researcher explained to the facilitator the requirements of the protocol needed to facilitate the validation process and the focus group meetings. In addition, written guidelines for the facilitator and participants were sent to the facilitator (see Appendices A, B, and C). For purposes of this study, the principal, who was assigned the role of co-investigator, completed a human subjects training in fulfillment of Virginia Tech's Institutional Review Board (IRB) requirements and was awarded a certificate.

3. In spite of the fact that the co-investigator was an experienced facilitator of focus group discussions, and despite the guidance given to the co-investigator on how best to use the nominal group technique in a focus group meeting, the researcher had hoped to attend the focus group meetings via Skype in order to give support to the co-investigator in the use of the nominal group technique. However, due to technical problems relating to internet connectivity at the venue of the meetings, it was not possible for the researcher to participate in the meetings as intended. This limitation had the potential to affect the quality of the results of the nominal group technique.

## Assumptions

This study was based on the following assumptions:

1. The selection of a sample of only nine occupations and three career clusters would not affect the significance of the study.

2. The engagement of a third party to monitor the validation of portable technical skills and to facilitate the NGT sessions would not seriously affect the quality of the study;

3. The discovery of portable technical skills will have pedagogical as well as economic advantages;

## Definitions

For purposes of this study, the following terms will be used in the sense indicated below:

- **Apprenticeship:** A system of training regulated by law or custom which combines on-the-job training and work experience while in paid employment with formal classroom training. The apprentice enters into a contract of training or training agreement with an employer which imposes mutual obligations on both parties. (Mackenzie & Polvere, 2009)
- **Competence:** An individual's demonstrated capacity to perform, i.e. the possession of knowledge, skills and personal characteristics needed to satisfy the special demands or requirements of a particular situation. (Mackenzie & Polvere, 2009).
- **Multi-skilling:** Training workers in a number of skills, enabling them to perform a variety of tasks or functions across traditional boundaries. Multi-skilling may be horizontal (broad skilling), vertical (up-skilling) or diagonal (contributory skilling) (*Mackenzie* & Polvere, 2009).
- **Portable skills,** also referred to as generic skills: A skill which is not specific to work in a particular occupation or industry, but is important for work, education and life generally, including communication skills, mathematical skills, organizational skills, computer literacy, interpersonal competence and analytical skills.
- **Portable soft skills:** These areunderpinning skills, cognitive skills, literacy and numeracy skills, communication skills, cultural skills and conceptual skills, which are not specific to any particular occupation;
- **Portable technical skills:** The term refers to knowledge and/or proficiency in a specialized field such as manufacturing, construction, or engineering, which can be utilized in more than one occupation;

- **Technical and vocational education and training (TVET), also referred to as vocational education and training (VET):**

Educational training that provides practical knowledge and experience in a particular occupational field, as agriculture, home economics, or industry**.**

## Chapter Summary

The main purpose of this chapter was to provide an introduction to the study. In the literature, much has been reported about skill shortages in the labor market and many solutions have been suggested but most of them do not appear to work well for developing countries. This study investigated the place of portable technical skills as an option for addressing skill shortages, particularly in developing countries. The objective of the study was to determine whether different occupations have portable technical skills, which graduates of workforce development programs can carry with them as they transfer from one occupation to another. Although in the literature the importance of portable skills has been recognized, research has tended to focus on the portability of soft skills such as communication and problem-solving. This study is unique in that in addition to soft skills, it explores the existence and usefulness of portable technical skills such as maintenance of equipment and use of hand tools.

The remaining chapters will: (a) review the related literature; (b) explain the research methodology; (c) present the research findings; and (d) present conclusions and recommendations.

# CHAPTER 2 – REVIEW OF LITERATURE

This chapter is a review of literature on the subject of portable skills. The review of literature had the following objectives, on which the sections of this chapter are based:

1. To identify world trends in workforce development (WfD);
2. To describe the mismatch between demand and supply of skills;
3. To outline the possible solutions to the problem of skill shortages in the labor market, with special reference to the following strategies:
    a. Fostering close linkages between training providers and employers;
    b. Expansion of workforce development programs;
    c. Multi-skilling of workers;
    d. Promotion of portable skills; and
    e. Striking a balance between soft skills and technical skills.
4. To explain the theoretical framework for this study.

## World Trends in Workforce Development

Over the last few decades, there has been a growing interest in workforce development (WfD) policies (UNESCO, 2005). This is largely because of the perceived relationship between WfD and productivity, as Cooke (2005) observed:

> Indeed, a well-trained, educated, hard-working and conscientious labor force is considered to be a major contributor to the remarkable economic performance records of the Asian tigers (Japan, Korea, Singapore and Taiwan) during the late 1970s until the mid-1990s. These governments' policy of post-secondary education technical skill training, focusing on vocationally and technologically

sophisticated disciplines, has created a broad and technically able human capital base well-suited to rapid economic development. (p 26)

In order to maximize the benefits of WfD programs, many countries have revised their WfD policies, reviewed their WfD laws and created new organizational structures for the governance of technical and vocational education and training. In the Philippines, for example, the Technical Education and Skills Development Authority (TESDA) was created in 1994 to enhance the coordination of technical education and vocational training (Mustapha, 2004). Examples of WfD governance structures established in Latin America include the National Employment Board (JUNAE) of Uruguay, the National Service of Training and Employment (SENCE) of Chile, and the National Secretariat of Training and Skills Development (SEFOR) of Brazil (Galhardi, 2002). Other examples of technical and vocational education and training (TVET) governance and coordination structures are given in Table 1.

Table 1
*Examples of Governance Structures for Workforce Development*

| **Country** | **Workforce Development Governance /Consultative Structure** | **Reference** Mutula, Molefe, and Rathapo (2004) |
|---|---|---|
| Botswana | Botswana Training Authority (BOTA) | |
| Jamaica | Human Employment and Resource Training Trust (HEART)/National Training Authority (NTA) | Downes (2006) |
| United Kingdom | Sector Skills Development Agency (SSDA) | Gunter (2008) |

WfD reforms have led to an increase in the number of industry-provider partnerships (Callan & Ashworth, 2004). This increase in industry-provider partnerships is based on the assumption that close collaboration between providers of training and employers will lead to

increased relevance of technical education and vocational training programs and therefore help providers to meet labor market needs (Kis& Field, 2009). In addition to the formation of TVET governance and coordination structures that have enhanced close involvement of social partners in TVET programs and activities, many nations have created national qualification frameworks to help streamline the diverse qualifications awarded by training providers. Commenting on the high incidence of national qualification frameworks across the globe, Young (2005) observed that: "A growing number of countries, at very different stages of economic development and with very different cultural and political histories, either have introduced, or are in the process of introducing, some form of national qualifications framework (NQF)" (p. 1).

Tuck (2007) traced the history of NQFs to the 1980s-1990s when the first generation of NQFs were established by Australia, New Zealand, Scotland, South Africa, and the United Kingdom (with the exception of Wales), to the third generation of NQFs which included work in progress in countries like Brazil, China, Macedonia, Turkey, Uzbekistan and Zimbabwe. To manage NQFs, some apex structures independent of the state authorities have been created.

**Mismatch between Demand and Supply of Skills**

In spite of these transformations of TVET systems outlined above, some of the conditions that had necessitated the changes in TVET policies are still evident, particularly in the developing world (Atchoarena & Delluch, 2002). For example, although structures have been established for enhancing partnerships between employers and providers of skills training as a way of ensuring relevance of programs, there are still some reports of mismatches between the supply and the demand for skills (Jelas & Azman, 2005; Kim 2002; Lerman, 2008; Siriwardene & Qureshi, 2009;). Darling-Hammond (2010) explained the complex nature of the problem of mismatch between supply and demand of knowledge and skills:

> The process of managing decisions and solving social scientific problems in contemporary democracies is growing ever more complex. At least 70% of U.S. jobs now require specialized knowledge and skills, as compared to only 5% at the dawn of the last century…Furthermore, the nature of work will continue to change ever more rapidly… Thus the new mission of schools is to prepare students to work at jobs that do not exist, creating ideas and solutions for products and problems that have not yet been identified, using technologies that have not yet been invented. (p. 2)

As Darling-Hammond observed, in developed countries such as the United States, the problem of mismatch between supply and demand of skills is largely due to two factors: (a) the speed at which the nature of work is changing, and (b) rapid technological advancements. In developing countries, the problem is compounded by inadequate financial resources for training materials, equipment, and retention of qualified staff (Lanka & Muniek, 2006; Mupinga, Busby & Ngatiah, 2006).

## Possible Solutions to Problem of Skills Shortages

### Close Linkages between Training Providers and Employers

In the literature, there are a number of proposed solutions to the problem of mismatch between supply and demand of skills. Some of the suggestions have in fact already been tried and their effectiveness is not quite evident. For example, Lerman (2008) suggested that: "One way to minimize mismatches is to develop close linkages between education and training systems and employers, so as to glean at least some information about employers' current and future demands" (p 43). This suggestion has been tried. As noted earlier, private sector-led TVET governance structures have been established in many countries to ensure close coordination between training providers and employers as well as other stakeholders such as the

state and Non-Governmental Organizations (NGOs). As Atchoarena and Delluc (2001) observed, the problem with some employer associations is that they do not have the capacity needed for them to provide useful guidance to training providers on matters of training needs; as a result "the information that they can supply for the planning of TVE is often disappointing" (p 14). The suggestion that mismatches should be minimized through close linkages with employers may, therefore, not be very helpful until such time that employers through their associations have developed the capacity to articulate issues of employment and training needs.

**Expansion of WfD Programs**

Some authors have suggested that mismatch of skill supply and demand may be addressed through expansion of training programs. The rationale seems to be that if training providers offer a wide range of programs, employers will not run short of choices when selecting skilled workers from among TVET graduates. Every needed skill would be available in the labor market. Oketch, Green and Preston (2009) cited examples of universities and colleges that have expanded their range of course programs to include occupations that did not previously exist. The expansion that Oketch et al. were referring to is in terms of both broadening the range of training programs and introducing more advanced programs. They observed, for example, that "Community and technical colleges in the United States have developed post-diploma programmes to deliver such 'newer' skills to both degree and non-degree graduates, as well as to those wishing to upgrade skills" (p. 2088).

The issue of expansion of TVET programs has also been discussed within the context of vocationalization of the schools system (Akyeampong, 2002; Lauglo, 2009; Okordashivili, 2008). According to Lauglo "'Vocationalized secondary education' refers to a curriculum which remains overwhelmingly general or 'academic' in nature, but which includes vocational or

practical subjects as a minor portion of the students' timetable during the secondary school course" (p. 2295). Pavlova (2009) observed that the process of vocationalizing secondary schooling is advancing in many countries around the world. Pavlova cited Australia, Russia, the United Kingdom, and the United Sates as examples of countries that have vocationalized their secondary school systems. The examples cited by Pavlova are all from developed countries. According to Lauglo, vocationalization of secondary schools is a prudent decision for rich countries because they can afford it and because secondary schools in those countries enroll the majority of young people. Lauglo argued that low income countries cannot afford the cost of vocationalized secondary schools. He noted also that secondary schools in low income countries enroll only a minority of young people. Lauglo's observations are based on a World Bank study involving three African countries: Botswana, Ghana, and Kenya,. Drawing on the lessons learned from the study of these countries, Lauglo said:

> The cases illustrate how vulnerable vocationalization policies are. Unless they are backed up by the type of major financial resources which only relatively rich states can provide, and unless these policies can draw on strong professional capacity to plan, implement and to follow them up, implementation will falter. In these three cases, the countries 'went it alone' apparently without any involvement of external agencies. Botswana was the only country that had the financial capacity to sustain implementation in a systematic way, but has run up against local staffing shortages. Tellingly, in this situation, without external agency involvement, there was no impact evaluation—even in Botswana (as of 2004). (p. 2301)

After considering the pros and cons of vocationalized secondary school models, Orkodashvili (2008) concluded that teaching vocational skills outside of the mainstream

secondary school system is advantageous because, among other reasons, it is more responsive to technological change.

**Multi-Skilling of Graduates**

Another suggestion given for addressing mismatches is that institutions should produce multi-skilled graduates through broad-based training. It has been argued that in view of the challenges of globalization, developing nations need TVET systems that are need-oriented, flexible, and offering multi-skilling (Kazmi, 2007). In support of this suggestion, the construction industry has demonstrated that multi-skilling can reduce construction time by up to 20% and increase profits of construction enterprises by at least 7% (Lill, 2009). Another compelling argument for multi-skilling is the fact that today's workers have frequent job changes. Mayen (2006) aptly summed up the argument in favor of multi-skilling:

> For example, a welder who also has carpentry skills has always been in demand from small construction and renovation companies. These aspects of a dynamic labor market, one that is responsive to technological change and the challenges of globalization, suggest that a broad preparation is what is needed, rather than the acquisition of specialized skills. (p. 25)

This approach to minimizing the skills gap in the labor market is interesting when viewed against the revelation that today's jobs require workers who are specialized in their fields. It is said, for example, that about 70% of jobs in the United States' labor market require specialized knowledge and skills compared to only 5% at the beginning of the last century (Darling-Hammond, 2010). The interesting question is: Will producing multi-skilled workers help in meeting the skills needs of a highly specialized labor market? Regardless of the answer to this

question, multi-skilling has advantages for both employers and workers alike, as Mounier (2001) noted:

> A large range of skills (rather than generic skills) is an insurance against unemployment, and a tool to cope with a 'necessary' job-to-job mobility. In other words, a diversified and up to date portfolio of competencies is what make them portable. On the contrary, a worker who does not pay sufficient attention to his education and training may not keep up with this unstoppable evolution of skills. Therefore, if a worker is equipped with obsolete skills, he/she can expect the inevitable sanction, that is to get fired and to stay unemployed. He/she will be the only one responsible for being fired, for losing status and income when moving from job to job, or for remaining unemployed for a long time. In such a context where labor mobility is both a fact and a historical necessity, well endowed workers can face the harsh reality without fear and resistance. (p. 20)

**Portable Skills**

The point raised by Mounier (2001) i.e., the need for skills necessary for job-to-job mobility, is related to an issue that has attracted considerable debate in recent years. Employers are reported to be expressing demand for generic skills as well as job-specific skills (Bell, 1990). Following these reports from the labor market, portable skills have received much attention (Buchanan, Briggs, Considine, Schofield, & McIntyre, 2000; Estevz-Abez, Iversen& Soskice, 2001; Gibb, 2004; Hager, 1997; Jelas & Azman, 2005; Robinson, 2000).

According to Gibb (2003), the list of portable skills generally covers the following six categories of attributes:

- ***Basic/fundamental skills***: such as literacy, using numbers, using technology

- ***People-related skills:*** such as communication, interpersonal, team work, customer service skills
- ***Conceptual/thinking skills***: such as collecting and organizing information, problem-solving, planning and organizing, learning-to-learn skills, thinking innovatively and creatively, systems thinking
- ***Personal skills and attributes:*** such as being responsible, resourceful, flexible, able to manage one's own time, having self-esteem
- ***Business skills***: such as innovation skills, enterprise skills
- ***Community skills***: such as civic or citizenship knowledge and skills.

As can be seen, these portable skill categories fall into the realm of "soft skills." A lot has been written about these skills because of the potential they have as a strategy for preparing workers to cope with ever-changing occupations in the world of work. However, in the literature, there appears to be very little mention of portable "technical skills" that blue collar workers in different trades have in common and could carry from one occupation to another.

In facilitating debate on this matter among its member states, the International Labor Organization (ILO) (2007) pointed out that in a world undergoing rapid technological changes, workers need portable skills in order to have access to employment opportunities. Van der Heijden (2002) used an interesting term to refer to workers who have portable skills:

> People who are capable of acquiring more than one area of expertise within adjacent or radically different fields, or who are capable of acquiring a strategy to master a new area of expertise or expert performance in another territory can be termed "flexperts" (Van der Heijden, 1996). These are people who are both flexible and in possession of expertise. (p. 46)

The debate on portable skills has not been very clear, primarily because of the lack of unanimity in the description of the skills as Buchanan et al. (2000) observed. Curtis (2004) presented an overview of generic skills in the United States, the United Kingdom, Canada and Australia, shown in Table 2. The descriptions of generic skills in Table 2 indicate that the focus is on basic skills such as literacy, numeracy, and communication, as well other non-occupation-specific skills such as problem solving, teamwork, information technology, and personal qualities. Robinson (2000) grouped these generic skills into three categories: basic academic skills, higher-order thinking skills, and personal skills, as shown in Table 2.

Robinson offered suggestions on how these skills can be taught within school and employment settings and with the support of parents. One of the suggestions is modeling of the desired behavior, which can be done by teachers, trainers, and supervisors.

In closing her discussion on this subject, Robinson said: "Teaching of values should begin in the home as a child, be continued through development to adulthood, and reinforced as an adult. If good behavior is reinforced and good role models are presented, people can change for the better" (p. 3).

Table 2
*Description of Generic Skills in Selected Countries*

| | Generic 'core' or basic skills | Interpersonal or personal relationship skills | Personal attributes |
|---|---|---|---|
| Australia | • Literacy<br>• Numeracy<br>• Information technology capability<br>• Understanding of systems relationships | • Communication<br>• Team working<br>• Customer focus<br>• Project and personal management | • Capacity to learn<br>• Willingness to embrace change<br>• Independent problem solving and reasoning capability<br>• Practicality and a business orientation |
| Canada | **Academic skills**<br>• Skills needed to get, keep and progress in a job<br>• Communicate<br>• Think<br>• Learn | **Personal management skills**<br>• Personal skills, attitudes and behaviors to get, keep and progress in a job<br>• Positive attitudes and behaviors<br>• Responsibility<br>• Adaptability | **Teamwork skills**<br>• Skills needed to work with others to achieve the best results<br>• Work with others |
| United Kingdom | **Core skills**<br>communication<br>• problem-solving<br>• personal skills<br>• numeracy<br>• information technology<br>• competence in a modern (foreign) language. | | |
| United States | **Workplace competences**<br>Effective workers can productively use:<br>• Resources (time, money, materials, personnel)<br>• Interpersonal skills (teamwork, lead, negotiate)<br>• Information (acquire, evaluate organize data)<br>• Systems (social, organizational, technical)<br>• Technology | | **Foundation skills**<br>Competent workers in high performance workplaces need:<br>• Basic skills (literacy, numeracy, communication)<br>• Thinking skills (decision making, problem solving)<br>• Personal qualities (responsibility, self-esteem, integrity) |

Source: Curtis, D. (2004). The assessment of generic skills.In Gibb, J. (Ed.).*Generic skills in vocational education and training: Research readings*. pp. 136-156. Adelaide: Australian Training Authority.

Table 3
*Alternative Classification of Portable Skills*

| Basic Academic Skills | Higher-Order Thinking Skills | Personal Skills | |
|---|---|---|---|
| • Reading<br>• Writing<br>• Science<br>• Math<br>• Oral Communication<br>• Listening | • Learning<br>• Reasoning<br>• Thinking<br>• Creativity<br>• Decisions Making<br>• Problem Solving | • Responsible<br>• Self Confidence<br>• Social Skills<br>• Honest<br>• Have Integrity<br>• Adaptable and Flexible<br>• Team Spirit | • Punctual and Efficient<br>• Self Directed<br>• Good Work Attitude<br>• Well Groomed<br>• Cooperative<br>• Self Motivated<br>• Self Management |

Source: Robinson, J.P. (2000). What are employability skills? *Alabama Cooperative Extension System, 1*(3), 1-3. Retrieved from http://www.dillonatech.com/logon/employability-skills.pdf

Both Table 2 and Table 3 exclude vocational/technical skills in their classification of portable skills. The International Labor Organization (ILO) (2007), however, classifies skills into two types: vocational/technical skills and core skills. The vocational/technical skills constitute two sets of skills described as occupational/professional/entrepreneurial, and technical and vocational. Core skills, also referred to as soft skills, consist of social, communication, personal behavioral/ethical, learning, and cognitive/problem solving skills. The ILO's category of core skills comprises the set of skills that most authors (including Curtis [2004] and Robinson [2000]) have focused on in their discussions of portable skills. The ILO observed that these two sets of skills differ in their degree of portability. Core skills are more portable than vocational/technical skills. According to the ILO, differences in degree of portability can also be observed within the category of vocational/technical skills. Some vocational skills, such as operating industrial

machines, can be so general as to have a high degree of portability across different occupational boundaries. On the other hand, according to the ILO, skills which apply:

> …the basic principles and techniques of a trade are specific to particular industries and their transferability is limited to these boundaries. Furthermore, specific skills and knowledge which are entirely job-related or firm-specific which workers acquire in enterprises specialized in narrow product or service niches, are almost non-transferable. (p. 3)

Figure1 presents the ILO's classification of skills.

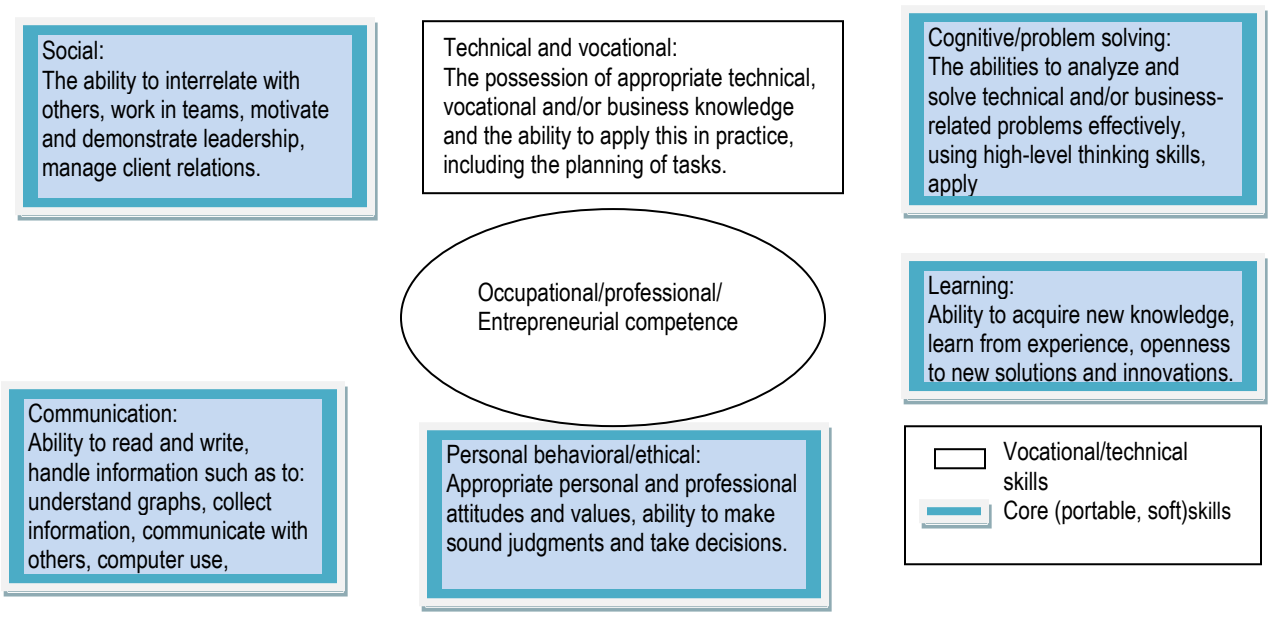


*Figure*. ILO classification of Skills. The skills in blue boxes are classified as core, or soft skills. The rest of the skills are vocational/technical skills. Adapted from "Sets of Skills Defining Competences" by International Labor Organization (ILO).(2007). *Portability of skills.*Committee on Employment and Social Policy, GB.298/ESP/3.298th Session. (p.2) Retrieved from http://www.ilo.org/public/libdoc/ilo/GB/298/GB.298_ESP_3_engl.pdf

## Balance between Soft Skills and Technical Skills

Most of what has been said about portable skills in the literature relates to soft skills, although the definition of portable skills includes both soft skills and technical skills. It is interesting, however, that some research is showing that the demand for technical skills in

industry is greater than the demand for soft skills. Markes (2006) reported a study in the United Kingdom that showed shortages of the following types of skills (a) technical/job-related skills; (b) computer literacy/user skills (c) customer handling skills (d) team working skills; personal skills; and (e) management skills. Markes also reported another study indicating that employers had more difficulty filling vacancies requiring technical or practical skills than those requiring problem-solving skills. These findings made by Markes indicated that discussions on the topic of portable skills should not just be limited to soft skills. Industry needs both sets of skills and in fact needs technical/job related skills more.

Furthermore, teaching soft skills outside the contexts of work may be counter-productive. Some authors have questioned the feasibility of teaching and assessing soft skills in isolation from occupational content and context. Young (2005), for example, observed that:

> No one doubts that there are important generic capabilities such as team working, problem solving and communication that are not specific to particular occupational sectors. However, whether they can be taught or assessed independently of their links to specific contents and contexts is open to serious questions. At the most fundamental level, learning takes place in specific contexts and involves specific contents; it does not take place generically. The key types of common skills pose different pedagogic and assessment issues. For example, people learn how to solve specific problems which may be in physics or in dealing with difficult customers, but there is no curriculum and no scheme of assessment that could teach or assess a form of generic problem solving that would apply to both. (p. 15)

Clearly, the discussion of portable skills needs to have a fair balance between soft skills and technical skills. Furthermore, given that part of the motivation for researching portability of

skills is to make TVET more demand-responsive, i.e. to better match the supply of skills to labor market demand, it is prudent to identify and promote both soft and technical skills that enable employers to find workers who can function in interdependent jobs (Overtoom, 2000).

## Theoretical Framework

The term "portable skills" might be a recent addition to the repertoire of TVET's technical jargon. However, the underlying principle of portability of skills is an issue that was part of the debate between John Dewey on one hand, and David Snedden and Charles Prosser on the other hand about a century ago. Snedden, who in 1914 was Commissioner of Education for Massachusetts, believed that the main aim of vocational education was to produce a workforce that would closely meet the skill needs of industry (Drost, 1977; Gordon, 2008; Hyslop-Margison, 1999). To make sure that vocational education effectively carried out its mandate of supplying industry with the required competencies, Snedden advocated for the establishment of specialized vocational schools that would provide occupational experiences better than the general education schools in existence at the time. Snedden's passion for what today would be referred to as demand-driven training resonated with the views of industrialists "who liked his criticism of literacy education and his advocacy of social efficiency" (Gordon, 2008; 27). Snedden also influenced his former student, Charles Prosser, whom he appointed as associate commissioner of the Board of Education for Massachusetts. According to Gordon, Prosser established the following 16 theorems of "demand-driven training":

1. Vocational education will be efficient in proportion as the environment in which the learner is trained is a replica of the environment in which he must subsequently work.

2. Effective vocational training can only be given where the training jobs are carried on in the same way, with the same operations, the same tools, and the same machines as in the occupation itself.
3. Vocational education will be effective in proportion as it trains the individual directly and specifically in the thinking habits and the manipulative habits required in the occupation itself.
4. Vocational education will be effective in proportion as it enables each individual to capitalize his interests, aptitudes, and intrinsic intelligence to the highest degree.
5. Effective vocational education for any profession, trade, occupation, or job can only be given to the selected group of individuals who need it, want it, and are able to profit by it.
6. Vocational training will be effective in proportion as the specific training experiences for forming right habits of doing and thinking are repeated to the point that these habits become fixed to the degree necessary for gainful employment.
7. Vocational education will be effective in proportion as the instructor has had successful experiences in the application of skills and knowledge to the operations and processes he undertakes to teach.
8. For every occupation there is a minimum of productive ability which an individual must possess in order to secure or retain employment in that occupation.
9. Vocational education must recognize conditions as they are and must train individuals to meet the demands of the "market" even though it may be true that more efficient ways for conducting the occupation may be known and better working conditions are highly desirable.

10. The effective establishment of process habits in any learner will be secured in proportion as the training is given on actual jobs and not on exercises or pseudo jobs.
11. The only reliable source of content for specific training in an occupation is in the experiences of masters of that occupation.
12. For every occupation there is a body of content which is peculiar to that occupation and which practically has no functioning value in any other occupation.
13. Vocational education will render efficient social services in proportion as it meets the specific training needs of any group at the time that they need it and in such a way that they can most effectively profit by the instruction.
14. Vocational education will be socially efficient in proportion as in its methods of instruction and its personal relations with learners it takes into consideration the particular characteristics of any particular group which it serves.
15. The administration of vocational education will be efficient in proportion as it is elastic and fluid rather than rigid and standardized.
16. While every reasonable effort should be made to reduce per capita cost, there is a minimum level below which effective vocational education cannot be given, and if the course does not permit this minimum of per capita cost, vocational education should not be attempted. (p. 341)

These 16 principles were based on the perception that TVET should be tailored to the specific needs of a worker in accordance with the specific occupational skill demands in the labor market. In other words, boiler-makers, for instance, should only learn those skills that make them competent boiler-makers in the existing labor market. The 13th principle sums up the basis of Snedden and Prosser's theory as cited by Gordon: "Vocational education will be socially

efficient in proportion as it meets the specific training needs of any group at the time they need…" (p. 342)

Snedden and Prosser's ideal TVET program was that which would give the student skills to function in a given occupation. For example, a carpenter should have only those skills necessary for the job of a carpenter. In other words, the range of skills should be narrow and occupation-specific rather than broad and applicable to more than one occupation.

This emphasis on specificity in the teaching of TVET is what John Dewey (1859-1952), a philosopher and educator, found impracticable. Dewey (1916) argued that:

> We must avoid not only limitation of conception of vocation to the occupations where immediately tangible commodities are produced, but also the notion that vocations are distributed in an exclusive way, one and only one to each person. Such restricted specialism is impossible; nothing could be more absurd than to try to educate individuals with an eye to only one line of activity (p. 359).

The exchange of views expressing philosophical differences, on the subject of TVET, between Snedden (as well as his disciples such as Prosser) and Dewey led to the production of scholarly works that have influenced TVET philosophy for many years. Gordon (2008) gave a summary of the philosophical differences between Dewey and Prosser. According to Gordon, the benefit of a TVET program from the point of view of Prosser was that students gained marketable skills to become productive members of society. On the other hand, from Dewey's perspective, the benefit was that students gained life skills and adaptability skills. Labaree (2008) used the labels administrative and pedagogic progressivism to situate the Snedden and Dewey positions in America's twentieth century progressive education movement. He classified

Snedden's philosophy as administrative progressivism and Dewey's philosophy as pedagogical progressivism. Labaree observed that both contestants in the TVET debate were advocates of educational reform, the difference being that while Snedden stood for an education system that preserved the existing social stratification, Dewey saw education as a vehicle for societal change by empowering students with skills for adaptation and change. Dewey's view of education and training was that it needed to be broad enough not to limit a graduate to an occupation-specific set of skills that would not be portable to other occupational areas.

The arguments raised by both Prosser (as well as Snedden) and Dewey when describing what constituted a good education and training philosophy served as the underpinning theoretical framework for this study. Prosser's argument that vocational training should closely meet the skill needs of industry is still relevant today, as can be seen in the demand-driven vocational curriculum movement. On the other hand, Dewey's argument that vocational training should be broad enough to facilitate labor force mobility across different occupations is equally relevant today, as can be seen in the emphasis being placed on portable skills in current conversations on workforce development.

## Chapter Summary

In this chapter an overview of the literature on the subject of portable skills was presented. Over the last three decades, TVET systems throughout the world have undergone considerable transformation in nature and purpose as a result of labor market changes. One of the drivers of change has been the perception that training systems should closely match the ever-changing occupational competences demanded by employers. However, these transformations of TVET systems have not yet yielded one of the major desired results, i.e., eliminating skill gaps.

Against this background, it comes as a consolation to training providers to learn that employers are expressing demand for some skills that do not seem to change much and also have the advantage of being so flexible as to be transferable from one occupation to the other. These skills, which have numerous labels such as core skills, generic skills, and key competences (Buchanan et al., 2000), have some interesting pedagogical implications. Despite the multiplicity of authors who have demonstrated the benefits of portable skills to workers requiring to perform tasks in more than one occupation, much of the discussion has tended to focus more on soft skills (such as communication, problem-solving, and working in teams) than on technical skills (such as welding). This bias towards soft skills is unfortunate because employers want both non-technical and technical skills. Portable technical skills have the potential of empowering trainees to fit into more than one occupation (Kim, 2002) and of enabling them to have the creativity required to transform the existing industrial system.

# CHAPTER 3 – RESEARCH METHODOLOGY

This chapter includes a description of the research methodology that was used to conduct this study. To facilitate the reader's understanding of the research methodology, the chapter is organized in eight separate and distinct sections. The first section is a description of the research methodology used in the study, which is followed by a section describing the design of the study. The method used in selecting the occupations that were analyzed in the study is presented in the third section, followed, in the fourth section, by a description of the method that was used to analyze the data. The fifth section is a description of the procedure used to validate the list of portable technical skills developed by the researcher. In the sixth section, the researcher describes the method used to determine the implications of portable technical skills identified in this study. A description of the research output is presented in the seventh section. Finally, highlights of the chapter are presented in the eighth section to summarize this chapter.

## Research Methodology

The research methodology used in this study was a combination of qualitative and quantitative approaches. The objective of the study was to compare and contrast the competency lists of nine occupations to identify common portable technical competences within and across the career clusters of the nine occupations. The competency lists were developed by Zambia's Technical Education, Vocational and Entrepreneurship Training Authority (TEVETA) in conjunction with industry representatives. By definition, qualitative research refers to "any kind of research that produces findings not arrived at by means of statistical procedures or other means of quantification" (Strauss & Corbin, 1990, p. 17). This definition of qualitative research is, of course, debatable because some authors have found the concept of qualitative research

difficult to express in a standard definition form. For instance, Ljungberg and Douglas (2008) commented that:

> Qualitative research cannot be defined; it can be only described since the qualitative research community presents a large spectrum of different theoretical perspectives, methodologies, and methods. In addition, the qualitative research tradition has been in constant flux, responding to changing cultural and historical movements. (p. 164)

According to Bogdan and Biklen (1982) and Van Maanen (1983), the label qualitative research is an umbrella term used to describe many research techniques that share some common characteristics. Some of these characteristics have to do with the purpose of the study and manner in which data are collected, analyzed, and shared with others (Ljungberg & Douglas, 2008).

Quantitative research, on the other hand, is any kind of research that involves the tallying, manipulation, or systematic aggregation of quantities of data (Henning, 1986). The difference between qualitative and quantitative research can also be described in terms of the data generated in the study. Quantitative data are numerical (Posavac & Carey, 2007), unlike qualitative data, which are textual. Both methods have their advantages and disadvantages. For instance, one advantage of qualitative research is that a researcher can study a phenomenon in depth (including the reasons behind it) and not just one variable, whereas in quantitative research the main focus is on the relationships between variables (Gelo, Braakmann, & Benetka, 2008). Furthermore, in qualitative research, the researcher does not have to have a large, randomly selected sample (Patton, 2002), which is a key characteristic of true experiments in quantitative research. Some of the advantages of quantitative research are that: (a) the study is perceived to be more objective than that of the qualitative approach (Hoepfi, 1977); (b) the results are more generalizable,

whereas in qualitative research the results might only hold true in a specific setting (Borrego, Douglas, & Amelink, 2009); and (c) data analysis is easier than in qualitative research because quantitative data do not involve transcription of long texts, which, as Hoepfi (1977) said, can be a daunting task.

Patton (2002) identified three characteristics relating to qualitative data collection: "(1) in-depth, open-ended interviews; (2) direct observation; and (3) written documents" (p. 4). This study collected portable technical skills through analysis of written documents. In the literature, there are some qualitative studies that have been conducted using document analysis (see for example Gagel, 1997; Freebody, 2003). In this study, however, document analysis was complemented with validation of the findings by experts comprising nine instructors, one from each occupational area. The instructors were asked to individually validate the list of portable technical skills.

## Research Design

The design of this study consisted of the following components in addition to a review of literature: (a) selection of occupational competency lists from which to identify portable technical skills; (b) analysis of competency lists from nine selected occupations; (c) validation of the list of portable technical skills; and (d) determination of implications of the list of portable technical skills.

## Selection of Zambian Training Institution

Because the data for this study was based on Zambian TVET competency lists, it was beneficial to have the validation of the data done by Zambian users of the task lists and to determine the views of Zambian employers and instructors concerning the significance of the portable technical skills identified in the syllabuses. Therefore, for purposes of research

components (c) and (d) mentioned above, the researcher selected a Zambian trades training institution that was running the course programs identified for this study. In Zambia, there are three large trades training institutes that have the capacity to offer the range of training programs represented in this study. These are Lukashya Trades Training Institute (LTTI) located in a rural area 534 miles from Lusaka the capital city of Zambia, Livingstone Institute for Business and Engineering Studies (LIBES) located in Livingstone, Zambia's tourist capital, and Kabwe Institute of Technology (KIT) located midway between Zambia's capital city and the country's highly industrialized region called the Copper-belt province. LTTI was not considered to be a suitable option for this study due to its distance from industries that employ most of the institute's graduates. Had the site been selected, employers would have had to travel long distances to participate in the focus group discussions. LIBES was a good option but unfortunately it was experiencing some network connectivity problems, which would have affected communication between the institute and the researcher. KIT was the best option because of its proximity to many industries and because it did not have problems with internet connectivity.

## Selection of Enterprises

In order to determine the labor market implications of the results of this study, there was need to consult employers from enterprises with a range of occupations that included construction trades, electrical trades, and mechanical trades. The enterprises could be either formal sector industries or Informal Micro-Enterprises (IMEs). It was important to include IMEs because according to research the IME sector accounts for more than 70% of the non-agricultural labor force in Africa (Haan, 2006). With specific reference to Zambia, Phillips and Bhatia-Pathaki (2007) reported that: "The Zambian private sector consists largely of micro-firms (94 per

cent of total firms) providing 68 per cent of the employment in the country. The rest of the private sector consists of small firms (5 per cent of total firms) and medium and large firms (0.4 and 0.06 per cent, respectively)" (p.795)

## Selection of Occupations

Zambia's Technical Education, Vocational and Entrepreneurship Training Authority (TEVETA), working together with representatives of employers, develops training programs for many different occupations. In constituting the sample for this study, the author selected the following nine occupations: Building Construction; Carpentry and Joinery; Painting, Decoration, and Graphics; Electrical Craft; Electronic Systems Maintenance; Telecommunications Repair; Fitting; Machining; and Metal Fabrication. The criterion for selecting occupations for inclusion in the study was the likelihood of the occupational programs to be offered in a single training institution. This criterion was important because part of the methodology was a focus group discussion with instructors of one training institution. These nine occupations were, therefore, selected because from the researcher's experience as a former national director of Vocational Education and Training (VET) in Zambia, the institution chosen for participation in the focus group discussion would run programs for the selected occupations.

## Selection of Occupational Competency Lists

For purposes of this study, it was necessary to have competency lists for each of the nine occupations. In deciding the size of the sample, the following advice from Patton (2002) was useful:

> There are no rules for sample size in qualitative inquiry. Sample size depends on what you want to know; the purpose of the inquiry; what's at stake, what will be useful, what will have credibility, and what can be done with available time and resources (p. 244).

This study drew nine occupations from the following three occupational clusters.

**Construction**

- Building Construction (Masonry)
- Carpentry and Joinery
- Painting, Decoration, and Graphics

**Electrical Engineering**

- Electrical Craft
- Electronic Systems Maintenance
- Telecommunications Repair

**Mechanical Engineering**

- Fitting
- Machining
- Metal Fabrication

In order to identify portable technical skills in these nine occupations, competency lists from the nine occupations were taken from Zambia's TVET curriculum. The competency lists were developed by the Technical Education, Vocational and Entrepreneurship Training Authority (TEVETA) in consultation with industry representatives.

## Analysis of Competency Lists

Analysis of competency lists consisted of five steps: (a) becoming familiar with the data, (b) focusing on the analysis, (c) categorizing information, (d) identifying patterns, and (e) interpreting the data (Taylor-Powell & Renner, 2003). The analysis was done as follows:

### Becoming Familiar with the Data

Competency lists for each of the selected occupations generally had the following components: (a) Title of Module, (b) Module Aim, (c) Module Objectives, (d) Skill Areas (arranged in units), and (e) Competencies.

### Focusing on the Analysis

From the five components of the competency list, this study focused only on the last two: (d) Skill Areas; and (e) Competencies.

### Categorizing Data from Competency Lists

Data were classified into the following three categories: (a) portable skills within construction programs, (b) portable skills within electrical engineering programs, (c) portable

skills within mechanical engineering programs, and (d) portable skills across clusters of occupations. Table 4 was used to record the data.

Table 4

*Portable Technical Skills Across Nine Occupations*

| **Skill Area** | **Competencies** | **OCCUPATIONS** | | | | | | | | | | | **% of skill incidence out of 9 occupations** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Construction** | | | **Electrical Engineering** | | | | | **Mechanical Engineering** | | | |
| | | **C1** | **C2** | **C3** | **E1** | **E2** | **E 3** | | | **M1** | **M2** | **M3** | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |

Key: C1 = Building (Masonry); C2 = Carpentry and Joinery; C3 = Painting, Decoration, and Graphics; E1 = Electrical Craft; E2 = Electronics Systems and Maintenance; E3 = Telecommunications Repair; M1 = Fitting; M2 = Machining; M3 = Metal Fabrication

**Identifying Patterns**

Comparison of data in the first three categories (i.e., portable technical skills within construction programs, portable technical skills within electrical engineering programs, and portable technical skills within mechanical engineering programs) helped in identifying patterns of competencies that cut across occupational clusters. Once the blanks in Table 4 had been completed, the skills cutting across all the clusters were clearly seen. The last column reflected the incidence of such skills by indicating a score of 100%.

**Interpreting the Data**

In interpreting the data, the researcher was answering the question: *What do the emerging themes mean?* Another question of interest was: *What is the degree of portability of each of the skills listed?* Degree of portability of competencies was measured by the extent to which a

competency occurred in more than one occupation. The higher the incidence of a skill across occupational boundaries, the higher the portability of the skill. In other words, for purposes of this study, any skill that was listed in at least two occupations was identified as a portable skill because such a skill could be transferred from one occupation to the other. In interpreting the data, the researcher took note of the number of occupations in which a given skill was listed, and indicated the frequency as a percentage of the total number of occupations (i.e., 9 occupations). The researcher's intention was not to determine what competencies to include in a generic course, but rather what competencies are portable and the degree of their portability (the number of occupations in which the skill occurs). Implications for curriculum will be considered later by curriculum developers.

## Validation of Competency Lists

To ensure credibility of this study, triangulation was used in generating the list of portable technical skills. Triangulation refers to "a search for convergence of the information on a common finding or concept" (Wiersma, 1995, p. 264) through use of multiple sources of data or methods. The aim of triangulation is to ensure that a researcher does not study only a fraction of the complexity which he seeks to understand (Rossman& Rallis, 2003). According to Patton (2002):

> "*Triangulation* is taken from land surveying. Knowing a single landmark only locates you somewhere along a line in a direction from the landmark, whereas with two landmarks (and your own position between the third point of the triangle) you can take bearings in two directions and locate yourself at their intersection." (p. 247)

In this research, data triangulation was achieved through expert validation of the identified portable technical skills. The list of portable skills generated from the analysis of nine different competency lists was submitted to instructors meeting the following criteria:

- Must be either a full-time or part-time teacher in a Zambian TVET college, or must have retired after teaching in a TVET institution;
- Must have taught for at least two years;
- Must have a teaching certificate; and
- Must have a minimum of a crafts certificate in their occupational program of instruction.

Because the researcher was not able to travel to Zambia, the list of portable technical skills was sent to the Principal of Kabwe Institute of Technology in Zambia, who agreed to collaborate with the researcher in the selection of the validation panel and to coordinate the validation of the list of portable skills.

Each instructor was given the following instructions:

1. Refer to the table of portable skills given to you. Look at the list of skills pertaining to your occupational program and check that:
   (a) Competencies are correctly stated;
   (b) The Xs represent the skills that your program has in common with at least one other occupational program; and
   (c) The zeros correctly indicate skills that your program does not teach but should be taught in other programs;
2. Indicate the corrections on the list by changing the competency, or replacing an X with a zero, or a zero with an X.

3. Ensure that the corrections are clear by using red ink.

**Determining Implications of List of Portable Technical Skills**

After the validation of portable technical skills, two focus group meetings were conducted to determine various implications for utilizing the list. The nominal group technique (NGT) was used to facilitate the meetings. According to Castiglioni, Shewchuk, Willett, Heudebert, and Centor (2008), the NGT " is a well-established structured, multi-step, facilitated group meeting technique used to elicit and prioritize responses to a specific question" (p. 1061). A number of authors have cited the following advantages of NGT over other data collection methods (such as interviews):

- Generation of more ideas (Kristofco, Shewchuk, Casebeer, Bellande, & Bennett, 2005);
- Diminishing competition among participants (Asmus& James, 2005);
- Anonymous voting (Castiglioni et al., 2008);
- Equal participation of group members (MacPhail, 2001);

This data collection method comprises between four and six steps. According to some authors (e.g. Castiglioni et al.; Kennedy & Clinton, 2009; Kristofco et al.) the following are the four basic steps of the NGT process:

1. Independent and silent generation of ideas in response to an exploratory open-ended question;
2. Round-robin listing of ideas with no discussion;
3. Clarification of each individual idea, and clustering of similar ideas;
4. Anonymous, individual voting and ranking of items to prioritize them.

In discussing the fourth step, Price (1985) said:

> Once the items are ranked, each participant is asked to give each item a value score according to its ranked position. The scale for the scores is as follows: Rank item 1 = 9 points; Rank item 2 = 8 points; Rank item 3 =7 points; Rank item 4 = 6 points; etc. After the values are assigned to each item, the participants are asked to shuffle the cards, which are then collected by the facilitator. A group decision is made regarding the importance and priority of each item by obtaining a sum value score for each item. (p. 13)

It is probably because of this mathematical way of arriving at group consensus and the resulting mathematical data that Castiglioni et al. concluded that: "The data generated by this process are quantitative, objective, and prioritized" (p. 1061).

The first focus group meeting conducted in this study was with the thirteen instructors who had participated in the validation of portable technical skills. The rationale for holding a nominal group technique session with trainers was to get their views on possible classroom implications of the list of portable technical skills. The second meeting was held with a group of eight participants consisting of: (a) seven representatives of industries that employ graduates from the programs on which this study was based; (b) one instructor identified by the principal from the members of the instructors' focus group participating in this study. Selection of employers was based on the following criteria:

- Must be from the Informal Micro-Enterprise (IME) sector or formal enterprise employing TVET graduates who include those from the nine different occupations comprising the sample of this study; and
- Must be either a shop floor supervisor or a director.

The purpose of the second focus group meeting was to get the views of employers in relation to portable technical skills. The following procedure was used at each of the two sessions:

1. Introduction to session: The facilitator welcomed the members and explained the objectives and rules of the session;
2. Generation of ideas: After the clarification of the purpose and procedures of the meeting, participants were asked to independently write down their responses to the following question:

   *(*For instructors*) In what ways can the list of portable technical skills that have been presented to you be used to enhance the quality of training provided for students at your institution?*

   *(*For employer representatives*) In what ways can the list of portable technical skills that have been presented to you be used to respond to labor demands in your enterprise?*[1]

   (a) Round-robin listing: From the list that each member had written, members were asked to present one idea (i.e., advantage or disadvantage) each, which was recorded by the facilitator on a flip chart. Participants took turns in giving one response at a time in round-robin fashion until all their responses were recorded verbatim on the chart. At this stage, there was no discussion of points or justifications for the responses;

[1]The two groups had different questions because the intention of the researcher was to determine classroom implications of the portable technical skills from instructors' perspective, and to determine the labor market implications of the portable technical skills from the perspective of employers.

(b) Clarifications of ideas: Once all the responses had been collected, the facilitator led a discussion meant to clarify the responses recorded on the flip chart. The clarification process was to ensure that all the participants understood the issues that were on the flip chart. It was not necessary to reach agreement. At this stage, participants merged some of the ideas that appeared to be similar.

(c) Prioritizing of items: The purpose of this step was to finalize a list of participants' perceptions of portable technical skills (for instructors, the perceptions were in relation to ways the list of portable technical skills could be used to enhance the quality of training provided for students at their institution; for industry representatives, the perceptions related to ways the list of portable technical skills can be used to respond to labor demands in their occupational clusters). Each participant was asked to select (from the list recorded on the chart) the three most important ways the portable technical skills list could be used to enhance training and the three most important ways the list could respond to industry demand. They ranked the three ideas in order of importance (3 = most important; 2 = important; 1 = least important). The ranks for each item were summed and the groups' mean score for each response was calculated. The ranking of ideas established the importance that group members (on aggregate) attached to the items on the lists**.** Each group session lasted about two and half hours.

Both meetings were facilitated by the person who coordinated the validation of portable technical skills, following the guidelines presented in Appendix A. Results of the two meetings were sent to the researcher electronically for analysis.

## Research Output

The following were the four main outputs of the study:

1. A list of portable technical skills, indicating the occupations in which they occur. The significance of this output is that it could be used to promote interdisciplinary collaboration in the planning, delivery and evaluation of occupational skills. The output could also have labor market value because employers' awareness of portable technical skills could enhance flexibility in the employment and placement of technical human resources.
2. A description of trainers' perceptions concerning how the list of portable technical skills could be used to enhance training. Views of instructors on the implications of portable technical skills are critical because they could confirm the practical value of such skills;
3. A description of employer representatives' perceptions concerning ways the list of portable technical skills could be used to respond to labor demands in a given occupational cluster. This output is important because it could confirm the labor market value of portable technical skills, and indicate some necessary strategic alliances between employers and college management for effective utilization of portable technical skills;
4. The researcher's recommendations to Zambian TVET policy makers (at national and local levels) on how the results of the study should be used to benefit the nation's

workforce development system: This output is important because the ultimate value of the findings of the study could be measured by the extent to which it contributes to effective and efficient implementation of the existing policies on Zambia's workforce development.

## Chapter Summary

In this chapter, the researcher described the research methodology of this study in seven distinct sections. In the first section, the researcher described the research methodology of this study as a combination of qualitative and quantitative approach. The qualitative part of the research consisted of analyzing task lists of nine different occupations to identify portable technical skills. The quantitative part of the study consisted of mathematical generation of data through use of the nominal group technique. The second section of the chapter was a description of the design of the study. In the third section, the researcher presented the method used in selecting the occupations that were analyzed in the study and explained that selection of occupations was based on the number of syllabuses available to the researcher, and the purpose of the study. This was followed by the fourth section, in which the researcher presented the method that was used to analyze the data. In the fifth section, the researcher described triangulation, which was the credibility strategy that was used in the research methodology. The description of the credibility strategy was followed by the sixth section, in which the researcher described the nominal group technique, which was used during discussions with participants. In the seventh section, the researcher explained that the study had the following four outputs: (a) a list of portable technical skills, (b) a description of occupational instructors' perceptions of the classroom implications of portable technical skills, (c) a description of employer representatives'

perceptions of labor market implications of portable technical skills, and (d) policy recommendations based on the findings of this study.

# CHAPTER 4- PRESENTATION OF FINDINGS

In this chapter, the results of the study are presented in two parts. The first part comprises the results of an analysis of competency lists for nine different occupations. The second part consists of the results of focus group sessions which were held with panels of instructors and industry representatives.

## Question 1: Portable Skills within Clusters

The first question of this study was: What skills do the technical occupations listed below have in common within their occupational clusters?

a. Construction Occupational Cluster
    i. Building Construction (i.e. Masonry)
    ii. Carpentry and Joinery
    iii. Painting, Decoration, and Graphics
b. Electrical Engineering Occupational Cluster
    vii. Electrical Craft
    viii. Electronic Systems Maintenance
    ix. Telecommunications repair
c. Mechanical Engineering Occupational Cluster
    x. Fitting
    xi. Machining
    xii. Metal Fabrication

Analysis of the competency lists for the nine occupations resulted in a list of 676 portable technical skills. The list can be found in Appendix D. The distribution of portable technical skills within occupational areas is shown in Table 5.

Table 5.
*Distribution of Portable Technical Skills between Pairs of Occupations*

| Cluster | Pairs of Occupations | Total Portable Skills Between Each Pair | Average Number of Portable Skills between Pairs | Ranking of Pairs According to Strength of Relationship |
|---|---|---|---|---|
| Mechanical Engineering | Fitting with Machining | 504 | 465 | 1 |
| | Fitting with Metal Fabrication | 459 | | 2 |
| | Machining with Metal Fabrication | 431 | | 3 |
| Electrical Engineering | Electronic System Maintenance with Telecommunications Repair | 357 | 338 | 4 |
| | Electrical Craft with Telecommunication Repair | 337 | | 5 |
| | Electrical Craft with Electronic Systems Maintenance | 319 | | 6 |
| Construction | Building (Masonry) with Carpentry and Joinery | 285 | 259 | 7 |
| | Building with Painting, Decoration, and Graphics | 255 | | 8 |
| | Carpentry and Joinery with Painting, Decoration, and Graphics | 238 | | 9 |

As Table 5 shows, Machining and Fitting were the most closely related occupational areas with a total of 504 technical portable skills. The second closest pair is Fitting and Metal Fabrication that shared 459 technical skills, followed closely by Electronic System Maintenance and Telecommunications Repair with 357 portable technical skills between them. The pair with the least number of portable technical skills in common (238) was Building and Painting, Decoration, and Graphics.

The cluster of Mechanical Engineering programs had the highest average of portable technical skills, which was 465, followed by Electrical Engineering at 338, and then Construction with an average of 259 portable technical skills between pairs of occupational areas. The correlation of skills within the cluster of construction programs indicated that although Building, Carpentry and Joinery, and Painting, Decoration, and Graphics (PDG) are in the same cluster of programs, their competence lists showed that the three occupational programs

had very little in common. A graduate from the Carpentry and Joinery program, for example, would have only 238 skills in common with a graduate of PGD, out of a total of 676 portable skills comprising the sample of this study. However, the Carpentry and Joinery graduate would have 285 skills in common with a graduate of the Building program, who would have only 255 skills in common with a graduate of PGD. This means that PGD had the weakest correlation with the other two programs in the construction cluster. Tables 6 to 8 show examples of portable technical skills within clusters. For the complete inventory of portable technical skills, see Appendix D.

Table 6
*Examples of Portable Skills in Mechanical Engineering*

| **Pair of Occupations** | **Example of portable skills** |
|---|---|
| Fitting - Machining | Describe types and uses of lifting devices<br>Describe lifting accessories<br>Describe scaffolding<br>Identify safe working loads<br>Perform periodical maintenance of scaffolding and lifting devices. |
| Fitting – Metal Fabrication | Explain heat treatment processes and procedures<br>Describe material properties before and after heat treatment<br>Assemble components from the drawing<br>Describe types and use of measuring tools<br>Interpret cooling curve diagrams in relation to heat treatment processes |
| Machining – Metal Fabrication | Describe types of engineering materials<br>Describe process of production of iron and Steel<br>Describe flat sheet and strip<br>Describe types of steel sections<br>Distinguish between ferrous and non ferrous metals |
| All combinations of pairs | Describe classification of filler metals<br>Explain braze welding principles<br>Explain application and limitations of Brazing<br>Describe flat position welding and Brazing<br>Explain principles of Gas welding<br>Explain principles of Gas cutting<br>Explain history and future in Gas welding<br>Observe safety<br>Set up and carry out maintenance of Oxy-fuel Welding equipment<br>Set up and carry out maintenance of Oxy-fuel Cutting equipment |

Table 7
*Examples of Portable Skills in Electrical Engineering*

| Pair of Occupations | Example of portable skills |
|---|---|
| Electronic System Maintenance – Telecommunications Repair | Unpack and install a Photocopier<br>Dismantle and assemble a photocopier<br>Service a photocopier<br>Troubleshoot photocopiers<br>Repair a photocopier<br>Explain braze welding principles<br>Explain application and limitations of Brazing<br>Describe flat position welding and Brazing<br>Demonstrate manual and machine Oxy-fuel cutting<br>Describe types of welding electrodes |
| Electrical Craft-Telecommunications Repair | Draw characteristic curves for diodes and transistors<br>Apply the results of the drawing to circuit design<br>Perform Polarity checks on a diode by the use of multitester<br>Explain the stages of IC fabrication<br>Fit semi-conductors<br>Explain principles of Gas Tungsten Arc Welding<br>Explain safety rules and equipment<br>Describe procedures in joints design and welds |
| Electrical Craft-Electronic System Maintenance | Explain safety rules and regulations<br>Describe arc welding equipment<br>Describe joint designs<br>Demonstrate flat position welding<br>Explain principles of Gas welding<br>Describe machines for Shielded Metal Arc Welding<br>Describe cables and fasteners<br>Describe setup and use of Gas Tungsten arc welding equipment<br>Perform welds in various positions |
| All combinations of pairs | Differentiate digital from analog signals<br>Define number systems and codes<br>Identify number systems and codes<br>Convert number systems and codes<br>Describe grinding machines<br>Describe metal rolling machines<br>Describe drilling machines<br>Describe folding and bending machines<br>Describe classification of fuels<br>Describe classification of filler metals |

Table 8
*Examples of Portable Skills in Construction Engineering*

| Pair of Occupations | Example of portable skills |
|---|---|
| Building –Carpentry and Joinery | Demonstrate use of drawing instruments<br>Maintain drawing instruments<br>Interpret scales for different drawings<br>Abbreviate building related terms<br>Identify materials symbols used in building drawing |
| Building-Painting, Decoration, & Graphics | Produce pictorial drawing<br>Prepare hand-drawn technical sketches using regular and isometric grid paper.<br>Choose the appropriate line types from the Alphabet of Lines for drawing and sketching.<br>Demonstrate inclined and vertical style hand-lettering.<br>Explain fundamentals of geometry |
| Carpentry & Joinery - Painting, Decorating & Graphics | Explain types and uses of marking out tools<br>Explain types and uses of hand tools<br>Demonstrate care, storage and maintenance of marking out tools<br>Demonstrate care, storage and maintenance of hand tools<br>Observe safety procedures<br>Explain the history of information technology<br>Describe application packages<br>Describe the computer system<br>Describe parts of a computer and their uses |
| All combinations of pairs | Identify types of materials used in the building industry<br>Identify classification of building materials<br>Describe composition and properties of building materials<br>Carry out joint consideration of problems<br>Give instructions<br>Produce pictorial drawing<br>Prepare hand-drawn technical sketches using regular and isometric grid paper.<br>Choose the appropriate line types from the Alphabet of Lines for drawing and sketching.<br>Demonstrate inclined and vertical style hand-lettering.<br>Explain fundamentals of geometry |

### Question 2: Portable Skills Across Occupational Clusters

The second question was: What skills do the selected technical occupations have in common across their occupational clusters?

The list in Appendix D reveals evidence of existence of portable technical skills across occupational clusters. Table 9 presents the distribution of portable technical skills across clusters

of occupational areas. Out of a sample of 676 portable skills, there were 152 skills that were portable across all occupations.

A comparison of each occupational area with occupational areas outside its cluster generated twenty-seven pairs that were analyzed to determine portability of skills across clusters. The pairs were ranked according to strength of correlation. The pair with the highest number of portable skills (i.e. which had the strongest correlation) was ranked as number 1. The top five pairs of occupational areas were as follows:

1. Electrical Craft and Metal Fabrication, sharing 387 portable skills;
2. Electrical Craft and Fitting, sharing 367 portable skills;
3. Electrical Craft and Machining, sharing 359 portable skills;
4. Telecommunication Repair and Machining, with 296 portable skills; and
5. Telecommunications Repair and Fitting, with 293 portable skills.

The bottom five pairs of occupational areas (i.e. those with the lowest number of portable skills between them) were as follows:

21. Carpentry and Joinery and Telecommunications Repair, with 201 portable technical skills;
22. Building and Telecommunications Repair, with 191 portable technical skills;
23. Carpentry and Joinery and Electronic Systems Maintenance (ESM), with 183 portable technical skills;
24. Painting, Decoration and Graphics (PDG) and Electronic Systems Maintenance ESM, with 181 portable skills;
25. Building and Electronic Systems Maintenance (ESM), with 176 portable technical skills.

Table 9

*Distribution of Portable Technical Skills Across Clusters.*

| **Comparison of Clusters** | **Occupational Areas** | **Portable Skills between Pairs** | **Ranking Within Cluster** | **Overall Ranking** |
|---|---|---|---|---|
| Electrical with Mechanical Engineering | Electrical Craft with Metal Fabrication | 387 | 1 | 1 |
| | Electrical Craft with Fitting | 367 | 2 | 2 |
| | Electrical Craft with Machining | 359 | 3 | 3 |
| | Telecommunications Repair with Machining | 296 | 4 | 4 |
| | Telecommunications Repair with Fitting | 293 | 5 | 5 |
| | Telecommunications Repair with Metal Fabrication | 292 | 6 | 6 |
| | Electronic Systems Maintenance with Fitting | 284 | 7 | 8 |
| | Electronic Systems Maintenance with Machining | 277 | 8 | 10 |
| | Electronic Systems Maintenance with Metal Fabrication | 277 | 8 | 10 |
| Construction with Mechanical Engineering | Carpentry and Joinery with Metal Fabrication | 290 | 1 | 7 |
| | Building (Masonry) with Metal Fabrication | 269 | 2 | 10 |
| | Painting, decoration with Fitting | 260 | 3 | 12 |
| | Painting, decoration with Metal Fabrication | 256 | 4 | 13 |
| | Carpentry and Joinery with Fitting | 253 | 5 | 14 |
| | Carpentry and Joinery with Machining | 252 | 6 | 15 |
| | Building (Masonry) with Fitting | 239 | 7 | 16 |
| | Painting, decoration with Machining | 217 | 8 | 18 |
| | Building (Masonry) with Machining | 211 | 9 | 19 |
| Construction with Electrical Engineering | Carpentry and Joinery with Electrical Craft | 283 | 1 | 9 |
| | Painting, decoration with Electrical Craft | 266 | 2 | 11 |
| | Building (Masonry) with Electrical Craft | 226 | 3 | 17 |
| | Painting, decoration with Telecommunications Repair | 205 | 4 | 20 |
| | Carpentry and Joinery with Telecommunications Repair | 201 | 5 | 21 |
| | Building (Masonry) with Telecommunications Repair. | 191 | 6 | 22 |
| | Carpentry and Joinery with Electronic Systems Maintenance | 183 | 7 | 23 |
| | Painting, decoration with Electronic Systems Maintenance | 181 | 8 | 24 |
| | Building (Masonry) with Electronic Systems Maintenance. | 176 | 9 | 25 |
| All Clusters | All occupational areas | 152 | | |

One of the interesting findings from the comparison of Table 5 and Table 9 is that within its own cluster, Electrical Craft had 337 skills in common with Telecommunications Repair and 357 skills in common with Electronic Systems Maintenance. However, outside its cluster, as shown in Figure 2, Electrical Craft had the following numbers of portable skills:

- 387 with Metal Fabrication;
- 367 with Fitting; and
- 359 with Machining.

Similarly, Carpentry and Joinery had stronger relationships with some occupations outside its cluster than within the cluster, as shown in Figure 3. Outside its cluster, Carpentry and Joinery had 283 portable skills in common with Electrical Craft, and 253 and 252 portable skills in common with Fitting and Machining respectively. However, within its cluster, Carpentry and Joinery had only 238 portable skills in common with Painting, Decoration, and Graphics.

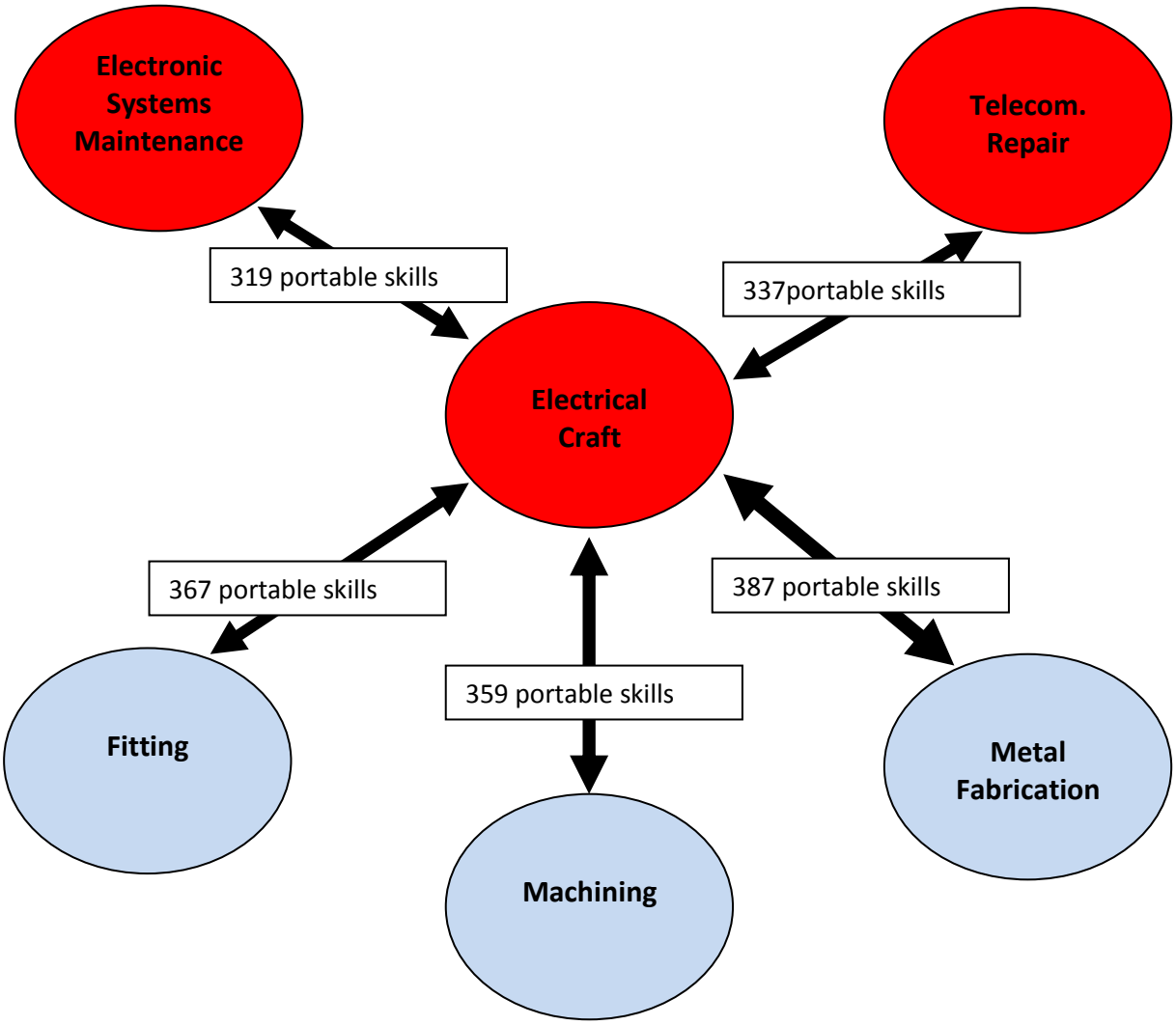


*Figure 2.* Portability of Electrical Craft Skills. Blue represents the mechanical engineering cluster and red represents the electrical engineering cluster. Electrical Craft has more skills in common with the mechanical engineering cluster than with programs within its cluster of electrical engineering.

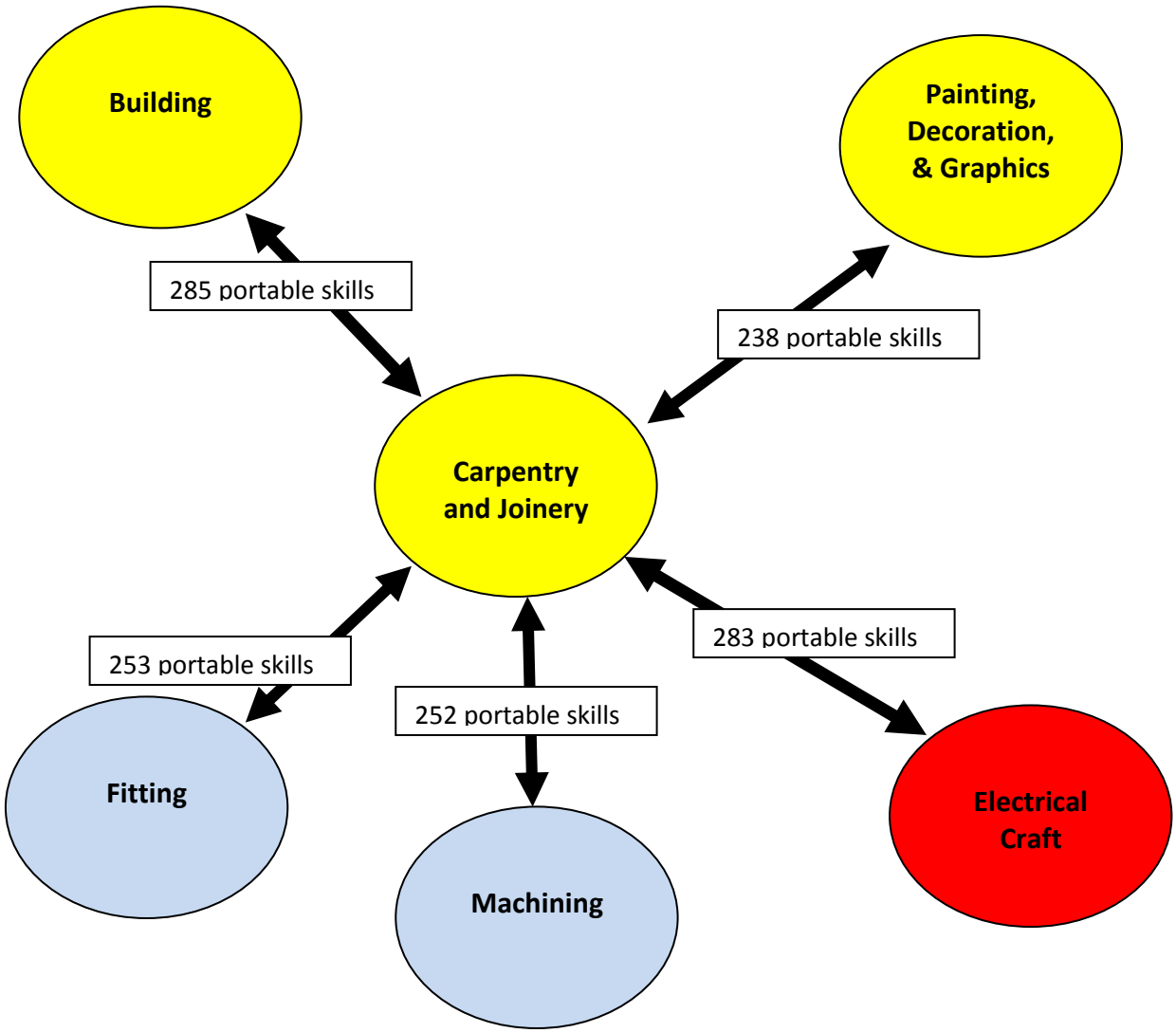


*Figure 3*. Portability of Carpentry and Joinery Skills. Blue represents the mechanical engineering cluster, yellow represents the construction cluster, and red represents the electrical engineering cluster. Carpentry and Joinery has more skills in common with Electrical Craft, Fitting and Machining than with programs within its cluster of construction engineering.

Examples of portable technical skills across clusters of occupations are given in Tables 10 to 12.

Table 10

*Examples of Portable Technical Skills between Electrical Engineering and Mechanical*

| **Occupational Areas** | **Examples of portable technical skills** |
|---|---|
| Electrical Craft with Fitting | Demonstrate the ability to create and read an engineering drawing using standard views, and both conventional and GD&T dimensioning and tolerance techniques to describe form, orientation, and location accurately; Convert orthographic projection in to isometric Projection; Perform hot wire welding |
| Electrical Craft with Machining | Describe the purposes of dimensioning; Explain the differences between dimension line, extension line, leaders etc; Apply geometric dimensioning and tolerance (GD&T); Demonstrate use of multi-view and auxiliary view drawings; Set up and carry out maintenance of Oxy-fuel Cutting equipment |
| Electrical Craft with Metal Fabrication | Interpret symbols and conventions; Produce lines by use of computer; Perform basic operations of C.A.D; Produce commonly used project drawings using Auto-CAD; Explain principles of Gas welding; |
| Electronic System Maintenance with Fitting | Describe types of cells; Explain electro chemistry; Define semiconductors and thyristors; Describe the semiconductor theory; Solve fractions and percentages as applied to the course. |
| Electronic System Maintenance with Machining | Identify the nature and sources of electricity; State the basic laws in electricity (Ohms Law and Kirchhoff's Law); Analyze the behavior of passive components in AC circuits; Perform welds in various positions. |
| Electronic System Maintenance with Metal Fabrication | Describe magnetism and its effects; Describe magnetism and its application to instruments; Repair electrical components; Draw graphs demonstrating reduction of non-linear laws to linear form; Draw graphs with logarithmic scales; Set up and carry out maintenance of Oxy-fuel Cutting equipment |
| Telecommunication with Fitting | Explain electrical energy; Describe fuses; Describe lamps; Analyze the behavior of passive components in AC circuits; Read the values of passive and active components; Demonstrate manual and machine Oxy-fuel cutting |
| Telecommunication with Machining | Describe magnetism and its effects; Describe magnetism and its application to instruments; Repair electrical components; Describe types of resistors; Demonstrate flat position welding. |
| Telecommunication with Metal Fabrication | Join pieces by riveting; Demonstrate use of adhesives; Demonstrate use of electrical connections; Join pieces by brazing; Describe types and uses of joints; Calculate angles and sides by using the Pythagoras Theorem; Carryout calculations involving trigonometric ratios (Sine, Cos, Tan); Plot a graph given X and Y axes; Draw graphs demonstrating reduction of non-linear laws to linear form; Describe machines for Shielded Metal Arc Welding |

Table 11

*Examples of Portable Technical Skills between Construction and Mechanical.*

| **Pairs of Occupational Areas** | **Examples of portable technical skills** |
|---|---|
| Building (Masonry) with Fitting | Explain types and uses of marking out tools; Explain types and uses of hand tools; Demonstrate care, storage and maintenance of marking out tools; Demonstrate care, storage and maintenance of hand tools. |
| Building (Masonry) with Machining | Demonstrate care, storage and maintenance of hand tools; Observe safety procedures; Describe marking tools; Describe cutting tools. |
| Building (Masonry) with Metal Fabrication | Describe types and use of measuring tools; State principles of measuring instruments; Practice using measuring instrument; Describe classification of workshop measurement errors. |
| Carpentry with Fitting | Describe grinding machines; Describe metal rolling machines; Demonstrate use of drilling machines; Demonstrate use of power saws; Carry out turning operations. |
| Carpentry with Machining | Explain types and uses of hand tools; Describe metal rolling machines; Describe drilling machines; Demonstrate care, storage and maintenance of hand tools; Demonstrate use of drilling machine. |
| Carpentry with Metal Fabrication | Demonstrate care, storage and maintenance of marking out tools; Describe drilling machines; Explain types and uses of hand tools. |
| Painting and Decorating with Fitting | Prepare hand-drawn technical sketches using regular and isometric grid paper; Choose the appropriate line types from the Alphabet of Lines for drawing and Sketching; Demonstrate inclined and vertical style hand-lettering. |
| Painting and Decorating with Machining | Prepare hand-drawn technical sketches using regular and isometric grid paper; Choose the appropriate line types from the Alphabet of Lines for drawing and Sketching; Demonstrate inclined and vertical style hand-lettering. |
| Painting and Decorating with Metal Fabrication | Prepare hand-drawn technical sketches using regular and isometric grid paper; Choose the appropriate line types from the Alphabet of Lines for drawing and Sketching; Demonstrate inclined and vertical style hand-lettering. |

Table 12

*Examples of Portable Technical Skills between Construction and Electrical*

| **Occupational Areas** | **Examples of portable technical skills** |
|---|---|
| Building (Masonry) with Electrical Craft | Produce first angle; Produce third angle; Produce dimensional drawings |
| Masonry with Electronic System Maintenance | Use drawing instruments; Maintain drawing instruments; Interpret scales for different drawings. |
| Building (Masonry) with Telecommunications Repair | Simplify and evaluate expressions using the properties of *logarithms*; Solve exponential Equations; |
| Carpentry with Electrical Craft | Outline an introduction to cutting machines; Describe grinding machines; Describe metal rolling machines; Describe drilling machines<br>Interpret different projection drawings<br>Draw an oblique drawing in 3-dimension form<br>Draw axonometric drawings in 3-dimension form<br>Draw an isometric drawing 3-dimension form<br>Draw orthographic drawings using 1st and 3rd angle projection. |
| Carpentry with Electronic System Maintenance | Explain multiples and submultiples; Carry out calculations in S I units; Measure length, angle and weight. |
| Carpentry with Telecommunications Repair | Describe types and uses of joints; Use mechanical fasteners; Demonstrate riveting; Demonstrate use of adhesives |
| Painting and Decorating with Electrical Craft | Define stress and strain; Explain Young's Modulus of Elasticity; Describe types of stresses and strain<br>Explain internet and web;<br>Explain the benefits of using internet;<br>Browse the web;<br>Open web pages; Save web pages<br>search engines;<br>Apply rules for using the internet, video and teleconferencing. |
| Painting and Decorating with Electronic System Maintenance | Describe types and use of measuring tools; State principles of measuring instruments; Demonstrate use of measuring instrument. |
| Painting and Decorating with Telecommunications Repair | Demonstrate care and storage of measuring instruments; Calibrate and zero measuring instruments; Explain types and uses of marking out tools. |

Table 13

*Examples of Portable Technical Skills Across All Occupations*

| Occupations | Examples of Portable Technical Skills |
|---|---|
| Building - Carpentry and Joinery – Painting, Decoration and Graphics – Electrical Craft – Electronic Systems Maintenance – Telecommunications Repair – Fitting – Machining – Metal Fabrication | State possible accidents in a mechanical workshop; Carry out procedures for reporting and recording accident; Use personal protective equipment (PPE); Describe parts of a computer and their uses; Describe Government policy on enterprise development; Create networking for enterprise; Demonstrate skills for maintaining business records Demonstrate skills for maintaining business records; Describe the communication process; Describe barriers to effective communication; Write memorandum; Carry out calculations in S I units; Solve algebraic equations; Calculate algebraic fractions; Solve linear equations; Calculate area of regular figures |

## Validation of List of Portable Technical Skills

Validation of the list of portable skills was done by instructors of technical training programs at Kabwe Institute of Technology in Zambia. An inventory of portable skills was given to each instructor according to their areas of specialization. The instructors analyzed the lists individually and then discussed their findings in order to cross check their analyses. They identified additional portable technical skills and the list presented in Appendix D was amended accordingly.

## Question 3: Occupational Instructors' Perceptions

The third question of this study was: What are occupational instructors' perceptions of the classroom implications of the identified portable technical skills? Perceptions of occupational instructors concerning classroom implications of the identified portable technical skills was determined by conducting a small focus group session with thirteen instructors from Kabwe Institute of Technology in Zambia. The nominal group technique (NGT) was used to facilitate the small group discussion. The focus question for the group was: *In what ways can the list of portable technical skills that have been presented to you be used to enhance the quality of training provided for students at your institution?* Responses to the question are listed below in

the order in which the facilitator collected them from participants. They are therefore not ranked according to degree of importance.

1. Portable technical skills facilitate multi-skilling.
2. Portable skills will encourage harmonization of the syllabi and curriculum of different courses.
3. Team teaching should be encouraged.
4. Awareness of portable technical skills allows a common approach of delivery where these portable skills can be delivered by one instructor/lecturer to all the different groups whilst the others concentrate on other duties.
5. Students wishing to learn additional trades will only have to focus on non-portable technical skills.
6. Awareness of portable technical skills makes instructors appreciate one another's knowledge and skills.
7. Portable technical skills facilitate inter-disciplinary collaboration.
8. Portable technical skills encourage joint planning of schemes of work for instructors.

The focus group was asked to merge ideas that seemed to be similar. When they had merged some of the ideas, the focus group was asked to identify three most important ideas from the list, which they then ranked in the order of importance as presented in Table 14. (For the minutes of the focus group, see Appendix E).

Table 14.

*Summary of Instructors' Focus Group Results*

| Agreed Main Points | RANKINGS |
|---|---|
| Portable skills facilitate multi-skilling. Students wishing to learn additional trades will only have to focus on the non-portable skills because they will already have learned the portable skills relevant to the new trade. | 1 |
| Portable skills will encourage harmonization of the syllabi and curriculum of different courses. | 2 |
| Awareness of portable technical skills allows a common approach of delivery where these portable skills can be delivered by one instructor/lecturer to all the different groups whilst the others concentrate on other duties | 3 |

## Question 4: Employers' Perceptions

The fourth question of this study was: From the point of view of employers, what are the labor market implications of the identified portable technical skills? Perceptions of employers concerning labor market implications of the identified portable technical skills was determined by conducting a small focus group session with seven employers from local industries. The nominal group technique (NGT) was used to facilitate the small group discussion. The focus question for the group was as follows: *In what ways can the list of portable technical skills that have been presented to you be used to respond to labor demands in your enterprise?* Responses to the question are listed below in the order in which they were collected from participants. The responses were not ranked in any order of importance.

1. Portable technical skills enable Informal Micro-Enterprises (IME) to save money.
2. IMEs employ smaller labor force because of portable technical skills.
3. With the use of portable technical skills, employees are capable of doing tasks from more than one occupation.
4. Portable technical skills have been used effectively and efficiently in the IME sector.
5. There is need to put more emphasis on entrepreneurship skills to prepare graduates for a wider range of jobs and future personal developments.

6. Training institutions should design and conduct short training programs focusing on portable technical skills to give graduates the flexibility and adaptability needed in informal sector industries.
7. Training programs offered by formal training institutions are not responsive to the needs of the IME sector.
8. Linkages between training providers and the Informal Sector should be encouraged so as to enable institutions improve on their instructional abilities and skills that are related to informal labour markets.

The focus group was asked to select three most important ideas from the list given above. They merged some of the ideas that appeared to be related and then picked the three most important ones, which they ranked in order of importance as presented in Table 15. (For the minutes of the focus group, see Appendix F)

Table 15

*Summary of Employers' Focus Group Results*

| **Agreed Main Points** | **RANKINGS** |
|---|---|
| Portable technical skills have long been used effectively and efficiently in the Informal Micro-Enterprise sector but there is need to enhance the development of entrepreneurship skills in order to prepare graduates for a wider range of jobs and future personal developments. | 1 |
| Training institutions should design and conduct short training programmes focusing on portable technical skills to give graduates the flexibility and adaptability needed in informal sector industries. | 2 |
| Training programmes offered at present are not responsive to the needs of the Informal Sector, promotion of linkages between training providers and the Informal Sector should be encouraged so as to enable institutions improve on their instructional abilities and skills that are related to informal labour markets. | 3 |

## Chapter Summary

In this chapter, the researcher presented the data that were gathered from an analysis of selected competency lists of nine different occupations and the results of two small focus group sessions. The following are the highlights of the data:

1. The cluster of Mechanical Engineering programs had the highest average of portable technical skills, which was 465, followed by Electrical Engineering at 338, and then Construction with an average of 259 portable technical skills between pairs of occupational areas. The correlation of skills within the cluster of construction programs indicated that although Building, Carpentry and Joinery, and Painting, Decoration, and Graphics (PDG) are in the same cluster of programs, their competence lists showed that the three occupational programs had very little in common.

2. Out of a sample of 676 portable skills, there were 152 skills that were portable across all occupations. A comparison of each occupational area with occupational areas outside its cluster generated twenty-seven pairs that were analyzed to determine portability of skills across clusters. The pairs were ranked according to strength of correlation. The pair with the highest number of portable skills (i.e. which had the strongest correlation) was Electrical Craft and Metal Fabrication, sharing 387 portable skills. The pair with the weakest correlation was Building and Electronic Systems Maintenance (ESM), with 176 portable technical skills.

3. According to instructors, the most important benefit of portable technical skills is that such skills facilitate students' multi-skilling because students wishing to learn additional trades will only have to focus on the non-portable skills because they will already have learned the portable skills relevant to the new trade. Employers confirmed that portable technical skills have long been used effectively and efficiently in the Informal Micro-Enterprise sector and

recommended that the development of entrepreneurship skills should be enhanced in order to prepare graduates for a wider range of jobs and future personal developments.

## CHAPTER 5- CONCLUSIONS, DISCUSSION, AND RECOMMENDATIONS

As stated in the preceding chapters, the objective of the study was to compare and contrast the competency lists of nine occupations to identify common portable technical skills within and across the career clusters of the nine occupations. The study sought to answer the following questions:

1. What portable technical skills exist within each of the occupational clusters listed below?
    a. Construction Occupational Cluster
        i. Building Construction (i.e., Masonry)
        ii. Carpentry and Joinery
        iii. Painting, Decoration, and Graphics
    b. Electrical Engineering Occupational Cluster
        i. Electrical Craft
        ii. Electronic Systems Maintenance
        iii. Telecommunications Repair
    c. Mechanical Engineering Occupational Cluster
        i. Fitting
        ii. Machining
        iii. Metal Fabrication
2. What skills do the selected technical occupations have in common across their occupational clusters?
3. What are occupational instructors' perceptions of the classroom implications of the identified portable technical skills?
4. From the point of view of employers, what are the labor market implications of the identified portable technical skills?

In this chapter, the author presents conclusions, discussions, and recommendations for practice and future study.

## Conclusions

The following conclusions can be drawn from the data presented in chapter 4 of this study:

1. **Portability of technical skills within occupational clusters**: There were many portable technical skills within clusters of technical training occupations. The number of skills that were portable from one trade to another within a given occupational cluster varied from one cluster to another.

Within the cluster of construction occupations comprising Building; Carpentry and Joinery; and Painting, Decoration, and Graphics (PDG), the pair with the largest number of portable skills between them was Building and Carpentry and Joinery, which shared 285 portable skills. The pair with the least number of portable skills was Carpentry and Joinery and PDG, which had 238 portable skills between them. The data indicate that it should be possible to design common units of study for the occupations in this cluster. The data also indicate that graduates of construction programs have some skills in common, which they could apply if they chose to migrate from the occupation of their specialization to either of the other occupations. However, graduates from the Building program wishing to change to Carpentry and Joinery and vice versa would have an advantage over those from PDG wishing to make a similar change of occupations because PDG graduates have the fewest portable skills relevant to the other two occupations. Graduates from Building and Carpentry and Joinery have more skills in common with each other than they have with those in PDG. Because PDG did not have strong correlation with other occupations, a PDG graduate transferring to another occupation would require a considerable re-skilling. Similarly, a graduate of another occupational program wishing to

transfer to PDG would have little prior knowledge on which to build in order to cope with the job.

In the electrical engineering cluster comprising Electrical Craft, Electronic Systems Maintenance, and Telecommunications Repair, there is high portability of technical skills between all combinations of pairs. This indicates that designing common units of study for occupations in this cluster is possible. It also indicates that graduates transferring from one occupation to another within the cluster would move with many technical skills from their primary occupations to any of the other two occupations.

Mechanical engineering occupations had the highest number of portable technical skills, with an average of 465 portable technical skills shared by any cluster would be very advisable. The data also indicate that graduates wishing to transfer from their primary occupations to either of the other two occupations would move with many technical skills to their new occupations.

2. **Portability of technical skills across occupational clusters**: There were some skills that were relevant to all programs across all clusters. Furthermore, some occupations had more skills in common with occupations outside their clusters than they had with occupations within their own clusters. In the data, there was evidence of portability of skills across clusters. There were some skills that were portable across all clusters. For instance, the following skills were common among all programs: *observing safety, preparing occupational accident reports, care of hand tools, use of personal computers, entrepreneurial skills, and communication skills.*

From the data, it can be noted that some occupations have stronger relationships with occupations outside their own clusters than they had within the clusters. For instance, within the construction cluster, the lowest number of portable skills that Carpentry and Joinery had with another occupation (PDG) was 238. However, outside its cluster, Carpentry and Joinery had 283

portable skills in common with Electrical Craft. Similarly, within its own cluster, Electrical Craft had 337 skills in common with Telecommunications Repair and 319 skills in common with Electronic Systems Maintenance. However, in terms of portability across clusters, Electrical Craft had the following numbers of portable skills:

- 387 with Metal Fabrication;
- 367 with Fitting; and
- 359 with Machining.

The data suggest that it is possible to design common core units that can be taken by students from all occupations. The data also indicate that there are opportunities for occupational mobility across occupational clusters, using portable skills as leverages. For instance, a graduate of Carpentry and Joinery has a good number of portable skills with which to transfer to mechanical engineering occupations. Examples of such skills include operation of workshop machines, care and use of hand tools, and workshop safety. Similarly, a graduate of Electrical Craft transferring to Metal Fabrication will carry a large number of skills relevant to the new trade. The skills include: *setting up and carrying out maintenance of oxy-fuel welding equipment, repairing of electrical components, distinguishing between ferrous and non ferrous metals, soldering, and brazing.*

3. **Instructors' perceptions of portable technical skills:** According to the data, instructors identified three main implications of portable technical skills. First, portable technical skills could be used as a foundation for multi-skilling. Second, awareness of the existence portable technical skills could encourage harmonization of syllabi and curricula of different occupations. Third, the existence of portable technical skills would allow a common approach of delivery where these portable skills could be delivered by one instructor/lecturer to all the

different groups whilst the others concentrate on other duties. From the data collected during the focus group discussion with instructors, it can be concluded that the subject of portable technical skills has classroom implications.

4. **Employers' perceptions of portable technical skills.** Employers identified three key points about portable technical skills. In the Informal Micro-Enterprise (IME) sector, portable technical skills were being used effectively and efficiently. However, there was need to enhance the development of entrepreneurship skills in order to prepare graduates for a wider range of jobs and future personal developments. Employers' second point was that training institutions should design and conduct short training programs focusing on portable technical skills to give graduates the flexibility and adaptability needed in informal sector industries. The final point noted by employers was that training programs offered at present were not responsive to the needs of the Informal Micro-Enterprise sector, and, therefore, promotion of linkages between training providers and the Informal Sector should be encouraged so as to enable institutions improve on their instructional abilities and skills that are related to the needs of the IME sector. From the data collected from the focus group discussion with employers, it can be concluded that the topic of portable technical skills is important to employers because of the benefits to the IME sector.

## Discussion

The theme of this dissertation concerns one major issue affecting workforce development in developing countries, namely striking a healthy balance between the supply and demand of labor. One of the challenges noted in the literature on workforce development is that in the wake of globalization and rapid technological change, the shift from supply- to demand-driven training is made difficult by the constant transformation of occupations. This challenge is not only

peculiar to the developing world. According to Darling-Hammond (2010), workforce development systems even in the developed world have the unenviable task of preparing "students to work at jobs that do not yet exist, creating ideas and solutions for products and problems that have not yet been identified, using technologies that have not yet been invented" (p.2). The challenge is, however, greater in vulnerable economies than it is in high income countries.

One of the factors that disadvantage workforce development systems in developing countries include the high cost of technical and vocational education and training (TVET). In many developing counties, financing of TVET is a challenge because costs of training inputs are higher in TVET institutions than in primary and secondary schools. TVET programs tend to have smaller student-to-teacher ratios, expensive training equipment, and costly training materials that are used during practical lessons (African Union, 2007). Despite the higher unit costs of TVET programs, public funding to TVET is too little. For developing countries, which cannot afford to have training programs for all permutations of occupational competences required by the labor market, one option is to develop a flexible workforce through putting much emphasis on portable technical skills. As Estevez-Abe, Iverson and Soskice (2001, p.7) observed, "highly portable skills are less risky than highly specific skills."

This study identified 676 portable technical skills. Out of this number, 142 portable technical skills were found to be relevant to all the nine programs comprising the corpus of this study. Portability of technical skills within clusters was very high in mechanical engineering occupations. For instance, Fitting and Machining had as many as 504 portable technical skills between them. This result, the detail of which is in Appendix D, is significant for two reasons. First, it confirms the existence of portable technical skills. This is important because in the

literature on workforce development, very little has been done to prove the existence of portable technical skills although much has been done to identify soft skills (which only tell one part of the story). Second, the result of this study is important because the usefulness of portable technical skills has been affirmed by both instructors and employers, representing the supply side and the demand side of workforce development in a developing country.

One key implication of portable technical skills on the supply side of workforce development is that the existence of portable skills allows a common approach of delivery where these portable skills can be delivered by one instructor/lecturer to all the different groups while the others concentrate on other duties. Portable technical skills could be the bases for designing common core units bringing together students and faculty from different disciplines. Appendix D could be used as a resource from which to draw competencies that are portable within and across occupational clusters. Another application of this study is that regardless of their different academic departments, instructors could jointly plan the teaching of a unit or units of portable technical skills (e.g., workshop safety), team-teach the unit or units, and assess their students jointly.

Another key implication of the results of this study from the perspective of training providers is that awareness of portable skills can facilitate harmonization of syllabi and curricula of different courses. As a result of working together through the activities of this study, instructors who participated in the validation of competency lists and in focus group discussions must have seen that despite the many skills that their different syllabi and curricula have in common, their syllabi and curricula have some unnecessary differences. When instructors are drawn by portable skills to work together, they are likely to harmonize their syllabi and curricula

to facilitate collaboration among themselves and articulation among their programs to accommodate mobility of students across trades.

From the demand side of workforce development, employers that participated in this study confirmed that portable technical skills are important, particularly in the IME sector. By definition, the IME sector is identified, inter alia, by the small size of the workforce (Haan, 2006). Because of the size of the workforce, employers want to hire workers who are flexible and adaptable enough to cross occupational boundaries and carry out tasks outside their primary occupational areas. It is advantageous, for example, for a welder to also know how to repair and maintain the welding equipment. Apart from the obvious fact that a flexible and adaptable workforce helps reduce the wage bill, there is evidence that "when work boundaries are crossed, shared, merged, or eliminated, new opportunities for innovation arise" (Burleson et al., 1998, p. 480). Innovation gives an enterprise a competitive edge.

Employers in the focus group recommended that training institutions should foster closer ties with the Informal Micro-Enterprise sector in order to ensure relevance of training programs to the labor market. According to employers, training programs in TVET colleges are not responsive to the needs of the Informal Micro-Enterprise sector both in terms of the methodologies used and the content of the programs.

These perceptions of employers are consistent with what some studies have found with regard to training for the informal sector. For instance, Haan (2006) noted that:

> By all accounts the technical and vocational education and training (TVET) sector in Africa has so far paid little, if any, attention to the skills needs of informal sector operators. Various studies have pointed out that training provided by the public sector, apart from being generally inefficient and ineffective, is hardly relevant for those

> working in the informal micro-enterprise sector… The International Labor Organization (ILO) was one of the first to place emphasis on the need of relevant skills training for those working in the informal sector. (p. 5)

In developing countries, concerns raised about lack of support to the IME sector deserve attention because, as many authors have pointed out, the sector employs a big proportion of the labor force (Ayyagari, Beck, & Demirguc-Kunt, 2003; Liedholm, 2001; Liedholm, McPherson, & Chuta, 1994). It is estimated that the IME sector contributes 78% to non-agricultural employment in Africa (Haan, 2006). This statistic shows why the subject of portable technical skills is of particular significance to the clients and suppliers of skills training in developing countries. More than half of the students enrolled in TVET programs will be employed in the IME sector where employees are expected to have portable technical skills that will make them flexible enough to carry out tasks outside their primary trade.

## Recommendations

The recommendations presented below are addressed to Zambian TEVET policy makers at national and local levels. This is because the data for this study were based on competency lists from Zambia's TEVET system and the focus group discussions were conducted with Zambian participants. The recommendations could, however, be relevant to vocational education and training policy makers of other countries with similar occupational training programs to those discussed in this study. Arising from the findings of the study, the following recommendations are made:

1. As Shulman (1993) and Palmer (1998) observed, one characteristic of the teaching profession is solitude. Teachers tend to work in isolation as individuals, unlike other professionals, such as surgeons, who work in teams for purposes of best results through

collaboration, cooperation, and peer monitoring. This study has shown that different occupations have a lot of similarities in content. The researcher, therefore, recommends that colleges should develop policies that foster teamwork among instructors. The necessary policy instruments include inducements, system changing, and capacity building (McDonnell & Grubb, 1991). Inducements do not need to be monetary. They could take the form of special recognition, in the college newsletter, of instructors whose results have improved as a result of teamwork. The results could be measured by savings made on resources, or students' achievements scores. An example of a system changing policy instrument is the redesigning of course structures by introducing common core classes based on portable technical skills provided in Appendix D. Instead of every academic section running teaching workplace safety or hand tools, for example, a common core class for all the sections could offer the course and the instructors could share topics or team teach. The capacity building policy instrument could take the form of professional development programs enabling instructors and administrators to acquire skills for creating and maintaining the culture of team work, including joint planning of courses, joint delivery of lessons, joint assessment of students, and joint reflection/evaluation of their work.

2. As pointed out by employers who participated in the focus group discussions of this study, colleges should strengthen their linkages with employers to ensure relevance of training programs to the skills needs of the labor market. The linkages could be strengthened by establishing course advisory committees at local level comprising employer representatives and instructors. The advisory committees could provide advice on local curriculum design, student assessment, certification, and placement. For example, the suggestion by employers that colleges should design short intensive courses based on portable skills could be implemented in close consultation with course advisory committees.

3. Employers who participated in this study noted that formal training institutions are not responsive to the needs of the Informal Micro-Enterprises. It is, therefore, recommended that formal training institutions should work closely with Informal Micro-Enterprises and offer training programs that meet the needs of the informal sector. The training programs should include short intensive courses based on portable technical skills. Furthermore, it is recommended that training providers should enhance their entrepreneurship development programs to prepare students for a wide range of jobs and for self-employment.

## Recommendations for Further Studies

1. This study was based on a sample of three occupational clusters and nine occupations. From the findings of this study, the researcher recommends that similar studies should be done with other clusters and occupational programs to determine the full extent of portable technical skills among TEVET programs. The researcher further recommends that follow up studies should be based on competency lists from developed economies such as the United States, the United Kingdom, and Japan to determine whether the phenomenon of portable technical skills is common in industries worldwide.

2. As pointed out in chapter 3, the researcher's intention was not to determine what competencies to include in a generic course, but rather what competencies are portable and the degree of their portability. It is, therefore, recommended that a study should be conducted to determine the competencies that could be included in a generic course based on the portable technical skills identified in this study.

3. When a new curriculum based on portable technical skills is implemented, it is recommended that a follow-up study should be done to determine the achievements and challenges of inter-disciplinary collaboration.

## Concluding Remarks

The researcher hopes that training providers will find this study as useful as the principal who hosted the focus groups of this study did. The principal remarked that:

> As for my comment on the whole exercise, I have found it very educative. It has revealed some of the things that we were not aware of, i.e. the similarities of the portable skills across the courses. The study provides a platform for effective planning of the delivery of various training modules for all the courses, taking into consideration the portable technical skills. The study also gave us an opportunity to learn from people in industry how useful the portable technical skills are, especially for the formal sector which now in Zambia has become a big force to reckon with. All in all, it has been an eye opening exercise, very relevant to training and industry and I hope that this can be further developed into a working platform (A.K. Sayila, personal communication, February 21, 2012).

## REFERENCES


Akyeampong, A. K. (2002). *Vocationalization of secondary education in Ghana: A case study.* Paper prepared for Regional Vocational Skills Development Review Human Development Africa Region World Bank. Retrieved from http://siteresources.worldbank.org/INTLM/214578-1103217503703/20295552/VETGhana.pdf.

Asmus, C. L., & James, K. (2005). Nominal group technique, social loafing, and group creative project quality. *Creativity Research Journal*, *17*(4), 349-354. doi:10.1207/s15326934crj1704_6.

Atchoarena, D. &Delluc, A. (2002). *Revisiting technical and vocational education in Sub-Saharan Africa: An update on trends, innovations and challenges. New trends in technical and vocational education.* Retrieved from ERIC database.

Ayyagari, M., Beck, T., & Demirguc-Kunt, A. (2003). Small and medium enterprises across the globe: A new database. *World Bank Policy Research Working Paper*. Washington, DC: The World Bank.

Bell, D. (1990). Down to business in the classroom. *Canadian Business*, *63*(5), 19. Retrieved from Business Source Complete database.

Bogdan, R. C., &Biklen, S. K. (1982). *Qualitative research for education: An introduction to theory and methods*. Boston: Allyn and Bacon.

Borrego, M., Douglas, E. P., &Amelink, C. T. (2009). Quantitative, qualitative, and mixed research methods in engineering education. *Journal of Engineering Education,98(1),* 53-66. Retrieved from EBSCOhost.

Buchanan, J., Briggs, C., Considine, G., Schifield, K., & McIntyre, P. (2000). *Vocational education and training and the changing nature of work: An overview of work in progress*. Sydney, Australia: Board of Vocational Education and Training.

Burleson, R. C., Haas, C. T., Tucker, R. L., & Stanley, A. (1998). Multiskilled labor utilization strategies in construction. *Journal of Construction Engineering and Management, 124(6), 480–489JCEMD4000124000006000480000001*. [CEDB]JCEMD4000124000006000480000001[ISI]

Callan, V., & Ashworth, P. (2004). Working together: Industry and VET provider training partnerships. National Centre for Vocational Education Research *(NCVER)*. Retrieved from ERIC database.

Castiglioni, A., Shewchuk, R. M., Willett, L. L., Heudebert, G. R., & Centor, R. M. (2008). A pilot study using nominal group technique to assess residents' perceptions of attending rounds. *JGIM: Journal of General Internal Medicine*, *23*(7), 1060-1065. doi:10.1007/s11606-008-0668-z.

Castrol, C. M. (2000). V*ocational training at the turn of the century*. Frankfurt, Germany: Peter Lang.

Chappell, C. (2003). Researching vocational education and training: Where to from here? *Journal of Vocational Education and Training*, 55(1). 21-32

Clark, R., &Chopeta, L. (2004). Graphics for learning: Proven guidelines for planning, designing, and evaluating visuals in training materials. 989 Market Street, San Francisco, CA: Jossey-Bass/Pfeiffe.

Cohen, M., &Besharov, D.J. (2002). *The role of career and technical education: Implications for the federal government.* Washington DC: Office of Vocational and Adult Education (ED) Retrieved from http://www.gpoaccess.gov/eric/200302/ed466939.pdf

Cooke, F. (2005). Vocational and enterprise training in China: Policy, practice and prospect. *Journal of the Asia Pacific Economy,10* (1) 26 - 55 doi: 10.1080/1354786042000309062.

Contact Management Services CMS). (2008). A *tracer study of the graduates for the years 2004, 2005 and 2006*. Lusaka, Zambia: Ministry of Science, Technology and Vocational Training.

Curtis, D. (2004). The assessment of generic skills. In Gibb, J. (Ed.). *Generic skills in vocational education and training: Research readings*. pp. 136-156. Adelaide: Australian Training Authority.

Darling-Hammond, L. (2010). *The flat world and education: How America's commitment to equity will determine our future*. New York: Teachers College, Columbia University Press.

Dewey, J. (1916). *Democracy and education*. New York: Free Press.

Downes, A. S. (2006). *Best practices of public-private partnerships on education and skills training in the Caribbean*. Barbados: University of West Indies.

Drost, W. H. (1977). Social efficiency reexamined: The Dewey-Snedden controversy. *Curriculum inquiry. 7(1),* 19-32.

Estevez-Abe, M., Iversen, T., & Soskice, D. (2001). *Social formation and the formation of skills: A re-interpretation of the welfare state.* Oxford: Oxford Scholarship Online Monographs. Retrieved from http://www.people.fas.harvard.edu/~iversen/PDFfiles/Estevezetal.pdf

Farrell, D., Labassire, M. A., & Rosenfeld, J. (2005). *Sizing the emerging global labor market: Rational behavior from both companies and countries can help it work more efficiently*. New York: McKinsey & Company. Retrieved from http://www.mickeybutts.com/globallaborsupply.pdf

Freebody, P. (2003). *Qualitative research in education: Interaction and practice*. London: Sage Press.

Gagel, C. (1997). Literacy and technology: Reflections and insights for technological literacy. *Journal of Industrial Teacher Education,34*(3), 6-34.

Galhardi, R. (2002). *Financing training: Innovative approaches in Latin America.* Paper prepared for the International IVETA 2002 Conference, Port Louis, Mauritius, 20–24 July, 2002. Retrieved from http://www.ilo.org/wcmsp5/groups/public/---ed_emp/---ifp_skills/documents/publication/wcms_103994.pdf

Gelo, O., Braakmann, D., & Benetka, G. (2008). Quantitative and qualitative research: Beyond the debate. *Integrative Psychological & Behavioral Science*, *42*(3), 266-290. doi:10.1007/s12124-008-9078-3.

Gibb, J. (2003). *What impact is implementing a quality system having on the vocational education and training classroom?* Leabrook, Australia: National Center for Vocational Education Research (NCVER).

Gordon, H. R. D. (2008). The *history and growth of career and technical education in America*. Long Grove, IL: Waveland Press.

Gunter, H. (2008). Policy and workforce reform in England. *Educational Management Administration and Leadership*, *36*(2), 253-270. Retrieved from ERIC database.

Haan, H.C. (2006). *Training for work in the informal sector: New evidence from the Eastern and Southern Africa.* Turin: International Center of the ILO.

Hager, P. (1997). *Learning in the workplace.* Leabrook, Australia: Australian National Training Authority.

Hailikari, T., Katajavuori, N., & Lindblom-Ylanne, S. (2008). The relevance of prior knowledge in learning and instructional design. *American Journal of Pharmaceutical Education, 72(5),* 1-8.

Henning, G. (1986). Quantitative methods in language acquisition research. *TESOL Quarterly*, *20*(4), 701-708. Retrieved from EBSCO*host*.

Hoepfl, M. C. (1997). Choosing qualitative research: A primer for technology education researchers. *Journal of Technology Education, 9*(1), 47-63. Retrieved from http://scholar.lib.vt.edu/ejournals/JTE/v9n1/pdf/hoepfl.pdf

Holmes, K. (2009). The reform and governance of public TVET institutions: Comparative experiences. In R. Maclean, D. Wilson (eds.), *International handbook of education for the changing world of work*. (pp. 905-919). doi: 10.1007/978-1-4020-5281-1 VI.3.

International Labor Organization. (2007). *Portability of skills.* Committee on Employment and Social Policy, GB.298/ESP/3. 298th Session. Retrieved from http://www.ilo.org/public/libdoc/ilo/GB/298/GB.298_ESP_3_engl.pdf

Jelas, Z., &Azman, N. (2005). Generic skills provision in higher education. *International Journal of Learning, 12(5),* 199-210. Retrieved from http://search.ebscohost.com.

Kazmi, S. W. (2007). Vocational education and skills development: A case of Pakistan. SAARC *Journal of Human Resource Development, 3,* 105-117.

Kemal, A. R. (2005). Skills development in Pakistan. *The Pakistan Development Review44* (4), 349-357.

Kennedy, A., & Clinton, C. (2009). Identifying the professional development needs of early career teachers in Scotland using nominal group technique. *Teacher Development, 13*(1), 29-41. doi:10.1080/13664530902858485.

Kim, Y. H. (2002). A state of art review on the impact of technology on skill demand in OECD countries. *Journal of Education and Work*, *15*(1), 89–109.

Kis, V. and Field, S. (2009). *Learning for jobs OECD reviews of vocational education and training Chile: A first report*. Retrieved from http://www.oecd.org/dataoecd/33/13/44167258.pdf

Kristofco, R., Shewchuk, R., Casebeer, L., Bellande, B., & Bennett, N. (2005). Attributes of an ideal continuing medical education institution identified through nominal group technique. *Journal of Continuing Education in the Health Professions, 25*(3), 221-228. Retrieved from EBSCO*host*.

Krueger, R., & Casey, M. A. (2000). *Focus groups: A practical guide for applied research* (3rd edition). Thousand Oaks, California: Sage.

Krueger, R.A. (1994). *Focus groups: A practical guide for applied research.* Thousand Oaks, California: Sage.

Labaree, D.F. (2008). How Dewey lost: The victory of David Snedden and social efficiency in the reform of American education. Paper prepared for presentation at conference on "Pragmatism as the reticule of modernization: Concepts, contexts, critiques", Centro Stefano Franscini, Monte Verita, Ascona, Switzerland, September, 2008.

Lanka, A. & Murnieks, E. (2006). Vocational education and training in Latvia: Problems and solutions. In Bunning, F. (ed.) *The transformation of VET in the Baltic states,* 47-68. The Netherlands: Springer.

Lauglo, J. (2009). Vocationalized secondary education. In R. Maclean, D. Wilson (Eds.), *International handbook of education for the changing world of work*. (pp. 2295-2312). doi:10.1007/978-1-4020-5281-1 XIII.7, C _

Lerman, R. I. (2008). Are skills the problem? Reforming the education and training system in the United States. W.E. Upjohn Institute for Employment. Retrieved from http://www.upjohninst.org/publications/books/fgj/ch2_lerman.pdf.

Liedholm, C. (2001). *Small firm dynamics: Evidence from Africa and Latin America*. Washington, DC: The World Bank.

Liedholm, C., McPherson, M., & Chuta, E. (1994). Small enterprise employment growth. *American Journal of Agricultural Economics, Vol. 76*.No.5, 1177-1182

Lill, I. (2009). Multiskilling in construction: A strategy for stable employment. *Technological and Economic Development of Economy 15*(4), 540–560.

Ljungberg, M., & Douglas, E. P. (2008). State of qualitative research in engineering education: Meta-analysis of JEE articles, 2005-2006. *Journal of Engineering Education, 97*(2), 163-175. Retrieved from EBSCO*host*.

Mackenzie, J. & Polvere, R. (2009). TVET glossary: Some key terms. In R. Maclean and D. Wilson, (Eds.), *International handbook of education for the changing world of work*. (pp. 59-76). Springer Science + Business. Retrieved from http://www.springerlink.com/content/n360231426668287/fulltext.pdf

MacPhail, A. (2001). Nominal group technique: A useful method for working with young people. *British Educational Research Journal, 27*(2), 161-170. doi:10.1080/01411920120037117.

Markes, I. (2006). A review of literature on employability skill needs in engineering. *European Journal of Engineering Education, 31*(6), 637–650.

Mayen, G. (ed.) (2006). *Technical and vocational education and training in Jordan: Areas for development cooperation*. Luxemburg: European Communities. Retrieved from http://213.215.218.75/pubmgmt.nsf/(getAttachment)/ACE62B7AC28F6695C1257218005884B3/$File/NOTE6V4LW5.pdf

McDonnell, L.M. & Grubb, W.N. (1991). *Education and training for work. The policy instruments and institutions*. Berkeley, CA.: University of California.

Middleton, J., Ziderman, A., & Adams, A. V. (1993). *Skills for productivity: Vocational education and training in developing countries.* New York: Oxford University Press.

Ministry of Foreign Affairs, Danida. (2002). *Evaluation of Danish assistance to vocational education and training. Annex VIII - Zambia Country Report*. Retrieved from: http://www.um.dk/publikationer/danida/english/evaluations/vocationaleducationtraining/annex_8_vet_zambia.pdf

Morgan, D. L. (1997). *Focus groups as qualitative research*. Thousand Oaks, CA: Sage

Mounier, A. (2001). *The three logics of skills in French literature.* Sydney: NSW Board of Vocational Education and Training. Retrieved from http://www.bvet.nsw.gov.au/pdf/threelogics.pdf

Mupinga, D. M., Busby, J. R., & Ngatiah, J. (2006). Postsecondary technical and vocational institutions in Kenya: needs and challenges. *International Journal of Vocational Education And Training*, *14*(1), 21-35.

Mustapha, R. (2004). Workforce education and development in East Asia and the Pacific. In J. W. Rojewisk, *International perspectives of workforce education and development.* Greenwich, CT: Information Age.

Mutula, S., Molefe, C., & Rathapo, S. (2004). Information for the vocational education and training Sector in Botswana. *Information Development*, *20*(1), 51-60. doi:10.1177/0266666904043801.

Ministry of Science, Technology and Vocational Training (MSTVT). (1996). *Technical education, vocational and entrepreneurship training (TEVET) policy.* Lusaka: Government of the Republic of Zambia.

MSTVT/Central Statistical Office (CSO). (2008). *National skills survey 2008: A baseline survey on the status of skills in the Zambian labor market.* Lusaka, Zambia: Ministry of Science, Technology and Vocational Training.

Noue, D.L. (2010). *Hard skills*. Retrieved from: http://www.bmcc.cuny.edu/ce/upload/Hard_Skills.pdf

Oketch, M. O., Green, A. & Preston, J. (2009). Trends and issues in TVET across the globe. In R. Maclean, D. Wilson (Eds.), *International Handbook of Education for the Changing World of Work*, (pp. 2081-2093). doi: 10.1007/978-1-4020-5281-1 XII.5.

Orkodashvili, M. (2008). *Investment in human capital: Vocational vs academic education*. Munich Personal RePEC. Retrieved from http://mpra.ub.uni-muenchen.de/16558/

Overtoom, C. (2000). Employability skills: An update. *Eric Digest No. 220*. Retrieved from http://www.brownfields-toolbox.org/files/employability_skills.pdf

Palmer, P.J. (1998). *The courage to teach: Exploring the inner landscape of a teacher's life.* San Francisco: Jossey-Bass Publishers.

Patton, M. Q. (2002). *Qualitative research & evaluation methods (3rd ed.)*. Thousand Oaks, CA: Sage Publication.

Pavlova, M. (2009). The Vocationalization of secondary education: The relationships between vocational and technology education. In R. Maclean and D. Wilson (Eds.), *International handbook of education for the changing.world of work*. (pp. 1805-1821). doi: 10.1007/978-1-4020-5281-1 X.17.

Peano, S., Vergel de Dios, B., Atchoarena, D., & Mendoza, U. (2008).*Investment in technical and vocational education and training (TVET) in the Philippines*. Paris: UNESCO.

Phillips, C. & Bhatia-Panthaki, S. (2007) Enterprise development in Zambia: Reflections on the missing middle. *Journal of International Development 19(6):* 793–804.

Posavac. J. E. & Carey. G. R. (2007). *Program evaluation: Methods and case studies.* Upper Saddle River, NJ: Prentice Hall.

Price, W.T. (1985). The nominal group technique: A needs assessment methodology for vocational education. *Journal of Vocational Education, 2*(1), 11-24.

Robinson, J.P. (2000). What are employability skills? *Alabama Cooperative Extension System, 1*(3), 1-3. Retrieved from http://www.dillonatech.com/logon/employability-skills.pdf

Results Oriented Results Utilization Management (RORUM). (2007). *Study on needs and demands for labor market and the capacity of the TEVET system to address these needs and demands. Final report submitted by Results Oriented Results Utilization and Management* Ltd. Lusaka, Zambia: International Labor Organization.

Rossman, G., & Rallis, S. (2003). *Learning in the field: An introduction to qualitative research.* (2nd ed.). Thousand Oaks, CA: Sage.

Shulman, L. (1993). *Teaching as community property*. Princeton, NJ: Carnegie Foundation for the Advancement of Teaching.

Siriwardene, L. & Qureshi, M.A. (2009). TVET in the Asian region: Issues, concerns and prospects. In Maclean.R. & Wilson, D. (eds.) *International handbook of education for the changing world of work*. (pp. 547-564). Springer Science + Business. Retrieved from http://www.springerlink.com/content/h75l61v21n413553/fulltext.pdf

Strauss, A., & Corbin, J. (1990). *Basics of qualitative research: Grounded theory procedures and techniques*. Newbury Park, CA: Sage Publications.

Taylor-Powell, E., & Renner, M. (2003).*Analyzing qualitative data*. Retrieved from http://learningstore.uwex.edu/pdf/G3658-12.pdf

Tuck, R. (2007). *An introductory guide to national qualifications frameworks: Conceptual and practical issues for policy makers*. Geneva: International Labour Organization.

Van der Heijden, B. (2002). Prerequisites to guarantee life-long employability.*Personnel Review. 31*(1). 41-61. ISSN: 0048-3486.

Van Maanen, J. (1983). *Qualitative methodology*. Beverly Hills, CA: Sage Publications.

Tyack, D. (1974). *The one best system.* Cambridge, MA: Harvard University Press.

UNESCO. (2005) Vocational education: The comeback. *Newsletter* No. 13,April-June, 2005. Retrieved from: http://unesdoc.unesco.org/images/0013/001394/139459e.pdf

Wiersma, W. (1995). *Research methods in education: An introduction* (6th edition). Boston, MA: Allyn & Bacon.

Young, M. (2005). *National qualifications frameworks: Their feasibility for effective implementation in developing countries*. Geneva: International Labour Office.

Ziderman, A. (2003). *Financing vocational training in Sub-Saharan Africa*. Washington, DC: World Bank.

## Appendix A

## Guidelines for Facilitator

## Validation of List of Portable Technical Skills

1. **Selection of instructors**

   Instructors selected to validate the list of portable technical skills must meet the following criteria:

   (a) Must be either a full-time or part-time, or retired teacher on your program or a program offered by another institution. In the event that your institution does not have a suitable person, you may request for a suitable person from another institution.

   (b) Must have taught for at least two years;

   (c) Must have a teaching certificate;

   (d) Must have a minimum of a crafts certificate in their occupational program of instruction

2. **Objective of validation**

   The objective of the validation is to ensure that the competencies are correctly stated and accurately capture the technical skills that occupations have in common

3. **Materials**

   Each instructor should be given the following materials:

   (a) List of portable technical skills; and

   (b) Competency list of the occupation taught by the instructor (if the instructor does not have a copy already);

   (c) Information sheet marked Appendix B, giving instructions to the instructor

**4. Outputs**

(a) Instructors will work individually to validate the lists and then submit their comments to you. You will then send the instructors comments to me as email attachments.

(b) The following information about each of the nine instructors should be submitted to me together with the instructors' comments:

i. Instructor's initials (no name)

ii. Occupational program taught;

iii. Qualification;

iv. Years of experience as an instructor

**Focus Groups**

**1. Selection of participants**

You will convene two meetings. One meeting will be for instructors and the second meeting will be for a group comprising at least seven employer representatives. The following criteria will be used for selecting the participants:

(a) Instructors:

All the nine instructors participating in the validation of the list of portable technical skills will also participate in a focus group meeting

(b) Employer representatives

Employers must be from an informal or formal enterprise employing TVET graduates who include those from the nine different occupations comprising the sample of this study. At least one instructor identified by the principal from the group of instructors participating in the validation of the portable technical skills should attend the employers' focus group discussion.

**2. Objective of focus groups**

The objective of the meetings is to determine participants' perceptions of the implications of portable technical skills

**3. Materials**

Each participant should be given the following materials:

(a) List of portable technical skills; and

(b) Information sheet marked Appendix B (for instructors) and Appendix C (for heads of section and employer representatives).

**4. Procedure of the meetings**

You will use the nominal group technique in both meetings. The procedure will be as follows:

(a) Introduction to session: The facilitator welcomes the members and explains the objectives and rules of the session. Members are assured that their individual views are going to be respected;

(b) Generation of ideas: After the clarification of the purpose and procedures of the meeting, participants are asked to independently write down their responses to the following question:

(For instructors) *In what ways can the list of portable technical skills that have been presented to you be used to enhance the quality of training provided for students at your institution?*

(For employer representatives) *In what ways can the list of portable technical skills that have been presented to you be used to respond to labor demands in your enterprise?*

(c) Round-robin listing: From the list that each member has written, members are asked to present one idea each, which is recorded by the facilitator on a flip chart. Participants take turns in giving one response at a time in round-robin fashion until all their responses are recorded verbatim on the chart. At this stage, there is no discussion of points or justifications for the responses;

(d) Clarifications of ideas: Once all the responses have been collected, the facilitator leads a discussion meant to clarify the responses recorded on the flip chart. The idea is to make sure that all the participants have understood the issues that are on the flip chart. It does not matter whether they agree with them or not; the important thing is to understand the issues.

(e) Prioritizing of items: Each participant is asked to select three of what they consider to be the most important justifications from the list recorded on the chart. They rank the three ideas in order of importance (3 = most important; 1 = least important). The voting is done anonymously. The ranks for each item are summed and the groups' mean score for each response is calculated. Each group session may last about two hours.

**5. Outputs**

(a) You will send to me minutes of both meetings; and

(b) You will also send the following information about participants:

i. Initials

ii. Qualifications;

iii. Years of experience

iv. Current position

## Appendix B

## Guidelines for Instructors

### Introduction

Have you ever wondered whether the skills that you teach your students can be used in careers other than those for which you are preparing them? Of course, related subjects such as trade math, science, communication skills, drawing, and use of computers are transferable from one occupation to another. However, setting aside these skills, to what extent are trade theory and practical skills transferable across occupations? That is the central question of this activity in which you have agreed to participate. You may wish to reflect on the importance of this question to you as a trainer, to the student, and to employers.

A list of portable technical skills has been developed from an analysis of task lists of the following occupations:

a. Construction Programs
   i. Building Construction
   ii. Carpentry and Joinery
   iii. Painting, Decoration, and Graphics
b. Electrical Engineering Programs
   i. Electrical Craft
   ii. Electronic Systems Maintenance
   iii. Telecommunications repair
c. Mechanical Engineering Programs
   i. Fitting
   ii. Machining

iii. Metal Fabrication

You have been requested to participate in this activity, which will have two parts. First, you will examine an inventory of portable skills given to you and verify that the skills relating to your program have been accurately identified from your task list. Secondly, you will participate in a nominal group technique (NGT) discussion with colleagues from other occupations.

1. **Verification**
2. 1.1 With reference to the table of portable skills given to you, look at the list of skills pertaining to your occupational program and check that:
   (a) Competencies are correctly stated;
   (b) The Xs represent the skills that your program has in common with at least one other occupational program;
   (c) The zeros correctly indicate skills that your program does not teach but are taught in other programs;

   1.2. Indicate the correction on the list by changing the competency, or replacing an X with a zero, or a zero with an X.

   1.3 Submit the corrected document to the Principal.

   1.4 Ensure that the correction is clear by using a red ink.

   1.5 If the list is correct as it is, please indicate that and still submit the document to the Principal.

**3. Nominal Group Technique (NGT) Discussion**

3.1 The Principal will convene a nominal group technique meeting to which he will invite you. The purpose of the discussion is to share views on the implications of the skills that your program has with your colleagues' programs. During the meeting, all views will be respected, so please feel free to express your opinion.

3.2 The meeting may take up to two hours.

3.3 The discussion will be based on the following question:

- *In what ways can the list of portable technical skills that has been presented to you be used to enhance the quality of training provided for students at your institution?*

3.4 The facilitator will record the following details about each participant:

- Initials only. No name
- Occupational Program taught;
- Qualification;
- Years of experience as an instructor.

3.5. During the meeting, the facilitator will give you more details about the NGT procedure.

## Appendix C

## Guidelines for Employers

### Introduction

In the literature on workforce development, a lot has been said about employability skills, or portable soft skills, such as teamwork, communication, problem solving, and creative thinking. However, very little mention has so far been made of portable technical skills (which are occupation-related skills such as operating a lathe machine, using percussion tools, and care of hand tools). These skills have enormous potential contribution to the discussion on responsiveness of technical colleges to the needs of the labor market. Responsiveness of workforce development to the labor market requires providers to expand their training portfolios by including all the different programs required by industry. For a developing country, such as Zambia which is the main beneficiary of this study, with inadequate training resources, this option is unaffordable. What would be more affordable would be to identify and teach portable technical skills which could be applicable to a range of occupational trades. A list of portable technical skills has been generated from an analysis of task lists of the following nine different occupations.

(a) Construction Programs

i. Building Construction

ii. Carpentry and Joinery

iii. Painting, Decoration, and Graphics

(b) Electrical Engineering Programs

i. Electrical Craft

ii. Electronic Systems Maintenance

iii. Telecommunications repair

(c) Mechanical Engineering Programs

i. Fitting

ii. Machining

iii. Metal Fabrication

You have been invited to participate in a nominal group technique (NGT) discussion to find out what your views are on portable technical skills. Please find attached a list of portable technical skills.

**Focus Group Discussion**

1. The Principal will convene an NGT meeting to which he will invite you.
2. The meeting may take up to two hours.
3. The discussion will be based on the following question:

   *In what ways can the list of portable technical skills that has been presented to you be used to respond to labor demands in your enterprise?*

4. The facilitator will give you details about the procedure to be used during the meeting;
5. The facilitator will record the following details about each participant:
   (a) Initials only, no name;
   (b) Occupation;
   (c) Qualification; and
   (d) Years of experience as a supervisor.

Thank you for agreeing to participate in this activity.

## Appendix D.
## Portable Skills Across Nine Occupations

| Skill Area | Competencies | OCCUPATIONS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | |
| | | Building | Carpentry | Painting | Electrical | Electronics | Telecom. | Fitting | Machining | Metal Fab. | |
| Workshop Safety | State possible accidents in a mechanical workshop | X | X | X | X | X | X | X | X | X | 100% |
| | Apply First Aid | X | X | X | X | X | X | X | X | X | 100% |
| | Carry out procedures for reporting and recording accident | X | X | X | X | X | X | X | X | X | 100% |
| | Demonstrate fire fighting and prevention | X | X | X | X | X | X | X | X | X | 100% |
| | Maintain a safe and clean workplace | X | X | X | X | X | X | X | X | X | 100% |
| | Use personal protective equipment (PPE) | X | X | X | X | X | X | X | X | X | 100% |
| | Observe safety signs and colors | X | X | X | X | X | X | X | X | X | 100% |
| | Observe electrical safety | X | X | X | X | X | X | X | X | X | 100% |
| | Observe safety in terms of gangways, lighting, ventilation and all unguarded parts of machinery | X | X | X | X | X | X | X | X | X | 100% |
| | Observe procedures for disposal of hazardous materials and for material storage | X | X | X | X | X | X | X | X | X | 100% |
| | Observe regulations relating to HIV/AIDS in the workplace | X | X | X | X | X | X | X | X | X | 100% |
| | Observe regulations relating to safety and gender issues | X | X | X | X | X | X | X | X | X | 100% |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab. | | |
| **Forging and Heat Treatment Practices** | Describe types of furnaces | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | | 33% |
| | Select appropriate furnaces for specific use | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | | 33% |
| | Use selected furnace to carry out forging | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | | 33% |
| | Select Forging Tools | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | | 33% |
| | Apply handling and lifting techniques | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | | 33% |
| | Explain heat treatment processes and procedures | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | | 33% |
| | Describe material properties before and after heat treatment | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | | 33% |
| | Describe heat treatment of forged components - forging temperatures and color coding | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | | 33% |
| | Interpret equilibrium diagrams in relation to structural changes in forged components | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | | 33% |
| | Interpret cooling curve diagrams in relation to heat treatment processes | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | | 33% |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab. | |
| **Forging and Heat Treatment Practices (Continued)** | Explain equilibrium diagram | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 33% |
| | Explain cooling curves | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 33% |
| | Observe operational safety | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 33% |
| **Engineering or Construction Materials** | Describe types of engineering materials | 0 | 0 | 0 | X | 0 | 0 | X | X | X | 44% |
| | Describe process of production of iron and Steel | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 33% |
| | Describe flat sheet and strip | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 33% |
| | Describe types of steel sections | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 33% |
| | Distinguish between ferrous and non ferrous metals | 0 | 0 | X | X | 0 | 0 | X | X | X | 56% |
| | Describe heat treatment | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 33% |
| | Demonstrate materials Identification | 0 | 0 | 0 | X | 0 | 0 | X | X | X | 44% |
| | Describe metal protection | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 33% |
| | Identify types of materials used in the building industry | X | X | X | 0 | 0 | 0 | 0 | 0 | 0 | 33% |

| Appendix D. Portable Technical Skills across Nine Occupations (Continued) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Skill Areas** | **Competencies** | **OCCUPATIONS** | | | | | | | | | | **% of skill incidence out of 9 occupations** |
| | | **Construction** | | | **Electrical Engineering** | | | **Mechanical Engineering** | | | | |
| | | **Building** | **Carpentry** | **Painting** | **Electrical** | **Electronic** | **Telecom** | **Fitting** | **Machining** | **Metal Fab.** | | |
| **Engineering or Construction Materials** | Identify classification of building materials | X | X | X | X | 0 | 0 | 0 | 0 | 0 | | 44% |
| | Describe composition and properties of building materials | X | X | X | X | 0 | 0 | 0 | 0 | 0 | | 44% |
| | Describe uses of materials | X | X | X | X | 0 | 0 | 0 | 0 | 0 | | 44% |
| **Fabricating Components** | Demonstrate laying out components | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | | 33% |
| | Describe template loft | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | | 33% |
| | Demonstrate setting out on the template loft | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | | 33% |
| | Demonstrate marking out on flat sheets or plates | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | | 33% |
| | Demonstrate making templates or card templates | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | | 33% |
| | Fabricate components within the drawing tolerances | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | | 33% |
| | Assemble components from the drawing | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | | 33% |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab | |
| **Equipment for Cutting, Forming, Drilling, and Bending Plates** | Describe types and uses of cutting machines | 0 | X | 0 | X | X | X | X | X | X | 78% |
| | Describe grinding machines | 0 | X | X | X | X | X | X | X | X | 89% |
| | Describe metal rolling machines | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| | Describe drilling machines | X | X | 0 | X | X | X | X | X | X | 89% |
| | Describe folding and bending machines | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| | Describe other forming machines | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| **Measuring Instruments** | State units of measurements | X | X | X | X | X | X | X | X | X | 100% |
| | Describe types and use of measuring tools | X | X | X | X | X | X | X | X | X | 100% |
| | State principles of measuring instruments | X | X | X | X | X | X | X | X | X | 100% |
| | Demonstrate use of measuring instrument | X | X | X | X | X | X | X | X | X | 100% |
| | Describe classification of workshop measurement errors | X | X | X | X | X | X | X | X | X | 100% |

| Appendix D. Portable Technical Skills across Nine Occupations (Continued) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Skill Areas** | **Competencies** | **OCCUPATIONS** | | | | | | | | | | **% of skill incidence out of 9 occupations** |
| | | **Construction** | | | **Electrical Engineering** | | | **Mechanical Engineering** | | | | |
| | | **Building** | **Carpentry** | **Painting** | **Electrical** | **Electronic** | **Telecom** | **Fitting** | **Machining** | **Metal Fab** | | |
| **Measuring Instruments (Continued)** | Demonstrate care and storage of measuring Instruments | X | X | X | X | X | X | X | X | X | | 100% |
| | Calibrate and zero measuring instruments | X | X | X | X | X | X | X | X | X | | 100% |
| | Explain sources of errors | X | X | X | X | X | X | X | X | X | | 100% |
| **Bench Work** | Explain types and uses of marking out tools | X | X | X | X | X | X | X | X | X | | 100% |
| | Explain types and uses of hand tools | X | X | X | X | X | X | X | X | X | | 100% |
| | Demonstrate care, storage and maintenance of marking out tools | X | X | X | X | X | X | X | X | X | | 100% |
| | Demonstrate care, storage and maintenance of hand tools | X | X | X | X | X | X | X | X | X | | 100% |
| | Observe safety procedures | X | X | X | X | X | X | X | X | X | | 100% |
| | Describe marking tools | X | X | X | X | X | X | X | X | X | | 100% |
| | Describe cutting tools | X | X | X | X | X | X | X | X | X | | 100% |
| | Describe drilling tools | X | X | 0 | X | X | X | X | X | X | | 89% |
| | Describe forming and other tools | 0 | X | 0 | X | X | X | X | X | X | | 78% |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab. | |
| **Performing Electric Arc Welding** | Explain safety rules and regulations | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| | Describe arc welding equipment | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| | Describe joint designs | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| | Demonstrate flat position welding | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| **Performing Gas Welding and Gas Cutting Operations** | Explain principles of Gas welding | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| | Explain principles of Gas cutting | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| | Explain history and future in Gas welding | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| | Observe safety | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| | Set up and carry out maintenance of Oxy-fuel Welding equipment | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| | Set up and carry out maintenance of Oxy-fuel Cutting equipment | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| | Describe classification of fuels | 0 | 0 | 0 | X | X | X | X | X | X | 67% |

| Appendix D. Portable Technical Skills across Nine Occupations (Continued) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Skill Areas** | **Competencies** | **OCCUPATIONS** | | | | | | | | | | **% of skill incidence out of 9 occupations** |
| | | **Construction** | | | **Electrical Engineering** | | | **Mechanical Engineering** | | | | |
| | | **Building** | **Carpentry** | **Painting** | **Electrical** | **Electronic** | **Telecom** | **Fitting** | **Machining** | **Metal Fab.** | | |
| **Performing Gas Welding and Gas Cutting Operations (Continued)** | Describe classification of fuels | 0 | 0 | 0 | X | X | X | X | X | X | | 67% |
| | Describe classification of filler metals | 0 | 0 | 0 | X | X | X | X | X | X | | 67% |
| | Explain braze welding principles | 0 | 0 | 0 | X | X | X | X | X | X | | 67% |
| | Explain application and limitations of Brazing | 0 | 0 | 0 | X | X | X | X | X | X | | 67% |
| | Describe flat position welding and Brazing | 0 | 0 | 0 | X | X | X | X | X | X | | 67% |
| | Demonstrate manual and machine Oxy-fuel cutting | 0 | 0 | 0 | X | X | X | X | X | X | | 67% |
| | Describe types of welding electrodes | 0 | 0 | 0 | X | X | X | X | X | X | | 67% |
| **Performing Gas Tungsten Arc Welding Operations** | Explain principles of Gas Tungsten Arc Welding | 0 | 0 | 0 | X | X | X | X | X | X | | 67% |
| | Explain safety rules and equipment | 0 | 0 | 0 | X | X | X | X | X | X | | 67% |
| | Describe procedures in joints design and welds | 0 | 0 | 0 | X | X | X | X | X | X | | 67% |
| | Explain effects of welding parameters | 0 | 0 | 0 | X | X | X | X | X | X | | 67% |
| | | | | | | | | | | | | |

| Appendix D. Portable Technical Skills across Nine Occupations (Continued) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Skill Areas** | **Competencies** | **OCCUPATIONS** | | | | | | | | | | **% of skill incidence out of 9 occupations** |
| | | **Construction** | | | **Electrical Engineering** | | | **Mechanical Engineering** | | | | |
| | | **Building** | **Carpentry** | **Painting** | **Electrical** | **Electronic** | **Telecom** | **Fitting** | **Machining** | **Metal Fab.** | | |
| **Performing Gas Tungsten Arc Welding Operations (Continued)** | Describe machines for Shielded Metal Arc Welding | 0 | 0 | 0 | X | X | X | X | X | X | | 67% |
| | Describe cables and fasteners | 0 | 0 | 0 | X | X | X | X | X | X | | 67% |
| | Describe setup and use of Gas Tungsten arc welding equipment | 0 | 0 | 0 | X | X | X | X | X | X | | 67% |
| | Perform welds in various positions | 0 | 0 | 0 | X | X | X | X | X | X | | 67% |
| | Perform hot wire welding | 0 | 0 | 0 | X | X | X | X | X | X | | 67% |
| | Compare various welding profiles | 0 | 0 | 0 | X | X | X | X | X | X | | 67% |
| **Workshop Machines and Equipment** | Explain types of workshop machines and equipment | X | X | X | X | X | X | X | X | X | | 100% |
| | Demonstrate operation of the following workshop machines and equipment: Milling machines, Cutting/shaping equipment and tools, Grinding Welding, Drilling machines, Punching machines, Power saws Guillotines, Universal cropper Nibbling machine, Bench shears Others (Compressors, conveyors, etc) | X | X | X | X | X | X | X | X | X | | 100% |
| | | | | | | | | | | | | |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab. | |
| **Sheet Metal Work** | Describe types of sheet metal | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 33% |
| | Practice cutting and bending sheet metal | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 33% |
| | Explain types and use of sheet metal tools | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 33% |
| | Develop sheet metal patterns (round shapes, conical shapes, square to round, pyramid shapes, elliptical shapes, square shapes) | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 33% |
| | Perform sheet metal joints. | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 33% |
| | Practice hollowing and annealing | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 33% |
| **Lathes and Lathe Operations** | Describe types of lathe machines | 0 | X | 0 | 0 | 0 | 0 | X | X | 0 | 33% |
| | Carry out cutting operations | 0 | X | 0 | 0 | 0 | 0 | X | X | 0 | 33% |
| | Carry out grinding cutting operations | 0 | X | 0 | 0 | 0 | 0 | X | X | 0 | 33% |
| | Carry out turning Operations | 0 | X | 0 | 0 | 0 | 0 | X | X | 0 | 33% |
| | Carry out threading | 0 | X | 0 | 0 | 0 | 0 | X | X | 0 | 33% |

| Appendix D. Portable Technical Skills across Nine Occupations (Continued) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Skill Areas** | **Competencies** | **OCCUPATIONS** | | | | | | | | | | **% of skill incidence out of 9 occupations** |
| | | **Construction** | | | **Electrical Engineering** | | | **Mechanical Engineering** | | | | |
| | | **Building** | **Carpentry** | **Painting** | **Electrical** | **Electronic** | **Telecom** | **Fitting** | **Machining** | **Metal Fab.** | | |
| **Lathes and Lathe Operations (Continued)** | Carry out knurling | 0 | X | 0 | 0 | 0 | 0 | X | X | 0 | | 33% |
| | Explain cutting speeds and feeds | 0 | X | 0 | 0 | 0 | 0 | X | X | X | | 44% |
| | Use fixing and holding devices | 0 | X | 0 | 0 | 0 | 0 | X | X | X | | 44% |
| | Practice use of lubricants during machining. | 0 | X | 0 | 0 | 0 | 0 | X | X | X | | 44% |
| | Observe safety procedures. | 0 | X | 0 | 0 | 0 | 0 | X | X | X | | 44% |
| **Joining Methods** | Describing joining metals | 0 | 0 | 0 | X | X | X | X | X | X | | 67% |
| | Describe types and uses of joints | 0 | X | 0 | X | X | X | X | X | X | | 78% |
| | Use mechanical fasteners | 0 | X | 0 | X | X | X | X | X | X | | 78% |
| | Demonstrate welding skills | 0 | 0 | 0 | X | X | X | X | X | X | | 78% |
| | Demonstrate brazing skills | 0 | 0 | 0 | X | X | X | X | X | X | | 67% |
| | Demonstrate soldering skills | 0 | 0 | 0 | X | X | X | X | X | X | | 67% |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab. | |
| **Joining Methods (Continued)** | Join pieces by riveting | 0 | X | 0 | X | X | X | X | X | X | 78% |
| | Demonstrate use of adhesives | 0 | X | X | X | X | X | X | X | X | 89% |
| | Demonstrate use of electrical connections | 0 | 0 | 0 | X | X | X | X | X | X | 66% |
| | Describe relative methods of joining metals | 0 | 0 | 0 | X | X | X | X | X | X | 66% |
| **Rigging** | Describe types and uses of lifting devices | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 33% |
| | Describe lifting accessories | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 33% |
| | Describe scaffolding | X | 0 | X | 0 | 0 | 0 | X | X | X | 56% |
| | Identify safe working loads | 0 | 0 | 0 | 0 | 0 | 0 | X | X | 0 | 22% |
| | Demonstrate periodical maintenance of scaffolding and lifting devices. | 0 | 0 | 0 | 0 | 0 | 0 | X | X | 0 | 22% |
| | Carry out visual inspection of lifting devices | 0 | 0 | 0 | 0 | 0 | 0 | X | X | 0 | 22% |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab. | |
| **Fundamentals of Electricity** | State the basic laws in electricity (Ohms Law and Kirchhoff's Law) | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| | Identify the nature and sources of electricity | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| | Read the values of passive and active components | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| | Analyze the behavior of passive components in DC circuits | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| | Analyze the behavior of passive components in AC circuits | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| | Describe magnetism and its effects | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| | Describe magnetism and its application to instruments | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| | Repair electrical components | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| | Explain electrical Laws and theorems | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| | Describe types of resistors | 0 | 0 | 0 | X | X | X | X | X | X | 67% |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab. | |
| **Calculating Power and Energy** | Explain electrical power | 0 | 0 | 0 | X | X | X | X | 0 | X | 56% |
| | Explain electrical energy | 0 | 0 | 0 | X | X | X | X | 0 | X | 56% |
| | Describe fuses | 0 | 0 | 0 | X | X | X | X | 0 | X | 56% |
| | Describe lamps | 0 | 0 | 0 | X | X | X | X | 0 | X | 56% |
| **Using Cells** | Describe types of cells | 0 | 0 | 0 | X | X | X | X | 0 | 0 | 44% |
| | Explain electro chemistry | 0 | 0 | 0 | X | X | X | X | 0 | 0 | 44% |
| | Explain maintenance cells | 0 | 0 | 0 | X | X | X | X | 0 | 0 | 44% |
| **Semi-conductors** | Define semiconductors and thyristors | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| | Identify semi conductors and thyristors | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| | Differentiate semiconductors, conductors, insulators and Thyristors | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| | Describe the semiconductor theory | 0 | 0 | 0 | X | X | X | X | X | 0 | 56% |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab. | |
| **Semi-Conductors (Continued)** | State common faults in conductors | 0 | 0 | 0 | X | X | X | 0 | 0 | 0 | 33% |
| | Explain the operation principles of a diode and a transistor | 0 | 0 | 0 | X | X | X | 0 | 0 | 0 | 33% |
| | Draw characteristic curves for diodes and transistors | 0 | 0 | 0 | X | X | X | 0 | 0 | 0 | 33% |
| | Apply the results of the drawing to circuit design | 0 | 0 | 0 | X | X | X | 0 | 0 | 0 | 33% |
| | Perform Polarity checks on a diode by the use of multitester | 0 | 0 | 0 | X | X | X | 0 | 0 | 0 | 33% |
| | Explain the stages of IC fabrication | 0 | 0 | 0 | X | X | X | 0 | 0 | 0 | 33% |
| | Fit semi-conductors | 0 | 0 | 0 | X | X | X | 0 | 0 | 0 | 33% |
| | Categorize ICs by structure and scale of integration. | 0 | 0 | 0 | X | X | X | 0 | 0 | 0 | 33% |
| | Apply semiconductor devices and thyristors to basic circuits Configure semi conductors | 0 | 0 | 0 | X | X | X | 0 | 0 | 0 | 33% |
| | Examine semi conductors for faults | 0 | 0 | 0 | X | X | X | 0 | 0 | 0 | 33% |
| | Rectify faults | 0 | 0 | 0 | X | X | X | 0 | 0 | 0 | 33% |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab | |
| **Amplifiers and Oscillators** | Define amplifiers and oscillators | 0 | 0 | 0 | X | X | X | 0 | 0 | 0 | 33% |
| | Explain the principles of amplification and oscillation | 0 | 0 | 0 | X | X | X | 0 | 0 | 0 | 33% |
| **Power Supplies** | Explain the characteristics of different power supplies | 0 | 0 | 0 | X | X | X | 0 | 0 | 0 | 33% |
| | Solve mathematical problems related to power supplies | 0 | 0 | 0 | X | X | X | 0 | 0 | 0 | 33% |
| **Digital Electronics** | Differentiate digital from analog signals | 0 | 0 | 0 | X | X | X | 0 | 0 | 0 | 33% |
| | Define number systems and codes | 0 | 0 | 0 | X | X | X | 0 | 0 | 0 | 33% |
| | Identify number systems and codes | 0 | 0 | 0 | X | X | X | 0 | 0 | 0 | 33% |
| | Convert number systems and codes | 0 | 0 | 0 | X | X | X | 0 | 0 | 0 | 33% |
| | Interpret logic circuits | 0 | 0 | 0 | X | X | X | 0 | 0 | 0 | 33% |
| | State different types of Radios and monochrome Televisions | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |
| | Interpret the circuit diagrams for radios and Television receivers. | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab | |
| **Digital Electronics (Continued)** | Identify common faults in Radios and monochrome Television receivers | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |
| | Carry out troubleshooting procedures in Radios and monochrome Television receivers | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |
| | Repair the Radio or monochrome Television. | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |
| | Service a color TV | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |
| | Carry out fault finding procedures | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |
| | Repair a color TV | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |
| | Identify different types and components of computer systems | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |
| | Explain functions of each component of a computer system | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |
| | Configure a computer system | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |
| | Install computer program | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |
| | Service computer system | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab | |
| **Digital Electronics (Continued)** | Trouble shoot computer system | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |
| | Rectify faults in a computer system. | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |
| | Install the various DSTV networks, telephones, modems, PBX and fax machines. | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |
| | Install soft ware networks | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |
| | Dismantle and assemble communication systems | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |
| | Identify common problems in communication systems | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |
| | Identify different components of a printer | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |
| | Explain functions of each component of a printer | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |
| | Explain the operating principles | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |
| | State common faults in printers | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab. | |
| **Printers (Continued)** | Operate a printer | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |
| | Configure a printer | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |
| | Install printer programmes | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |
| | Service printers | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |
| | Trouble shoot printers | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |
| | Rectify faults in printers. | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |
| **Photocopiers** | Define photocopier | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |
| | Distinguish photocopiers from other copying machines | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |
| | Explain the functions of each unit in a photocopier | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |
| | Operate photocopiers | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |
| | Interpret the (service) technical manuals | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab. | |
| **Photocopiers (Continued)** | Unpack and install a Photocopier | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |
| | Dismantle and assemble a photocopier | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |
| | Service a photocopier | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |
| | Troubleshoot photocopiers | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |
| | Repair a photocopier | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |
| **Scanners** | Define scanner | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |
| | Distinguish scanners from other copying machines | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |
| | Explain the functions of each unit in a scanner | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |
| | Operate scanners | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |
| | Unpack and install a scanner | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |
| | Dismantle and assemble a scanner | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab. | |
| **Scanners (Continued)** | Service a scanner | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |
| | Troubleshoot scanners | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |
| | Repair a scanner | 0 | 0 | 0 | 0 | X | X | 0 | 0 | 0 | 22% |
| **Atomic Structure and Bonding** | Define atoms and molecules | 0 | 0 | X | X | 0 | 0 | X | X | X | 56% |
| | Use the mole and Avogadro's number | 0 | 0 | 0 | 0 | 0 | 0 | X | X | 0 | 22% |
| | Explain primary and secondary bonds and relationship with metals | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 33% |
| | Explain characteristics of polymers and ceramics | 0 | 0 | 0 | 0 | 0 | 0 | X | X | 0 | 22% |
| **Atom Arrangement – Crystalline and Amorphous Solids:** | Explain concept of a 'crystal' | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 33% |
| | Describe unit cell | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 33% |
| | Explain crystalline and amorphous structure | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 33% |
| | Describe grains and grain boundaries | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 33% |

| Appendix D. Portable Technical Skills across Nine Occupations (Continued) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Skill Areas** | **Competencies** | **OCCUPATIONS** | | | | | | | | | | **% of skill incidence out of 9 occupations** |
| | | **Construction** | | | **Electrical Engineering** | | | **Mechanical Engineering** | | | | |
| | | **Building** | **Carpentry** | **Painting** | **Electrical** | **Electronic** | **Telecom** | **Fitting** | **Machining** | **Metal Fab.** | | |
| **Atom Arrangement – Crystalline and Amorphous Solids (continued)** | Describe polycrystalline and single crystals | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | | 33% |
| | Explain polymorphism | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | | 33% |
| **Crystalline Imperfections** | Classify various types of crystal imperfections | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | | 33% |
| | Describe crystal defects, point defects, line defects, dislocations | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | | 33% |
| | Describe basics of plastic deformation | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | | 33% |
| **Concept of Metals and Alloys and Phases** | Distinguish between pure metals and alloys | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | | 33% |
| | Distinguish between ‘mixture’, compound’ and inter-metallic | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | | 33% |
| **Solidification of Metals** | Describe the processes of solidification of pure metals and alloys | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | | 33% |
| | Describe basic nucleation and growth | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | | 33% |
| | Describe cast structures | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | | 33% |
| | Define dendrites, columnar and equiaxed grain structure | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | | 33% |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab. | |
| **Polymer Structures** | Describe polymeric materials | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 33% |
| | Define thermoplastics | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 33% |
| | Describe thermosets and elastomers | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 33% |
| | Describe polymerisation reactions | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 33% |
| **Properties of Materials** | Describe chemicals and physical properties | 0 | 0 | 0 | X | 0 | 0 | X | X | X | 44% |
| | Define thermal | 0 | 0 | 0 | X | 0 | 0 | X | X | X | 44% |
| | Define electrical materials | 0 | 0 | 0 | X | 0 | 0 | X | X | X | 44% |
| | Define magnetic materials | 0 | 0 | 0 | X | 0 | 0 | X | X | X | 44% |
| | Define optical materials | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 33% |
| | | | | | | | | | | | |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab. | |
| **Mechanical Properties of Metals:** | Describe tensile testing, | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 33% |
| | Explain concepts of stress and strain | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 33% |
| | Explain elastic and plastic response | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 33% |
| | Define ductility and malleability | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 33% |
| | Explain hardness testing | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 33% |
| | Explain Impact testing | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 33% |
| | Explain toughness and temperature effects. | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 33% |
| **Failure Analysis** | Define fracture | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 33% |
| | Explain ductile and brittle; ductile/brittle transition | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 33% |
| | Describe fatigue testing, factors affecting fatigue properties of Materials | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 33% |
| | Explain creep and stress rupture, creep testing. | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 33% |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab. | |
| **Basic NC And CNC: Programming** | Describe motion control. | 0 | 0 | 0 | 0 | 0 | 0 | X | X | 0 | 22% |
| | Explain point to point machining | 0 | 0 | 0 | 0 | 0 | 0 | X | X | 0 | 22% |
| | Describe continuous path control | 0 | 0 | 0 | 0 | 0 | 0 | X | X | 0 | 22% |
| | Describe linear and circular interpolation, | 0 | 0 | 0 | 0 | 0 | 0 | X | X | 0 | 22% |
| | Describe contouring control | 0 | 0 | 0 | 0 | 0 | 0 | X | X | 0 | 22% |
| | Explain co-ordinate conventions, | 0 | 0 | 0 | 0 | 0 | 0 | X | X | 0 | 22% |
| | Describe positioning systems-absolute and incremental. | 0 | 0 | 0 | 0 | 0 | 0 | X | X | 0 | 22% |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab. | | |
| **Programming** | Explain program design, | 0 | 0 | 0 | 0 | 0 | 0 | X | X | 0 | | 22% |
| | Explain NC coding, | 0 | 0 | 0 | 0 | 0 | 0 | X | X | 0 | | 22% |
| | Describe part programming | 0 | 0 | 0 | 0 | 0 | 0 | X | X | 0 | | 22% |
| | Describe manual/computer assisted programming | 0 | 0 | 0 | 0 | 0 | 0 | X | X | 0 | | 22% |
| | Describe post- processing programming | 0 | 0 | 0 | 0 | 0 | 0 | X | X | 0 | | 22% |
| | Define high level programming languages. | 0 | 0 | 0 | 0 | 0 | 0 | X | X | 0 | | 22% |
| **Material Handling** | Describe types of material handling requirements. | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | | 33% |
| | Describe conveyors, continuous and segmented. | 0 | 0 | 0 | 0 | 0 | 0 | X | X | 0 | | 22% |
| | Explain parts feeding and orienting mechanisms (vibratory bowl etc.) | 0 | 0 | 0 | 0 | 0 | 0 | X | X | 0 | | 22% |
| | Explain factors involved in selecting the correct system. | 0 | 0 | 0 | 0 | 0 | 0 | X | X | 0 | | 22% |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab. | | |
| **Machining Centres** | Demonstrate work-piece transfer. | 0 | 0 | 0 | 0 | 0 | 0 | X | X | 0 | | 22% |
| | Describe tool change mechanisms | 0 | 0 | 0 | 0 | 0 | 0 | X | X | 0 | | 22% |
| **Robotics** | Describe characteristics and advantages of different types of robotics, | 0 | 0 | 0 | 0 | 0 | 0 | X | X | 0 | | 22% |
| | Describe envelopes, | 0 | 0 | 0 | 0 | 0 | 0 | X | X | 0 | | 22% |
| | Describe end effectors, | 0 | 0 | 0 | 0 | 0 | 0 | X | X | 0 | | 22% |
| | Explain robot control and industrial applications. | 0 | 0 | 0 | 0 | 0 | 0 | X | X | 0 | | 22% |
| **Design for Manufacturing** | Describe problems for the manufacturing system with traditional design approach, | 0 | 0 | 0 | 0 | 0 | 0 | X | X | 0 | | 22% |
| | Explain how DFM overcomes these, using practical design examples. | 0 | 0 | 0 | 0 | 0 | 0 | X | X | 0 | | 22% |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab. | |
| **Exhibiting Skill in Parallel Line Development** | Explain the principle of parallel line development | 0 | 0 | 0 | X | 0 | 0 | 0 | 0 | X | 22% |
| | Draw right cylindrical elbow | 0 | 0 | 0 | X | 0 | 0 | 0 | 0 | X | 22% |
| | Draw right – angled Tee of equal diameter pipes | 0 | 0 | 0 | X | 0 | 0 | 0 | 0 | X | 22% |
| | Draw right – angled Tee off-centre | 0 | 0 | 0 | X | 0 | 0 | 0 | 0 | X | 22% |
| | Produce the right segmental bend | 0 | 0 | 0 | X | 0 | 0 | 0 | 0 | X | 22% |
| | Apply the alphabet of lines to oblique drawings | 0 | 0 | 0 | X | 0 | 0 | 0 | 0 | X | 22% |
| **Radial Line Development** | Explain radial development | 0 | 0 | 0 | X | 0 | 0 | 0 | 0 | X | 22% |
| | Produce right cone | 0 | 0 | 0 | X | 0 | 0 | 0 | 0 | X | 22% |
| | Draw a frustum of a right Cone | 0 | 0 | 0 | X | 0 | 0 | 0 | 0 | X | 22% |
| | Draw right conic frustum cut obliquely | 0 | 0 | 0 | X | 0 | 0 | 0 | 0 | X | 22% |
| | Draw oblique conic frustum or smoke hood | 0 | 0 | 0 | X | 0 | 0 | 0 | 0 | X | 22% |
| | Draw oblique conical hopper | 0 | 0 | 0 | X | 0 | 0 | 0 | 0 | X | 22% |

| Appendix D. Portable Technical Skills across Nine Occupations (Continued) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Skill Areas** | **Competencies** | **OCCUPATIONS** | | | | | | | | | | **% of skill incidence out of 9 occupations** |
| | | **Construction** | | | **Electrical Engineering** | | | **Mechanical Engineering** | | | | |
| | | **Building** | **Carpentry** | **Painting** | **Electrical** | **Electronic** | **Telecom** | **Fitting** | **Machining** | **Metal Fab.** | | |
| **Applying Principles of Drawing** | Use drawing instruments | X | X | 0 | X | 0 | 0 | X | X | X | | 67% |
| | Maintain drawing instruments | X | X | 0 | X | 0 | 0 | X | X | X | | 67% |
| | Interpret scales for different drawings | X | X | 0 | X | 0 | 0 | X | X | X | | 67% |
| **Interpreting Building Graphical Communication/ symbols** | Abbreviate building related terms | X | X | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 22% |
| | Identify materials symbols used in building drawing | X | X | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 22% |
| | Interpret materials symbols | X | X | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 22% |
| | Interpret graphical symbols | X | X | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 22% |
| | Use graphical symbols in building drawing | X | X | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 22% |
| **Producing Geometrical Constructions** | Identify and use drawing equipment | X | X | 0 | X | 0 | 0 | X | X | X | | 67% |
| | Bisect lines and angles of different types | X | X | 0 | X | 0 | 0 | X | X | X | | 67% |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab. | |
| **Producing Geometrical Constructions (Continued)** | Construct angles of different degrees | X | X | X | X | 0 | 0 | X | X | X | 78% |
| | Construct arc tangent curves of different angles | X | X | X | X | 0 | 0 | X | X | X | 78% |
| | Construct circles | X | X | X | X | 0 | 0 | X | X | X | 78% |
| | Construct polygons | X | X | X | X | 0 | 0 | X | X | X | 78% |
| **Drawing Projections** | Interpret different projection drawings | X | X | X | X | 0 | 0 | X | X | X | 78% |
| | Draw an oblique drawing in 3-dimension form | X | X | X | X | 0 | 0 | X | X | X | 78% |
| | Draw axonometric drawings in 3-dimension form | X | X | X | X | 0 | 0 | X | X | X | 78% |
| | Draw an isometric drawing 3-dimension form | X | X | X | X | 0 | 0 | X | X | X | 78% |
| | Draw orthographic drawings using 1st and 3rd angle projection. | X | X | X | X | 0 | 0 | X | X | X | 78% |

| Appendix D. Portable Technical Skills across Nine Occupations (Continued) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Skill Areas** | **Competencies** | **OCCUPATIONS** | | | | | | | | | | **% of skill incidence out of 9 occupations** |
| | | **Construction** | | | **Electrical Engineering** | | | **Mechanical Engineering** | | | | |
| | | **Building** | **Carpentry** | **Painting** | **Electrical** | **Electronic** | **Telecom** | **Fitting** | **Machining** | **Metal Fab.** | | |
| **Producing Engineering Drawings** | Produce first angle | X | X | 0 | X | 0 | 0 | X | X | X | | 67% |
| | Produce third angle | X | X | 0 | X | 0 | 0 | X | X | X | | 67% |
| | Produce dimensional drawings | X | X | 0 | X | 0 | 0 | X | X | X | | 67% |
| **Construction Drawing** | Convert standard measurements from imperial to metric | X | X | 0 | 0 | 0 | 0 | 0 | 0 | X | | 33% |
| | Interpret drawing plans of different types | X | X | 0 | 0 | 0 | 0 | 0 | 0 | X | | 33% |
| | Produce drawing plans of different nature | X | X | 0 | 0 | 0 | 0 | 0 | 0 | X | | 33% |
| | Draw elevation drawings | X | X | 0 | 0 | 0 | 0 | 0 | 0 | X | | 33% |
| **Detailing Drawings** | Produce a detailed foundation plan for the drawing | X | X | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 22% |
| | Produce a detailed floor plan for the drawing | X | X | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 22% |
| | Produce detailed plans for stairs and stairways of the Drawing | X | X | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 22% |
| | Draw graphical symbols for roof, door and window for openings | X | X | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 22% |

| Appendix D. Portable Technical Skills across Nine Occupations (Continued) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Skill Areas** | **Competencies** | **OCCUPATIONS** | | | | | | | | | | **% of skill incidence out of 9 occupations** |
| | | **Construction** | | | **Electrical Engineering** | | | **Mechanical Engineering** | | | | |
| | | **Building** | **Carpentry** | **Painting** | **Electrical** | **Electronic** | **Telecom** | **Fitting** | **Machining** | **Metal Fab.** | | |
| **Exhibiting Skill in Parallel Line Development** | Explain the principle of parallel line development | 0 | 0 | 0 | X | 0 | 0 | 0 | 0 | X | | 22% |
| | Draw right cylindrical elbow | 0 | 0 | 0 | X | 0 | 0 | 0 | 0 | X | | 22% |
| | Draw right – angled Tee of equal diameter pipes | 0 | 0 | 0 | X | 0 | 0 | 0 | 0 | X | | 22% |
| | Draw right – angled Tee off-centre | 0 | 0 | 0 | X | 0 | 0 | 0 | 0 | X | | 22% |
| | Produce the right segmental bend | 0 | 0 | 0 | X | 0 | 0 | 0 | 0 | X | | 22% |
| | Apply the alphabet of lines to oblique drawings | 0 | 0 | 0 | X | 0 | 0 | 0 | 0 | X | | 22% |
| **Radial Line Development** | Explain radial development | 0 | 0 | 0 | X | 0 | 0 | 0 | 0 | X | | 22% |
| | Produce right cone | 0 | 0 | 0 | X | 0 | 0 | 0 | 0 | X | | 22% |
| | Draw a frustum of a right Cone | 0 | 0 | 0 | X | 0 | 0 | 0 | 0 | X | | 22% |
| | Draw right conic frustum cut obliquely | 0 | 0 | 0 | X | 0 | 0 | 0 | 0 | X | | 22% |
| | Draw oblique conic frustum or smoke hood | 0 | 0 | 0 | X | 0 | 0 | 0 | 0 | X | | 22% |
| | Draw oblique conical hopper | 0 | 0 | 0 | X | 0 | 0 | 0 | 0 | X | | 22% |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab | |
| **Pictorial Drawing and Sketching** | Produce pictorial drawing | X | X | X | X | 0 | 0 | X | X | X | 78% |
| | Prepare hand-drawn technical sketches using regular and isometric grid paper. | X | X | X | X | 0 | 0 | X | X | X | 78% |
| **Line Types, Lettering, Fundamental Geometry** | Choose the appropriate line types from the Alphabet of Lines for drawing and sketching. | X | X | X | X | 0 | 0 | X | X | X | 78% |
| | Demonstrate inclined and vertical style hand-lettering. | X | X | X | X | 0 | 0 | X | X | X | 78% |
| | Explain fundamentals of geometry | X | X | X | X | 0 | 0 | X | X | X | 78% |
| **Geometric Constructions** | Define geometric nomenclatures like angles, lines etc | X | X | X | X | 0 | 0 | X | X | X | 78% |
| | Describe the steps to construct different geometric figures like lines, arcs, polygon, ellipse etc | X | X | X | X | 0 | 0 | X | X | X | 78% |
| | Demonstrate the ability to create and read an engineering drawing using standard views, and both conventional and GD&T dimensioning and tolerance techniques to describe form, orientation, and location accurately | X | X | X | X | 0 | 0 | X | X | X | 78% |

| Portable Technical Skills across Nine Occupations (Continued) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Skill Areas** | **Competencies** | **OCCUPATIONS** | | | | | | | | | | **% of skill incidence out of 9 occupations** |
| | | **Construction** | | | **Electrical Engineering** | | | **Mechanical Engineering** | | | | |
| | | **Building** | **Carpentry** | **Painting** | **Electrical** | **Electronic** | **Telecom** | **Fitting** | **Machining** | **Metal Fab.** | | |
| **Geometric Constructions (Continued)** | Convert orthographic projection in to isometric Projection | X | X | 0 | X | 0 | 0 | X | X | X | | 67% |
| | Explain the purposes of dimensioning | X | X | 0 | X | 0 | 0 | X | X | X | | 67% |
| | Explain the differences between dimension line, extension line, leaders etc. | X | X | 0 | X | 0 | 0 | X | X | X | | 67% |
| | Apply geometric dimensioning and tolerance (GD&T) | X | X | 0 | X | 0 | 0 | X | X | X | | 67% |
| | Draw the dimension of technical drawings as per the standard | X | X | 0 | X | 0 | 0 | X | X | X | | 67% |
| **Sections** | Describe the purpose of sectioning in technical drawings | X | X | 0 | 0 | 0 | 0 | X | X | X | | 56% |
| | Define cutting plane lines, direction of sight, section lining etc | X | X | 0 | 0 | 0 | 0 | X | X | X | | 56% |
| | Mention and explain the different kinds of sectioning | X | X | 0 | 0 | 0 | 0 | X | X | X | | 56% |
| **Auxiliary Views** | Demonstrate use of multi-view and auxiliary view drawings**.** | X | X | 0 | X | 0 | 0 | X | X | X | | 67% |
| | Explain standards for drawing symbol conventions and international standards | X | X | 0 | X | 0 | 0 | X | X | X | | 67% |
| | | | | | | | | | | | | |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab. | |
| **Simple Drawings** | Interpret symbols and conventions | X | X | 0 | X | 0 | 0 | X | X | X | 67% |
| | Produce lines by use of computer | X | X | 0 | X | 0 | 0 | X | X | X | 67% |
| **Geometrical and Machine Drawing** | Distinguish between plane and solid geometry | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 33% |
| | Produce drawings of a two-dimensional nature | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 33% |
| | Produce three dimensional drawings | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 33% |
| | Construct a polygon, parallel lines, perpendicular lines, bisecting lines and angles, Regular polygons inscribed in circles, Tangents, Circles & lines in contact, involutes of a circle, hyperbola & ellipse. | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 33% |
| | Produce drawings following principles of isometric projections | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 33% |
| | Produce drawings following principles of oblique projections | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 33% |
| | Produce drawings following principles of orthographic projections | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 33% |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab. | |
| **Geometrical and Machine Drawing (Continued)** | Construct surface development of right and oblique solids, and frustum of solids | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 33% |
| | Produce engineering drawings of different components, assemblies and circuits using a variety of sketching, drawing and computer-aided drafting techniques | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | 33% |
| **Producing trade drawings using Auto –Cad** | Produce a report using word processing common packages | X | X | 0 | X | 0 | 0 | X | X | X | 67% |
| | Identify software and hardware components | X | X | 0 | X | 0 | 0 | X | X | X | 67% |
| | Perform basic operations of C.A.D | X | X | 0 | X | 0 | 0 | X | X | X | 67% |
| | Convert data from one format to another | X | X | 0 | X | 0 | 0 | X | X | X | 67% |
| | Produce commonly used project drawings using Auto-CAD | X | X | 0 | X | 0 | 0 | X | X | X | 67% |

| Appendix D. Portable Technical Skills across Nine Occupations (Continued) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Skill Areas** | **Competencies** | **OCCUPATIONS** | | | | | | | | | | **% of skill incidence out of 9 occupations** |
| | | **Construction** | | | **Electrical Engineering** | | | **Mechanical Engineering** | | | | |
| | | **Building** | **Carpentry** | **Painting** | **Electrical** | **Electronic** | **Telecom** | **Fitting** | **Machining** | **Metal Fab** | | |
| **Introduction To Personal Computers** | Explain the history of information technology | X | X | X | X | X | X | X | X | X | | 100% |
| | Describe application packages | X | X | X | X | X | X | X | X | X | | 100% |
| | Describe the computer system | X | X | X | X | X | X | X | X | X | | 100% |
| | Describe parts of a computer and their uses | X | X | X | X | X | X | X | X | X | | 100% |
| | Distinguish between computer **h**ardware and software | X | X | X | X | X | X | X | X | X | | 100% |
| | Demonstrate starting and closing the computer | X | X | X | X | X | X | X | X | X | | 100% |
| | Demonstrate using the key board | X | X | X | X | X | X | X | X | X | | 100% |
| | Demonstrate file management | X | X | X | X | X | X | X | X | X | | 100% |
| **Word Processing** | Describe various parts of the MS-Word screen. | X | X | X | X | X | X | X | X | X | | 100% |
| | Create a simple document. | X | X | X | X | X | X | X | X | X | | 100% |
| | Use simple editing tools. | X | X | X | X | X | X | X | X | X | | 100% |

| Appendix D. Portable Technical Skills across Nine Occupations (Continued) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Skill Areas** | **Competencies** | **OCCUPATIONS** | | | | | | | | | | **% of skill incidence out of 9 occupations** |
| | | **Construction** | | | **Electrical Engineering** | | | **Mechanical Engineering** | | | | |
| | | **Building** | **Carpentry** | **Painting** | **Electrical** | **Electronic** | **Telecom** | **Fitting** | **Machining** | **Metal Fab.** | | |
| **Word Processing (Continued)** | Demonstrate saving the document and exit. | X | X | X | X | X | X | X | X | X | | 100% |
| | Demonstrate retrieving of a document. | X | X | X | X | X | X | X | X | X | | 100% |
| | Demonstrate formatting text. | X | X | X | X | X | X | X | X | X | | 100% |
| | Use file menu. | X | X | X | X | X | X | X | X | X | | 100% |
| | Use the edit menu | X | X | X | X | X | X | X | X | X | | 100% |
| | Use the view menu | X | X | X | X | X | X | X | X | X | | 100% |
| | Use the tools menu. | X | X | X | X | X | X | X | X | X | | 100% |
| | Create tables | X | X | X | X | X | X | X | X | X | | 100% |
| | Demonstrate working with multiple documents | X | X | X | X | X | X | X | X | X | | 100% |
| | Use the windows menu | X | X | X | X | X | X | X | X | X | | 100% |
| | Demonstrate getting help from MS-Word. | X | X | X | X | X | X | X | X | X | | 100% |
| | | | | | | | | | | | | |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab. | |
| **Word Processing (Continued)** | Use the key board | X | X | X | X | X | X | X | X | X | 100% |
| | Demonstrate file Management | X | X | X | X | X | X | X | X | X | 100% |
| **Computer Application** | Computer Gated x-ray Control systems, | X | X | X | X | X | 0 | X | X | X | 89% |
| | Explain Local Area Network (LAN) | X | X | X | X | X | 0 | X | X | X | 89% |
| | Explain Wide Area Network (WAN) | X | X | X | X | X | 0 | X | X | X | 89% |
| | Demonstrate use of computers for problem solving and calculating | X | X | X | X | X | 0 | X | X | X | 89% |
| **Sending and Receiving E-Mail: Outlook Express** | Identify elements of Outlook Express. | X | X | X | X | 0 | 0 | 0 | 0 | X | 56% |
| | Compose e-mail message | X | X | X | X | 0 | 0 | 0 | 0 | X | 56% |
| | Send e-mail. | X | X | X | X | 0 | 0 | 0 | 0 | X | 56% |
| | Receive e-mail. | X | X | X | X | 0 | 0 | 0 | 0 | X | 56% |
| | Reply to e-mail. | X | X | X | X | 0 | 0 | 0 | 0 | X | 56% |

| Appendix D. Portable Technical Skills across Nine Occupations (Continued) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Skill Areas** | **Competencies** | **OCCUPATIONS** | | | | | | | | | | **% of skill incidence out of 9 occupations** |
| | | **Construction** | | | **Electrical Engineering** | | | **Mechanical Engineering** | | | | |
| | | **Building** | **Carpentry** | **Painting** | **Electrical** | **Electronic** | **Telecom** | **Fitting** | **Machining** | **Metal Fab.** | | |
| **Sending and Receiving E-Mail: Outlook Express (Continued)** | Forward e-mail. | X | X | X | X | 0 | 0 | 0 | 0 | X | | 56% |
| | Observe 'netiquette' when using e-mail. | X | X | X | X | 0 | 0 | 0 | 0 | X | | 56% |
| | Describe various Outlook Express folders. | X | X | X | X | 0 | 0 | 0 | 0 | X | | 56% |
| **Using the Internet: Microsoft Explorer** | Explain internet and web | X | X | X | X | 0 | X | 0 | 0 | X | | 67% |
| | Explain the benefits of using internet | X | X | X | X | 0 | X | 0 | 0 | X | | 67% |
| | Browse the web | X | X | X | X | 0 | X | 0 | 0 | X | | 67% |
| | Open web pages | X | X | X | X | 0 | X | 0 | 0 | X | | 67% |
| | Save web pages | X | X | X | X | 0 | X | 0 | 0 | X | | 67% |
| | Use search engines | X | X | X | X | 0 | X | 0 | 0 | X | | 67% |
| | Download documents | X | X | X | X | 0 | X | 0 | 0 | X | | 67% |
| | Apply rules for using the internet, video and teleconferencing | X | X | X | X | 0 | X | 0 | 0 | X | | 67% |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab. | |
| **Using Spreadsheets: Microsoft Excel** | Identify the various parts of the MS-Excel screen. | X | X | X | X | 0 | X | 0 | 0 | X | 67% |
| | Create a simple worksheet | X | X | X | X | 0 | X | 0 | 0 | X | 67% |
| | Use simple editing tools. | X | X | X | X | 0 | X | 0 | 0 | X | 67% |
| | Save the worksheet and exit. | X | X | X | X | 0 | X | 0 | 0 | X | 67% |
| | Retrieve the worksheet. | X | X | X | X | 0 | X | 0 | 0 | X | 67% |
| | Format the worksheet. | X | X | X | X | 0 | X | 0 | 0 | X | 67% |
| | Use tools menu | X | X | X | X | 0 | X | 0 | 0 | X | 67% |
| | Use the data menu | X | X | X | X | 0 | X | 0 | 0 | X | 67% |
| | Use the View menu | X | X | X | X | 0 | X | 0 | 0 | X | 67% |
| | Work with multiple worksheets | X | X | X | X | 0 | X | 0 | 0 | X | 67% |
| | Use the Window menu | X | X | X | X | 0 | X | 0 | 0 | X | 67% |

| Appendix D. Portable Technical Skills across Nine Occupations (Continued) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Skill Areas** | **Competencies** | **OCCUPATIONS** | | | | | | | | | | **% of skill incidence out of 9 occupations** |
| | | **Construction** | | | **Electrical Engineering** | | | **Mechanical Engineering** | | | | |
| | | **Building** | **Carpentry** | **Painting** | **Electrical** | **Electronic** | **Telecom** | **Fitting** | **Machining** | **Metal Fab** | | |
| **Using Spreadsheets: Microsoft Excel (Continued)** | Getting Help from MS-Excel | X | X | X | X | 0 | X | 0 | 0 | X | | 67% |
| | Use the Excel and drawing packages | X | X | X | X | 0 | X | 0 | 0 | X | | 67% |
| **Using Powerpoint Presentation** | Prepare a presentation | X | X | X | X | 0 | X | 0 | 0 | X | | 67% |
| | Manage inserts | X | X | X | X | 0 | X | 0 | 0 | X | | 67% |
| | Format a presentation | X | X | X | X | 0 | X | 0 | 0 | X | | 67% |
| | Use diagrams and drawings | X | X | X | X | 0 | X | 0 | 0 | X | | 67% |
| **Introduction To Entrepreneurship** | Explain concepts of entrepreneurship | X | X | X | X | X | X | X | X | X | | 100% |
| | Identify economic trends in Zambia | X | X | X | X | X | X | X | X | X | | 100% |
| | Describe Government policy on enterprise development | X | X | X | X | X | X | X | X | X | | 100% |
| **Developing Entrepreneurial Competences and Attitudes** | Demonstrate self-motivation | X | X | X | X | X | X | X | X | X | | 100% |
| | Describe strategies for exploiting business opportunities | X | X | X | X | X | X | X | X | X | | 100% |
| | Demonstrate skill for creating networking for enterprise | X | X | X | X | X | X | X | X | X | | 100% |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab. | |
| **Enterprise Management Skills** | Describe management and leadership styles for an enterprise | X | X | X | X | X | X | X | X | X | 100% |
| | Demonstrate marketing skills | X | X | X | X | X | X | X | X | X | 100% |
| | Calculate cost and price per product / service | X | X | X | X | X | X | X | X | X | 100% |
| | Demonstrate skills for management of finances | X | X | X | X | X | X | X | X | X | 100% |
| | Demonstrate skills for maintaining business records | X | X | X | X | X | X | X | X | X | 100% |
| | Demonstrate enterprise and technology skills | X | X | X | X | X | X | X | X | X | 100% |
| | Describe business ethics and values in managing an enterprise | X | X | X | X | X | X | X | X | X | 100% |
| **Establishing an Enterprise** | Develop Business Plan / project | X | X | X | X | X | X | X | X | X | 100% |
| | Describe procedures for formalizing an enterprise | X | X | X | X | X | X | X | X | X | 100% |
| **Sustaining an Enterprise** | Describe appraisal of one's enterprise | X | X | X | X | X | X | X | X | X | 100% |
| | Describe sustainability of enterprise through productivity and management | X | X | X | X | X | X | X | X | X | 100% |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab | |
| **Sustaining an Enterprise (Continued)** | Describe strategies for managing survival and growth | X | X | X | X | X | X | X | X | X | 100% |
| | Develop a project | X | X | X | X | X | X | X | X | X | 100% |
| **Introduction to Written and Spoken Communication** | Describe types of English for Specific Purposes (ESP) | X | X | X | X | X | 0 | X | X | X | 89% |
| | Describe the communication process | X | X | X | X | X | X | X | X | X | 100% |
| | Describe barriers to effective communication | X | X | X | X | X | X | X | X | X | 100% |
| **Types of Communication** | Describe verbal communication | X | X | X | X | X | X | X | X | X | 100% |
| | Describe non- verbal communication | X | X | X | X | X | X | X | X | X | 100% |
| | Describe written communication | X | X | X | X | X | X | X | X | X | 100% |
| **Study Skills** | Demonstrate library, e-library and locating skills | X | X | X | X | 0 | X | X | X | X | 89% |
| | Demonstrate intensive reading skills | X | X | X | X | 0 | X | X | X | X | 89% |
| | Demonstrate effective writing skills | X | X | X | X | 0 | X | X | X | X | 89% |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab. | |
| **Study Skills (Continued)** | Demonstrate listening and speaking skills | X | X | X | X | 0 | X | X | X | X | 89% |
| **Correspondence** | Write letters | X | X | X | X | X | X | X | X | X | 100% |
| | Write memorandum | X | X | X | X | X | X | X | X | X | 100% |
| | Compose circulars | X | X | X | X | X | X | X | X | X | 100% |
| | Compose notices | X | X | X | X | X | X | X | X | X | 100% |
| | Fill forms and prepare documentation (personal/official) | X | X | X | X | X | X | X | X | X | 100% |
| | Describe communication in organizations | X | X | X | X | X | X | X | X | X | 100% |
| **Applying Job Seeking Skills** | Write application letters | X | X | X | X | X | X | X | X | X | 100% |
| | Write an effective curriculum vitae | X | X | X | X | X | X | X | X | X | 100% |
| | Describe types of interviews | X | X | X | X | X | X | X | X | X | 100% |
| | Plan for and attend Interviews | X | X | X | X | X | X | X | X | X | 100% |

| Appendix D. Portable Technical Skills across Nine Occupations (Continued) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Skill Areas** | **Competencies** | **OCCUPATIONS** | | | | | | | | | | **% of skill incidence out of 9 occupations** |
| | | **Construction** | | | **Electrical Engineering** | | | **Mechanical Engineering** | | | | |
| | | **Building** | **Carpentry** | **Painting** | **Electrical** | **Electronic** | **Telecom** | **Fitting** | **Machining** | **Metal Fab.** | | |
| **Applying Job Seeking Skills (Continued)** | Describe interview procedures | X | X | X | X | X | X | X | X | X | | 100% |
| **Report Writing** | Demonstrate research techniques | X | X | X | X | X | X | X | X | X | | 100% |
| | Describe and prepare types of reports | X | X | X | X | X | X | X | X | X | | 100% |
| | Describe report formats | X | X | X | X | X | X | X | X | X | | 100% |
| **Meetings** | Describe types of meetings | X | X | X | X | X | 0 | X | X | X | | 89% |
| | Draw up the meeting agenda | X | X | X | X | X | 0 | X | X | X | | 89% |
| | Write notice of meeting | X | X | X | X | X | 0 | X | X | X | | 89% |
| | Write minutes of meetings | X | X | X | X | X | 0 | X | X | X | | 89% |
| | Explain terms used in meetings | X | X | X | X | X | 0 | X | X | X | | 89% |
| **Seminars and Consultations** | Describe seminars and consultations | X | X | X | 0 | 0 | 0 | X | X | X | | 67% |
| | Deliver oral presentations | X | X | X | 0 | 0 | 0 | X | X | X | | 67% |

| Appendix D. Portable Technical Skills across Nine Occupations (Continued) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Skill Areas** | **Competencies** | **OCCUPATIONS** | | | | | | | | | | **% of skill incidence out of 9 occupations** |
| | | **Construction** | | | **Electrical Engineering** | | | **Mechanical Engineering** | | | | |
| | | **Building** | **Carpentry** | **Painting** | **Electrical** | **Electronic** | **Telecom** | **Fitting** | **Machining** | **Metal Fab** | | |
| **Seminars and Consultations (Continued)** | Conduct and participate in group discussions | X | X | X | X | 0 | 0 | X | X | X | | 78% |
| **Applying Oral Communication** | Develop good listening skills | X | X | X | X | X | 0 | 0 | 0 | X | | 67% |
| | Write notes from both written and spoken materials | X | X | X | X | X | 0 | 0 | 0 | X | | 67% |
| | Interpret non-verbal communication | X | X | X | X | X | 0 | 0 | 0 | X | | 67% |
| | Present public speeches | X | X | X | X | X | 0 | 0 | 0 | X | | 67% |
| **Communication in Organizations** | Demonstrate skills for consulting with colleagues, supervisors and subordinates | X | X | X | X | X | X | 0 | 0 | X | | 78% |
| | Carry out joint consideration of problems | X | X | X | X | X | X | 0 | 0 | X | | 78% |
| | Give instructions | X | X | X | X | X | X | 0 | 0 | X | | 78% |
| | Receive instructions | X | X | X | X | X | X | 0 | 0 | X | | 78% |
| | Seek permission | X | X | X | X | X | X | 0 | 0 | X | | 78% |
| | Grant permission | X | X | X | X | X | X | 0 | 0 | X | | 78% |
| | | | | | | | | | | | | |

| Appendix D. Portable Technical Skills across Nine Occupations (Continued) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Skill Areas** | **Competencies** | **OCCUPATIONS** | | | | | | | | | | **% of skill incidence out of 9 occupations** |
| | | **Construction** | | | **Electrical Engineering** | | | **Mechanical Engineering** | | | | |
| | | **Building** | **Carpentry** | **Painting** | **Electrical** | **Electronic** | **Telecom** | **Fitting** | **Machining** | **Metal Fab** | | |
| **Heat, Temperature and the Gas Laws** | Define temperature | 0 | 0 | 0 | X | X | X | X | X | X | | 67% |
| | Describe temperature measurement | 0 | 0 | 0 | X | X | X | X | X | X | | 67% |
| | Describe heat as a form of energy | 0 | 0 | 0 | X | X | X | X | X | X | | 67% |
| | Describe measurement of energy | 0 | 0 | 0 | X | X | X | X | X | X | | 67% |
| | Describe calorimetry specific and latent heat | 0 | 0 | 0 | X | X | X | X | X | X | | 67% |
| | Describe thermal expansion | 0 | 0 | 0 | X | X | X | X | X | X | | 67% |
| | Describe heat transfer | 0 | 0 | 0 | X | X | X | X | X | X | | 67% |
| | Explain laws of thermodynamics | 0 | 0 | 0 | X | X | X | X | X | 0 | | 56% |
| | Explain gas laws: | 0 | 0 | 0 | X | X | X | X | X | 0 | | 56% |
| | Explain specific heat capacity | 0 | 0 | 0 | X | X | X | X | X | X | | 67% |
| | Describe heat engines | 0 | 0 | 0 | X | X | X | X | X | 0 | | 56% |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab. | |
| **Heat, Temperature and the Gas Laws (Continue)** | Describe real engines | 0 | 0 | 0 | X | X | X | X | X | 0 | 56% |
| | Describe thermal radiation | 0 | 0 | 0 | X | X | X | X | X | 0 | 56% |
| | Calculate coefficient of linear expansion | 0 | 0 | 0 | X | X | X | 0 | 0 | X | 44% |
| **Solving Problems Involving Electricity** | Explain electron theory | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| | Explain electrical conductivity | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| | Explain Ohms law | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| | Explain Kirchoff's laws | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| | Describe generation and power sources | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| | Describe DC generation | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab. | |
| **Explaining Principles of Moment** | Explain principles of moment | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| | Explain conditions of equilibrium | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| | Explain support of connection and their associated forces | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| | Calculate forces using principles of moment | 0 | 0 | 0 | X | X | X | X | X | X | 78% |
| | Explain the following terms: Tensile Force; Compressive Force; Triangle of Forces; Parallelogram of Forces; and Polygon of Forces | X | 0 | 0 | X | X | X | X | X | X | 78% |
| **Finding Centre of Gravity** | Define centre of gravity | X | 0 | 0 | 0 | 0 | 0 | X | 0 | X | 33% |
| | Describe methods of determining the location of centre of gravity | X | 0 | 0 | 0 | 0 | 0 | X | 0 | X | 33% |
| **Applying Chemistry Principles** | Describe corrosion and its relationship to the E.C.S | 0 | 0 | 0 | 0 | 0 | 0 | 0 | X | X | 22% |
| | Describe oxidation and reduction | 0 | 0 | 0 | 0 | 0 | 0 | 0 | X | X | 22% |

| Appendix D. Portable Technical Skills across Nine Occupations (Continued) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Skill Areas** | **Competencies** | **OCCUPATIONS** | | | | | | | | | | **% of skill incidence out of 9 occupations** |
| | | **Construction** | | | **Electrical Engineering** | | | **Mechanical Engineering** | | | | |
| | | **Building** | **Carpentry** | **Painting** | **Electrical** | **Electronic** | **Telecom** | **Fitting** | **Machining** | **Metal Fab.** | | |
| **Relative Humidity and Surface Tension** | Explain dew point methods for measuring humidity | 0 | 0 | 0 | 0 | 0 | 0 | X | X | 0 | | 22% |
| | Describe the wet and dry bulb hydrometer, | 0 | 0 | 0 | 0 | 0 | 0 | X | X | 0 | | 22% |
| | Describe calibration method. | 0 | 0 | 0 | 0 | 0 | 0 | X | X | 0 | | 22% |
| **Gases and Solvents** | Explain industrial uses of: oxygen, hydrogen, nitrogen, carbon dioxide, inert gases, natural and bottled gas. | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | | 33% |
| | Describe acids, bases and solvents: pH; toxicity; flammability | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | | 33% |
| | Explain storage and disposal of chemicals | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | | 33% |
| **Waves** | Define waves | 0 | 0 | 0 | 0 | 0 | X | X | X | 0 | | 33% |
| | Describe types of waves | 0 | 0 | 0 | 0 | 0 | X | X | X | 0 | | 33% |
| | Explain reflection and refraction | 0 | 0 | 0 | 0 | 0 | X | X | X | 0 | | 33% |
| | Describe superposition | 0 | 0 | 0 | 0 | 0 | X | X | X | 0 | | 33% |
| | | | | | | | | | | | | |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab. | |
| **Waves (Continued)** | Conduct the double-slit experiment | 0 | 0 | 0 | 0 | 0 | X | X | X | 0 | 33% |
| | Describe diffraction | 0 | 0 | 0 | 0 | 0 | X | X | X | 0 | 33% |
| | Describe resolving detail | 0 | 0 | 0 | 0 | 0 | X | X | X | 0 | 33% |
| | Explain speed of light and speed of mechanical waves | 0 | 0 | 0 | 0 | 0 | X | X | X | 0 | 33% |
| | Describe standing waves | 0 | 0 | 0 | 0 | 0 | X | X | X | 0 | 33% |
| | Describe polarization | 0 | 0 | 0 | 0 | 0 | X | X | X | 0 | 33% |
| | Describe geometrical effects | 0 | 0 | 0 | 0 | 0 | X | X | X | 0 | 33% |
| | Describe optical instruments | 0 | 0 | 0 | 0 | 0 | X | X | X | 0 | 33% |
| **Sound** | Describe production and propagation of sound | 0 | 0 | 0 | 0 | X | X | X | X | 0 | 44% |
| | Describe properties of Sound | 0 | 0 | 0 | 0 | X | X | X | X | 0 | 44% |
| | Describe frequency and speed of sound | 0 | 0 | 0 | 0 | X | X | X | X | 0 | 44% |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab. | |
| **Sound (Continued)** | Demonstrate application of sound | 0 | 0 | 0 | 0 | X | X | X | X | 0 | 44% |
| **Light** | Describe the electromagnetic spectrum. | 0 | 0 | X | X | X | X | X | X | 0 | 67% |
| | Describe reflection; refraction; total internal reflection; fiber optics; mirrors; lenses; magnifiers, microscopes | 0 | 0 | X | X | X | X | X | X | 0 | 67% |
| | Explain sources of light: comparison of incandescent (GLS), discharge and fluorescent (CFL) lamps. | 0 | 0 | X | X | X | X | X | X | 0 | 67% |
| | Describe interference, diffraction and polarization of light; the spectrometer; optical flats, anti reflection coatings. | 0 | 0 | X | X | X | X | X | X | 0 | 67% |
| **Applying Principles of Magnetism** | Describe magnetic materials | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| | Explain polarity of magnets | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| | Describe demagnetizing materials | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| | Demonstrate magnetic Induction | 0 | 0 | 0 | X | X | X | X | X | X | 67% |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab. | |
| **Applying the Principles of Electromagnetism** | Describe **e**lectrostatics | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| | Describe electrodynamics | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| | Describe electromagnetism | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| | Describe field parameters | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| | Describe application of electromagnetic principles | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| **Applying Principles of Electronics** | Describe semi- conductors | 0 | 0 | 0 | X | X | X | 0 | X | X | 56% |
| | Describe thermionic emission | 0 | 0 | 0 | X | X | X | 0 | X | 0 | 44% |
| | Describe photoelectric effect | 0 | 0 | 0 | X | X | X | 0 | X | 0 | 44% |
| | Describe diodes | 0 | 0 | 0 | X | X | X | 0 | X | 0 | 44% |
| | Describe logic gates | 0 | 0 | 0 | X | X | X | 0 | X | 0 | 44% |
| | | | | | | | | | | | |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab | | |
| **Nuclear Physics** | Describe natural and artificial radioactivity; | 0 | 0 | 0 | 0 | 0 | 0 | X | X | 0 | | 22% |
| | Describe dosage units and environmental limits; | 0 | 0 | 0 | 0 | 0 | 0 | X | X | 0 | | 22% |
| | Describe radiation risks. | 0 | 0 | 0 | 0 | 0 | 0 | X | X | X | | 33% |
| **Stress and Strain** | Define stress and strain | X | 0 | X | X | 0 | 0 | X | X | X | | 67% |
| | Explain Young's Modulus of Elasticity | X | 0 | X | X | 0 | 0 | X | X | X | | 67% |
| | Describe types of stresses and strain | X | 0 | X | X | 0 | 0 | X | X | X | | 67% |
| | State Hooke's Law | X | 0 | X | X | 0 | 0 | X | X | X | | 67% |
| | Carryout experiments on strain and stress | X | 0 | X | X | 0 | 0 | X | X | X | | 67% |
| | Carryout calculations involving strain and stress | X | 0 | X | X | 0 | 0 | X | X | X | | 67% |
| | Apply the principle of strain and stress to trade | X | 0 | X | X | 0 | 0 | X | X | X | | 67% |
| | | | | | | | | | | | | |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab. | |
| **Friction and Machines** | Explain laws of friction | 0 | X | 0 | X | 0 | 0 | X | X | X | 56% |
| | Describe friction | 0 | X | 0 | X | 0 | 0 | X | X | X | 56% |
| | Describe advantages and disadvantages of friction | 0 | X | 0 | X | 0 | 0 | X | X | X | 56% |
| | Explain determination of Friction force between two surfaces | 0 | X | 0 | X | 0 | 0 | X | X | X | 56% |
| | Describe coefficient of friction | 0 | X | 0 | X | 0 | 0 | X | X | X | 56% |
| | Describe lubrication | 0 | X | 0 | X | 0 | 0 | X | X | X | 56% |
| | Explain effects of lubrication on machines | 0 | X | 0 | X | 0 | 0 | X | X | X | 56% |
| | Describe basic properties of oil | 0 | X | 0 | X | 0 | 0 | X | X | X | 56% |
| | Describe friction and wedges | 0 | X | 0 | X | 0 | 0 | X | X | X | 56% |
| | Explain theory of screw thread | 0 | X | 0 | X | 0 | 0 | X | X | X | 56% |
| | Explain mechanical advantage and velocity ratio | 0 | X | 0 | X | 0 | 0 | X | X | X | 56% |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab. | |
| **Frictions and Machines (Continued)** | Explain mechanical efficiency | 0 | 0 | 0 | X | 0 | 0 | X | X | X | 44% |
| | Describe lifting machines | 0 | 0 | 0 | X | 0 | 0 | X | X | X | 44% |
| **Hazards and Control of Electrostatic Discharge (ESD) in Static Workplaces** | Describe types of hazards | 0 | 0 | 0 | 0 | 0 | 0 | X | X | 0 | 22% |
| | Describe control mechanisms | 0 | 0 | 0 | 0 | 0 | 0 | X | X | 0 | 22% |
| **Electricity and Magnetism** | Describe electrostatics and electric fields | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| | Define direct current electricity | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| | Distinguish between primary and secondary cells | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| | Distinguish between simple and complex circuits | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| | Define alternating current | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| | Define magnetic field | 0 | 0 | 0 | X | X | X | X | X | X | 67% |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab. | |
| **Electricity and Magnetism (Continued)** | Define electromagnetism | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| | State laws of electricity and magnetism | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| | Describe application of electricity and magnetism | 0 | 0 | 0 | X | X | X | X | X | X | 67% |
| **Physical Optics** | Describe types of optical instruments and application | 0 | 0 | 0 | X | X | X | X | X | 0 | 56% |
| | Describe electromagnetic wave propagation | 0 | 0 | 0 | X | X | X | X | X | 0 | 56% |
| | Describe polarization and crystal optics | 0 | 0 | 0 | X | X | X | X | X | 0 | 56% |
| | Describe absorption and dispersion | 0 | 0 | 0 | X | X | X | X | X | 0 | 56% |
| | Describe propagation and diffraction | 0 | 0 | 0 | X | X | X | X | X | 0 | 56% |
| | | | | | | | | | | | |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab. | |
| **Units of Measurement and Estimation** | Explain basic S I units | X | X | X | X | X | X | X | X | X | 100% |
| | Explain multiples and submultiples | X | X | X | X | X | X | X | X | X | 100% |
| | Carry out calculations in S I units | X | X | X | X | X | X | X | X | X | 100% |
| | Carry out conversion and estimation of units | X | X | X | X | X | X | X | X | X | 100% |
| | Demonstrate application of S I units | X | X | X | X | X | X | X | X | X | 100% |
| | Measure length, angle and weight | X | X | X | X | X | X | X | X | X | 100% |
| **Algebra** | Explain relevance of algebra | X | X | X | X | X | X | X | X | X | 100% |
| | Explain algebraic expressions | X | X | X | X | X | X | X | X | X | 100% |
| | Solve algebraic equations | X | X | X | X | X | X | X | X | X | 100% |
| | Calculate algebraic fractions | X | X | X | X | X | X | X | X | X | 100% |
| | Solve linear equations | X | X | X | X | X | X | X | X | X | 100% |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab. | |
| **Algebra (Continued)** | Solve exponential Equations | X | X | X | X | X | X | X | X | X | 100% |
| | Carry out workshop calculations | X | X | X | X | X | X | X | X | X | 100% |
| | Solve simultaneous equations | X | X | X | X | X | X | X | X | X | 100% |
| | Solve quadratic equations | X | X | X | X | X | X | X | X | X | 100% |
| | Simplify and evaluate expressions using the properties of *logarithms*. | X | X | X | X | X | X | X | X | X | 100% |
| | Solve exponential Equations | X | X | X | X | X | X | X | X | X | 100% |
| | Carry out workshop calculations | X | X | X | X | X | X | X | X | X | 100% |
| | Solve simultaneous equations | X | X | X | X | X | X | X | X | X | 100% |
| **Solving Problems Involving Mensuration** | Carry out numerical computations | X | X | X | X | X | X | X | X | X | 100% |
| | Define logarithms | X | X | X | X | X | X | X | X | X | 100% |
| | Solve equations involving logarithms | X | X | X | X | X | X | X | X | X | 100% |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab | |
| **Solving Problems Involving Mensuration (Continued)** | Calculate area of plane figures | X | X | X | X | X | X | X | X | X | 100% |
| | Calculate area of regular figures | X | X | X | X | X | X | X | X | X | 100% |
| | Solve mathematical problems involving curves and arcs | X | X | X | X | X | X | X | X | X | 100% |
| | Calculate area of irregular figures | X | X | X | X | X | X | X | X | X | 100% |
| | Calculate volumes of solids | X | X | X | X | X | X | X | X | X | 100% |
| | Apply mensuration area to workshop calculations | X | X | X | X | X | X | X | X | X | 100% |
| **Calculating Trigonometric Equations** | Define trigonometry | X | X | X | X | X | X | X | X | X | 100% |
| | Calculate angles and sides by using the Pythagoras Theorem | X | X | X | X | X | X | X | X | X | 100% |
| | Carryout calculations involving trigonometric ratios (Sine, Cos, Tan) | X | X | X | X | X | X | X | X | X | 100% |
| | Carryout calculations involving Sine Rule | X | X | X | X | X | X | X | X | X | 100% |
| | Carryout calculations involving Cosine Rule | X | X | X | X | X | X | X | X | X | 100% |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab | |
| **Calculating Trigonometric Equations (Continued)** | Apply trigonometry to workshop calculations | X | X | X | X | X | X | X | X | X | 100% |
| **Charts, Graphs and Plotting Graphical Solutions of Equations** | Define a chart | X | X | X | X | X | X | X | X | X | 100% |
| | Construct a chart | X | X | X | X | X | X | X | X | X | 100% |
| | Define a graph | X | X | X | X | X | X | X | X | X | 100% |
| | State the types of graph | X | X | X | X | X | X | X | X | X | 100% |
| | Plot a graph given X and Y axes | X | X | X | X | X | X | X | X | X | 100% |
| | Carry out graphical calculations | X | X | X | X | X | X | X | X | X | 100% |
| | Present data in various graphical forms | X | X | X | X | X | X | X | X | X | 100% |
| | Draw graphs demonstrating reduction of non-linear laws to linear form | X | X | X | X | X | X | X | X | X | 100% |
| | Draw graphs with logarithmic scales. | X | X | X | X | X | X | X | X | X | 100% |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab | |
| **Co-ordinates Geometry** | Explain two-dimensional Cartesian plane | X | X | X | X | 0 | 0 | X | X | X | 78% |
| | Determine distance in the Cartesian plane | X | X | X | X | 0 | 0 | X | X | X | 78% |
| | Solve equations of lines | X | X | X | X | 0 | 0 | X | X | X | 78% |
| | Construct circles and tangents | X | X | X | X | 0 | 0 | X | X | X | 78% |
| | Construct polar co-ordinates in 2D | X | X | X | X | 0 | 0 | X | X | X | 78% |
| | Construct three dimensional Cartesian axes | X | X | X | X | 0 | 0 | X | X | X | 78% |
| | Construct graphs of quadratic functions | X | X | X | X | 0 | 0 | X | X | X | 78% |
| **Equations** | Solve equations in one variable | X | X | X | X | X | X | X | X | X | 100% |
| | Solve simultaneous equations | X | X | X | X | X | X | X | X | X | 100% |
| | Solve quadratic equations | X | X | X | X | X | X | X | X | X | 100% |
| | | | | | | | | | | | |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab. | |
| **Variations** | Solve direct variation problems | X | X | X | X | 0 | 0 | X | X | X | 78% |
| | Solve inverse variations | X | X | X | X | 0 | 0 | X | X | X | 78% |
| **Sequences and Series** | Use summation notation to explore series. | X | X | X | X | 0 | X | X | X | X | 89% |
| | Recognize and use simple sequences. | X | X | X | X | 0 | X | X | X | X | 89% |
| | Recognize and use geometric sequences. | X | X | X | X | 0 | X | X | X | X | 89% |
| **Applying Fundamental Calculations** | Calculate ratio and proportion | X | X | X | X | X | X | X | X | X | 100% |
| | Calculate rates | X | X | X | X | X | X | X | X | X | 100% |
| | Round off figures | X | X | X | X | X | X | X | X | X | 100% |
| | Calculate averages | X | X | X | X | X | X | X | X | X | 100% |
| | Evaluate fractions | X | X | X | X | X | X | X | X | X | 100% |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab. | |
| **Applying Fundamental Calculations (Continued)** | Convert fractions to decimals and percentages | X | X | X | X | X | X | X | X | X | 100% |
| | Convert numbers from standard form to decimal form or vice versa | X | X | X | X | X | X | X | X | X | 100% |
| | Solve fractions and percentages as applied to the course. | X | X | X | X | X | X | X | X | X | 100% |
| | Apply law of indices | X | X | X | X | X | X | X | X | X | 100% |
| | Define a ratio and a proportion | X | X | X | X | X | X | X | X | X | 100% |
| | Evaluate ratios and proportions | X | X | X | X | X | X | X | X | X | 100% |
| | Solve ratios and proportions as applied to the course | X | X | X | X | X | X | X | X | X | 100% |
| | Apply fundamental calculations to workshop calculations | X | X | X | X | X | X | X | X | X | 100% |
| | Demonstrate functions of a scientific calculator | X | X | X | X | X | X | X | X | X | 100% |
| | | | | | | | | | | | |

**Appendix D. Portable Technical Skills across Nine Occupations (Continued)**

| Skill Areas | Competencies | OCCUPATIONS | | | | | | | | | % of skill incidence out of 9 occupations |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Construction | | | Electrical Engineering | | | Mechanical Engineering | | | |
| | | Building | Carpentry | Painting | Electrical | Electronic | Telecom | Fitting | Machining | Metal Fab. | |
| **Using the Binary Number System** | Explain binary system | X | X | X | X | X | X | 0 | 0 | X | 78% |
| | Explain conversions from decimal to binary and vice versa | X | X | X | X | X | X | 0 | 0 | X | 78% |
| | Demonstrate application of binary System | X | X | X | X | X | X | 0 | 0 | X | 78% |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

**Appendix E**

**Minutes of Focus Group, Instructors**

**MEMBERS PRESENT**

1. Mr. A.K.S. - Co-investigator
2. Mr. R.N.
3. Mr. M.J. N.
4. Mr. A. L.
5. Mr.C. M.
6. Mr.E. B. - Secretary

**1.0 INTRODUCTION OF THE WORKSHOP**

The Co-investigator welcomed everyone to the meeting and explained the objectives and methods to be used by the group. Members were encouraged to participate freely and assured them that their individual views were going to be respected.

**2.0 IRB CONSENT FORM**

Each participant was given an IRB consent form and the conditions of the project were read, signed and given back to the Co-investigator.

**3.0 ANALYSE THE DATA GIVEN**

An examination of an inventory of portable skills was given to each participant according to their areas of specification. These were analyzed and verified relating to each programme that had been accurately identified from the syllabus.

**4.0 CORRECTION OF DATA**

Each member participated in a focus group discussion with colleagues from other occupations.

**5.0 SUMMARIZING OF THE DATA CORRECTED**

Summary of results was tabulated as shown in Tables 5(a) and 5 (b).

**Table 5(a).*Distribution of Technical Portable Skills between Pairs of Occupational Areas within Clusters of Occupational Programs.***

| CLUSTER | Pairs of Occupations | Total Portable Skills Between Each Pair | Average Number of Portable Skills between Pairs | Ranking of Pairs According to Strength of relationship |
|---|---|---|---|---|
| Construction | Building (Masonry) with Carpentry and Joinery | 285 | 259 | 7 |
| | Building (Masonry) with Painting, decoration, and Graphics. | 238 | | 9 |
| | Carpentry and Joinery with Painting, decoration, and Graphics. | 255 | | 8 |
| Electrical Engineering | Electrical Craft with Electronic Systems Maintenance. | 319 | 338 | 6 |
| | Electrical Craft with Telecommunications Repair. | 337 | | 5 |
| | Electronic Systems Maintenance with Telecommunications Repair. | 357 | | 4 |
| Mechanical Engineering | Fitting with Machining | 504 | 465 | 1 |
| | Fitting with Metal Fabrication | 459 | | 2 |
| | Machining with Metal Fabrication | 431 | | 3 |

**Table 5(b)** ***Portable Technical Skills across Clusters of Occupational of Occupational Programs (as identified by instructors).***

| CLUSTER | Occupational Areas | Portable Skills Between Pair | Ranking |
|---|---|---|---|
| Construction With Electrical | Building (Masonry) with Electrical Craft | 304 | 15 |
| | Building (Masonry) with Electronic Systems Maintenance. | 239 | 22 |
| | Building (Masonry) with Telecommunications Repair. | 242 | 21 |
| | Carpentry and Joinery with Electrical Craft | 300 | 16 |
| | Carpentry and Joinery with Electronic Systems Maintenance | 233 | 25 |
| | Carpentry and Joinery with Telecommunications Repair | 245 | 20 |
| | Painting, decoration with Electrical Craft | 75 | 26 |
| | Painting, decoration with Electronic Systems Maintenance | 235 | 24 |
| | Painting, decoration with Telecommunications Repair | 238 | 23 |
| Construction With Mechanical Engineering | Building (Masonry) with Fitting | 313 | 12 |
| | Building (Masonry) with Machining | 312 | 13 |
| | Building (Masonry) with Metal Fabrication | 326 | 10 |
| | Carpentry and Joinery with Fitting | 311 | 14 |
| | Carpentry and Joinery with Machining | 313 | 12 |
| | Carpentry and Joinery with Metal Fabrication | 322 | 11 |
| | Painting, decoration with Fitting | 270 | 19 |
| | Painting, decoration with Machining | 273 | 17 |
| | Painting, decoration with Metal Fabrication | 272 | 18 |
| Electrical With Mechanical Engineering | Electrical Craft with Fitting | 403 | 3 |
| | Electrical Craft with Machining | 416 | 2 |
| | Electrical Craft with Metal Fabrication | 433 | 1 |
| | Electronic Systems Maintenance with Fitting | 348 | 6 |
| | Electronic Systems Maintenance with Machining | 346 | 7 |
| | Electronic Systems Maintenance with Metal Fabrication | 334 | 9 |
| | Telecommunications Repair with Fitting | 364 | 4 |
| | Telecommunications Repair with Machining | 362 | 5 |
| | Telecommunications Repair with Metal Fabrication | 339 | 8 |
| All Clusters | All Occupational areas | 219 | |

## 6.0 RESPONDING TO THE RESEARCH QUESTIONS

The procedure was as follows:-

**Generation of ideas**

Participants were asked to independently write down their responses to the question for instructors. From the list that each member had written, members were then asked to present one idea each, which was recorded by the Co-investigator on a white board. Each participant then took turns in giving one response at a time in round-robin fashion until all their responses were recorded by verbatim on the white board as listed below:

Portable technical skills facilitate multi-skilling;

1. Portable skills will encourage harmonization of the syllabi and curriculum of different courses;
2. Awareness of portable technical skills allows a common approach of delivery where these portable skills can be delivered by one instructor/lecturer to all the different groups whilst the others concentrate on other duties.
3. Team teaching should be encouraged;
4. Students wishing to learn additional trades will only have to focus on non-portable technical skills;
5. Awareness of portable technical skills makes instructors appreciate one another's knowledge and skills;
6. Portable technical skills facilitate inter-disciplinary collaboration;
7. Portable technical skills encourage joint planning of schemes of work for instructors

**ANALYSIS OF GENERATED IDEAS**

Once all the responses had been collected, the Co-investigator led a discussion meant toclarify the responses recorded and each participant was again presented with the three (3) generated ideas which were analysed and ranked according to priority. Each

idea was ranked in order of importance i.e (3=Most important, 2=important,

1=Least important).

During the discussion, the group was further expanded to include the following individuals listed below:

Mr.B.N, Mr.R.L, Mr.T.T.K, Mr.K.K, Mr.D.N,

Mr.R.K.,Mr.M.C., and Ms.J.M..

The voting was done anonymously and the ranking for each were summarised as follows in tables I and II:

Results of the Instructors' Focus Group

| Rank | GENERATED IDEA | RANKINGS FROM PARTICIPANTS | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | M.C | J.M | B.N | D.N | K.K | T.T.K | R.L | R.K | EB | RN | MJ | AL | CM | Total Score | Weighted Average (Total score/No. of participants) |
| 3 | Awareness of portable technical skills allows a common approach of delivery where these portable skills can be delivered by one instructor/lecturer to all the different groups whilst the others concentrate on other duties | 2 | 2 | 1 | 2 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 18 | 1 |
| 1 | Portable skills facilitate multi-skilling. Students wishing to learn additional trades will only have to focus on the non-portable skills because they will already have learned the portable skills relevant to the new trade. | 3 | 1 | 3 | 3 | 1 | 3 | 2 | 3 | 3 | 2 | 3 | 2 | 3 | 32 | 3 |
| 2 | Portable skills will encourage harmonization of the syllabi and curriculum of different courses. | 1 | 3 | 2 | 1 | 2 | 2 | 3 | 2 | 2 | 3 | 2 | 3 | 2 | 28 | 2 |

Scale: 1= Least important; 2 = important; 3 = Most important

## 7.0 SUMMARIZING OF THE DATA

The voting was done anonymously and the items were prioritized and ranked in order of Importance as listed below:-

| NO | Agreed Points | RANKINGS |
|---|---|---|
| 1. | Awareness of portable technical skills allows a common approach of delivery where these portable skills can be delivered by one instructor/lecturer to all the different groups whilst the others concentrate on other duties | 3 (most important) |
| 2. | Portable skills facilitate multi-skilling. Students wishing to learn additional trades will only have to focus on the non-portable skills because they will already have learned the portable skills relevant to the new trade. | 1 (least important) |
| 3. | Portable skills will encourage harmonization of the syllabi and curriculum of different courses. | 2 (important) |

Below is the final ranking of the response to the Research Question for Instructors in order of importance:

1. Awareness of portable technical skills allows a common approach of delivery where these portable skills can be delivered by one instructor/lecturer to all the different groups whilst the others concentrate on other duties
2. Portable skills will encourage harmonization of the syllabi and curriculum of different courses.
3. Portable skills facilitate multi-skilling. If students wish to learn additional trades, they will only need to focus on the non-portable skills because they will already have learned the portable skills relevant to the new trade.

.

## 8.0 OUT PUT (I)

**Information about participants**

| Initials | Qualifications | Yrs of Experience | Current Position |
|---|---|---|---|
| A.K.S | BA. Tech. Educ. | 30 | Principal |
| R.N | Cert. Painting<br>Dip. Tech. Education | 16 | Lecturer |
| M.J. | Cert. Carpentry<br>Dip. Tech. Education | 16 | Lecturer |
| A. L | Cert. Building | 16 | Lecturer |

| | | | |
|---|---|---|---|
| | Dip. Tech. Educ. | | |
| E. B | Metal Fab-Tech. | 13 | Lecturer |
| | Dip. Tech. Educ. | | |
| C.M | Electrical Tech. | 6 | Lecturer |

**OUT PUT (II)**

**Information about participants included.**

| Initials | Qualifications | Yrs of Experience | Current Position |
|---|---|---|---|
| B.N | Dip. Agric.Eng. | 16 | Lecturer |
| | Dip. Tech.Educ. | | |
| J.M | Cert.Plumbing/Sheetmetal | 03 | Lecturer |
| R.L | Cert. Metal Fab | 07 | Lecturer |
| K.K. | BA.Elect. Eng. | 01 | Lecturer |
| T.T.K | BA.Mech. Eng | 01 | Lecturer |
| D.N | BA.Elect. Eng | 01 | Lecturer |
| R.K | BA.Mech. Eng. | 01 | Lecturer |
| M.C | Dip. Electrical | 06 | Lecturer |

## 9.0 CLOSING REMARKS

The Co-investigator thanked everyone for participating in the discussion and the meeting was officially closed at 19:30 hours.

Co-investigator: …… Date:……

Secretary:…… Date:……

Appendix F

**Minutes of Focus Group, Employers**

**MEMBERS PRESENT**

7. Mr. A.K.S. - Co-investigator
8. Mr.L. R.B.
9. Mr. K.T
10. Mr. M.K
11. Mr.B.M. M.
12. Mr.A. B
13. Mr.C. L
14. Mr.C. P
15. Mr.E. B. - Secretary

**1. INTRODUCTION OF THE WORKSHOP**

The Co-investigator welcomed the participants to the meeting and explained the objectives and methods to be used by the group. He thanked them for deciding to take part in the discussion despite being invited at short notice. He further informed them that the information that they will provide was going to be respected and will assist in the awareness and development of training programmes that would enhance the capacities and capabilities of the society and communities in the country since their experiences and knowledge in practicing the acquired skills would be of much help to the overview of the exercise.

**2. IRB CONSENT FORM**

Each participant was given an IRB consent form and the conditions of the project were read, signed and given back to the Co-investigator.

**3. ANALYSE THE DATA GIVEN**

An examination of an inventory of portable skills was given to each participant according to their areas of specialization. These were analyzed and verified relating to each program (s) that had been accurately identified from the syllabus.

**4. CORRECTION OF DATA**

Each member participated in a focus group discussion with colleagues from other occupations.

## 5. SUMMARIZING OF THE DATA CORRECTED

The analysis of the competence lists for the above mentioned occupations of portable skills was Summarized and the results are tabulated in Table 5(a) and (b).

**Table 5(a).*Distribution of Technical Portable Skills between Pairs of Occupational Areas within Clusters of Occupational Programs.***

| CLUSTER | Pairs of Occupations | Total Portable Skills Between Each Pair | Average Number of Portable Skills between Pairs | Ranking of Pairs According to Strength of relationship |
|---|---|---|---|---|
| Construction | Building (Masonry) with Carpentry and Joinery | 285 | 259 | 7 |
| | Building (Masonry) with Painting, decoration, and Graphics. | 238 | | 9 |
| | Carpentry and Joinery with Painting, decoration, and Graphics. | 255 | | 8 |
| Electrical Engineering | Electrical Craft with Electronic Systems Maintenance. | 319 | 338 | 6 |
| | Electrical Craft with Telecommunications Repair. | 337 | | 5 |
| | Electronic Systems Maintenance with Telecommunications Repair. | 357 | | 4 |
| Mechanical Engineering | Fitting with Machining | 504 | 465 | 1 |
| | Fitting with Metal Fabrication | 459 | | 2 |
| | Machining with Metal Fabrication | 431 | | 3 |

**Table 5(b)** ***Portable Technical Skills across Clusters of Occupational of Occupational Programs (as identified by instructors).***

| CLUSTER | Occupational Areas | Portable Skills Between Pair | Ranking |
|---|---|---|---|
| Construction With Electrical | Building (Masonry) with Electrical Craft | 304 | 15 |
| | Building (Masonry) with Electronic Systems Maintenance. | 239 | 22 |
| | Building (Masonry) with Telecommunications Repair. | 242 | 21 |
| | Carpentry and Joinery with Electrical Craft | 300 | 16 |
| | Carpentry and Joinery with Electronic Systems Maintenance | 233 | 25 |
| | Carpentry and Joinery with Telecommunications Repair | 245 | 20 |
| | Painting, decoration with Electrical Craft | 75 | 26 |
| | Painting, decoration with Electronic Systems Maintenance | 235 | 24 |
| | Painting, decoration with Telecommunications Repair | 238 | 23 |
| Construction With Mechanical Engineering | Building (Masonry) with Fitting | 313 | 12 |
| | Building (Masonry) with Machining | 312 | 13 |
| | Building (Masonry) with Metal Fabrication | 326 | 10 |
| | Carpentry and Joinery with Fitting | 311 | 14 |
| | Carpentry and Joinery with Machining | 313 | 12 |
| | Carpentry and Joinery with Metal Fabrication | 322 | 11 |
| | Painting, decoration with Fitting | 270 | 19 |
| | Painting, decoration with Machining | 273 | 17 |
| | Painting, decoration with Metal Fabrication | 272 | 18 |
| Electrical With Mechanical Engineering | Electrical Craft with Fitting | 403 | 3 |
| | Electrical Craft with Machining | 416 | 2 |
| | Electrical Craft with Metal Fabrication | 433 | 1 |
| | Electronic Systems Maintenance with Fitting | 348 | 6 |
| | Electronic Systems Maintenance with Machining | 346 | 7 |
| | Electronic Systems Maintenance with Metal Fabrication | 334 | 9 |
| | Telecommunications Repair with Fitting | 364 | 4 |
| | Telecommunications Repair with Machining | 362 | 5 |
| | Telecommunications Repair with Metal Fabrication | 339 | 8 |
| All Clusters | All Occupational areas | 219 | |

## 6. RESPONDING TO THE RESEARCH QUESTIONS

QUESTION:*"In what ways can the List of Portable Technical Skills that have been presented to you be used to respond to labour demands in your enterprise?"*

The procedure used was as follows:-

**Generation of ideas**

Participants were asked to independently write down their responses to the question for instructors. From the list that each member had written, members were then asked to present one idea each, which was recorded by the Co-investigator on a white board. Each participant then took turns in giving one response at a time in round-robin fashion until all their responses were recorded by verbatim on the white board as listed below:

1. Portable technical skills enable Informal Micro-Enterprises (IME) to save money;
2. IMEs employ smaller labor force because of portable technical skills;
3. With the use of portable technical skills, employees are capable of doing tasks from more than one occupation;
4. Portable technical skills have been used effectively and efficiently in the IME sector;
5. There is need to put more emphasis on entrepreneurship skills to prepare graduates for a wider range of jobs and future personal developments;
6. Training institutions should design and conduct short training programmes focusing on portable technical skills to give graduates the flexibility and adaptability needed in informal sector industries;
7. Training programs offered by formal training institutions are not responsive to the needs of the IME sector;
8. Linkages between training providers and the Informal Sector should be encouraged so as to enable institutions improve on their instructional abilities and skills that are related to informal labour markets.

## 7. ANALYSIS OF GENERATED IDEAS

Once all the responses had been collected, the Co-investigator led a discussion meant toclarify the responses recorded and each participant was again presented with the three (3) generated ideas which were analysed and ranked according to priority.

Each idea was ranked in order of importance i.e (3=Most important, 2=important, 1=Least important).

The voting was done anonymously and the ranking for each were summarized as follows in tables 7:

Table 7

| NO | GENERATED IDEA | RANKINGS FROM PARTICIPANTS | | | | | | | | Weighted Average (Total Score/No of Participants) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | L.R.B | K.T | M.K | M.K | B.M.M | C.L | C.F | Total Score | |
| 1. | Training institutions should design and conduct short training programmes focusing on portable technical skills to give graduates the flexibility and adaptability needed in informal sector industries | 2 | 2 | 3 | 2 | 3 | 1 | 1 | 14 | 2 |
| 2. | Portable technical skills have long been used effectively and efficiently in the Informal Sector but there is need to enhance the development of entrepreneurship skills in order to prepare graduates for a wider range of jobs and future personal developments. | 3 | 3 | 1 | 3 | 2 | 3 | 3 | 18 | 3 |
| 3. | Training programmes offered at present are not responsive to the needs of the Informal Sector, promotion of linkages between training providers and the Informal Sector should be encouraged so as to enable institutions improve on their instructional abilities and skills that are related to informal labour markets | 1 | 1 | 2 | 1 | 1 | 2 | 2 | 10 | 1 |

Scale: 1=Least important; 2=important; 3=most important.

## 8. SUMMARIZING OF THE DATA

Below is the final ranking of the response to the Research Question for the Informal Sector in order of importance:

1. ***Training Programmes offered at present are not responsive to the needs of the Informal Sector, promotion of linkages between training providers and the Informal Sector should be encouraged so as to enable institutions improve on their instructional abilities and skills that are related to informal labour markets.***

2. ***Training institutions should design and conduct short training programmes focusing on portable technical skills to give graduates the flexibility and adaptability needed in informal sector industries.***

3. ***Portable technical skills have long been used effectively and efficiently in the Informal Sector but there is need to enhance the development of entrepreneurship skills in order to prepare graduates for a wider range of jobs and future personal developments.***

## 9. OUT PUT

**Information about participants**

| Initials | Qualifications | Yrs of Experience | Activities | Current Position |
|---|---|---|---|---|
| L.R.B | Dip. Metal Fab. | 16 | Fabrication | Director |
| K.T | Trade Cert..<br>- Metal Fab.<br>- Auto. Mech.Fitting.<br>- Machining.<br>- Fitting. | 10 | Fabrication<br>Machining | Director |
| M.K | Trade Cert.<br>-Instrumentation<br>-Telecommunication<br>-Electrical | 10 | Instrumentation<br>Electrical<br>Telecoms | Director |
| B.M.M | Cert. Metal Fab. | 4 | Fabrication | Supervisor |
| A.B | Cert. Wood Mach. | 6 | Wood Mach. | Supervisor |
| C.L | Trade Cert.<br>-Wood Mach. | 16 | Building Matl. | Director |
| C.P | Trade Cert.<br>-Building | 7 | Building | Director |

**10. <u>CLOSING REMARKS</u>**

The Co-investigator thanked the participants for their attendance, valuable time and information presented during the discussion and the meeting was officially closed at 19:45 hours.

Co-investigator: …… Date:……

Secretary:…… Date:……