PEDAGOGICAL PRACTICES OF LECTURERS IN AUTOMOTIVE MECHANICS IN VOCATIONAL TRAINING IN SWAZILAND: THREE INSTITUTIONAL CASE STUDIES

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EXAMINER'S COPY

DECLARATION

Submitted in fulfilment of the requirements for the degree of **Doctor of Philosophy** in the Graduate Programme in **Humanities,** University of KwaZulu-Natal, Pietermaritzburg, South Africa.

I, **Musa Thabang Mokoena**, declare that:

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14 AUGUST 2017
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Abstract

This thesis explores the pedagogical practices used by lecturers in vocational training programmes for automotive mechanic students in Swaziland. It seeks to determine the process which training institutions use to specialize students into automotive mechanics, the levels of practical abilities students acquire during training and how this can be analysed using existing theories for vocational training.

The research involves case studies of three vocational institutions offering automotive mechanics as a specialization in Swaziland, with a focus on the first year of training. Evidence is obtained from semi-structured interviews with lecturers, observations of classroom and workshop activities and course documents, as well as other relevant documents, such as those from the directorate dealing with trade testing. The research is qualitative and follows the descriptive and interpretive research paradigm, using a combination of deductive and inductive reasoning to relate themes that arise from the data to existing theory and to allow new themes that emerge to be explored in their own terms.

The research uses the framework for vocational pedagogy developed by Lucas, Spencer and Claxton (2012) as well as other tools found in the literature which facilitate analysis of the theoretical aspects of vocational pedagogy. Using a thematic analysis approach, the research found that lecturers typically relied on exploratory and demonstrative approaches in their lessons. Applying Lucas et al.'s (2012) conceptual framework of six desired vocational outcomes to the pedagogical practices observed in these lessons, the study found that the lecturers' exploratory and demonstrative approaches focussed primarily on achieving the vocational outcome of *routine expertise*, while half of the lessons also addressed the vocational outcomes of *resourcefulness* and *craftsmanship*.

Aspects of the vocational outcome of *business-like attitudes* were documented to a smaller extent, while the outcomes of *wider skills for growth* and *functional literacies* were not observed.

The teaching methods that lecturers used most often while teaching first year automotive mechanics students, and which were embedded in their exploratory and demonstrative approaches, were *learning by practicing (trial and error), learning by watching*, and *learning by imitation.* These methods are identified in Lucas et al.'s (2012) framework as supporting education within the broader category of *physical materials* in which automotive mechanics falls. The core method used in the exploratory approach was *learning by practicing (trial and error),* while when using the demonstrative approach, the lecturers employed the methods *learning by watching*, *learning by imitation*, and *learning by practicing (trial and error),* which all constitute forms of demonstration.

The fact that the pedagogical practices used by the lecturers in this study were focused heavily on achieving only vocational outcome – *routine capacity* –suggests that the lecturers' existing repertoire of pedagogic practices is inadequate for achieving the remaining five vocational outcomes which Lucas et al (2012) argue are essential for attaining vocational competence in the 21st century. This study proposes that when all six vocational outcomes are achieved in vocational education, a student's competence may reach the level of *transversal abilities* – which is only the third of five levels in a student's epistemic ascent, as conceptualised by Winch (2014). This thus provides for the level of *technique* for which the first year automotive mechanics lecturer pedagogy prepares students, as well as the second level of *skill* as conceptualised by Winch (2014). Tied to the pedagogical practices used by lecturers were the contexts that limited their ability to

achieve the six vocational outcomes in their teaching. These included the lecturers' own backgrounds, in terms of their vocational education and exposure to research-informed pedagogies, the demographics of the learners who study automotive mechanics and the limited resources available for vocational training and lack of workplace attachment opportunities available to students.

ACKNOWLEDGEMENT

I would first like to acknowledge my supervisor, Prof Wayne Hugo, of the Department of Education at the University of KwaZulu-Natal (Pietermaritzburg campus), for his oversight role in guiding this research from its conception to finality. He is a genuine man who would never do your work for you, but who would give of his time to engage with you in order to broaden your thinking.

I owe it to my family for tolerating the long hours when I was either away, or sitting in the same room but disconnected from them: reading, writing, or thinking through my work. I am, in particular, indebted to my wife, Khanyisile Mokoena, for convincing me to pursue my PhD, when I initially had dilly-dallied about doing it. My children, Nomsa, Leeto, Naleli and Mqo, watched amusedly from the sidelines – with Nomsa occasionally pushing me on, and Leeto interrupting me continually. I recognize my mother, Elina Sonakele Malindzisa, who, despite her age and ill health, has always believed in me although she did not know all the details of what I was doing. She would call me even when I was away consulting, only to tell me that my dog, Tasman, had broken off his leash and eaten her chickens.

There are others who, merely through their genuine intention to be of service to others, made some contribution which has benefitted this thesis. These include the two lecturers from each of the three institutions teaching automotive mechanics in Swaziland. They know who they are, and their participation has made a significant contribution to understanding of issues related to the training of automotive mechanics in Swaziland. On the many occasions when my laptop would misbehave, or I couldn't find my equipment, or I was not sure how to do something, Musa Nyawo was always willing to assist. Even when he, like me, would initially fail to solve a problem, he would not give up until the problem gave in. To all these people: thank you; I owe this to you.

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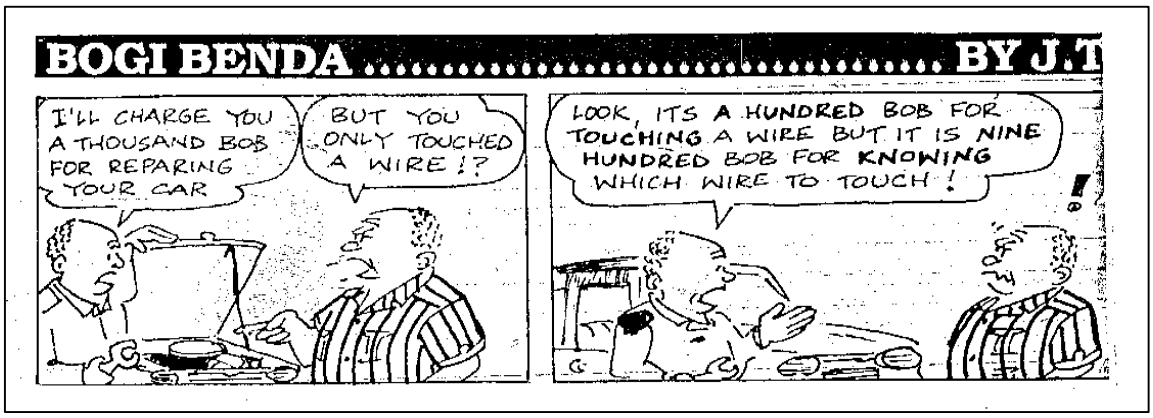
List of acronyms

BDC	Bottom Dead Centre
B. Tech	Bachelor of Technology
CEO	Chief Executive Officer
CPM	Construction Plant Mechanic
CTA	Central Transport Administration
DIVT	Directorate of Industrial and Vocational Training
FET	Further Education
GTZ	German Technical Cooperation
HND	Higher National Diploma
HT	High Tension
ICT	Information and Communication Technology
IVET	Initial Vocational Education and Training
MITC	Manzini Industrial Training Centre
MVT	Motor Vehicle Technician
NQF	National Qualifications Framework
Ph.D.	Doctor of Philosophy
SCOT	Swaziland College of Technology
SGCSE	Swaziland General Certificate in Secondary Education
STIs	Sexually Transmitted Infections
TDC	Top Dead Centre
TVET	Technical and Vocational Education and Training
UK	United Kingdom
VET	Vocational Education and Training
VID	Vocational Instructor Diploma
VOCTIM	Vocational and Commercial Training Centre Matsapha
VUT	Vaal University of Technology
WDA	Workforce Development Agency
ZPD	Zone of Proximal Development

Chapter 1: Introduction



1.1 Introduction

When I first saw the cartoon above pinned on the wall of an automotive workshop at Gwamile VOCTIM during the data collection phase of this research project, I thought that it resonated with my research project in that, underlying the practice of a trained automotive mechanic, are the pedagogic practices used by the lecturers in the vocational programme in which he or she was trained. These broad pedagogical practices may result in the attainment of a level or levels of competence in which the knowledge, the curriculum and the broad pedagogy connect. This connection may bring the student to a level where both the know-how and the knowledge that informs the know how ultimately influence the observable actions of the mechanic in his or her work. This thesis seeks to understand how this comes about. The title of this thesis is "*Pedagogical Practices of Lecturers in Automotive Mechanics in Vocational Training in Swaziland: Three Institutional Case Studies*".

The case studies were conducted at three of the vocational training institutions where automotive specialization is taught in Swaziland, and which constitute the bulk of formal specialization in automotive mechanics. The research seeks to answer the research question:

> What pedagogical practices do lecturers in automotive mechanics use to train first year students and what levels of competence do these achieve?

The research will attempt to answer this broad question in three specific ways:

1. What pedagogical practices do lecturers use in training first year automotive mechanics students?
2. What competencies or capabilities do the first year students attain as a result of these pedagogical processes used by lecturers, and how do these competencies or capabilities relate to the concept of epistemic ascent?
3. What role do apprenticeship or workplace attachment opportunities play in complementing or augmenting first year automotive mechanics capabilities or competencies?

I shall be using the word 'specialization' to refer to all of the training that occurs within a vocational education institution that develops a student's competencies to the level of a tradesman. Lecturers who train these students for these trades will be said to 'specialize' these students.

This research is significant in that it brings to the public domain research-informed discourse in the training of automotive mechanics in Swaziland; first, in terms of establishing an understanding of what it entails, and possibly how it relates to the sustenance of the automotive mechanics trade or maintenance of vehicles in the Swazi setting; and second, in providing the first evidence-based inquiry into this area of vocational training. While lecturers continue to specialize students in various vocational specializations in the country, no research had to date been done in this area. Even the broader area of vocational education has been neglected by researchers, resulting in policy makers and academicians engaging with issues of vocational education from a generalist perception. The dangers of this may be onerous – particularly considering that academicians carry with them intellectual credibility. When they propagate a perception, even when that perception is not premised on researched evidence, the rest of the people listen.

I will next give an account of how this research was inspired.

As the principal of a vocational institution that specializes in automotive mechanics, I had long observed students begin their programme and slowly develop competence as

automotive mechanics and was curious about the pedagogies that the lecturers used to develop them from novice to expert. Many times I would see someone who been trained at a vocational education training institution fix a car that had a problem and wonder whether their skill was just a matter of know how or if they relied on some understanding of the theory behind a system. I myself come from a background in the humanities and had only limited exposure to technical subjects (technical drawing, metal work and woodwork) when I was at secondary school. Though I later worked in vocational education and training institutions teaching academic communication skills, and was involved to some extent in education for trainee teachers and vocational instructors, my 'understanding' of automotive mechanics and electrical engineering was limited.

I was drawn closer to automotive mechanics as a specialization by my first car, a pre-used Opel Kadett which had all sorts of problems. Almost every week I would have it brought to an automotive mechanics lecturer at the Swaziland College of Technology; sometimes his students would assist him with it. Through my experience with this (and later cars which the students and lecturers also helped me with) I not only developed a basic understanding of some aspects of car mechanics but also developed an interest in learning more about what practices or activities occurred in the workshops and classrooms that were used to specialize students into automotive mechanics.

There was yet another reason that motivated me to learn more about what students' specialization in automotive mechanics entailed. Long before I had ever driven a car, I would wonder how someone could open the bonnet of car and know which engine part or wire to examine. Bogi Benda, in the comic strip shown at the beginning of the chapter, charges only a hundred *bob* for touching a wire and nine hundred *bob* for knowing which wire to touch. A piece of wisdom I pick up from this is that the knowledge and trade competency required to be an automotive mechanic involves both know how and the theoretical knowledge which underpins it. There were times when I would see a student carry out a repair procedure – like bleeding brakes or dismantling and refitting brake shoes – yet he or she did not know how to drive. I found this fascinating.

Below, I outline the structure of this thesis with respect to answering the research questions.

1.2 Thesis Structure

Chapter two of this thesis first explores the context of vocational education systems through literature as a basis for understanding the education system of Swaziland. It then explores the vocational education and training context in Swaziland within which automotive training takes place, including some background on the operations of the Directorate of Industrial and Vocational Training (DIVT) which does national trade testing for vocational skills. At this stage I attempt to provide the setting in which these occur without delving into issues surrounding vocational education and training in depth as these are handled in the main in the literature section (chapter 3), as well as elsewhere in this work (chapters 5 and 6). As there is little published literature available which addresses the provision of vocational education and training – specifically with regard to automotive mechanics – in Swaziland, I was required to make use of in-house documents for some parts of this section.

For the Swaziland College of Technology, I have referred to in-house documents such as the prospectus, historical notes and course documents, among others, as well as making use of personal accounts given by lecturers who have been part of some of the key events. These mainly relate to events that happened from the early 1980s onwards, with my own personal experience of these events starting in 1989 when I first began working at the institution. For Gwamile VOCTIM I have referred to similar documents, including my own account beginning in 2009 when I joined the institution, and interviews with two lecturers who were present in 1987 when the institution was founded. For MITC I also used similar documents, along with an interview with the director of the Skills Centres.

Chapters 3 and 4 cover the literature review and the methodology used in this research, respectively. The former chapter explores the discourse in vocational education pedagogy and relates this to the Swazi context in which automotive specialization is carried out, while the latter chapter charts the methodology and methodological considerations that form the basis of this research.

Chapters 5 and 6 present the thematic analysis of the data in its entirety. Within them they carry the loci of the findings as informed by the research questions. I detail the findings

and engage on the issues and themes that arise in the data. Given that both deductive and inductive methodologies were used, some of the issues that emerged were not directly linked to theory. Chapter 5 explores the pedagogical practices of lecturers documented in this study and chapter 6 looks at apprenticeship, as an emergent theme, within the repertoire of lecturers' pedagogical practices.

Chapter 7 provides a summary of the main findings of this research in terms of the research questions. It sums out the significant findings of the research as they relate to the theoretical frameworks on which the data was tested, suggesting what implications these have for the training of automotive mechanics in Swaziland.

Chapter 2: Vocational Education and Training in Swaziland

2.1 The Context for Vocational Education Systems

This chapter first explores vocational education systems through the literature, before navigating vocational education and training in the context of Swaziland. A conceptual model is discussed that represents the distinctive ways in which skill development is structured in different countries. The model allows for diversity in VET systems in a country or between countries in terms of building occupational capability. The vocational education systems that are considered here provide a conceptual framework through which the vocational education system in Swaziland can be interrogated and understood.

The terrain of vocational education and training (VET) is under scrutiny even within the European Union (EU) as economic growth patterns are shifting, placing demands on the calibre of an educated and skilled workforce. According to Murray and Polesel (2013), the twin challenges of globalization and Europeanization in the EU have led to the development of transnational approaches to common problems. They indicate that Australia and Member States of the EU such as Denmark have continued to remain largely autonomous in their vocational education and training policies; this has been so despite the fact that these member states have been equally affected by the pressures of globalization. Denmark has a coordinated market economy with a high commitment to vocational training based on a strong apprenticeship system (ibid). As is the case in Germany, they explain, skills training is structured around institution-based training and work-based training; however, the Danish system allows for secondary education until the age of sixteen, with 60% of young people entering university education and about 30% entering vocational education. The system provides extensive adult learning opportunities beyond initial skills training, supported by the input of employers, trade unions and the Ministry of Education (ibid). The system is thus responsive to the skills needs of the country. In contrast, Murray and Polesel (2013) say that Australia has poor linkages between vocational education and specific occupations, with the result that the country is vulnerable to jobs moving offshore; licenced trades such as plumbing, however, are an exception to this. They believe that this challenge is due in part to the absence of mechanisms that involve industry, unions and other actors, as well as reluctance by government to adapt education to address skills shortages and provide for

broader educational pathways. Another challenge relates to the practice of locating TVET within generalist upper secondary schools, stifling it in an academic environment and limiting it to one or two subjects with weak vocational competencies (ibid). They note that as a result, students from school-based vocational training from the state of Victoria have been increasingly transiting to university, with very few pursuing post high school vocational education.

The view that different countries tend to follow different models of skills development due to their 'skills ecosystems' (Wheelahan, Buchanan, & Yu, 2015) or their political and socio-economic circumstances, is echoed by Murray and Polesel (2013) who indicate that there are distinctive ways in which skills formation is structured. These ways are related to the different systems or national institutional structures that may exist. Wheelahan, et al. (2015) posit a conceptual model based on the variations, of capitalism where the nature of a country's social and political institutions, economy and labour market determine what they refer to as that country's type of 'transition system'. The transition system defines the 'enduring' institutional and structural arrangements that mediate entry of youth into the labour market (Raffe, 2008) and into and out of the labour market (Buchanan, et al, 2009). In countries with a liberal market economy such as Australia, New Zealand and the United Kingdom, education itself becomes a market and the relationship between employers and educational institutions becomes detached and is only put into play through the market. Graduates in this 'liberal' market economy set up have to compete with each other for jobs. This is, in a way, a form of disconnect that happens between employers and educational institutions, with the result that graduates have to have the 'goods' that the prospective employer demands. In contrast, 'coordinated' market economies, as exemplified in Germany's 'dual system' of apprenticeship, have strong social partnerships involving employers, educational institutions and governing bodies. In 'coordinated' market economies such as in the Germany example, vocational education takes place in the educational system and in the workplace in the form of apprenticeships. The benefit from this is that social partners have input into vocational education, with employers connected with both the students and trainers in vocational institutions.

Building on the 'transition system' research, Wheelahan et al. (2015) note that the structure of secondary and post-secondary education in liberal market economies shows marked differences when compared to the structure found in coordinated market economies. As a consequence, they argue, there are different relationships between education and the labour market in each. Borrowing from the work of Iannelli and Raffe (2007) on their description of education systems in terms of their logic, Wheelahan et al, indicates that liberal market economies as are found in Anglophone countries are characterized by an 'education logic' that results in weak links between work and education (Wheelahan et al., 2015). In 'education logic' systems VET has stronger connections to tertiary education, yet as employers do not have connections with educational institutions, they weigh in on qualifications to select workers with the result that vocational education qualifications are afforded a lower status; this is the case in Anglophone liberal economies, in contrast to the 'employment logic' exemplified in vocational education systems in Germany, where there are strong institutional links between work and education (ibid). While upper level vocational education tends to have weak connections with higher education in these systems, except to provide for advancement in the same vocational line, due to the networks of relationships involving employers, there is agreed division of labour between institutions and work, resulting in the high value placed on VET qualifications (ibid).

To refine this model, Wheelahan et al (2015) advocate in their study of the situation in Australia that the transition systems approach be mediated at a secondary level with a 'skills ecosystem' approach. While the former indicates the tendency towards an education logic or employment logic, and may appear to homogenise the relationship between education and the labour market; the latter moves from 'pocketing' a logic type to allow and identify diversity within nations, regions and industries. Hence, while the 'education' logic may dominate in Australia, some parts of the country's labour markets – such as nursing and engineering -- have an 'employment' logic. This means that while the VET system is based overall on an educational logic and VET is given low status, some fields of practice like engineering are highly valued and are based on strong relationships between VET and the workplace. Hence, in regulated occupations in Australia there tends to be an employment logic that ensures that graduates have the knowledge and skills that are known and acknowledged to meet the requirements of

employers. In addition to this, Wheelahan et al (2015) argue that it should be possible to identify educational and occupational progression within vocational streams allowing for vocational streams to differ and adopt differentiated approaches to build capability. For the foregoing reasons, they make the argument for a differentiated approach to workforce development in Australia that need not align with Northern European models for skills development.

The argument for a differentiated approach to workforce development for different countries or within the same country is significant to this exploration of VET in Swaziland, which may not fully comply with the Northern Europe models of skills development. It suggests that as a country Swaziland may follow a workforce development approach that may be unique to her situation. In addition, Winch (2013) argues that in Europe there are 'high skill' societies such as Germany and 'low skills' societies such as the United Kingdom, and that 'high skill' societies employ a level of internal rigour in their VET programmes that produce the discipline, commitment and reliability that are characteristic of them. It is imperative to indicate here that the UK is an advanced economy and that the strength of this categorization implies that a 'low skills' level for the VET system of a fledgling economy like Swaziland is a different order of 'low skill'. Hence Swaziland may not fully fit in with this categorization of developed countries.

The specific skills required in 'high skill' societies, according to Winch (2013), are *transversal abilities*, which enable an individual to make substantial and independent contributions in the work environment and increase his or her capacity to engage in extended, articulated and complex sequences of tasks to achieve an end result. These complex tasks require the use of planning skills and seriousness of intent and attention in order to be completed. At a 'low skills' level, tasks are simpler and involve repetitive procedures. From this perspective, VET in Swaziland cannot be compared to VET in developed countries, and it therefore may not be appropriate to apply the categorizations used in these countries to the Swazi context.

The literature above provides a description of vocational education in wealthier countries with better resourced TVET systems than Swaziland. This has implications for a less

developed country like Swaziland, suggesting a restricted relevance due to the gaps that exist between the education system and the labour market. This point is raised in some detail in section 2.3, as well as section 2.8.

Below, I explore vocational education and training in Swaziland since the country gained independence, and how the VET sector has developed.

2.2 Initial Vocational Training Aspirations in the Education System of Swaziland

Vocational training in Swaziland has long been seen as an important driver of both the development of industry in Swaziland, and of sustained economic development. The country was a British protectorate until 6 September 1968, when it gained independence. Vocational training started in 1946 at what was then the Mbabane Trade School -- now the Swaziland College of Technology (SCOT) -- with basic trade training in carpentry and building. These vocations were seen as crucial for providing housing for the British government officers of the time, who were administrators of the country before independence. At independence, the Imbokodvo National Manifesto – a document drawn up by the first governing first party – sought to redirect the education system and to rid it of its colonial bias, which was seen not only as morally wrong but as limiting the aspirations of learners to a few select fields:

> The present bias inherited from our colonial past will have to be uprooted branch, stem and root. Today most children in school aspire to be clerks, teachers, nurses, etc. very few think of farming, the trades, handicrafts etc. This the Imbokodvo National Movement believes is wrong and a start must be made to effect a change (Dlamini, 1972, p. 24).

The Manifesto embraces vocational training for national development, stating that the content of education must be work-oriented from the primary to the highest levels.

These aspirations fit with the view of vocational education as a means to supply the skills and competencies that drive the growth of post-industrial economies (Marope, 2010; Murray and Polesel. 2013). A World Bank report (Marope, 2010) advances the argument that skills are determinants of not only employability but also self-employability and

therefore contribute to income distribution and reduction of poverty. Some, however, hold the view that without adaptability, responsive structures and contextually appropriate government agendas, the foregoing aspirations will remain a pipe dream (Brooks, 2009; Raffe, 2008; Simmonds, 2009).

Vocational education in Swaziland is placed essentially at post-secondary school level. Secondary school vocational education was piloted in about sixteen secondary schools in the mid-1990s but encountered challenges in terms of continuity. Issues that were raised centred around the level of skill that secondary school graduates would have and the lack of a pathway between secondary school vocational training and post-secondary education or vocational education. Essentially, VET in schools in Swaziland has had weak links, or no links, with work. Typifying this secondary school VET as an 'education logic' however presents challenges in that it has no links with post-secondary VET or tertiary education. On the other hand, it leans towards an 'employment' logic only insofar as it seeks to be the practically-oriented education or 'work-oriented' education envisaged at independence, but not in terms of being premised on any strong institutional links between work and education. The lack of a link to work may be due to the economic position of the country as a middle-income country that operates a free market system dependent on agriculture and a contracting manufacturing sector. This may have been worsened by the effects of drought and the pulling out of companies which had investments in manufacturing due to the world economic 'crunch'. There is a need to explore other ideas such as reconceptualising VET in schools towards 'themed' subjects that closely relate to a vocational field of practice and a coherent program of studies (Wheelahan, Buchanan, & Yu, 2015). In this respect, in Swaziland efforts began in early 2017 to review and reconceptualise secondary school VET with a view to creating pathways into post-secondary VET and aligning it with vocational fields of practice.

Though post-secondary vocational education and training has been under the spotlight during parliamentary debates, in cabinet discussions and in engagements by the Ministry of Education and Training, the proportion of students who are enrolled in VET is far smaller than those enrolled in university education, as shown in Table 2.1.

Table 2.1 Proportion of Students by Number and Type of Educational Institution (Kotecha, Wilson-Strydom and Fongwa, 2012)

Type of higher institution	Number of institutions	Estimated percentage of students enrolled in this type of institution
Publicly-funded universities	1	24
Publicly-funded technical and vocational colleges	2	5
Privately-funded universities or colleges	2	3

*68 per cent of students who completed high school were unaccounted for. This may be because they were not furthering their studies or were studying at South African institutions.

Swaziland has one public university with two new private universities, and these together are unable to cater for the high numbers of students completing high school. There are also limitations in terms of Swaziland moving towards a knowledge economy in the near future as universities in the country focus on undergraduate degrees, with very few master's degrees in a limited number of areas. Technical and Vocational Education, as can be seen in Table 2.1, absorbs a smaller proportion of the enrolments at post-secondary education owing to the limited numbers of VET providers and the cost of facilities involved. A further factor is that government limits the number of scholarships awarded to students who pursue either VET or university education. The result is that students from disadvantaged backgrounds who are unable to secure scholarship funding are not able to pursue VET, college or university education. A proportion of students pursue study opportunities in South Africa, partially funded by parents and government. However, statistics for these or for the number who do not pursue any further study are not available. The ongoing debates in parliament and in government around restructuring secondary school VET and broadening scholarship funding for VET are influenced, to a significant extent, by the number of youth who are not able to pursue post-secondary VET and are excluded from being players in the economy.

This situation indicates that VET and tertiary education institutions train only a fraction of the students who complete high school. Apart from those who pursue their post high school education in South Africa, the balance of youth leaving school are unable to pursue training and to contribute to the economy. In addition, if the available university education

system generally provides opportunities only for undergraduates, with few opportunities to pursue post-graduate qualifications, then the path towards economic development or the development of a knowledge-based economy becomes long. Even more serious is the negative impact on youth from disadvantaged backgrounds when they are excluded from the opportunities that could be provided by a VET, college or university education. While they are not selectively excluded, if they are unable to enrol locally their chances of find alternative funding or support to study in South Africa are even more remote.

In Swaziland, at the time of this study VET was offered at the Swaziland College of Technology and Gwamile Vocational and Commercial Training Institute Matsapa (VOCTIM), which were the two public providers. The third provider was a church institution which started to provide lower level vocational training with a view to occupy youth who had dropped out of school, providing training in customer-focused skills where an instructor 'works' with the trainees to provide services to customers such as fixing brakes (automotive mechanics), build wardrobes (carpentry) or repairing a sofa (upholstery). At the time of writing, SCOT had an enrolment capacity of just over 1000 students; VOCTIM had a capacity of 200; and the church-based Skills Centre accommodated 150. SCOT had concentrated on providing mainly technical vocational education and training at diploma level with a higher theoretical content to create capacity for skills for, over the long term, mid-supervisory positions. VOCTIM's mission was primarily to concentrate on vocational skills at entry level, and differed from SCOT in its emphasis of practice over theory. Training had initially been provided at certificate level but was then made available at diploma level. Vocational education and training had been limited to diploma level in Swaziland. Plans were underway, however, for SCOT to become a university of science and technology. Without the mechanisms to allow students to progress to degree level for VET, or to PhD level (or even master's level, for many disciplines) for university education, the education system has been restricted in its quest to develop the country's human resource capacity.

In keeping with Swaziland's aspirations for a work-oriented curriculum throughout the education system, as expressed in the independence Manifesto, lecturers in automotive mechanics build the skills that will enable the graduates to participate in the economy as automotive mechanics. These roles may vary due to where they will 'work' and what

capacities they have been able to develop. The methods that the lecturers use in training these students to be automotive mechanics are central to forming these abilities.

In the sections which follow, I describe the context of each of the three vocational institutions where automotive mechanics is taught in Swaziland and provide an overview of grade testing and apprenticeship in the Swazi VET system.

2.3 The Swaziland College of Technology (SCOT) and Technical and Vocational Education and Training Development in Swaziland

Training at what was then the Mbabane Trade School started in 1946 with only twenty-four students who were taught by two instructors. The Trade School slowly expanded such that by 1967 training in automotive, mechanical and electrical skills was introduced. Training in such skills became necessary to attend to the few, but steadily rising, number of cars, as well as increased demand for welding and the installation and maintenance of electrical fittings and appliances. By 1973, the Commercial Training Unit had been established and courses in hotel management and catering, as well as the first education courses in commercial and technical teaching, were introduced.

In 1974, the institution became the Swaziland College of Technology (SCOT). Many new courses were introduced to produce the manpower required for the expanding local industry, and in keeping with government's localization policy that sought to involve Swazis in the economic development of their country, which had previously depended primarily on expatriates – most often from England. As a result of Swaziland's colonization by England, until the late 1990s most of the country's key institutional positions were held by expatriates. SCOT had an English principal for quite a long time, as well as English heads of departments for Building and Construction, Engineering, Commerce, and Teacher Education. There were also a few other expatriates holding teaching positions, including American Peace Corps volunteers and some Germans. Germany had offered a few scholarships for Swazi teachers to train in Germany; in exchange - or as a supportive measure – it had sent German lecturers for such specializations as Electrical and Panel Beating, among others. As a result of this situation, all examinations for technical or engineering specializations complied with the City and

Guilds of London; and with Pitman, for commercial specializations. This explains why, for instance, even after introducing localized national diplomas in the different specializations – including automotive mechanics – in the mid-1990s some lecturers lacked the confidence or ability to draft course outlines and continued to quietly use City and Guilds course outlines. One lecturer in automotive mechanics, who had been unwilling to give me a copy of the syllabus or course outline used for automotive specialization, told me:

> You are guided by the syllabus. But you have worked here. We used City and Guilds, but even now in the National Diploma it is taken from City and Guilds. We took City and Guilds and decided what will go in first year, and then we said if in first year we do A to M then in third year we do N to Z. [SCOT1, 12.08.2015]

Until about the mid-1990s, SCOT had the following departments, each with its own Head of Section:

Table 2.2 Departments and Specializations at SCOT through the mid-1990s

Department	Specializations
Automotive Department	Automotive mechanics
Department of Building and Construction	Building, plumbing, Water Technology
Department of Commerce & Hospitality	Secretarial Studies, Clerical, Accounting, Hotel and Catering
Mechanical Department	Mechanical
Electrical Department	Electrical Wiring and Installation
Department of Teacher Training and Curriculum Development	Commercial Teaching, Technical Teaching

In 1996, a move was made to introduce local National Diploma programmes, which resulted in the formation of the following faculties:

Table 2.3 Departments and Specializations at SCOT since 1996

Faculty	Specializations
Commerce and Hospitality	Secretarial, Accounting, Hotel and Catering
Education	Design and Technology
Building and Civil Engineering	Architecture, Building Studies, Quantity Surveying, Civil Engineering
Engineering and Science	Electrical Engineering, Automotive Mechanics, Mechanical Engineering
Computer Science	Information Systems, Computer Science

The three-year National Diploma programmes were introduced following the departure of the last cohort of English expatriates from SCOT. There were ongoing complaints about the escalating exam fees that were paid to City and Guilds, in particular with respect to the value of the local currency (Lilangeni). Also, the person who had been responsible for the coordination of City and Guilds examinations had been an Englishman. A few specializations had still been left under City and Guilds examinations, but these were soon to be localized as well. It is necessary to point out that many lecturers had not received pedagogical training, as most had been former students at SCOT. For this reason, revising the curriculum has been a challenge, with some course outlines not properly drafted and some lecturers quietly opting to use the City and Guilds curriculum, as was the case with the automotive mechanics lecturer quoted earlier. This said, in fairness some schools were found to have well-developed course outlines and regulations, in particular those which had some staff with training that equipped them to handle this, such as those with first or second degrees in education.

Pursuant to a parliamentary motion by the prime minister in 2010 regarding the fact that the Swaziland College of Technology was not offering degree programmes, a delegation comprising Ministry of Education and Training officials visited South Africa to find an institution that would offer some form of collaboration to assist SCOT with upgrading so as to offer degree TVET programmes. The idea was to ultimately turn SCOT into a University of Science and Technology through some mentoring, guidance and

accreditation through a university in South Africa offering technical Vocational Education and Training. The Vaal University of Technology (VUT) was identified, and a follow-up team, led by the Vaal University Vice Chancellor, travelled to Swaziland to undertake an audit of both staff qualifications and facilities.

The VUT found that the facilities available at SCOT were inadequate to support degree programmes requiring specialized equipment and facilities. As a result, the decision was made to introduce 'soft' programmes at the B. Tech level in Computer Science, Human Resources, Auditing, and other qualifications. These programmes were offered in collaboration with VUT, with VUT staff travelling to lecture on short term visits; only a few local lecturers were given some topics and materials by VUT to use and visiting lecturers handled those areas or modules for which there was no qualified local lecturer. Examinations were set at VUT and the B. Tech degrees were given in VUT's name. The staff qualification audit had found that the majority of staff at SCOT did not have the qualifications and content knowledge to teach at degree level. Partly for this reason, VUT invited a few Swazi lecturers to further their studies at VUT; those who went were mainly Information and Communication Technology lecturers. The principal of SCOT was also accepted for a part-time Ph.D. programme at VUT.

While these activities were undertaken with an aim to provide some form of accreditation support for SCOT's newly introduced B. Tech programmes, they were met with some resistance from local lecturing staff. While some were excluded by VUT from lecturing in these programmes on the basis of lacking relevant qualifications, some lecturers – including some heads of departments – queried the rating of the Vaal University of Technology within South Africa itself, saying it did not have much credibility to bring to SCOT's programmes. At one point, dissatisfied staff took both SCOT and the Swazi government to the industrial court in an attempt to prevent SCOT from being granted university status by the government until their requirements for engagement were met; as of July 2017 the case was still pending.

Although the government had initially indicated that SCOT would be granted university status by 2014, this date kept shifting, such that by the end of 2016 a new date had been proposed for 2018. Given the issues that keep emerging, another proposal for a further

date may not be unexpected. Even prior to this, there had been ongoing complaints by staff that due to restricted study opportunities from government most SCOT lecturers had not had access to further training, and as a result there were many diploma-holding lecturers teaching diploma candidate students. There were few lecturers holding bachelor's or master's degrees, particularly in engineering courses such as Building and Civil and Automotive and Electrical. There is no option in Swaziland for obtaining a bachelor's or master's degrees in vocational education and training, in particular for technical courses. However, a visit to Ekurhuleni FET in Johannesburg in 2013 by lecturers and administration from Gwamile VOCTIM found that that that institution also had VET lecturers without degrees in the technical courses.

In response to a request from SCOT, in 2014 the government gazetted the establishment of an interim council to oversee SCOT's transition into a university. SCOT proposed that this council would address the following challenges, among others, in order for the institution to achieve autonomy, or semi-autonomy:

- Shortage of qualified staff
- Attempts to attract lecturing staff with PhD and master's degrees for the B. Tech programmes had been unsuccessful due to the low government pay scale of C6 (about E13 000 per month gross).
- The institution had no funds to procure the teaching equipment or resources required in order to introduce B. Tech programmes.

The first report produced by the interim council in 2015 indicated there were challenges that it faced as it sought to determine the way forward. Many of the lecturers would not be accepted for enrolment in degree programmes because the institutions – particularly in South Africa – did not recognize their previous training. As a result, SCOT would have to give these lecturers severance packages. For those who did qualify for enrolment, the government would be required to approve a training budget. The report indicated that despite efforts to advertise regionally for lecturers, capacity remained inadequate. For instance, 10 lecturers still had diplomas or certificates, 5 had Higher National Diplomas, 10 had bachelor's degrees, 11 had master's degrees and only 2 had Ph.Ds. In preparation for a new university, the institution had intended to attract only master's and PhD candidates to replace those with lower qualifications. At least two newly recruited

lecturers with master's and PhD qualifications had left within two months, citing unsatisfactory conditions of service.

In response to these challenges, SCOT connected with a new five-year project launched by Taiwan to introduce degree programmes in Information Communication Technology and Electrical Engineering. Through the TVET Enhancement Project, the Taiwanese government was attempting to procure equipment and resources for SCOT for these two specializations, and was advising SCOT on the drafting of a four-year degree course curriculum that was to be launched in 2017. However, as the academic year was to begin in August 2017 the degree could not begin owing to logistics of accreditation and staff training. A few lecturers in the targeted departments were sent to Ching Yin University in Taiwan for a two-month training course. It had turned out that the agreement with VUT had lapsed and that SCOT was looking elsewhere including Taiwan for accreditation of these programmes. The TVET Enhancement Project later took a decision to send two members of staff on two year masters training to Chin Yin University and will be considering whether to not to send more in the future.

In summary, automotive specialization at SCOT has progressed in terms of moving away from the City and Guilds model to a three-year National Diploma; however, courses are still taught by the same lecturers who themselves were trained at SCOT, with only two who obtained Higher National Diplomas in England in the early nineties. In addition, it appears that to some extent the switch to a new curriculum for the National Diploma is only superficial, with many lecturers continuing to rely on the course guides which they used for City and Guilds. In these respects, then, students specializing in automotive mechanics have not yet had a significant direct or indirect benefit from the drive towards university status. There is also not much evidence that this will change in the near future, and it is possible that automotive specialization may not continue to university level any time soon.

2.4 Gwamile Vocational and Commercial Training Institute in Matsapha

Over the years, the provision of vocational training in Swaziland has seen the establishment of Gwamile Vocational and Commercial Training Institute Matsapha

(VOCTIM) which opened in 1987 essentially to provide craftsman training in such specializations as Wood Work, Building Construction and Mechanical Engineering. At its inception, Gwamile VOCTIM was an initiative of the Federal Republic of Germany through the *Deutsche Gesellschaft Fur Technische Zusammenarbeit* GTZ (German Technical Cooperation) and was launched in cooperation between the Kingdom of Swaziland and the Federal Republic of Germany. The German government took full responsibility for conceptualizing this training institute from its design and through construction, staffing, curriculum development, procurement of equipment and staff training. Administrative staff as well as key teaching staff were sourced from Germany. The departments were headed by Germans. A few Swazi members of staff were recruited from industry with the plan that they would undergo initial training and induction under German staff within the training institute. One of these Swazi lecturers, who had been with the institution since it opened in 1987, related some quite unusual experiences under these German supervisors:

> It was hard in those days …. you hear me. There was this German supervisor who was responsible for assigning each Swazi lecturer what to teach. He would make sure he made you teach what you had not trained for. He would take me as a motor mechanic and give me a handout to go and teach in the mechanical department…and he would take a lecturer in mechanical to go and teach motor mechanics…and sometimes the trainees would know better than us…. then he would sit in your class, and suddenly he would stand up and shout that what you were teaching was wrong…in front of the students. You know why I think they would do this…they wanted to prove that Swazi lecturers did not know anything…so that the Germans would be here longer. [Interview notes, M1, 24 February 2016].

The same lecturer indicated that each of the departments at the time, such as Motor Vehicle Mechanics, Wood Work, Electrical and Mechanical, had a German supervisor, and that in terms of their knowledge and expertise they were quite a mix:

> But in Motor Vehicle Mechanics, there was this first supervisor; he was a specialist in auto electrics – this one was very good. You could bring any problem in a car – any electric problem – he would solve it in no time. When he left they brought another one. This one did not know anything about motor vehicle repairs. [Interview notes, M1, 24 February 2016].

Opportunities were made available for the Swazi teaching staff to undergo various short term training sessions in South Africa. All these were funded by the government of Germany, with some funds provided to the Swazi staff to encourage attendance. There was, in the main, a recognition that the Germans brought high quality and durable equipment, and that those departments – particularly technical departments such as Wood Work, Electrical, Mechanical or even Motor Vehicle Mechanics – which had German supervisors who were strong in their specializations ran their departments with a high work ethic and a high level of technology in their training:

> … for the technical courses vocations like Wood Work – where there were strong German lecturers – there was a high level of teaching there: the students would make quite novel wood products.
>
> …in general, [the Germans] brought with them a high level of technology. They also brought with them German-made machinery and tools that are in use even today. The materials were high quality – even the [eraser] was from Germany and was of better quality. [Interview notes, M2, 25 February 2016].

The above scenario indicates a strong German influence on the training in the early years resulting in a training model that emphasized hands-on practice, although in the first year of training the trainees sat for local examinations, with the certificate signed by the project manager and government. In 1988, City and Guilds Examinations were introduced following complaints from industry about recognition of the German certificate, and also owing partly to the British influence in the country as well as the fact the Swaziland College of Technology had been using the same examinations for some time.

Under the German Technical Cooperation, virtually all the Swazi lecturers were afforded various training opportunities that were either short or long term. Most short term training was done in South Africa and was fully funded by GTZ. Sometimes others would be sent on long term training of up to two years in various overseas countries including Germany, Japan and England – again, funded by GTZ. Thus, in terms of upgrading skills and keeping up with technological developments globally, GTZ made committed attempts to

keep Swazi lecturing staff abreast. This training did, however, tend to focus on sharpening know how as it related to work and/or industry requirements rather than offering a vertical progression towards a degree. Hence, even to date there are fewer degree holders at VOCTIM than those holding diplomas and short-term training certificates. These few have obtained their degrees post the GTZ era, with qualifications in areas such as Mechanical Engineering, Electrical Engineering and Commercial Studies.

While in the early stages of its operations Gwamile VOCTIM tended to focus on craft level vocational education, over the years its offerings have spanned both certificate level and craft and diploma. At the time of this study, Gwamile VOCTIM offered the following specializations:

Table 2.4 Specializations offered at Gwamile VOCTIM

Department	Specialization	Duration
Automotive	Diploma in Automotive Mechanics Certificate in Vehicle Body Repairs	3 years 1 year
Commercial	Diploma in Business Finance	2 years
Building and Construction	Diploma in Building Diploma in Plumbing	18 months 18 months
Electrical	Diploma in Electrical Installation	2 years
Mechanical	Diploma in Mechanical and Manufacturing Engineering	3 years
Wood Work	Diploma in Carpentry and Joinery	2 years

Unlike SCOT, where all the specializations were examined internally, VOCTIM still used the City and Guilds examinations, with local examinations for selected programmes, as shown in Table .

Table 2.5 Examinations of specializations at Gwamile VOCTIM

Specialization	Duration	Examination
Diploma in Automotive Mechanics Certificate in Vehicle Body Repairs	3 years 1 year	City and Guilds Internally examined
Diploma in Business Finance	2 years	City and Guilds
Diploma in Building Diploma in Plumbing	18 months 18 months	City and Guilds City and Guilds
Diploma in Electrical Installation	2 years	City and Guilds
Diploma in Mechanical and Manufacturing Engineering	3 years	Internally examined

With respect to the two locally examined specializations, there were similar motivating factors that accounted for them being examined locally. There was need for these specializations in industry at the time that City and Guilds did not offer them. The certificate in Vehicle Body Repairs was required due to the gap that arose when SCOT stopped offering this specialization more than a decade ago because City and Guilds stopped offering examinations on it, due to the emerging practice of replacing body panels with new ones rather than repairing them. Another factor which contributed to this was the move towards fibre for body panels in newer cars rather than metal. Swaziland still has many 'old school' cars made of metal. In the case of the Mechanical and Manufacturing diploma, it was started at the request of industry demand for workers with this specialization. There is no basis to assume that these internally examined programmes are less rigorous than the others. They have required greater engagement from lecturers who have had to rely on their resourcefulness and collaborate with industry to develop course outlines, teaching modules, provide regular assessments and set examinations. Selected members of industry holding at least a degree and long experience in industry moderate the exams before they are set and also moderate the marked scripts for consistency.

Despite this, some employers and some members of the public favour City and Guilds examinations over local examinations. In my view, this attitude may owe its origins to a

deep-seated belief in the strength of England as a first world country that went through a developing phase like Swaziland in its own history before arriving at established and recognized certification programmes. I am cautious to say overtly that this attitude reflects the enduring influence of colonialism, as this may only be so in the case of adults who had lived in the pre-1968 (independence) period. It is also a bit puzzling how this mentality has influenced even the current students who, when in 2015 the City and Guilds examinations fees for Wood Work rose to the equivalent of E8000, resisted efforts to introduce local examinations in order to reduce their costs. They opposed this idea despite the fact that many were supported by parents who themselves were sometimes struggling financially. While it may at some point be required that students be "courted" towards change, the hardest aspect is changing the mind set of lecturers who have been teaching for a long time and are now comfortable with the practice of leaving the setting and marking of examinations to a third party. The additional workload introduced by having to set examinations and have these examinations moderated for credibility, then mark the exams and have the marking checked by someone else, creates some apprehension among lecturers.

2.5 Manzini Industrial Training Centre

Manzini Industrial Training Centre (MITC) is the main skills centre of three skills centres that form what is known as the Swazi Skills Centres. Apart from offering skills training, like the other two centres, MITC also functions as the administrative centre for all three skills centres. Initially, only MITC operated in the country; the concept of the she skills centres was developed later.

The director of the skills centres, who was based at MITC, indicated that there is no written documentation that provides a history for these skills centres, hence the information he gave during the interview [07 September 2016] was based on oral history passed down from his predecessors and existing staff who were present at inception. In his account, the Manzini Industrial Training Centre was formed by the Roman Catholic Church, represented by a father of the order of Saint John Bosco, together with the Anglican Church, represented by a sister of the order of the Holy Paraclete in 1984. This information is corroborated by a Memorandum of Association and Articles of Association

of Swazi Skills Centres drawn up in 1994 when another similar entity was established in Nhlangano, in the south of Swaziland. It was then necessary to use a different name to identify the new centre. The director indicated that the churches saw that there were a lot of idle youths around Manzini and wanted to occupy them by teaching them skills while they would at the same time be servicing the needs of customers. The two churches, through their representatives, saw that since the possibility of building other centres in the future could not be ruled out, such centres should be centrally administered from MITC and be called Swazi Skills Centres – differentiated only according to where they were located. The second centre, built in 1994, was called Nhlangano Industrial Training Centre. A third centre, constructed later at Siteki in the east of Swaziland, was called the Siteki Industrial Training Centre.

In terms of funding, the churches sought funds from church organizations internationally, including Italy. In addition, quite a lot of partly used equipment and machinery was donated to MITC. The father from the order of Saint John Bosco and the sister from the order of the Holy Paraclete were equal shareholders of the company as indicated in the Memorandum of Association of 1994. The land on which MITC was built was donated by the Anglican Church, while government later contributed a farm on which the Nhlangano Industrial Training Centre was built.

When eventually church funding became scarce, and the two directors retired, a request was made to government to continue funding. At the time of this study, the Government of Swaziland provides a subvention of 75% of the running budget of the skills centres, with 15% coming from an external donor, *Kindernothilfe*, which is a German-based humanitarian organization that focuses on vulnerable and marginalized children to develop their potential so that they can secure livelihoods. The balance of the funding comes from fees paid by students and from profits raised by trainees during their practical training. Sometimes the Swazi skills centres have taken on bigger projects such as the building of feedlots using staff and student skills, and 60% of profits realized from such projects has gone to the skills centres, with 40% distributed to the students and staff who contributed to the projects.

The director indicated that that the satellite skill centres were based on the MITC, and the specializations offered at all centres were essentially the same. Course outlines, setting of assessments and marking were all undertaken centrally at MITC, with staff from the other centres converging to work with MITC staff on these. MITC offered more courses than the other centres by virtue of having more facilities, and skills centres would only introduce new programmes if they were already offered at MITC and were found to be needed at the other centres.

The skills centres carried out hands-on training through production, otherwise known as 'training on production', enrolling mainly disadvantaged youths who had dropped out of school for various reasons. The trainees paid a nominal fee towards their training, and learned through doing production for customer needs. This required that there be a demand for the service that they offered, presenting a challenge in that the customer would require quality products yet the producer was at the same time learning on the task that he or she was performing. The director indicated that one of the major challenges of this kind of training that they experienced was that training on production had the inherent challenge of sourcing clients on a regular basis to engage trainees in practical work. Thus, in practice, it was unavoidable that trainees spent a lot of time waiting with the hope that a customer would come and seek their services. One automotive mechanics lecturer described what it could be like as follows:

> We don't have a car... we first give [the students] handouts... they have all the features of the car...then a customer brings a car, then we show the trainees the features. Sometimes there is no car. We use customer cars [MITC2, 27072015].

While carrying out this research, there were days when I was told it was not possible to conduct observations as there was no production for customers happening at the time. I initially avoided asking why this was so, but one day I was told I would be called when a customer who had promised to bring a car finally did so. It only dawned on me some time later that actually there was very little demand for trainee services and so the programme was not thriving using this model. The chapter on pedagogy provides more discussion of this.

The following courses were offered at the Swazi Skills Centres:

Table 2.6 Courses Offered at the Swazi Skills Centres

MITC	Nhlangano Industrial Training Centre	Siteki Industrial Training Centre
General Agriculture	General Agriculture	General Agriculture
Auto Electrical	Electrical	Sewing
Building	Carpentry & Joinery	Motor Vehicle Mechanic
Carpentry & Joinery	Metal Work	Metal Work
Electrical	Motor Vehicle Mechanic	Carpentry & Joinery
ICT Program	Plumbing	
Metalwork		
Motor Vehicle Mechanic		
Panel Beating & Spray Painting		
Plumbing		
Sewing		
Upholstery		

All courses were of one-year duration, with the second year reserved for work place attachment. It was only after the work place attachment that trainees were awarded a certificate. The director indicated though that there were challenges with finding work placements for trainees, such that in some instances they asked trainees to volunteer their services even for two or three months at a work place in order to be able to be awarded their certificates.

In keeping with the spirit of caring and providing for vulnerable and marginalized youth, there were no prescribed entry requirements to study at the skills centres. While lecturers indicated that there was an unwritten requirement of Grade 7, they said that on occasion they had taught someone who could not write. This presented challenges not only in terms of such a trainee developing know how, but also to the lecturers. However, of late there had been some improvement in the education levels of the trainees following the introduction of free education at primary school, and occasional funding available for orphaned and vulnerable children.

I will next examine the operations of the Directorate of Industrial and Vocational Training (DIVT) which carries out national trade testing for vocational skills, including automotive mechanics.

2.6 The Directorate of Industrial and Vocational Training

The Directorate of Industrial and Vocational Training (DIVT) was formed by an act of parliament: The Industrial and Vocational Training Act of 1982. Among other things, the Act establishes the directorate, setting out its functions and those of committees and policy on apprenticeship and proposing a training levy. The role of the directorate is to oversee apprenticeship training as well as to establish mechanisms for conducting national trade tests.

The proposed training levy would require employers or companies to contribute to an industrial and vocational training fund through a method that would be determined through a training levy order. Among other uses, the Act indicates that disbursements from the fund may be made for payment of maintenance and travelling expenses to persons attending training courses; providing loans or grants to employers providing training courses or training facilities; or even the reimbursements of an employer's training costs or other costs related to training such as apprenticeship allowances.

Section 34 of the Act provides for setting out of regulations for carrying out the Act, prescribing, among others, the following:

- The form of contracts of apprenticeship or traineeship and the matters to be included in such contracts;
- The manner by which educational standards may be proved;
- Procedures for registration and transfer of apprenticeship contracts, notification of their expiry, or their termination;
- Forms of certificates for completion of apprenticeship or traineeship;
- The establishment and maintenance of trade and occupation standards, the holding of trade tests, and the granting of a certificate of proficiency for a person passing such test

2.6.1 Trade Testing

The Trade Testing Regulations of 1989 were formulated following the Industrial and Vocational Training Act of 1982. These regulations establish a Trade Testing Committee whose duties include, among others, advising the Industrial and Vocational Training Board and the appointing of trade testing panels. The trade testing panels are comprised of members who are qualified in the particular trade or occupation, and are to be nominated to represent each of the following:

(a) The Swaziland College of Technology, or the Gwamile Vocational and Commercial Training Centre, or both
(b) The government or parastatal sector
(c) Industry

In practice, the trade testing panels have – for each specialization for which a trade test is provided – not less than two members from each of the above sectors or institutions. Hence, for the automotive mechanics trade testing panel there are at least two members each from VOCTIM, SCOT, government and industry.

The trade testing panels set standards, formulate tasks and conduct trade tests to determine the levels of skills of workers in designated trades or occupations. The panels are responsible for, among other things:

(a) establishing an appropriate trade standard for approval by the Trade Testing Committee
(b) preparing marking schemes in respect of trade tests, and selected tasks for trade testing
(c) grading the results of the test applicants and submitting these to the Director of DIVT

Members of trade testing panels are appointed for a renewable period not exceeding three years, and are paid such fees as approved by the Board from time to time. In practice, however, such members do not normally lose their membership and are only replaced due to attrition or further study.

Trade tests are offered for Grades 1, 2 and 3, with Grade 3 being the lowest and Grade 1 being the highest grade. According to the trade testing officer, requirements for trade testing are as follows:

(a) An applicant should be at least 18 years old at the time s/he applies for trade testing.

(b) Grade 3 applicants should have completed a minimum of 3 years in the trade or occupation in which they are to be tested, and any period spent in a vocational training institution approved by the Board for training in such a trade shall be taken as employment.

(c) For Grade 2, applicants should have obtained a Grade 3 certificate, and a further 18 months in employment after obtaining Grade 3. However, 9 months training at a vocational training institution approved by the director shall be treated as equivalent.

(d) In the case of Grade 1, applicants should have obtained a Grade 2 certificate, and a further 30 months in employment after obtaining Grade 2. However, 6 months of higher or advanced training at a vocational training institution approved by the director shall be treated as equivalent.

The trade tests were held annually or twice annually at either SCOT or Gwamile VOCTIM, to take advantage of their facilities. While the DIVT procured specific materials to be used for trade tests, durable materials like machinery and work benches were provided by the institutions. The trade tests are of varied complexity, thus have variable durations as follows:

Grade 1 - 24 working hours
Grade 2 - 16 working hours
Grade 3 - 8 working hours

In an interview with the Trade Testing officer [4 August 2016] he indicated that the minimum educational requirement for taking these trade tests is Grade 7, adding that employers have to pay workers who have done trade testing according to a government gazetted scale, as these grade test certificates were gazetted. He rated the grade tests in the following manner:

Table 2.7 Rating of Trade Test Grades

Trade Test Grade	Level
Grade 3	Semi-skilled
Grade 2	Skilled
Grade 1	Highly skilled

It is worth pointing out that while only Grade 7 and immersion into workplace practice are required for trade testing, such a practice does not expose a worker to the theory that informs practice. Thus the levels suggested by this Trade Testing Officer, while suggesting a rising display of 'skill,' do not fit in with Winch's (2014) theory of epistemic ascent, that derives from integrating workplace practice and theory building capabilities from novicehood to expert based on various kinds of knowledge from simple to more complex forms.

It is perhaps for similar reasons that many students who have undergone formal vocational education and training through SCOT or VOCTIM have not gone for trade testing. One lecturer in automotive mechanics made the following comments regarding trade testing, when asked how trade tests fit students specializing in automotive mechanics:

> …. Basically it does not fit them. By law we have skilled and unskilled in Swaziland. The skilled have proper training; proper learning. Our institution offers formal learning. Informal learning is when you learn on the job. The Ministry of Labour grades this informal knowledge, this why we call it grade testing. Grade 3 is the lowest, and Grade 1 is the highest.
>
> Our students do not require grade testing, but sometimes they do grade testing – so that they can have better chances to survive. Companies may want formal education or informal education, but it is all about the money. Look, [for example] if for Grade 1 government sets the pay scale at E5000 per month, and with a SCOT Diploma you have to be paid E9000, me as an employer will hire the one with Grade 1 – and pay him E5000.
>
> There are no jobs in Swaziland: there are very few industries, very few companies. Now even those with a formal education do Grade Tests to

> increase their chances. Even me, I have Grade 1. Why? If I lose this job and an employer wants someone with a Grade 1 in Motor Mechanics for a salary of E5000 per month, I apply with my Grade 1 – and have something to live on. I wait… I wait…one day they want someone for supervision, maybe with my qualifications…then I secretly pull out my Diploma from my back…[laughing]. So some of our students do take Grade Tests when they finish. [SCOT1, 12 August 2015]

The view expressed by the lecturer above indicates that students may take trade testing to increase their chances of obtaining employment in the event an employer wants someone who has taken a trade test and intends to pay him using a trade test scale.

2.6.2 Apprenticeship

As indicated earlier, apprenticeship in Swaziland is premised on the Industrial and Vocational Training Act of 1982, which established the Directorate of Industrial and Vocational Training responsible for both apprenticeship and national trade testing. According to the Act, an employer is obligated to seek the written approval of the Director of Vocational and Industrial Training before taking on apprentices. The Director will satisfy himself first regarding the employer's capacity to offer reasonable training opportunities for the proper training of trainees under his care.

Among the conditions to qualify for apprenticeship, the Act states that a person may only undertake apprenticeship subject to:

(a) Attaining an age of 15 years; and having completed any period of compulsory education
(b) In the case of a trade or occupation where a scheme has already been made, holds the qualifications required in that schedule
(c) Has been passed medically fit

The Act also provides for the transfer of an apprenticeship contract from one employer to another, subject to the approval of the Director; and also provides for suspension, termination and extension of contract – again, with the approval of the Director. Apprenticeship training normally takes 5 years and includes workplace practice under a

journeyman as well as theoretical training in a vocational education and training institution (VET). The 5-year period may include theoretical training at a VET institution. A learning consultant at the Royal Swaziland Sugar Association indicated in an interview [29 August 2016] that the advantage to employers of taking on apprentices is that it creates a talent pool from which to source or select the best workers or a 'locally-brewed' skilled base combining theoretical, practical and on-the-job training to apprentices. Asked what the difference between practical and on-the-job training is, he indicated that in his view practical training involved the use of models or practicals that are for demonstration rather than contributing to production, while on-the-job training involves working with actual production materials. While he indicated that as an employer he has the choice of the 'cream of the crop' in terms of who to select for job succession and continuity, he admitted there are not only declining chances of apprenticeship, but also that as a company they don't employ all those who have complete apprenticeships with them because, as he put it, "the taste of the pudding is in the eating."

DIVT has an apprenticeship officer who liaises with employers on issues around the apprenticeships such as registration, inspection of log books, and inspection of work sites and whether apprentices are rotated among different tasks. The officer also checks whether employers follow an established training guide that pre-identifies areas that apprentices should be exposed to. He indicated that in the log books the trainees log new tasks that they have completed. The Director only issues a certificate of apprenticeship subject to the completion of apprenticeship and the satisfying of other related conditions such as completed log book and rotation through different tasks.

The apprenticeship officer indicated however in the interview [4 August 2016] that apprenticeship opportunities have decreased significantly in Swaziland due to the absence of a training levy. While in the past a small training levy was paid by all companies, this has stopped. According to the apprenticeship officer, both government and companies contributed towards the training levy. At the time when industry was thriving in terms of profits and physical presence and the fiscal situation of the country was strong, this was possible. Companies that paid the training levy would benefit in terms of tax rebates. Of late, companies were suffering as they operated with significantly reduced profit margins. The training levy was stopped. It may be a point of conjecture to say that this may have

been because government needed to raise more taxes for its revenue – yet it is reality that a significant portion of government's tax base is derived from the surviving industries, among other sources. The Directorate of Industrial and Vocational Training has proposed to government the reintroduction of the training levy. This has so far not been effected and there are no mechanisms being created to effect it. The current economic climate may itself make for its abandonment as government is required to expand its collection of taxes.

The challenges that companies are facing are daunting, according to the apprenticeship officer. He indicated that companies feel that if they take on apprentices it will result in loss. Hence, he says, they now take on apprentices based on their own need – for example, training one fitter if they think they will need one fitter in a few years' time. They no longer provide for pool training, thus making it difficult for incoming investors to find a trained work force. He said that many companies want a worker who can hit the ground running to help sustain or lift their profits, but in the absence of a pool from which to source these, operations become a challenge.

2.7 City and Guilds Automotive Mechanics Curriculum Structure

The City and Guilds Motor Vehicle Systems Curriculum Structure on which the automotive mechanics specialization is based provides for two levels of training: certificate and diploma, with each level covering a year. The requirement for the diploma is that a candidate should have developed the skills level of the certificate. The practice used by SCOT and VOCTIM, however, was to require the students who had done first year training or the certificate to obtain a year of workplace practice to develop their skill level.

For the first year, or the certificate, the curriculum is structured as follows:

Unit 1 - Engine systems 1:	Petrol/diesel engines and fuel systems Ignition and electrical systems Cooling and lubrication systems Safety, and associated studies*
Unit 2 – Chassis systems 1:	covering vehicle systems Braking, steering and suspension systems Gearbox and transmission systems

Safety, and associated studies*

*Associated studies are made up of mathematics and science where the former focuses on maths topics such as geometry and trigonometry; fractions; percentages and proportions; and the latter refers to science related to automotive such as calculations of mass, force and movements; time, velocity and acceleration; force and moments and calculations of engine power.

The curriculum further breaks down each of the systems into parts, emphasizing at this level that candidates should be able to identify each part, as well as state its functions. For example, for engine components and functions, it says the following:

> The instructor must ensure candidates are able to:
> Identify main engine components and functions; stating the components as: cylinder heads, cylinder blocks, liners, manifolds, valve operating mechanisms, timing gears, camshafts, pistons, pushrods, connecting rods, crankshafts, flywheels, machined faces securing devices, journals/bearings, seals. Terms: top dead centre (tdc), bottom dead centre (bdc), bore, stroke, capacity, clearance, volume, swept volume, compression ratio.

Assessment is done through two final written examination papers with multiple choice questions, one on engine systems and one on chassis systems, lasting one and a half hours each. In addition, there is assessment of practical competence conducted by the lecturers on physical identification of the parts and carrying out of basic procedures of mechanics. In practice, the lecturers used an approach that did not fail a student on the practical, but gave the student time to develop the competence before returning for reassessment – and there was no limit to the number of times the student could be assessed until he/she passed.

In the second year, when the student comes to do the diploma after a year in the workplace, the curriculum covers the following:

Unit 21 - Engine systems 2:	covering petrol/diesel engines and fuel systems
	Spark ignition and electrical/electronic systems
	Cooling and lubrication systems
	Safety, and associated studies*
Unit 22 – Chassis systems 2:	Braking, steering and suspension systems
	Transmission systems
	Vehicle bodywork
	Associated studies (maths and science)

At this level, the above topics are covered in depth, involving more detailed understanding of systems, leading to an ability to carry out diagnostic procedures. This builds up from their developed and enhanced practice under a journeyman in the workplace. On petrol/diesel engines for instance, the City and Guilds Motor Vehicle Systems Curriculum Structure indicates the lecturer should ensure that candidates are able to:

> Identify systematic testing procedures by aural, visual and functional methods to establish the condition of, and locate faults in petrol/diesel engines and fuel systems.
>
> Symptoms/rectification procedures: poor starting, non-starting, resistance to crank rotation, misfire/uneven running, cutting out, hesitation, detonation, pinking/knocking, excessive fuel consumption, lack of power, running on, oil/coolant leaks, oil/coolant contamination, exhaust leaks/pollutants, black/blue/white smoke, excessive oil consumption, overheating/overcooling, fuel leaks/odours, abnormal mechanical noises.

Assessment is done through four written papers. There is one two-and-a-half-hour multiple choice paper and one short paragraph response type paper (also of two and a half hours) for Engine Systems 2, and the same applies for Chassis Systems 2. There is, in addition, an assessment of practical competence on diagnostic procedures conducted by the lecturers. This is divided into two parts: one on engine systems and the other on chassis systems. The assessment follows the same practical assessment regime that allows unrestricted opportunities to be assessed until a candidate obtains a pass.

2.8 Conclusion

Vocational education and training in Swaziland is motivated by the national aspirations expressed at independence to have an education system that is work-oriented. The extent to which this has been achieved has been limited due to the relatively small numbers of school leavers who enrol in VET, lack of a vertical pathway for further study and the lack of a strong structure that links VET to the workplace. Vocational education and training in Swaziland owes its and origins and influences to Britain and Germany, though the

British influence has been more pervasive as its impact on the curriculum has endured. This is understandable given that Swaziland was a British protectorate and English is the second language of the country. Vocational education and training in Swaziland can thus be said to be essentially Eurocentric in terms of the foundation on which it rests. On this basis, it might be possible to suggest that other countries with a similar VET background which are at different levels of economic development may reflect a VET system that fits within specific levels of a continuum that reflects Eurocentrism. This may be tied to the country-specific circumstances of VET. These circumstances may be defined in terms of characteristics that meet a broader type.

In terms of the model developed by Wheelahan et al. (2015), post-high school VET in Swaziland inclines more towards an 'education logic' in that it is not premised on any strong institutional links between education and work. Swaziland VET however fails to fit within this model of skills development in that it has no links with tertiary education. This suggests that the Northern Europe model of skills development may not fully apply to VET systems of countries of 'lower' skills level that lag behind in their economic development trajectories. The Swaziland VET system aspires to create capacity to link to the workplace or to participate in the economy but has so far done little to build structures that link education and work. It also fails to fit in with the 'education logic' exemplified in the UK system, whose influence on VET it seeks to model as it provides no links to tertiary education. The point made by Wheelahan, et al. (2015) that countries follow differentiated approaches to workforce development is significant here. That said, there might be a need to redirect or reconceptualise VET in Swaziland.

I will, in the next chapter, move into a discussion of the literature on vocational pedagogy which identifies the tools that will be used to interpret the data collected in this study.

Chapter 3: Literature Review

3.1 Introduction

In this chapter I first determine how vocational education differs from academic education, and what it is that could be said to be markedly 'vocational' about vocational education. I address knowledge forms as central to this distinction and how the concept of epistemic ascent provides vertical articulation to vocational education. There is, as well, the concept of signature pedagogies that could have relevance to vocational education. I later explore the conceptual frameworks that address pedagogy within vocational education and training, as well as draw on other frameworks that have relevance for categorizing vocational capacity or 'degree' of expertise. The concept of a vocational pedagogy is a relatively less researched area, marked by varied views about the possibility of identifying a universally accepted pedagogy that could be said to be a vocational pedagogy. I explore in particular the vocational pedagogy theory of Lucas, Spencer and Claxton (2012). This theory and the other works addressing vocational capacity are used to bring some depth to understanding the pedagogic practices of automotive lecturers in the research.

3.2 Vocational Education and Knowledge

3.2.1 Knowledge in Vocational Education

The context for understanding a vocational pedagogy requires that a distinction be made between academic and vocational education. It is this distinction that translates to the need for a relevant pedagogy that fits with the required VET competency. This thesis seeks to determine the specific pedagogical practices used by lecturers for teaching automotive mechanics students and explore how well these practices produce the competence levels required for the automotive mechanics trade. Literature on vocational pedagogy, though not specific to automotive mechanics, provides a framework through which the practices used by lecturers in automotive mechanics may be located and understood.

The question of 'knowledge' is central to the distinction between an academic and a vocational curriculum. Vocational education has been understood primarily in terms of

how it is linked to fields of practice while academic education is linked to fields of knowledge (Bathmaker, 2013). In this respect, knowledge has its full meaning within the context of its disciplinary frameworks as opposed to aspects of 'knowledge' that may be extracted to contextualize vocational education. The work of Bernstein (2000, p160) on vertical and horizontal knowledge structures presents the former as "specialized symbolic structures of explicit knowledge". These forms of knowledge, being 'specialized' and 'explicit' have tended to be the preserve of those involved in academic education while those involved in vocational education have been inimical to accessing this type of knowledge. As a result, those involved in vocational education have opted for *practice*-oriented education or skill rather than opting for knowledge at theory level. Lucas et al. (2012) advance the view that in vocational education, knowledge and theory need to be taught within the context of problem-solving. Knowledge may be recalled where appropriate to solve practice problems, rather than recited. The work of Bathmaker (2013) indicates the complicated and unstable nature of knowledge in vocational education, and makes the point that knowledge has to be used in greater depths so as to enable vocational qualifications to allow for progression whether within employment or into higher education. This point is made in reference to the less grounded nature of knowledge associated with vocational education. There have been various works that underscore the need for vocational education to transcend the horizontal/vertical knowledge divide by drawing on theoretical knowledge. These works say that practice needs to be informed by a wider theoretical base from which a vocational worker can draw to handle tasks of increasing complexity (Guile, 1998; Wheelahan, 2007; Winch, 2012; 2014). They point out that practice and knowledge go together and that this has implications for a lecturer in vocational education. The first is whether a lecturer's initial training itself was steeped in theory and practice. The second is whether there are mechanisms in place which enable both knowledge and practice to be upgraded in keeping with change within a vocation. The third is whether the lecturer is aware of methods for teaching that build competencies best informed by knowledge and practice. I hold the view that vocational education should be grounded at a deep level in theory, transcending practice. At the highest level this knowledge will create the capacity to move towards new knowledge forms that benefit vocational education.

The question of knowledge has been central to the view that ranks vocational education lower than academic education. It has bearing on, first, who becomes trained in vocational education and, second, on how this training is done. It also has bearing on how those who become vocational education lecturers are trained. Based on these three aspects alone, the methods that lecturers in vocational education employ in teaching may produce a graduate not immediately much above their own competence level, in terms of both practice and depth of theory. Avis, Canning, Morgan-Klein and Simmons (2012) indicate that despite attempts by the English Skills Commission at 'professional convergence' in the training of vocational and academic teachers, there has not been parity of esteem between vocational and academic teacher education in England or Scotland. They argue that such differences are underpinned by cultural and social divisions, pointing out that in vocational education and training there has always been strong emphasis on learning from a skilled artisan or practitioner. This learning from a 'non-academic' could contribute to the questioning of the status of VET, in particular when viewed against academic education. It also brings into question the degree of depth of knowledge that contributes to practice.

The term 'vocational' can be defined in terms of education that develops skills that prepare one for a specific trade, or training that gives access to employment in a skilled occupation (Jorgensen, 2013; Karmel, Mlotkowski and Awodeyi, 2008). The word 'trade' (or craft) itself refers to a skilled job requiring manual or hands-on skills. The methods that lecturers use in vocational education aim to develop these hands-on skills at entry level as well as create capacity for more advanced levels of work. With respect to engineering, for instance, the roles of an engineer, engineering technologist and engineering technician are differentiated by the level of knowledge and skill required for each function (Hanrahan, 2014). At the lower level, the role appears to work essentially within a context characterized by repetitive procedures that may not be overtly linked to a conceptual base. Muller and Gamble (2004) note that during many hours spent studying the field of cabinet making they observed that the language used during instruction centred around practical skills; this would not, however, cover the entire range from craftsman to master craftsman or artisan in the field. The former, even with a complete mastery of the craft skill, appeared to be separated by some gap from the latter through the lack of a knowledge base that would qualify him or her as a qualified cabinet maker.

There was a grey area with respect to how the knowledge base would connect to the craft or craftsman when the theoretical was not explicit – and when the knowledge could not be discussed like other forms of formal knowledge. There was thus a demarcation that would suggest a 'separation of hand and head'. The artisan would exemplify the level where he or she:

> …had grasped the principle of the whole, the relationship between the parts and the whole, the principle of arrangement, whereas the apprentice who had only learnt skills could not operate in terms of this larger principle (Muller & Gamble, 2004, p. 19).

Gamble (2012) brings in the concept of craft not only being a reproduction of known and fixed procedures requiring dexterity and accuracy, but also craft as innovation. The latter, she argues:

> …over and above dexterity and accuracy, is the ability to extrapolate beyond known procedures, materials and tools to create a new product, or to adapt an existing product to new specifications (Gamble 2012, p. 2).

There are different forms of trade or craft, and Gamble (2012) builds a typology of labour process segmentation in craft or trade work. In this typology, type 1 is where the craftsman is capable of working the full spectrum of production (extended craft-based production); in type 2 the worker does a single operation or a number of restricted operations (restricted craft based production); in type 3, an operation is isolated and divided between various trades or crafts; and in type 4, the machine replaces the craft skill resulting in deskilling of the craftsman into semi-skilled or unskilled (fully mechanised production). It thus does appear that the requirements that would prepare a worker for one of these categories of craft would vary. I derive from this typology that there are demands that are placed on a lecturer in automotive mechanics; for instance, to use methods that develop competencies that may span either type 2 or aspire for 'full spectrum' operations in a trade.

3.2.2 Knowledge Categories

In many areas of his work, Winch (2006, 2010, 2013, and 2014) makes the case that vocational education and training serves the role to move someone from novice to expert.

This begins from a point of entry where an aspiring worker starts from developing a crude idea of the rules related to a trade, before developing his understanding of these rules to the point that his understanding of these rules increases such that they can now be applied to different situations, slowly bringing to bear the contextual base on which these rules are premised. He introduces the idea of *epistemic ascent,* arguing that it has relevance for vocational education and training.

The idea of epistemic ascent as it relates to both academic and vocational curricula (Winch, 2014) refers to an underlying idea that knowledge has categories and that the relationship between different knowledge categories can be understood in terms of its contribution to supporting the progression of learners from novice to expert, rather than just being a logical structure. Winch (2014) contends that the idea of a growing subject expertise is central to the design of a curriculum, be it academic or vocational, as consideration of the different kinds of knowledge will require consideration of their relationship and how they may be integrated into the curriculum.

The components of a curriculum that would specialize a student into becoming an automotive mechanic should embody the idea of *epistemic ascent,* as it is a concept that is equally applicable to both the academic and vocational curricula. This concept involves integration of the various kinds of knowledge from simpler forms to more complex forms which in turn would create avenues for *epistemic ascent* from novice-hood to expertise. While policy makers and those in training may be inclined to regard epistemic ascent as a mere academic debate, and continue to follow practices which produce restricted vocational achievement, Winch (2014) argues that in doing so they are making choices that may not only devalue certain kinds of 'know that', 'know how' or personal characteristics; they need to be aware of the implications of the choices they make and should be able to account for them in terms of how they create or restrict avenues for epistemic ascent. Put simply, the curriculum choices made will determine the level of operation a worker may be able to rise to in the workplace and within an occupation, and these are choices that those in control should be able to account for.

Elsewhere, Winch (2006) indicates how vocational education develops someone from being a novice to being an expert. He says the novice who is new to the rules needs to be instructed in them and in their use, starting with a crude idea of what is involved in following the rules without having applied them to differing contexts. Novices have an uncertain grasp of how these rules come to exist, but as they continue with their vocational education they may be able to refer to the evidential base of these rules and note that their application may need to be contextually nuanced (ibid).

Winch differentiates 'skill' from 'technique', and argues that the conflagration of these two terms to mean one thing by those who define know-how is damaging. He argues that skill should be seen as agent property transcending technique to encompass a person's character, diligence and attention to detail (Winch, 2013; 2014). In convergence with the idea of epistemic ascent within professional or vocational education and training, Winch brings in the concept of practical abilities: technique, skill, transversal abilities, project management abilities and occupational capacity – and argues that acquiring these in their entirety may lead to more professional autonomy and deeper understanding of one's occupation and its role in the wider economy (ibid). Winch notes that in some way the practical abilities may be *nested*, where possession of the first is necessitated by possession of the second and so forth – yet there may be instances where a higher one may not necessarily mean possession of the one just before it (Winch 2014). These practical abilities – which are, by their very nature, varied – imply that those who have more or all of them will be at a higher level of epistemic ascent than if they were merely concentrating on technique and repeating procedures (ibid). The distinctions between the practical abilities are discussed below.

Technique

Technique refers to the method that is followed when carrying out a procedure, and may be more or less fully described by the task performer or an observer. The carrying out of a procedure is central to the learning of automotive mechanics in Swaziland, particularly during the earlier years where there tends to be a lot of training on the performance of a technique. However, as Winch (2014) indicates, the attainment of a technique does not necessarily mean the acquisition of a skill. While training in a technique is of great

importance in vocational education and training, a professional education that limits itself to this is deficient in many aspects.

Skill

Winch (2014), using Stanley and Williamson's (2001) criteria of know-how, says to have acquired skill to carry out a task is to have acquired the ability to carry it out in *contextually relevant conditions*. Contextually relevant conditions may include different factors such as commercial, financial and temporal constraints; difficult weather conditions; hazardous circumstances or lack of opportunity to correct errors, among others. The constraints present operational conditions that are out of the ordinary which require the vocational or professional worker to draw on personal resources or grit [my own word] far beyond the acquisition and practice of a skill.

Transversal abilities

Winch (2014) uses the German words ***fertigkeiten*** (skills) and ***fahigkeiten (***transversal abilities), stating that the distinction between them is central in countries following the German tradition. Transversal abilities involve planning that is over and above the mere exercising of a planning skill, and incorporates a degree of care about the outcome and a degree of attention to the detail of achieving the desired outcome. It involves more than the 'motions' of the planning, emphasizing the care and attention necessary to accomplish a complex outcome. Such transversal abilities become central for workers operating autonomously in a work environment, so that they have an ability to act without instruction or supervision and even to manage projects. The care and attention to the success of a complex task distinguishes skills from transversal abilities and it is through a curriculum recognising these latter abilities that a worker capable of independent operation is developed. In short, someone with skill can plan but fail to follow the plan through to its ultimate accomplishment, while one with transversal abilities not only 'conceives' but 'delivers,' following through to the desired end.

Project Management Abilities

Project management abilities are at the higher end of a scale or continuum in terms of challenges we set ourselves with regard to *duration, complexity* and *scope of judgement* and *decision making*. The projects that we find at this end require both the use of skills

and transversal abilities and concern the 'bigger picture,' where instead of just laying a line of bricks, the builder is concerned with the entire two storey house; that is, its accomplishment as a unit. To manage and execute a project requires first skills and transversal abilities and entails that one does not need to be supervised, but depends on one's own personal independence and responsibility. The complex abilities that are required in project management include planning, coordinating, communication, controlling and evaluating and may also include patience and self-discipline, among others; they include a resilience which may result in the creation of an ability that may be transferred and applied in another sphere of activity. Winch (2014) says that this transferability is related more to the development of personal characteristics than to the acquisition of skills.

Occupational Capacity

Occupational capacity presupposes the above abilities, and corresponds to the German notion of *Beruf*, which encompasses a wide ranging sphere of activity where an individual establishes himself or herself in the social order of individuals who acquire occupational capacity and practise it (Winch, 2014; Greinhert, 2007; Hanf, 2011). Winch (2014) explains that occupational capacity, like skills and transversal abilities, requires knowledge as well as systematic knowledge, but supersedes these in its requirement for knowledge in the form of systematic knowledge which spans the occupation as a whole: the knowledge of the principles underlying practice within the occupation, including capacity to respond to social and technological change. This now lives in the world of the 'know that' and 'know how' and entails reflection on underpinning knowledge, related occupations as well as the wider society — a wait and look back, if you like — and a look towards the boundaries. The realms at the heart of occupational capacity are both inward looking towards attainment of excellence in the occupation, and outward looking in terms of breaking into new horizons that may come with societal change needs and changing technology, with the productive activities of the occupation impacting on the wider society in the way the products and services of the occupation present themselves.

This becomes a continuum, in a way, which spans the practical abilities that a vocational student may develop. These determine his/her level of epistemic ascent (as defined by Winch). Depending on the extent to which a vocational student has developed these

abilities, he/she will be able to perform or display abilities that will be defined in terms of the level of technique, skill, transversal abilities, project management abilities or occupational capacity – each of which is a sphere of activity establishing the worker or vocational student in the social order as he or she strives towards higher capability in the occupation.

Some of the findings in this research relate to *epistemic ascent,* linking the pedagogic practices of the lecturer to the building of knowledge categories that relate to the progression of a worker from novice to expert. This concept is analysed with respect to the pedagogic practices of the lecturers and the levels of epistemic ascent for which these prepare the automotive mechanics students.

3.3 Signature Pedagogies

The concept of signature pedagogies was developed by Shulman (2005). Shulman (2005, p52) notes:

> The psychoanalyst Erik Erikson once observed that if you wish to understand a culture, study its nurseries. There is a similar principle for the understanding of professions: if you wish to understand why professions develop as they do, study their nurseries, in this case, their forms of professional preparation.

Shulman (2005) argues that there are fundamental methods by which those who enter a profession are prepared for that profession, which he calls 'signature pedagogies'. These address the question of how best to prepare those who aspire to enter a profession to develop the capabilities and attributes required for that profession.

In fields such as law, medicine and social work, signature pedagogies are the characteristic forms of teaching and learning. Shulman (2005) says these are types of teaching that organize the fundamental ways by which novices and future practitioners are educated into their new professions. Could there be fundamental ways of teaching that apply to vocational education – or to automotive mechanics in particular? Is automotive mechanics a profession? Borg asks the question, "How can we understand the occupation's ambiguous social status – between stigmatized dirty service work and technological expertise – as both servants and savants?" (cited in Franz, 2010). In Borg's

work, the mechanic (of the twentieth century) is seen as in need of a social status (Franz, 2010). Norton (2008) indicates that the work of an automotive mechanic did not occupy the best ground that a tradesman would aspire to. This 'ground' has shifted over time with the work of automotive mechanics now formally taught at vocational training institutions and through apprenticeships and attachments. Husen and Postlethwaite (1989) argue that professions denote power and privilege, and are based on extensive knowledge and a mystique not available to their clients. While according to this definition automotive mechanics does not qualify as a profession – particularly, and in stark contrast to, the paragons of professions like law and medicine – the research has brought to the fore the characteristic forms of teaching and learning for automotive mechanics that emulate signature pedagogy.

According to Shulman (2005), signature pedagogies operate at all levels of education, and the emphasis on professions arises mainly because professions have to have pedagogies that measure up to the standards not only of the academy but of the particular profession. Thus different professions develop particular pedagogies that transmit methods and standards of practice in a profession. For example, the setup in a first year class at a typical law school —the seats are arranged in a semi-circle, the instructor clearly visible behind a lectern interacting with students individually through exchanges of questions and answers, the use of a board to make salient points of case law or phrases – denotes a signature pedagogy that derives from law practice in the courtroom. Wayne, Raskin and Bogo (2010), in their work on *field education as the signature pedagogy of social work education*, argue that there is merit in considering pedagogical principles that may qualify as a universal component of social work education. Equally so, pedagogical practices that stand as a hallmark of automotive mechanics specialization may benefit automotive mechanics specialization.

Any signature pedagogy, according to Shulman (2005), has three dimensions. First it has a surface structure which refers to the operational acts of teaching and learning, demonstrating, questioning and answering, interacting and withholding, among others. Beck and Eno (2012) indicate that surface structure is made up of the actual methods used by teachers to teach. They are the methods that teachers use to engage students in the learning process. The second dimension, according to Shulman (2005), is deep structure,

which refers to underlying assumptions about how best to transmit knowledge and know how. Beck and Eno (2012) view deep structure as a road map towards a given destination, and they indicate that for most destinations there is more than one path by which one could arrive there. The third dimension is implicit structure, which relates to the transmission of the values, attitudes and dispositions that make up the moral dimension of the set of beliefs about that profession. In the same vein, there are operational acts of teaching and learning in automotive mechanics, just as there are underlying assumptions about how best to transmit this knowledge and know how; in addition, there exists a moral dimension that governs expectations about automotive mechanics as a trade in the workplace.

Wayne et al. (2010) indicate that previous studies by the Carnegie Foundation on the preparation of professions in the areas of medicine, law, nursing and the clergy identified ways by which the forms of preparation for graduates build towards professional understanding, skills, and integrity required to meet their responsibility to society (Shulman, 2005). Sullivan, Colby, Wegner and Shulman (2007) indicate that through a process of dominant pedagogical practice, a law student learns to "think like a lawyer". Wayne et al. (2010), in their review of the study of the pedagogies used in related professions, note that there is not one common approach used across professions for preparing students.

Shulman (2005) notes some significant aspects of signature pedagogies that raise the bar for students' participation or contribution to their learning. They entail active student performance and interaction that require vigilance and accountability and thus reduce passivity and anonymity. They also encourage peer to peer scaffolding of learning. At one level, their pedagogies of uncertainty create settings of unpredictability fostering not only surprise, excitement and anxiety at the unfolding of a concept, but also risk and fear that may lead to intellectual and formational yield.

What informs the development of signature pedagogies? Shulman (2005) believes they exist and evolve precisely for their role in facilitating student learning, understanding, skills and dispositions. They are not only pervasive and routine, cutting through topics

and courses, but allow for a bridging of theory and practice to create habits from newly learnt practices.

3.4 Vocational Education Pedagogy

Given the debate around what constitutes knowledge in vocational education, there is a tacit acceptance that the pedagogy used in academic education is not the same as that used in vocational education. This suggests that vocational education should have some form of pedagogy that helps transmit and build the vocational competence that a worker needs in order to be a tradesman. Competence involves the taking of decisions and use of expertise in solving problems within the work setting. Lucas et al. (2012) view competence as the ability to make good decisions in a real situation at a specific time, rather than merely going through a specific and predefined checklist. A vocational graduate is the result of the activities and decisions that lecturers make on a day-to-day basis in classrooms and workshops. This is in addition to other interventions, such as the quality of facilities that are necessary to make learning more meaningful. Concepts such as vocational pedagogy and vocational didactics are relatively new, according to Mjelde (2009), and are used in seeking to understand teaching/learning processes where workshop learning and work life are at the centre. The work activity itself becomes an important part of the learning activity. Lucas et al. (2012, p13) see a vocational pedagogy as 'the science, art and craft of teaching' which involves how a lecturer best engages with learners to achieve a desired vocational outcome. In the context of automotive mechanics, it is understanding how the practices of the automotive lecturer result in creating the competencies that are required for automotive mechanics students to become mechanics.

Other definitions for vocational pedagogy have been put forward, including one provided by Kyambogo University in Uganda (Habib and Nsibambi, 2014), which describes vocational pedagogy as a field oriented towards trades and occupations in which learners acquire the knowledge and skills required to work. However, this definition omits the teaching element and may leave the developing of competencies to chance rather than to a 'pedagogy' which, as both science and art, develops vocational competence through a teacher or lecturer. Central to a vocational pedagogy, according to Habib and Nsibambi (2014) is the use of teaching methods by experienced lecturers or instructors that support

the knowledge, skills and attitudes required for the work place. Quality vocational education and training should not just provide basic skills that ultimately limit a worker's capacity to handle new situations or to develop higher level competencies, hence Habib and Nsibambi (2014) argue that it should involve overarching aspects of the position that handle new situations and can develop towards higher competencies. This suggests then that vocational pedagogies should be studied with an eye to also delineate what capacities for worker competence the vocational pedagogic processes address.

A vocational pedagogy such as would apply in automotive mechanics is bound to differ from a pedagogy used in, for instance, an academic institution. Vocational lecturers in Swaziland are generally employed on the basis of having industry experience in addition to their initial training at a vocational institution. Lucas et al. (2012) see vocational pedagogy as sitting somewhere between what is taught in colleges and what is needed in the workplace. Thus the dual worlds of educational institution and workplace require two sets of expertise: teachers with workplace experience and workers who can teach. Employers often complain about the quality of vocational graduates, yet there are challenges in having a lecturer who is both a worker and teacher. There is also the challenge that a vocational pedagogy may have to deal with a learner who may have less fulfilling experiences with a general education or a learner in a hurry to enter employment. These challenges are linked to perceptions about vocational education and to the socio-economic backgrounds of learners in VET. Lucas et al. (2012) indicate that a vocational pedagogy will need to respond to these challenges. In Swaziland, the challenge related to socio-economic background affects the length of study of automotive mechanics students. They either go to MITC to study for one year so that they can thereafter seek employment, or they go to VOCTIM where they sometimes leave after only obtaining the one-year certificate and do not return to complete their diploma. This suggests that an automotive mechanics lecturer will have to determine an appropriate way to engage with students who may exit their study of automotive mechanics this way.

3.5 Approaches to Vocational Teaching

There exists controversy over whether there is a defined way in which vocations or occupations are taught. 'Vocation' and 'education' were first used in combination in

reference to education for middle class occupations such as merchants and master craftsmen (Georg & Kunze, 1981). With time, vocational education came to be associated with the education of young people from the lower social strata, and it has been from this earlier reference that the words 'vocational education' as used today have been derived (Pahl, 2014). Vocational teaching methods in Germany evolved from what was known as the 'Frankfurt methodology' which developed characteristic features of didactics for vocational education (Ott, 2011). Following this, there was a focus on experimental methods with attempts to adapt these to vocational learning. These were controversial, particularly with respect to their orientation to the scientific disciplines. Ott (2011) indicates that these experimental methods were broad in that they took in a broader work field including its associated working processes as well as encompassing an approach of interoccupational didactics. It is a point that informs this research that the pedagogical processes that are particular to a specific trade or occupation should be studied to bring out what may be particular. Harkin (2012) suggests that rather than looking for a universal vocational pedagogy, it might be helpful to move away from a one-size-fits-all approach and towards a study of overlapping pedagogies relevant to the subject area. Pahl (2014) makes a similar observation that for an ideal didactic case, occupation didactics that considers a particular occupation is more meaningful, despite the high costs that may go with associated research activities. It is occupations and knowledge about them that should be key to research, and general vocational education research may be premised on existing knowledge related to occupations, including that of teaching and learning research in an occupation. Teaching and learning processes particular to an occupation may bring a refinement and visibility to learning processes in a specific occupation. A vocational pedagogy may presuppose the specific pedagogic processes that are associated with each occupation, to the point that some occupation-specific aspects of pedagogy may be blurred or omitted. There is ground for research in pedagogic processes within specific vocations, just as there is ground for research that will build to the development of a broader vocational pedagogy. Pahl (2014) sums it up thus:

> …future research should be conducted in particular at two levels to a greater extent:
>
> - Expansion of the occupation and vocational training research on as many occupations as possible

- Research on higher level vocational education theory and the possibility of an overall didactic concept for nonacademic and academic vocational education (Pahl, 2014, p35)

A universal pedagogy for vocational education is not within easy reach as various researchers argue (Gessler and Herrera, 2015; Pahl, 2014; Herrera, 2015; Ojimba, 2012). Even country contexts may generate specific challenges that affect methods used for teaching vocational education and training, and hence the quality of VET graduates. For instance, in Nigeria, among problems associated with VET curricula, there is a shortage of highly competent teaching staff with appropriate experience in technology; there is, as well, heavy reliance on the method of dictating notes to VET students (Ojimba, 2012).

That it could be possible to develop a universal vocational pedagogy remains contested. Other special requirements or elements come into play that suggest that a pedagogy that is used within a context or country is influenced to some extent by the contexts within which vocational education takes place. This suggests that lecturers may adopt methods that are congruent with the settings in which vocational education takes place. Specifically, this relates to how vocational education seeks to link with work or where graduates of vocational education fit on completion of their studies. Though not particular to post high school vocational education, research based on the vocational didactics of Denmark, Germany, Norway, Spain and Sweden (Gessler & Herrera, 2015) presents six core criteria that the design of a vocational didactic has to meet:

Table 3.1 Core criteria which a vocational didactic should meet (Gessler & Herrera, 2015)

Outcome orientation	The outcome of the vocational education endeavor requires that the design of learning opportunities is made to shape the practical requirements of the workplace or the work that the graduate will do.
Cultural-historical embedding	A vocational didactic should reflect the cultural character and changes of that system, including its inherent objectives, values and norms.
Horizontal structure	A vocational didactic has to reflect a horizontal structure, which should align with a professional domain.
Vertical structure	A vocational didactic should align with the corresponding levels of that occupation.

Temporal structure	A vocational didactic has to be aligned with the respective objectives pursued in a particular phase of (work) life: vocational orientation, vocational development and education and further vocational training and re-orientation.
The changing nature of work	A vocational didactic need not adapt to only the employment model or standard occupations but should also orient to the changing nature of work, risk of poverty and exclusion and reality of global supply chains.

These special requirements that a vocational didactic has to meet can be used as a point of reference to interrogate the influences and motivations that surround the pedagogic processes that lecturers use in training automotive mechanics in the context of Swaziland. For instance, with respect to outcome orientation, the pedagogic processes of lecturers for automotive mechanics may need to be seen in the context of the requirements that exist on the ground in terms of the options available for an automotive mechanics graduate. This is with respect to the competencies that available job or practice opportunities require. Not only that, these available job or practice opportunities should ideally provide an environment in which the worker will improve capability so that he or she can progressively handle work that is more complex in the automotive mechanics occupation. These requirements will not remain static as a country develops. Okoye and Arimonu (2016) argue that VET has a direct impact on the development of any country, and in the Nigerian context its neglect has contributed to rising unemployment, poverty and crime. If technical and vocational education is an engine to power growth and economic development in a country, then the methods that lecturers use to transfer these skills and knowledge should relate to the capacity for capabilities to sustain that development.

In the context of the special requirement of *cultural-historical embedding*, the argument can be made that the processes that lecturers use to specialize students into automotive mechanics may reflect the influence of a vocational didactic that relates to the Swazi situation. This is in terms of the origins, changes, influences and direction of the VET system in Swaziland. *Cultural and historical embedding* relates to context, which has been discussed by a number of researchers (Lucas et al., 2012; Gessler and Herrera, 2015). Lucas et al. (2012) state that there will be contemporary challenges in each setting that a vocational pedagogy will have to deal with. These will influence the pedagogic choices that the teachers make.

On the other hand, with regard to the assumptions that a vocational didactic should relate to both the *horizontal* and *vertical* structures within that vocational occupation, the pedagogic practices of the lecturers need to be interpreted in terms of what lateral and vertical opportunities they provide within the trade of automotive mechanics. For the latter, the research uses Winch's theory of epistemic ascent (Winch, 2014). This requires that vocational education and training provide the means for a worker to move from a lower level towards expertise, rather than merely provide for entry into the lowest level of the trade. With respect to the two assumptions of *temporal structure* and *changing nature of work*, the point here is that a vocational didactic is linked to each. For the former, a vocational didactic may link to whether it is initial vocational education and training or continuing vocational education and training. For the latter, it may be linked to what new changes there are in the nature of the work as well as how issues of poverty or social exclusion affect vocational education and training. It is necessary to indicate that for the Swazi situation, though these last two assumptions may be implied, the extent to which they are rigorously pursued or interrogated as central to VET is minimal. It is also possible that the last two assumptions of Gessler and Herrera (2015) find prominence in more economically advanced countries with a commitment to innovation. Yet this idea is challenged by an observation made by Habib and Nsibambi (2014) in the Ugandan context, that in countries where there is trauma and civil strife, such as in periods following war, TVET could be an effective tool for providing skills to enable people to earn non-violent livelihoods. This may suggest then that countries that are developing but are stable and without easily identifiable divisions or readily visible 'pockets' of poverty or social exclusion, may not seriously pursue VET for such a purpose.

3.6 A Framework for a Vocational Pedagogy

A conceptual model is developed by Lucas et al. (2012) to provide the theoretical underpinning for a vocational pedagogy on which vocational teachers (or lecturers) can develop a variety of teaching methods that will lead to different learning outcomes. It is the pedagogical decisions the lecturers make on a day-to-day basis that result in progress toward the desired outcome (ibid). The definition of a vocational pedagogy on which this framework is built is the science, art and craft of teaching that prepares people for work; it is contained in the decisions, practices and processes that the teachers (or lecturers) use

for training students to be workers (ibid). This view is central to the definition of pedagogy used in this research. The framework seeks to provide a basis on which research can be built to bring meaning to the 'under-researched and under-theorized' area of vocational pedagogy (Lucas, 2014; Lucas, et al., 2012).

3.6.1 Three Broad Vocational Categories

Lucas et al. (2012) provide an approach which could form a basis on which different kinds of vocational education could be distinguished, using broad categorization based on the particular medium through which the work is expressed. Three broad categories could be distinguished as shown in:

Table 3.2 Vocational categories proposed by Lucas, et al. (2012)

Physical materials	Work that primarily involves physical materials, such as plumbing or bricklaying
People	Work that is primarily people-oriented, such as nursing, hospitality, retail and care industries
Symbols	Work that is primarily abstract, relating to words, numbers or images, such as accountancy, journalism or graphic design

In terms of pedagogic decisions, Lucas et al. (2012) indicate it may be possible to categorize teaching methods according to these categories, for example:

1 Physical materials: imitation, practice, trial and error

2 People: feedback, conversation, simulation (especially role play)

3 Symbols: critical thinking, virtual environments

These categories are not mutually exclusive: although a vocation may fit primarily in one, it will probably contain elements of the other two. This means that while a vocational education endeavor essentially emphasizes one category, it still needs to bring the other two categories to bear within the broader vocational education endeavor as well. Each category could provide a focus for discussion about the most appropriate learning methods, or even signature pedagogies, that have relevance for specific vocational domains. This categorization has the potential to play this role, although in my view research would benefit more if individual vocational pedagogies for vocational specializations that incline towards a vocational domain are studied. This could provide the basis on which the pedagogies are typified or constitute a broader signature pedagogy

related to a vocational domain. Pahl (2014) makes a similar assertion that in the framework of vocational pedagogy only limited studies have been made that paid close attention to the content and skills required for each occupation. He calls this a 'deficit of vocational pedagogy' that calls for comprehensive research on vocational teaching and learning to be carried out in as many areas where vocational education takes place as possible. This research seeks to study one such area through lecturer pedagogy in automotive mechanics. Another more poignant implication arising from the lack of a pedagogy in vocational education is that vocational learners become the losers (Lucas et al., 2012), suggesting that graduates of vocational education may be restricted in attaining their desired outcomes.

3.6.2 Scope and Context of Vocational Education

Given that the goal of vocational education is to build working competence in a vocational area, it follows that a pedagogy that is relevant for developing this competence would involve a hands-on approach, among other methods. Referring to research evidence, Lucas et al. (2012) indicate that vocational education needs to take place in a context of practical problem-solving, involving broadly hands-on and experiential learning with feedback, questioning, application, reflection and use of models, among other approaches. In order to create this context, lecturers will need to have recourse to various teaching methods that map well with a desired outcome as well as with the vocational specialization that it is used for. Without this, vocational teachers may use a narrow range of methods that limit vocational learning.

Another problem is that of the context within which vocational teaching and learning takes place. Lucas et al. (2012) indicate that the characteristics of vocational learners may influence the pedagogic choices that lecturers make, while the learning and skills workforce tends to be inadequately trained. The context for automotive mechanics training in Swaziland is defined to an extent by the background of the students who choose to study automotive mechanics, as well the restricted training opportunities for lecturers who teach automotive mechanics. These create a context within which whatever pedagogic choices are made become circumscribed.

3.6.3 Vocational Outcomes

In reference to their framework, Lucas et al. (2012) state that vocational education has the goal of developing working competence and needs to achieve the following six outcomes:

Table 3.3 The six vocational outcomes which vocational education must produce in order for students to attain working competence (Lucas et al., 2012)

Routine expertise	mainly involved with everyday procedures
Resourcefulness	the aptitude to stop and think effectively when required
Functional literacies	mastery of literacy, numeracy and digital literacy
Craftsmanship	thoughtfulness and pride in one's work
Business-like attitudes	the economic and social sides of work
Wider skills for growth	an inquisitive and resilient attitude towards constant improvement

They posit that all six outcomes should be borne in mind when designing learning experiences. This means that a lecturer pedagogy that focuses on one and omits the other, while achieving one learning outcome will not fully develop a vocational learner. The implications of this will in some way translate to the workplace, with the result that the calibre of the worker will be compromised.

3.6.4 Pedagogic Methods that Support Vocational Education

Lucas et al. (2012) identify a list of teaching methods that are relevant for vocational education, as shown below. These methods support 'learning by doing' or 'experiential learning' with others combining reflection, feedback and theory. They include:

Table 1 Teaching methods that are relevant for vocational education (Lucas et al., 2012)

Learning by:	**Learning through**
○ watching ○ imitating ○ practicing (trial and error) ○ teaching and helping ○ real-world problem-solving ○ thinking critically and producing knowledge ○ listening, transcribing and remembering ○ drafting and sketching ○ reflecting ○ being coached ○ competing	○ enquiry ○ feedback ○ conversation ○ virtual environments ○ simulation and role play ○ games **Learning on** the fly

It is on the basis of the three broad categories of vocational education, a consciousness of each of the six desired outcomes of vocational education and an understanding the variety of methods that support the different learning outcomes, that lecturers can make informed pedagogical choices.

To complement these three principles, and to optimize the pedagogical decisions made by lecturers, Lucas et al. (2012) present a tested decision-making tool to assist a vocational lecturer in choosing the best blend of teaching and learning methods. This blend is informed by the kinds of learners they work with, the skills and experience of the teacher as well as the settings in which the learning takes place. The tool works with ten dimensions as follows:

Table 3.5 Ten-dimension decision-making tool (Lucas, et al. 2012)

Element of pedagogy	**Choice**	
Role of teacher	facilitative	didactic
Nature of activities	authentic	contrived
Means of knowing	practice	theory
Attitude to knowledge	questioning	certain
Organization of time	extended	bell-bound
Organization of space	workshop	classroom
Approach to tasks	group	individual
Visibility of processes	high	hidden
Proximity of teacher	virtual	face to face
Role of the learner	self-managing	directed

A point to note with regard to this ten dimensional decision making tool is that each dimension represents a continuum, not a binary, either/or, choice: lecturers should make the most appropriate choice along the continuum based on the contexts within which the teaching takes place.

It is possible that the conceptual framework proposed by Lucas et al. (2012) will be found to have gaps or require further refinement. For example, it states that learning should provide wider skills for growth as one of the six outcomes. Within vocational education and training, one would expect wider skills for growth to facilitate vertical mobility within the work place, a concept that is similar to Winch's (2014) epistemic ascent. However, the framework omits the role of knowledge categories and how the relationship between knowledge categories contributes in terms of supporting the progression of a learner towards higher capabilities within an occupation. I contend that that teaching methods can enable a learner to develop an inquisitive and resilient attitude engendering continual growth, but this may need to relate to the appropriate categories of knowledge that ultimately build capacity for higher capabilities within an occupation if it is to have optimal relevance to vocational education and training.

In the context of this research on the pedagogy of lecturers in automotive mechanics, Lucas et al.'s (2012) framework may provide a tool that can help to identify aspects of vocational pedagogy that are within the lecturers' arsenal, given the context of VET in Swaziland. In addition, it provides a useful basis on which to premise the pedagogical practices of lecturers, with respect to developing competence and meeting the desired outcomes of vocational education. The framework itself is ambitious in terms of the challenges and limitations encountered in vocational education in developing countries, and may at this point represent a standard to be aspired to in the context of vocational education in Swaziland. Lucas et al. (2012) note that the framework requires precision planning in order to create optimal pedagogical environments. To factor in all of the relevant considerations is a complex exercise, particularly in a context with limited pedagogical and material resources.

3.7 Conclusion

Lucas et al's (2012) framework for vocational pedagogy and categories of knowledge within vocational education are used in this research as tools to deepen understanding of the pedagogic practices used by lecturers in automotive mechanics. In reference to the literature that has been discussed, the pedagogic practices that lecturers in this study use may be influenced by the context of VET and, specifically, automotive mechanics teaching in Swaziland. These practices, and the way they relate to Lucas et al's (2012) framework, have bearing on the outcomes of vocational education as well as on the competences of students and their capacity to progress from novice to higher levels. Their competences, in turn, have bearing on the vocational human resource capacity of a country. In addition to tools and insights gleaned from the literature which are brought to bear on this study, the use of both deductive and inductive methodologies enable new themes and learnings to emerge, bringing a wider perspective to bear.

In the next chapter I discuss the research methodology used in this study. I explore qualitative case study methodology and the interpretivist paradigm on which the research was premised.

Chapter 4: Research Methodology

This chapter discusses the research methodologies that are used in this study to bring to the fore the pedagogical processes that lecturers use to train automotive mechanics. While the methods discussed are employed to arrive at findings that engage with theory, the use of both deductive and inductive methodology may allow for the raising of new themes. The chapter begins with a discussion of the qualitative case study method, informed by the work of Yin (1989, 1994, and 2003) and others, as well as the use of a descriptive and interpretive research paradigm. It outlines the data collection processes and the considerations that inform the data collection strategy.

4.1 Research Design and Methodology

This research uses qualitative case studies of three vocational education institutions offering automotive mechanics specialization to students in Swaziland in order to determine which pedagogies are used to specialize students into automotive mechanics.

Case study allows one to examine a phenomenon by identifying it, then observing and documenting an exemplary instance of it – which could involve a specific context or a specific practice (O'Toole & Beckett, 2010). According to Yin (2003), qualitative case study allows the investigation of individuals or organizations through complex interventions, relationships, communities, or programs, thereby supporting a deconstruction and subsequent reconstruction of various phenomena. It provides the flexibility and rigour to explore and describe a phenomenon within its context using a variety of data sources (Baxter & Jack, 2008), thus providing for a composite – rather than single – lens through which a phenomenon is viewed and understood. The deconstruction allows the situation to be revealed through its facets and relationships, while a reconstruction may, within it, carry meanings that may not have been arrived at by other means (ibid). Hancock and Algozzine (2001) indicate that qualitative case study is different from other types of qualitative research study in that it provides intensive analysis and description of a single unit or system that is bounded by space and time, providing an in-depth understanding of a situation and its meanings for those involved (Hancock & Algozzine, 2001). As a research strategy, Eisenhardt (1989) says case study brings out understanding of the dynamics present within a setting. Voss et al (2002)

indicate that because case research is without the rigid limits of questionnaires and models, it may lead to new and creative insights, including the development of new theory. They further state that it has high validity for the practitioner or ultimate user of the research, enriching not only theory but the researchers themselves by allowing the researcher to be exposed to the real problems and insights of the people and the varied contexts of the cases themselves.

While a single qualitative case study could provide more depth of observation for a phenomenon under study, Barratt et al (2011) indicates, however, that multiple case studies have the potential to augment external validity and help guard against observer bias. The value this brings in relation to theory building is that it provides for more thorough and robust testable theory than would be provided by a single case study (Yin, 1994).

Within the context of this research – lecturer pedagogy in automotive mechanics in Swaziland – I initially considered looking at automotive mechanics specialization within the context of just one institution, which would have constituted a single case study. However, since automotive mechanics training in Swaziland is conducted at three institutions, it provided greater context for the study to include all three institutions. Using multiple case studies could facilitate a broader understanding of the pedagogy used by lecturers in specializing students into automotive mechanics in the Swaziland situation, while approaching each case as a single unit and deconstructing and reconstructing the data that is collected would enable what Hancock and Algozzine (2001) refer to as in-depth understanding of situations and meanings for those involved. The resulting picture would be both more defined and wider, in terms of both the similarities and differences found.

Within the context of Swaziland, specialization of students into automotive mechanics takes place at the Swaziland College of Technology, at Gwamile VOCTIM, and at the Swazi Skills Centres. The skills centres are managed centrally with the three small centres, which are spread across the country, following the same training regime: Manzini Industrial Training Centre (MITC), Siteki Industrial Training Centre and Nhlangano Industrial Training Centre. For purposes of this research only the Manzini Industrial

Training Centre was used. This is the main centre from which the other centres are run, and thus provides a feel for what transpires at the other two skills centres. Thus the research was carried out at the Swaziland College of Technology (SCOT), Gwamile VOCTIM and Manzini Industrial Training Centre.

Within the descriptive and interpretive research paradigm, the study uses a combination of both inductive and deductive methodology. Inductive reasoning allows the data to generate interesting themes and discussions, while deductive reasoning works with the data through a theoretical lens.

In order to guide the research process in a qualitative case study, underpinning conceptual frameworks should play an anchoring role, giving direction to the study so as to limit the scope of the research (Yin 2003; Stake 1995). Yin (2003) calls these 'propositions' and says the specific propositions are helpful in keeping the case study within feasible limits; they can be derived from various sources such as literature, personal/professional experience and theory. According to Baxter and Jack (2008), each proposition must have a distinct focus and purpose, as its role is to focus the data collection and to determine the direction and scope of the study. These propositions together contribute to the formation of a foundation for a conceptual structure or framework (Miles & Huberman 1994; Stake, 1995, in Baxter and Jack (2008). Stakes (1995) calls these propositions 'issues', and it is issues that may tie in with social, historical, political or personal contexts that may lead to the development of a conceptual framework that guides the research. Baxter and Jack (2008) caution, however, that it is possible that a conceptual framework may place limitations on the inductive approach that are too restrictive when exploring a phenomena and advise that to avoid becoming too deductive, researchers should journal their thoughts and discuss these with other researchers. In the inductive approach, Gasson (2004) refers to open coding where data is classified into themes or categories and then commonalities, associations or implied causalities are searched for, starting with a vague understanding of what might be relevant. She refers to the works of Glaser and Strauss (1967) and Glaser (1978) who even suggest that researchers avoid the literature closest to the area of research, lest they be sensitized to looking for concepts related to existing theory, thus limiting innovation. In any event, both the deductive and the inductive should be allowed to have their roles, if only to increase epistemology. Walsham (1995) also sounds a

warning that although theory may benefit the research by providing a valuable initial guide, the researcher should avoid seeing only that which theory suggests or use theory so rigidly that potential avenues of explorations are suppressed. Instead, the researcher should note that it is desirable for interpretive studies to maintain a degree of openness to allow emerging data from the field to raise its own issues, modifying initial assumptions and theories. Doing so results in an iterative process involving data collection and analysis which may lead to expansion of theory, its modification or even its abandonment altogether.

4.2 Interpretive Design

The qualitative case study method used in this study follows the interpretive design or paradigm. Kuhn (1996) defines a paradigm as a theoretical framework or a way of viewing or understanding the world that a group of scientists have come to adopt as their worldview. It provides a framework from which an inquiry operates. Hathaway (1995) indicates that when a scientist observes a phenomenon, and makes an interpretation of what it means, that scientist is using a particular paradigm in order to give meaning to that observation. In this respect, he views paradigms as lenses through which a researcher may perceive or understand the problems in their field and the scientific answers to these problems, thus dictating what they consider data, their role in the investigation, what they consider knowledge, what they view as reality and how to access that reality. A qualitative research approach, or a quantitative approach, and the insights that it brings to the fore, are thus each a function of the underlying assumptions of the paradigm that grounds that approach.

The interpretive paradigm searches to understand the subjective world of human experience (Cohen, Manion, & Morrison, 2007). Walsham (1995) says that researchers that seek to use interpretive inquiry are attempting a difficult task of trying to access other people's own interpretations while having to filter these through the researcher's own conceptual apparatus and having to represent this to others, including the respondents and other audiences. It thus calls on the interpretive researcher to be cognisant of his/her role in this complex human process, taking the role of an outside observer as well as an involved researcher, as a participant observer and action researcher. In latter two roles,

researchers are not as detached from a phenomenon being researched as in positivist-inspired research, with the result that they inevitably influence the interpretations of those being researched, particularly in cases of in-depth studies conducted over an extended period of time — if only by being in the domain of action and sharing interpretations with those being studied. Qualitative research is used not only to provide an in-depth description of human phenomena, but to add understanding and interpretation to that description (Lichtman, 2009). The social and educational worlds are characterized by complexity and richness, and qualitative research brings out the detail therein. It provides the opportunity for collection, analysis, and interpretation of data that relates to the social world and the concepts and behaviors of people within it (Anderson, 2010). Most qualitative research aims for description, understanding and interpretation (Lichtman, 2009).

Hathaway (1995) indicates that inquiry that is inspired by the interpretive paradigm brings with it the assumptions that the researcher can best come to know reality by being there, while documenting the understanding of the situation by those involved. Referring to the work of Jacob (1988), Hathaway (1995) pointing out that qualitative research places emphasis on doing research that brings out the understanding of perspectives of participants within a natural setting, thus validating knowledge experientially through human experience. The interpretive researcher is thus guided by an attempt to understand the reality experienced by the participants, as reality is constructed by those participating in it. For the interpretive researcher, meaning is drawn from engaging with what is being researched, and drawing on his or her understanding of what is seen and experienced for insight and interpretation. In this respect, Hathaway (1995) adds that the researcher's interpretation is itself a constructed part of the reality being observed.

While some may question the generalizability of results derive from interpretive research that uses case studies, some scholars assert that interpretive research is generalizable (Yin 1989; Walsham 1995). Yin (1989) contends that interpretive research using case studies is generalizable to theoretical propositions; Walsham (1995) augments Yin's answer arguing that it is generalizable in four ways, namely: in generating theory; in developing concepts; in drawing specific implications, and in contributing rich insight. Bhaskar (cited in Walsham, 1995) argues that while in the natural sciences theory is generated through

three phases – in which phenomena are identified, explanations constructed and tested empirically, and the mechanisms at work in generating these are described – in the social sciences a similar methodology can be used, noting that social structures do not exist independently and that the human agents and the generative mechanisms of these structures are not space-time variant. Building on this, Walsham (1995) argues that the generative mechanisms identified should be seen as 'tendencies' that are valuable in terms of interpreting data with possible relevance for future cases, settings and contexts.

4.3 Data Collection Sources

Qualitative case studies depend on various sources for their data. Yin (1989) cites six sources from which evidence for case studies may be derived. These are documents, archival records, interviews, direct observation and physical artefacts. Walsham (1995), however, indicates that specifically in interpretive case studies where the researcher is an outside observer, interviews become the primary source through which a researcher can best access the interpretations that participants have about phenomena or situations occurring in their natural setting. It is also through these interviews that a researcher can elicit the views and aspirations that the participants have of themselves as well as of other actors. Walsham (1995) adds that it is through interviews that a researcher can stand back and examine the interpretations of participants. Barratt et al (2011) indicates that there are two types of interview: the structured interview and the semi-structured interview. In the former, the interview tool remains fixed, with questions and stems rigid; while in the latter the interview tool is made flexible, and is updated according to emerging data, thus allowing some follow through.

While it is possible to use a single method to collect data in a qualitative case study, many authors (Eisenhardt 1989; Choi and Hong 2002; Voss et al 2002) indicate that the use of an additional method, or even multiple methods, assists 'triangulation' of data from different sources, increasing the reliability of data and providing a stronger premise for constructs and propositions. Yin (1994) says it is a major strength of case study data collection to use many different sources of evidence to provide a richer picture of events. Walsham (1995) says that since in interpretive study it is vital to capture people's interpretations as effectively as possible, while at the same time carrying out the other

interchanges of the interview, it is useful to collect audio recordings of research interviews as this provides a complete record of what was said. This can be used in addition to note taking, as note taking on its own is essentially partial. One alternative that Walsham (2011) suggests is to make rough notes and to write them in full as soon as possible after the interview. The use of audio recording may present problems in cases requiring confidentiality, with the result that it could be difficult to obtain some data. Not only this, some respondents might feel more inhibited in their responses at the very sight of the audio recording equipment.

Within the descriptive and interpretive research paradigm, this study uses a combination of inductive and deductive reasoning. The inductive approach helps bring out detail in phenomena by allowing the research on the ground to generate interesting themes and discussions. Inductive reasoning allows research findings to emerge from dominant themes in the raw data, without the constraints that could be imposed by structured methodology (Schwandt, 1997). Conversely, deductive reasoning moves from general theory down to particular specifics, and seeks to locate phenomena within the context of existing theory. Gasson (2004), referring to the work of Simon (1957), points out that research in psychology indicates that human reasoning is premised on both deductive and inductive reasoning. She indicates that if you put your hand on a stove and your hand is burned, you learn that a hot stove burns, yet through deduction from empirical evidence you learn to avoid hot stoves as it is expected that when a stove is hot it will burn someone. She argues that learning involves and depends on inductive-deductive cycles of analytical thinking, with inductive research techniques forming the basis of qualitative case study analysis.

With respect to this study on the pedagogy of lecturers on automotive mechanics, the deductive approach will be used with reference to the theoretical framework of Lucas et al. (2012) and Winch's (2014) typology contained in the concept of *epistemic ascent* (Winch, 2014; Shalem & Slonimsky, 2013). These theories will be used as tools to ascertain what (and how) phenomena in the pedagogy of lecturers in automotive mechanics operate in the three institutions, and will help illuminate these within existing operational frameworks. The inductive approach will allow emerging themes and

discussions to be generated by the study outside the remit of structured methodology, and may augment context-specific knowledge.

4.4 Research Objectives

The objectives of this study are:

1. to identify the pedagogical processes used by lecturers in training first year automotive mechanics students.
2. to determine the level(s) of competences these processes of induction achieve.

4.5 Research Questions

This study seeks to answer the following three questions:

1. What pedagogical practices do lecturers use in training first year automotive mechanics students?
2. What competences or capabilities do the first year students attain as a result of the pedagogical processes used by lecturers, and how do these competences or capabilities relate to the concept of epistemic ascent?
3. What role do apprenticeship or workplace attachment opportunities play in complementing or augmenting first year automotive mechanics capabilities or competences?

4.6 Ethics

Though the identification and eventual selection of a research topic for a thesis brings into it quite involved processes, building up into approval of a proposal that may lead to ethics approval, the relief that comes with the proposal approval soon dies down when as a researcher one is faced with the question of how to physically enter the data collection space.

As I worked at SCOT for some twenty years (1989 to 2009), serving as a senior lecturer and later as an acting vice principal, I was entering the space a colleague of the lecturers, in one sense, as a number of us had worked together as lecturers, but I was cognisant that in the position I now hold as principal of VOCTIM that I could be regarded by the

lecturers representing the 'other half' – i.e. the administration which they may perceive as failing to meet their needs for teaching resources and further training. Government had transferred me to VOCTIM as a vice principal in 2009 and eventually I was appointed as the principal in the year 2014. Naturally I had mixed feelings about including VOCTIM as a case study, wondering how I could close the divide between being an administrator and being the 'unknown researcher' that I so longed to be. But as my focus was 'the pedagogy of automotive specialization in Swaziland,' excluding VOCTIM would not have made sense given that it is one of the two main providers of automotive specialization in the country. My supervisor and fellow researchers ultimately convinced me that it was necessary to include VOCTIM. My main fear was that the lecturers, and possibly the students would be uncomfortable about my presence in the classroom. However, as the study focuses on the first year of training, many of the students would be new to the institution and might not know who I was; I hoped I could avoid being introduced in my work capacity. These were some of the thoughts that ran through my mind as I tried to work out how to enter this space. Then there was MITC; at least there, with the exception of the director, who knew me personally, I was known only vaguely as the principal of the 'other' institution.

I realized that in order to collect quality data I needed to be accepted by both lecturers and students in their learning environment. Acceptance requires trust – and trust has no specific formula by which it is attained. I saw the spaces where automotive specialization occurs – the classrooms and workshops – as the preserve of those who occupy them.

To gain entry to these research sites, I first had to seek permission to conduct doctoral research in the area of automotive specialization at the identified three institutions from the Ministry of Education and Training. I obtained authorization from the Chief Inspector of Tertiary Education. With this in hand I approached the principal of SCOT and the director of MITC with a written request to collect data at their sites and for them to assist me in identifying the staff lecturing in the automotive who had served longest and those who had served at least ten years. Voss et al (2002) says that an ideal prime contact should be someone senior enough to be able to open doors and who knows who best to interview to gather the data required. Having identified the research participants, and with the heads of the institutions finally giving the tentative nod, despite my earlier misgivings about

staff cooperation I obtained an undertaking by these leaders to consult the automotive department or, where relevant, the senior lecturer in the department as well as the selected participants on my behalf. I planned to then meet these participants myself a week later to discuss the same with them and hear their views. Thus, when I eventually went to consult the research participants at SCOT, I was already expected. I knew that in order to obtain their cooperation I should explain what I was trying to do in simple terms, and that I should express my genuine fascination with the process of a novice student gradually becoming a mechanic. I explained that was interested in what they as lecturers were doing that brought this process about. I explained also that I was doing the same study at VOCTIM and at MITC in order to get a sense of what happens in the different settings. This appeared to relieve their minds that they were not being singled out. I did the same at MITC and found that I was accepted. After the participants at the two institutions filled in the informed consent forms, I was in motion to take the first steps. Yet even then I could sense that there was a 'wait and see attitude' at both institutions – hence I would have to work at creating trust before I could collect data without the participants feeling I was encroaching.

With respect to VOCTIM, I took advantage of a meeting for lecturers in the automotive department with their senior lecturer, where I explained that I was doing a study at SCOT, MITC and VOCTIM to see how a student is specialized into becoming an automotive mechanic. I would join the first years attending some of the classes taught by two of the lecturers, and I would indicate who these lecturers would be after I had spoken privately to them. I had to assure them that this was purely for the purpose of understanding how the students learn progressively how to be automotive mechanics, and that I would not interfere with their teaching or make judgements about their work. When I finally spoke to the longest serving lecturer, I had to explain the criterion and make the necessary assurances. I did the same with the second participant, who met the criterion of ten years of service and who appeared to be the second longest serving lecturer after the longest serving one. After this, I mentioned casually to each lecturer in the automotive department who had been selected, the criteria for selection, and that I would be attending some classes or would ask someone to attend for me. This began to slowly have the effect that I had hoped for, as it facilitated more relaxed conversations with the automotive lecturers. After the two selected lecturers filled in their informed consent forms, the data collection

was due to start. My occasional small talk with the other automotive lecturers earlier also paid some dividends in that when it was time to trial run the pre-observation semi-structured interview instrument, they were willing to taking part.

At all three institutions – most of all at Gwamile VOCTIM – my position as a principal of a vocational institution doing research on vocational education matters was initially a source of discomfort to the lecturers who were participants in the research. This issue of the power dynamics became such a point of concern, even to me as a researcher, that the days preceding the beginning of the semi-structured interviews were long and heavy. The dynamics of power relationships between the researcher and the researched is, in a way, inevitably asymmetrical. This said, however, O' Toole and Beckett (2010) proffer that the very nature of the research interactions involve shifts in the role and point of view of the researcher, thus mitigating concerns about what constitutes acceptable research.

I knew that as a researcher I needed to be neutral, and that I needed to be as 'invisible' as I could for the data to reflect everyday reality as closely as possible. I also needed to ensure that any information that was obtained as part of the research on the lecturers' teaching of automotive mechanics would not be used against them or to judge them in relation to their work. This was a journey which required that I remove the 'human' in me. Not only that, I also needed to work hard at building bridges to the participants by turning myself into a plain, ordinary human being who just wanted to 'understand' how they were able to teach a student how to be a mechanic, so that I also could learn something. This involved assuring them that this was just about my learning and would not ever be used against them at work; it was to enable me to learn something new for the sake of my own development, and all they needed to do was what they always did. It also required that I develop a genuine interest in automotive mechanics; to do this I sometimes would ask about the tasks the students were given. I would do this after a lesson or at a later time when I happened to be having a conversation with the lecturer. These 'by the way' conversations eased the relationship between researcher and participant and tipped the 'power relations' scale in favour of the participants as they would enjoy explaining concepts – such as how the firing order of 3-1-4-2 in a 4-cylinder engine worked to produce power – to someone who did not know. Underlying all of this, Berger (2013) throws in a caveat that researchers need to carefully self-monitor the impact of their

biases, beliefs and personal experiences on their research as part of an ongoing project of reflexivity.

Despite the challenges that go along with conducting research as an insider, insider researchers have argued that this does not mean one cannot conduct rigorous research from this position (Ross 2017; Chavez 2008; Innes 2009). What is important, they note, is that an insider researcher addresses these issues with awareness of these positional challenges and in ways that will contribute not only to gaining knowledge but also challenge long held assumptions about this kind of research. Insider research carries with it the benefits of expediency of access and of rapport, and a richness in the interpretation of data due to its relatedness to the knowledge context; yet at the same time it can involve challenges in terms of existing relationships that may compromise understanding or limit discussion of certain concepts (Chavez, 2008). The latter suggests that the researcher-participant relationship must be handled cautiously in a manner that contributes to the quality of the research. Beyond this, Ross (2017) suggests that the benefits associated with insider research go beyond academic metrics, as there can be significant personal benefits, such as personal learnings which produce new directions in interviews which yield richer data.

In many of my interactions with the lecturers, this yielded benefits to me as a researcher and for the participants as it created enough openness that I could ask prodding questions and the participants were comfortable replying in some detail. In one such example involving an interview with one lecturer, I asked six follow-up questions to one particular question with the participant appearing quite at ease with providing this much detail. These are the personal benefits Ross (2017) speaks of. At times, also, there were challenges that arose that emanated from my having a work relationship with a participant. For example, one time when I asked a participant a question, he responded: "… I did HND... *but you were working with us here*…" [I ignore his comment]. These were instances in which the participant knew that the information I was asking for was something that I already knew, and it required patience and some prodding to get the participant to articulate the information for the sake of the data collection. The researcher-participant relationship itself began to shift and had to be negotiated over time. As the study progressed I observed that some lecturers would come and ask me, after the lesson,

if I had understood certain parts of the content. I found that I benefitted from learning from and through others and gained greater respect for what the lecturers do. I also needed to ensure that I maintained respect for the supervisory structures overseeing the lecturers and did not allow anything I witnessed during my research to influence any of my work-related decisions in the future. Ethics require that it be so, and in any event I will retire in three years' time, so all that is required is that I maintain ethical discipline for this period. That said, it becomes a secondary objective or even an ethical obligation, that if I have learnt anything in researching my own work context, then where administrative support is required to effect any improvements, I should be in position to provide the necessary support. In any event, research in education is often tied to particular contexts; for me it has been my own professional educational context that provided the impetus for the research in terms of the research questions, the sites and the target community of the research. That being so, the onus is on me as a researcher, bound by ethics, to respect the terms that govern research in these contexts. Even within the context of analysing the data, reflexivity remains integral, as argued by Berger (2013), in not only achieving in-depth understanding and interpretation of the perceptions of participants, but also in ensuring that my experience does not colour my understanding of the experience of participants.

The research itself was a journey for me that required self-transformation on my part, and that meant I first seek to understand and to reflect on the work that automotive lecturers do in producing automotive mechanics from students. Like Innes (2009), who says that he was able to navigate a research relationship that enhanced his insider status in a way that allowed the research participants to accept him, I went through a process of negotiating trust and acceptance. If anything, my relationship with lecturers teaching automotive mechanics at VOCTIM became more congenial, alerting me to the need to develop the same kind of relationship with the lecturers in the other disciplines. The supervisory support services have more direct interaction with the departments, while my role serves more as a central support mechanism. This has then meant that I could provide central support while maintaining a congenial relation with those who do most of the work in the institutional structures. In a similar way, my relationship with lecturers from the other two institutions which participated in this research became more congenial.

4.7 Sampling and Selection

The data collection for this research was conducted at three institutions in Swaziland which offer automotive mechanics, using purposive sampling rather than probabilistic sampling. The Swaziland College of Technology (SCOT), Gwamile VOCTIM and the Manzini Industrial Training Centre (MITC) were selected. The first two are the main providers of automotive specialization education in the country, while MITC is one of three skills centres spread across the country which also offer automotive specialization training – and is also the administrative base of these centres. The two main institutions offer a three-year training regime, with the first year and third years conducted at the institution while the second year is reserved for practice in industry or private garages. The skills centres, including MITC, offer a year of training without theory, using a system of training on production that primarily involves servicing customers' cars. The trainees are required to find practical placements in the second year before advancing to Grade 3 Trade Testing with the Directorate of Industrial and Vocational Training.

The research uses a multiple case study of the three institutions as these comprise the context in which automotive mechanics is taught in Swaziland. It was necessary that the data be collected during a defined time period as the automotive mechanics training programme at two of the institutions was soon to undergo some changes. With the proposed transition of SCOT into a University of Science and Technology, there was uncertainty about the continuation of automotive mechanics training going forward due to the lack of a partnering university and of qualified lecturing staff to teach at degree level. At VOCTIM, the automotive mechanics training programme was about to embark on a five-year transition process in collaboration with the Taiwanese government that involved trialling some new practices. During the limited data collection period it was not possible to involve all of the automotive lecturers as teaching times at one institution would clash with those at another institution. It was also necessary that I personally collect the data in order to maintain uniformity in the collection of data, particularly in terms of consistently tracking events and cues in the classroom that could inform the lecturer's pedagogy. For the foregoing reasons the multiple case study was done using a selected sample.

In line with the need to use multiple methods in order to increase reliability and a stronger premise from which to work with data (Eisenhardt, 1989; Choi and Hong, 2002; Voss et al, 2002), data was collected through several methods: semi-structured interviews, classroom or workshop observation of pedagogic practices and document study. I also took advantage of 'emergent' opportunities whenever these arose and had relevance to the research. These included meetings, which I had to attend as part of my own duties as an administrator, as well as opportunities where, for example, one of the lecturers participating in the study initiated an interaction about the factors which affect his work. In addition, some of the students would find opportunities, even outside of class time, to comment to me about how they wished their training was conducted. It was quite a journey for me to watch students who initially showed discomfort at seeing a stranger in their midst eventually reach the point where they would 'proudly' show off their grasp of concepts or practical skills to me, a mature adult who had shown an interest in what they were learning. I will return to other aspects of this journey later on in this chapter.

A sample of two (2) lecturers per institution was selected, with a total of six (6) lecturers selected out of a total of ten who worked at the institutions.

Table 4.1 Sampling of Lecturers by Institution

Institution	Total number of lecturers in automotive mechanics	Number of lecturers selected for data collection
Swaziland College of Technology	4	2
Gwamile VOCTIM	4	2
Manzini Industrial Training Centre	2	2

4.8 Participant Recruitment

For each institution, the two participants were selected according to the following criteria:

a) The longest serving lecturer in automotive mechanics at the institution
b) A lecturer who had served at least ten (10) years consecutively as an automotive mechanics lecturer at the same institution

The sample size enabled pre-observation and post-observation semi-structured interviews to be conducted with each participant as well as in-class and workshop observations of pedagogic practices. It also allowed for other interviews to be conducted that arose through the deductive/inductive nature of the research in order to provide a finer grained inquiry.

4.9 Profile of Research Participants

Preliminary selection of the participants for the research initially involved a request to the heads of the institutions to identify the longest serving lecturer in automotive specialization as well as all lecturing staff in the automotive specialization who had taught for at least ten years. This information was used to identify the longest serving lecturers who would be participants in the research, while one of the lecturers who had served at least ten years was then selected per institution, on the basis of their teaching times not clashing with that of the longest serving lecturer. In the study, these participants were not identified by name, but rather by institution and an assigned number. The six participants are tabulated below in terms of the selection criteria.

Table 4.2 Lecturers selected per selection criteria

Participant	Institution	Length of experience	Qualifying criterion
SCOT1	SCOT	24 years	10 year service
SCOT2	SCOT	29 years	Longest served
VOCTIM1	VOCTIM	29 years	Longest served
VOCTIM2	VOCTIM	10 years	10 year service
MITC1	MITC	18 years	10 year service
MITC2	MITC	22 years	Longest served

4.10 First Year Pedagogy Observations and Data Collection Methods

The pedagogy used by lecturers specializing first year students into automotive mechanics was observed using a range of data collection methods. Two sets of semi-

structured interview schedules were designed for pre-observation and post-observation use. The pre-observation schedule documented information presented by the lecturers about their educational background, their experience, their plans for the year for specializing their students and their perspective on what was required across the entire specialization programme to facilitate students' learning. The interview questions and other data collection methods were designed with special consideration for mapping the pedagogy used by lecturers, in terms of their decisions and interactions in the institutional setting, as well as investigating the broader aspects that linked vocational training to the workplace in the Swazi context. The post-observation interview schedule was designed to tie the loose ends together, closing any gaps and allowing the lecturer to look back at how he or she was able to specialize students and with what challenges; as well as to look forward to what chances the specializing students were moving towards. It also provided an avenue for the participant lecturers to raise other issues connected to pedagogic practice. These post-observation interviews were conducted after observation of lectures, following both theory lectures and workshop practicals, towards the end of the year.

In addition to the one-to-one interviews, other data collection methods used were observations and analysis of documents. The documents analysed included course materials and course guidelines, among others. Observations took place within a classroom setting for theory and within a workshop for all practical sessions, using field notes. A more detailed explanation of their use follows in the subsection on *observations and other methods.*

The main focus of the study was the specialization of first year students, to determine what pedagogies are used by lecturers to develop someone with little or no knowledge of automotive mechanics into a mechanic and how, on the basis of emerging data, this specialization contributes to, or ties in with, a student's progressive practical ability in automotive mechanics. The basis for selecting first year was that it provided a common ground for entry into automotive specialization that worked across all three settings, namely: Swaziland College of Technology (SCOT), VOCTIM and MITC. All three institutions offer first year training, with MITC training offering only this first year in terms of students being specialized within the institution. At SCOT and VOCTIM second year students are out on industrial attachments with private garages or industries to obtain

practice, and therefore are away from their institutions, with no lecturer contact. They return to do their third year, which is the last year of their diploma. It was, however, possible to gain an understanding of how lecturers prepare students for the second year of practical training from the lecturers' accounts during interviews. While the third year (the year after attachment) has been excluded from the study, it has been used for background information as this is the pathway graduates would take who would eventually rise to supervisory (or technician) levels. Lecturers commented on what happens in this third year in the one-to-one interviews.

Gwamile VOCTIM offers a one-year craft certificate in Motor Vehicle Systems, with the second year being a year of attachment for students to obtain practical experience with industry before they return to complete another year to obtain a diploma offered by City and Guilds. MITC offers a one-year training course in automotive mechanics providing a certificate of attendance, and then sends trainees on a one-year attachment to industry. MITC was of interest to me because it has a minimum entry requirement of Grade 7, and although many of the students now have Form 5 (or Grade 12), there were occasionally students who were hardly able to read and write. The institution is sometimes required to provide oral assessments in lieu of written assessments for students in this category. SCOT follows a regime similar to VOCTIM but trains with one year in, one year out, one year in – and awards a diploma, examined through lecturer set examinations.

Since pedagogy also requires assessment to evaluate what learning – or the extent of the learning – that has occurred, I also endeavoured to find out how assessment is used in the specialization of automotive mechanics. However, given that VOCTIM uses examinations that are set and controlled by City and Guilds of London, and that MITC does not offer formal examinations, for all institutions I had intended to follow what assessments were done and how, as part of students' formative assessments. When I attempted this, however, l found that the lecturers showed discomfort and uneasiness each time I requested information on assessments; there appeared to be a veil of secrecy that shrouded evaluation. Many times I was referred by the lecturers to the administrative structures for answers to my questions, only to meet with either a similar protectiveness or a referral back to the lecturers who had sent me. Eventually it began to dawn on me that I might compromise the trust that I had striven to build, and reluctantly I gave up my

pursuit. However, driven by my curiosity to see behind the curtain, I did manage to discover that at VOCTIM if a student fails to identify a component or part, or explain a function or process, in the City and Guilds end of year practical assessments, he/she is asked to prepare more by reading and consulting his/her peers and return when he/she was ready to try again. The questions would have been altered slightly. In some cases, students had been asked to prepare at least four times on different days. When I asked one student about this, he said that the reason was to eventually get all of them pass the assessments, and not to fail them. Although it took some time, eventually all the students passed the practical assessments.

4.11 Pre-Testing and Conducting the Interviews

Both pre-and post-observation interview schedules were pre-tested with the non-participating lecturers. This helped to identify questions which needed to be reframed, which were then improved. In addition, it identified where more follow-up questions were needed. It also helped to sensitize me to the need to prod and follow up on responses to get better clarity. As a result, the pre-test itself became a learning exercise as even the supervisor had commented on my tendency to let responses be without subsequent prodding.

The pre-observation interviews were conducted with VOCTIM, MITC and SCOT participants between May and early August in 2015. First year training finished by mid-June 2016, at the latest, at the Swaziland College of Technology. The interviews took between 50 and 70 minutes. The post-observation interviews were conducted when lecturers indicated they would not be handling any new topics as they would be winding down to the end of the academic year. This is because the first year training ran from August 2015 until June 2016. When I conducted the interviews I would indicate that I would make my own notes, but also used a small voice recorder to help me pick up later on elements I might have missed. Generally, participants did not mind the voice recorder as it was small – the size of a text marker. I then transferred the voice recordings onto a laptop and played them as I did the transcriptions in Microsoft Word, making use of the voice recording as well as the notes. This exercise was long and arduous as it required

rewinding some parts, listening again and then transcribing. Sometimes I would have to pause the recording while I caught up with the transcribing.

4.12 Observations and other methods

In addition to the data collection methods that have been described above, in-class and workshop observations were made at each of the three institutions using field notes. These notes were written out in full on the day the observation was made, using Microsoft Word on a laptop. If there were aspects that were unclear or required further explanation, I would either contact the participant lecturer by mobile phone or, if this was not possible, I would visit the participant personally. The longest distance involved to do this was 25 kilometres as this was the longest distance I had to travel from my office to any of the research institutions. This, on its own, had the benefit of increased contact, interaction and trust with the participants.

I found it necessary to rely on the in-class and workshop observations as the audio recordings from these sessions were sometimes inaudible due to the distance of the speakers from the device and background noise. Sometimes I seized the opportunity to talk privately with the participant to get greater clarity at the end of the lesson, if there were gaps in my field notes.

The workshops presented a mixed bag of opportunities and challenges regarding observations. They presented a space where the students were given practical tasks and directions to handle components, dismantle parts and put them together. It was in some of these workshop sessions that I found myself with a group of four to eight students who, once having identified a part, explained a concept, or put some parts together, would want to take the opportunity to explain to me what they were doing. When a chance would avail itself I would also ask a student to explain something about what he or she was doing – and he or she would be excited to explain. Sometimes I would quietly ask the participant lecturer for some clarification on aspects of a practical lesson and he would explain. These exchanges did a lot to building trust between the researcher and the research space occupants. Both the participant lecturer and the students soon began to see me as a colleague who relied on them to help him learn about what they were doing. Sometimes

the students would ask me, “When are you coming to class?” and many times the participant lecturers would make comments like “You are now becoming a mechanic” – mainly because by then I could ask questions that showed I understood some of the principles and aspects of automotive mechanics. Over time the fact that I was an authority figure and an outsider became almost invisible; I became just a reasonable, simple person who needed help understanding cars.

In the event that a participant lecturer wanted to make a comment about his teaching or some related matter, I would use the opportunity to obtain supplementary data. Eisenhardt (1989) indicates that additional adjustments can be made to data collection instruments to allow the researcher to probe emergent themes and to take advantage of a special opportunity that may present itself. On some occasions I was part of a meeting where issues touching upon aspects related to automotive specialization or vocational education and training were discussed or would arise. For example, beginning in June 2016 I attended monthly TVET project meetings as a member of the project team initiated by the Republic of China on Taiwan in collaboration with the Government of Swaziland, where the former had carried out an industry trend analysis for automotive mechanics to determine what gaps existed in the training. The project intended to introduce automotive computer diagnostics training at Gwamile VOCTIM to enable state-of-the-art technology to be used in automotive specialization. In this respect, Eisenhardt (1989) notes that additional data collection methods represent an acceptable kind of controlled opportunism that can help bring greater depth to a case, providing possibly a new line of thinking that may lead to new insights. Nonetheless, Voss, Tsikritsis and Frohlich (2002) indicate that at some point there are diminishing returns from incremental cases, and that the time to stop does come when you realize that you have enough cases and data to satisfactorily address the research questions.

An additional method that I used in the data collection part of this research was video recording, which was used in the workshop practicals. Where these videos were utilised, it was mainly to support the taking of field notes. The video camera would be mounted on a stand near a wall to limit its visibility. In some instances it would be hand held. The latter tended to be used on a limited basis to avoid disrupting students’ work. In many instances these videos would pick up noise in the workshop or would fail to maintain

continuity of action as students worked in restricted or hidden places such as under a car or while removing a hidden component. Another challenge was that the students worked for long hours in the workshop and my 16G memory card would reach capacity before they finished. At these times I would take the memory card and download the data onto the laptop for later viewing, transcription and re-storage. Many times these videos would show a student spending hours trying to dismantle parts with no audible utterance.

4.13 The Man in a Blue Overall Top

I have indicated that winning the trust of the participant lecturers and the students to the point of being able to maintain a presence in the workshop or class without drawing too much attention was a long journey – and this was so at all three institutions. On one occasion, at Gwamile VOCTIM I asked a colleague to observe a class and take notes after briefing him on what to look for while collecting data. Though he had a master's degree, the data he obtained was nothing close to what I had expected; it looked something like a teaching practice assessment. When, after two attempts I concluded that it would not work to have him collect the data, I took on this role myself. I realised that it was unreasonable to expect someone who was not well versed in the literature on pedagogy to know what to look for during an observation. I knew that I would need to take off my office tie in order to relate to the class environment. I had been introduced as someone also learning to understand automotive mechanics, and the students had been told they should just be free and treat me as one of themselves. They knew I was the principal, however, and would occasionally look my way, although I had opted to sit near the back of the room.

At SCOT and MITC I was introduced as an administrator from VOCTIM who had come to see how they learn to be mechanics. Then an incident happened at SCOT on the second day of my observation, 28 August 2015. Here is an extract from my field notes:

> *On this day I came to find a group of students still waiting for the lecturer outside the classroom. As I came holding pen and notebook in hand, they all scampered into class. As I later noticed, they were new in the college and were not even familiar with their class lecturer for the subject.*

This happened although I did not have a tie on in keeping with my earlier undertaking. I had also begun to put on simpler shirts on the days on which I would be making observations, but it had not seemed to have had the desired effect. Even at MITC I could feel that the students were not oblivious to my presence. Innes (2009) indicates that other researchers, such as Samuel Gilbert, argue that it is not merely being an insider researcher that gives insider status but that items such as physical appearance or manner of dress could be sources of distrust. In the context of my research it became necessary that my role be modified. Some researchers call this reflexivity as a systematic review of the role and position of the researcher in relation to the phenomenon being studied (Ross 2017; Berger 2013)

There was one thing common in the manner in which students dressed at all three institutions: they wore a two piece overall, while the lecturers wore either their formal clothes on their own or added a white or blue dustcoat. Since I did not want to be associated with the lecturers, I made a decision to put on at least the blue overall top over my shirt and zip it up. This did the trick for me. To this day, at the back of my office, I hang a blue overall top. It was the best decision I could have made. From then on, when I was in a classroom the students did not seem to notice me. Even in the workshops I would mingle with them and they would do their work and explain things to me as if to a colleague. At one time I was unable to make observations for some three days at SCOT, and when I came back someone said, “Here he comes! I missed the man with a blue overall top.” This was a student who had explained to me that in a 4-cylinder engine, when piston number 1 is on top, so is piston number 4, and that when one of these is in Inlet, the other one is at Exhaust. The blue overall top became my hallmark whenever I was to make observations, and the students liked it. Sometimes when I would find myself walking with them in the walkway someone would look my way and smile and say something along the lines of, “When are you coming again? We will be learning something new…” I had similar experiences at all three institutions; when my supervisor viewed some of the videos, he commented, “They are working like you are not there.”

4.14 Organization of data

After the pre-observation interviews, transcriptions were done in Microsoft Word on the same day and filed in a folder for *pre-observation* with subfolders for each institution differentiated according to date and lecturer code. A similar practice was adopted for post-observations with a file for *post-observations*, and institutional subfolders differentiated by lecturer code and name. I also made print outs of each transcription and filed them in folders marked *pre-observation* or *post observation* or *observation* or *video*, as the case might be, with the name of the institution at the top. For the observations, I transcribed them each day, sometimes in the evenings to avoid working on them long after the day they were captured. They were then saved in a main folder called o*bservations*, with subfolders for each institution identified by date and lecturer code. These were also be printed out and filed similarly to *pre* and *post observations*. I used the print outs to read at leisure when I had time, and formed tentative insights in the process.

It took longer to view the videos and relate them to field notes of what transpired on the dates. I spent many hours trying to decipher what I could from visual content where no verbal comment was made; sometimes after hours of viewing I would say to myself "I still have no idea what was going on there." The videos were initially downloaded onto the laptop and saved to be viewed and transcribed later, but before long the laptop ran out of space. At this point I had to buy an external hard disk that had capacity to store all the research data including the videos. I transferred all my data to this external hard disk, in addition to keeping a duplicate copy.

4.15 Final Data Analysis

Qualitative data analysis generally involves condensing raw data into themes based on interpretation and valid inference. This process is driven by inductive reasoning, where themes are drawn from the research data and become apparent from the data through the researchers thorough examination and interpretation. According to Patton (2002), qualitative analysis should not exclude the option of deductive reasoning. It is on this premise that deductive reasoning is also used in this study. Deductive reasoning seeks to locate phenomena within existing theory, and is thus a theory testing process that starts with an established theory and explores the extent to which the theory is applicable in

specific instances (Hyde, 2000). It starts with an idea and uses the data to either confirm the idea or not, whereas inductive reasoning allows research data to raise dominant themes without constraints imposed by structured methodologies (Schwandt, 1997). Inductive reasoning is a theory building process, beginning with observations of specific instances, and searching to draw generalizations about the phenomenon under investigation.

The purpose of analysis is to bring meaning, structure and order to data. Interpretation requires acute awareness of the data, concentration and openness to subtle undercurrents of social life (Marshall & Rossman, 1999). This process is not cast in stone, hence, the process of data analysis is eclectic and there is no 'right' way (Cresswell, 2002). Thus the process of identifying patterns, coding data and categorizing findings is a learning process in its own right.

Evidence based data generated from the interviews, observations, field notes, video transcriptions and document analysis was coded. A salient feature of qualitative data analysis is the coding process, which groups evidence and labels ideas so that they reflect broader perspectives (Creswell & Clark, 2011). The transcribed data obtained from the various sources of data was read and key phrases were noted. This was done for each category of data, and transcription by transcription for each data source. For example, I started with *pre-observation* transcription and then moved to *observation* and then *post-observation,* working participant by participant per institution according to the chronological order of dates for that participant. For video transcriptions I used video as a category and worked according to institution and participant dates.

After noting each key phrase, it was either marked or highlighted. Against each key phrase an initial thought or a short phrase was recorded in the margin. Each of these was assigned a code and these codes were grouped into themes. Themes that were related were put together in order to obtain a smaller set of themes. Descriptions of these themes were initially made for each case or institution. Common themes that related to all institutions were then identified, and these were analysed with respect to how they contributed to lecturer pedagogy in automotive mechanics – with cognizance of the unique characteristics each case. The bigger themes were made up of commonly emerging sets

of themes. These bigger themes were interpreted using the interpretivist paradigm to make meaning and understanding of the pedagogic practices of lecturers for preparing students to become automotive mechanics. For ease of reference a table was made consisting three columns, as shown below:

Table 4.6 Example of Table Used to Generate Themes

Key phrase	Key term/ theme	Bigger theme

While column 1 and 2 were always completed, the third column did not necessarily always align with a key term or theme, as there were far fewer bigger themes than key terms or theme sets. The use of themes ties in with Strauss and Corbin's (1990) analytical process where concepts are identified and developed with regard to their properties and dimensions, with individual observations, sentences or ideas given names and regrouped into subcategories and eventually bigger categories. Gasson (2004) brings in the idea of 'open coding' where data is 'coded' by classifying it into themes or categories and looking for patterns between categories. However, while patterns and bigger themes can be valuable, Miles and Huberman (cited in Voss et al., 2002) indicate that exceptional or discrepant instances have a payoff for case research; for this reason, notable deviant findings have been retained as integral to this research.

The final analysis was to involve the next step of conceptually interpreting the data in its entirety, through both deductive and inductive processes – distilling the raw data into some positional understanding of lecturer pedagogic practices in the training of automotive mechanics.

4.16 Generation of Themes

The generation of themes was based on the complete data set which included pre-observation and post observation semi-structured interview transcriptions, observation notes from classroom and workshop teaching and transcriptions of video recordings. This was an involved process that first required that all the sets of data be considered by date

of collection. Each transcription was read once initially, with each key phrase that related to aspects of pedagogy marked or highlighted. In the margin next to each a key term or initial key theme was noted; later some of these key terms were aggregated into bigger themes. A second reading was then done to ensure that nothing had been missed.

Sometimes it was difficult to generate the appropriate key term or initial theme. In such instances I found it helpful to refresh my mind by taking a walk or doing some work in the garden. Then, suddenly a theme would come to me. This was true particularly when developing the bigger themes. Sometimes even a cup of coffee would not help, and it was days before that *eureka* moment came. This was because the bigger theme would be comprised of key terms or initial themes that had to meet the criterion of applying to at least three participant lecturers from two different institutions. For this reason, there were far fewer bigger themes than initial themes. It is an integral aspect of qualitative data analysis to group evidence and label it according to ideas to reflect broader perspectives (Creswell & Clark, 2011). These bigger themes, by their very nature, could be generated inductively, but first and foremost they had to be related to existing theoretical frameworks for due reference. Consequently, some aspects called for further exploration of the literature to obtain some ground for meaning.

When identifying the key phrases, it was necessary to indicate the institution, date and lecturer code as well as whether the data was obtained from pre-observation semi-structured interviews or post observation semi-structured interviews, or from observation notes (with dates) or video recordings with lecturer codes and dates. This was useful when it became necessary to hunt for the context or origin of the key phrase, particularly later when developing and bringing meaning to the bigger themes.

4.17 Conclusion

Data collection in this research was premised on qualitative case study methodology that was informed by the interpretivist paradigm and relied on semi-structured interviews, class and workshop observations and video recordings of workshop teaching processes at the three institutions teaching automotive mechanics in Swaziland. Both deductive and inductive approaches were used to position findings in terms of their relationship to

theory and to generate subsequent discussion themes related to the pedagogical practices used by lecturers in Swaziland for teaching automotive mechanics.

4.18 Limitations of the Study

Although limitations of transferability may arise, Marshall and Rossman (1999) contend that findings can relate to other contexts. Qualitative study may allow the generation of knowledge that may be specific, but will however be cumulative in contributing to the development of knowledge and educational theory. Gasson (2004) notes that claims of transferability and fit must therefore arise as we identify similarities in factors that are part of theory and are consistent between the different contexts in which the theory has relevance. In any event, the use of inductive approaches as in this research provides rich ground on which to premise insights and situational examples of the building blocks of theory development.

Another limitation in this research may be linked to an asymmetrical relationship between me as a researcher and the research participants, given my position as a principal at a vocational training institution doing research on vocational education. These power relations not only required a shift of role and point of view by me as a researcher, but also called for a negotiation of the relationships between the researcher and researched. In some way these would need to allow for some mutual research-related personal benefits to researcher and participants in order to level the playing field for interviews and observations.

It may also be a limitation that I do not possess an automotive mechanics background. This would have helped to understand what I was seeing against what I knew to be another possibility. On the other hand, this afforded me an opportunity to study the pedagogy from both a neutral and inquisitive perspective. I assumed an outsider perspective but with elements of being an ‘insider’ in the sense that over my many years of experience with ‘creaky’ cars that I have referred to mechanics for repairs, I have developed a working knowledge of many car problems. This, together with the indirect benefit of having referred many of these car ‘cases’ to lecturer-supervised student mechanics, qualified me to some extent as an ‘adopted son’ to the automotive mechanics trade.

The next chapter discusses the main findings regarding the pedagogical practices of the automotive lecturers in terms of the theoretical framework of Lucas et al. (2012) and epistemic ascent as proposed by Winch (2014). Other themes that arose are also discussed and where possible are related to existing literature.

Chapter 5: A Pedagogy of Automotive Mechanics

5.1 Introduction

This chapter explores the pedagogical practices used by the lecturers to train students to be automotive mechanics, and the context that informs these practices. Pedagogy, as the science, art and craft of teaching, pertains to the decisions that lecturers make as they interact with students, yet according to Lucas et al. (2012) these pedagogical decisions are premised on the characteristics of the teachers, the background of the learners and the conditions on the ground in which vocational education takes place. These three factors have bearing on the pedagogical decisions that are made, and the ultimate capacities that vocational education provides. Automotive mechanics essentially falls into the broader category of physical materials, according to the framework put forward by Lucas, Spencer and Claxton (2012). This chapter will explore how the lecturers' pedagogy fits in with the theoretical framework, as well as discuss other emergent themes that relate to the lecturers' vocational pedagogy.

5.2 Background Training of Lecturers

The background of the lecturers in automotive mechanics, and their relevant education, training and exposure, provides the loci on which to premise their capacity to build the practical automotive capabilities and knowledge of students, and informs the pedagogical choices and practices used in their teaching. This section explores the background training of lecturers through the information provided by the lecturers themselves during the pre-observation semi-structured interviews. They are referred to with the masculine 'he' throughout due to the fact that the participant lecturers were all male; there was no female automotive lecturer at any of the three institutions. The students, too, were almost exclusively male. This has nothing to do with institutional policy, but rather the slow change in societal attitudes toward occupations such as automotive mechanics which traditionally have been the preserve of men. When the study was conducted each of the three institutions had one female student each.

Of the six lecturers who participated in the research, five were trained at the Swaziland College of Technology, and all were trained under the City and Guilds system. Of the

five, two were lecturers at the Swaziland College of Technology, two were lecturers at Gwamile VOCTIM, and one was a lecturer at the Manzini Industrial Training Centre. The sixth lecturer had learnt automotive mechanics on the job, and lectured at MITC. The interview transcriptions which follow provide information on the vocational education and training background of the lecturers as part of what contributes to their pedagogical practices. Below is a sample from an interview with a lecturer at SCOT in which he describes his background:

Transcription of interview	
Lecturer number: SCOT1	**Date: Wed 12 Aug 2015**
I went to Simunye for apprenticeship. Umm … within the apprenticeship the company sent me to SCOT to do CPM [Construction Plant Mechanics] 1… that was one year. Then I went back to industry for a year. Then I came back to do CPM 2. You would do part 1, go out… come for part 2 which was another year, it was a block release, and we came to SCOT to write the City and Guilds exam. Me, I grew up in a Motor Mechanics environment. My relatives were always working on car repairs. Apprenticeship is 5 years. After my 5 years, while we were still waiting for the company to decide if they would employ us, I saw an advertisement at SCOT and I applied, so you see me here today. I came to SCOT in 1992, went to UK to in 1999 to 2001. I did HND, but you were working with us here. *I ignore his comment.* I went to Bolton. The HND, it was more theory, more manufacturing more design, more like engineering thinking to solve problems - not much about just car repairs. But you have worked here. We used City and Guilds, but even now in the National Diploma it is taken from City and Guilds. We took City and Guilds and decided what will go in first year, and then we said if in first year we do A to M then in third year we do N to Z. But still the lecturer sits down, he decides where he can start.	

This particular lecturer (SCOT1) had grown up in a home where they worked on cars and had the benefit of being taken on apprenticeship and then was trained in automotive mechanics while he continued to enhance his practice as an apprentice. On finishing his apprenticeship, he applied for a position as lecturer at the Swaziland College of Technology and had been there since 1992. He had the opportunity to pursue a Higher National Diploma (HND) in Bolton, England; this programme involved a lot of theory. He had been head of department for some eight years at the time of the interview. He marked the point that although the Swaziland College of Technology says it is running a National Diploma, it is the same City and Guilds that they have always used – the same City and Guilds that they, as lecturers, were trained under. This comment is true for all

three institutions teaching automotive mechanics in Swaziland. Given that this lecturer had not done any pedagogical training, any recourse he might have in terms of methods to use in teaching would not be premised on formal learning. This suggests he either used methods he was trained in, or had learnt from peers, or eventually developed his own.

The next lecturer was also from the same institution, the Swaziland College of Technology:

Transcription of interview	
Lecturer number: SCOT2	**Date: Thur 13 Aug 2015**
I have been here from 1987 till now… you can count how many years is that. I did Motor Vehicle Technician level. You needed Science and Maths to qualify to study Auto Mechanics. There's craft, Technician, Diploma. I did the Technician, did 1.5 years in, then went for attachment, then I came to do 1 year. Because I had studied for 2 and half years, then I had to do Apprenticeship for another 2.5 years so that I had finished 5 years. If you had no formal training you needed to do a full 5 years apprenticeship. I later went to Coventry England to do B Tech… this was for 2 years. **What was the B Tech about?** My B Tech was Motor Mechanics Manufacturing. It was more about Body Design, that was the bias …1992- 1995.	

This lecturer (SCOT2) also studied at the Swaziland College of Technology. He then undertook an apprenticeship in the automotive industry. This was the norm at the time, given that there were still many industries in the country which wanted mechanics for their fleet, and that there were fewer vocational trainees available at the time. He also travelled to England to study and completed a B Tech in Coventry, which focused on design (Body Design) – also a programme with a high level of theory content. This lecturer, also, had not undergone any pedagogical training that would inform the practices that he used when teaching.

This leaves four lecturers – three of whom received pedagogical training through the Vocational Instructor Diploma. The first of the three was a lecturer at Gwamile VOCTIM; he described his background as follows:

Transcription of interview Lecturer number: VOCTIM1 Date: 27 July 2015
I studied at SCOT until technician level... that is Part 3. My study was two and a half years. I then went to do apprenticeship at Mhlume for another two and a half years. I was working under a mechanic … The mechanic would tell me what he was to do each time, and sometimes he would instruct me what to do, and he would check if I was doing as instructed. This continued until I was able to do a lot… and have confidence. I then worked as a mechanic at Mhlume for a number of years, and was sent for short training courses in South Africa. Sometimes I would not attend class in South Africa. They taught us what I knew. I would ask my friends to tell me when the test will be written. Each time I got 100%. I knew these things. And the people would ask "wenza ngani wena?" [how do you do this?]. I have been here now 28 years. I did VID [Vocational Instructor Diploma. It's been helpful. I can plan for training. I can evaluate my teaching. I use teaching aids, and ...and models.

This lecturer (VOCTIM1) also obtained vocational training at the Swaziland College of Technology and did an apprenticeship, where he said he was able to build his confidence. He was eventually employed as a lecturer at Gwamile VOCTIM, where he had the chance to take further short courses. He also did the Vocational Instructor Diploma, a course that was introduced at the Swaziland College of Technology specifically to provide pedagogy to tradesmen who had been employed to lecture at the various vocational training institutions in Swaziland, including SCOT. These were men (and women) who had learnt a trade like automotive mechanics, building, electrical, and carpentry among others but found themselves having to teach others the trade without having been trained themselves on how to teach.

The second of the three lecturers (VOCTIM2) commented as follows on his training background:

Transcription of interview Lecturer number: VOCTIM2 Date: 27 July 2015
I did VBR [Vehicle Body Repairs] Levels 1 & 2 at SCOT. That was 1991 to 1994. Then I did MVT {Motor Vehicle Technology] part 1, 2 and 3. That was 1995 to 2008. At the same time, I mean in the same period, I was able to do my 5-year apprenticeship with CTA. At CTA they would also send me to workshops and short training with dealers like Toyota, Nissan. These would be a week or so at a time. The dealers would come to Swaziland and we would be trained in places like Thokoza. For education, I then did the VID with SCOT. It has helped me improve my presentation skills. I now can read information… sit down and put in a way that trainees would follow.

This lecturer started off as a Vehicle Body Repairs tradesman, panel beating and spray painting cars. He then did automotive mechanics and was able to obtain apprenticeship experience as he studied for automotive mechanics. Both of his training programmes were done at SCOT. Given his background, he was more versatile than his peers as he understood both the vehicle body structure as well as automotive mechanics.

The third lecturer, who was based at the Manzini Industrial Training Centre, provided the following information:

Transcription of interview Lecturer number: MITC1 Date: 22 May 2015
Seventeen years teaching. I did VID. That was after I had done Part 1, 2 and 3 Automotive at SCOT. I had worked in employment at a garage repairing cars for about 5 years. I did my Teaching Practice for VID at VOCTIM. The VID has been of great help We drew up the curriculum for MITC, we looked at what is done in other vocational training institutions including some in South Africa. They teach maths, science. We don't want that. When we started many of our trainees did not have much education. Some could not write.

This lecturer, having obtained his automotive training at the Swaziland College of Technology, worked at a garage for some five years and then later went on to do pedagogy in the Vocational Instructor Diploma. This lecturer indicated the VID helped him when they had to draw up a curriculum for his institution.

As noted above, only three of the six lecturers had done any training in pedagogy. While this would have exposed the lecturers to methods they could use to teach, vocational pedagogy consists of more than methods, and deals with how to engage the learner in what is being learned (Hattie, 2009) with increasing opportunity for feedback from the learner as he or she learns (Lucas, Spencer & Claxton, 2012). Lucas, Spencer and Claxton (2012) say that teaching needs to address the six outcomes of vocational education and training which they identify, and should use methods that are in line with the particular vocational education categorization, as well as be anchored in decision making tools that optimise vocational learning.

Only one of the six lecturers did not have any formal training in automotive mechanics or pedagogy. This last lecturer, MITC2, had quite a different training background from all the other automotive mechanics lecturers who were respondents in the study:

Transcription of interview	
Lecturer number: MITC2	**Date: 27 July 2015**
I have tried to do the VID at SCOT but did not finish. I was left with one subject to repeat it. I mean, it gave me a bit of knowledge on how to handle learners, to teach them. With respect to cars, I learnt as I worked with people, workshops, people fixing cars. Then I would pick a bit, bit by bit. I would then do Grade Testing to gauge my skills. I was young. I think when I was 187. I was young. I was a bit blank. I first worked for Auto Mozambicano [*a garage*] I think 3 years, then I went to Swaziland Panel Beaters, there I opened up. There were many cars for repairs, engines to be fixed, panel beating, I would read a little bit, see pictures in books, read a little. I was lucky, the one I worked under was lazy... [*laughs*]. He would instruct me what to do, and would take me with on weekends to help him do his piece jobs fix cars, showing me what to do. Then I came to MITC. Oh! I wrote this somewhere [*pulls out a folder*] mmm... at Swaziland Panel Beaters... I started in 1985 till 1993 – that was 8 years. I first assisted a white man teaching here. He was from Australia, but he did not know much about fixing cars. I would help him, show him how to fix car faults He was good in electronics but not mechanics. Me, I was very good in engines, any engine, even if it is an engine I have never seen. Even today give me any engine. I had picked a little bit about the...harnesses [*not sure what he means*], the wires, I had worked with someone in the other garage. He was stingy, stingy with information. If you ask him to show you something, he wanted money. Me, I would secretly look as he was working. Then learnt a bit through what was doing. I found mechanics just had to fix engines, but would not understand wires, the watches, what they mean you see. I learnt that… oh you know ... this man would reassemble the engine without a torque wrench. He would say he would estimate how much power he put when loosening, and use about the same power *[from his head?]* when reassembling. Interruption: who are you talking about now? This mechanic at Auto Mozambicano. [*laughs].* I never took this as good practice. The engine for that car could not turn anymore. He started blaming the auto electrician, saying it was the starter. Me at the time was still blank, but took note of that. I noted that if you are a mechanic, you need to be careful and so know something about the other parts of the cars, even the auto electrics. How will you know if the engine turns, or if the engine does spark, if you don't know about the auto electrics?	

This is the story of a man who had no formal training in automotive mechanics, but worked his way through working in garages under mechanics as a helper until he built his practice. He had worked in two different garages for a total of eleven years. He did not talk about his educational background, but he did indicate that he tried to pursue the Vocational Instructor Diploma with no success. The institution MITC has made it a practice that all lecturers within its employment take up the Vocational Instructor

Diploma. This man started *young* and *blank*, in his own words. He had worked with a lazy mechanic who would instruct him in what to do, and would use him on weekends when doing his piece jobs. This was at the second garage where he worked for eight years. His earlier experience at the garage *Auto Mozambicano* has telling memories. His mechanic was 'stingy' with information and as a result he would 'peek' behind the mechanic's back to be able to 'steal' some knowledge. He had worked with a mechanic who relied on his own head when torqueing an engine; who had believed he knew the torque from the strength he needed when loosening. Through all this, MITC2 was able to learn the good and, maybe the bad, of automotive mechanics, hence he said he learnt that if you are a mechanic you need to be careful and should learn about all parts of the car – even the auto electrics.

Lucas et al. (2012) advance the argument that they have isolated learning and teaching methods that work well in vocational education, and comment that the pedagogic choices that vocational education lecturers use tend to be narrow owing to both the learning and skills workforce being generally under qualified and inadequately trained. The contexts in which the lecturers were trained were varied. Only two of the six lecturers was able to proceed beyond Part 3 City and Guilds to a higher National Diploma or B Tech. Three had completed just the Part 3. These five lecturers also had completed apprenticeships through which they obtained workplace practice experience that was a requirement for the lecturer positions they now held. Of these five, only three had undergone any form of pedagogic training. It is in this context that the role of the teacher needs to be viewed, taking into cognizance his or her own vocational background, in line with Lucas, Spencer and Claxton (2012) who say that the skills and experience of the teacher are integral in determining the methods that may be used.

Then there is the question of what recourse to teaching methods or pedagogical practices lecturers have who have not had any training in teaching? This question applies to three lecturers in this study: one who went as far as HND, one who completed a B. Tech. and one who learnt automotive mechanics on the job. These three lecturers had worked for 29, 24 and 22 years, as lecturers. All had worked alongside other lecturers. When class and/or workshop observations were made, their methods were not observed to be markedly different from those of the other lecturers. It is likely that they relied on

replicating the methods that their own instructors used when they were trained, or that they had picked up methods through observation from their peers who had had training in pedagogy. However, it might well be that these lecturers had, over time, identified their own repertoire of best methods which they used depending on the task at hand.

The context of the pedagogy used by a vocational lecturer cannot be divorced from the kinds of learners that the lecturer teaches. Accordingly, Lucas, Spencer and Claxton (2012) include the context in which vocational education takes place as influenced by who the learners who pursue VET are. Section 5.3 outlines who constitute the learners that study automotive mechanics.

5.3 Pre- requirements to Study Automotive Mechanics

5.3.1 The Role of Science and Maths

Below are the entry requirements for each of the three institutions offering automotive mechanics in Swaziland**.**

Table 5.1: Entry Requirements by Institution

Institution	Entry Requirements
Swaziland College of Technology (SCOT)	5 credits at SGCSE including Maths and Science plus a pass in English
Gwamile VOCTIM	A pass in English, Maths and Science
Manzini Industrial Training Centre (MITC)	No specific requirement for formal schooling

While on the surface it might appear that at least one institution, the Manzini Industrial Training Centre, viewed maths and science (including English) as non-core pre-requirements for a student to do automotive mechanics, automotive mechanic lecturers at all three institutions indicated an awareness of the role that these subjects play in 'making' an automotive mechanic.

The Manzini Industrial Training Centre is one institution which did not make maths and science a pre-requirement. The two participant lecturers from that institution expressed their views as follows:

Transcription of interview	
Lecturer number: MITC1	**Date: 22 May 2015**
We take even those who have not finished school…in secondary. Now some have Form 5. Some are very slow in learning. We have to repeat things a lot. They can't read. We let them do…many times. Some can't read. We use vernacular. Others are fast. Last year we had 1 student, he couldn't read. We would translate the tests, make them oral. Their skills at the end can be the same…but those who can't read, they stay slow, they stay static - no new learning. They do the same things, don't get better jobs, they can't advance in school. [He later continued] We take even those who have not finished school…in secondary. Now some have Form 5. Some are very slow in learning. We have to repeat things a lot. They can't read. We let them do…many times. Some can't read. We use vernacular. Others are fast. Last year we had 1 student, he couldn't read. We would translate the tests, make them oral. Their skills at the end can be the same…but those who can't read, they stay slow, they stay static - no new learning. They do the same things, don't get better jobs, they can't advance in school.	

Meanwhile his colleague, MITC2, said:

Transcription of interview	
Lecturer number: MITC2	**Date: 27 July 2015**
One should be able to do some little reading... but the policy here is that you can come and study even with no formal schooling but today it would be Standard 5 Form 3 or Form 5... Should be able to read and write. You speak to customers, so you should be able to talk to them. You should be able to read some specifications, but maybe some place can give you a job to do just engine reassembly only. But even that is difficult, you would end up doing wheels only, may be take them off, or remove the drums every day. You don't handle the challenging parts. Today's cars, you need to refer to the internet, see what the specifications of the car are in the internet, and attend to the car problems. If you can't read, then you can't do this.	

He later commented, as if in frustration:

Transcription of interview	
Lecturer number: MITC2	**Date: 27 July 2015**
One should be able to do some little reading, but the policy here is that you can come and study even with no formal schooling. But today it would be Standard 5 Form 3 or Form 5... Should be able to read and write. You speak to customers, so you should be able to talk to them. You should be able to read some specifications, but maybe some place can give you a job to do just engine reassembly only. But even that is difficult, you would end up doing wheels only, may be take them off, or remove the drums every day. You don't handle the challenging parts. Today's cars, you need to refer to the internet, see what the specifications of the car are in the internet, and attend to the car problems. If you can't read, then you can't do this.	

One particular day, during a practical assessment test called a phase test in which each student is expected to carry out a practical procedure in the workshop using out-of-car-parts, I observed a student using inside callipers to measure the inside bore of an engine block. After watching him measure the diameter 6 times at top and 6 times at the bottom to get an average of the both the top and bottom diameter and then work out the difference, I asked the lecturer if there was an easier way to measure the wear in the bore. He replied:

Transcription of interview	
Lecturer number: MITC2	**Date: 27 July 2015**
One should be able to do some little reading, but the policy here is that you can come and study even with no formal schooling. But today it would be Standard 5 Form 3 or Form 5... Should be able to read and write. You speak to customers, so you should be able to talk to them. You should be able to read some specifications, but maybe some place can give you a job to do just engine reassembly only. But even that is difficult, you would end up doing wheels only, may be take them off, or remove the drums every day. You don't handle the challenging parts. Today's cars, you need to refer to the internet, see what the specifications of the car are in the internet, and attend to the car problems. If you can't read, then you can't do this.	

These lecturers at the Manzini Industrial Training Centre – the only institution with no specific requirements for entry – faced with an institutional policy that does not provide for a specific pre-requirement for studying automotive mechanics, had to devise a curriculum that did not rely on maths and science, and sometimes English. This is not an easy task given that concepts in automotive mechanics are steeped in these. Theory of automotive mechanics hinges on these, hence the removal of theory and non-use of English suggests that some aspects of automotive mechanics were not effectively taught. By his own admission, MITC1 said these students remained static, with no new learning, and that they ended up doing the same things or carrying out basic automotive repetitive procedures. If they did the 'same things' then they were only capable of carrying out a restricted aspect of automotive mechanics which does not meet the six outcomes of vocational education as outlined by Lucas et al. (2012). Consequently, they would have less chances of rising in the trade. As discussed earlier, Winch (2014) calls this concept where the development of practical abilities enables those who have undergone vocational training to rise to different higher order functions *epistemic ascent.* This will be discussed further in this chapter. MITC2 put this even more bluntly, saying that students need literacy in order to be able to read specifications and communicate with

customers. Otherwise, he noted, “you will be doing wheels only”. The student who could not write is not on the path to becoming a mechanic as he would not be able to understand what he was learning.

The type of students studying automotive mechanics, and the removal of theory from the teaching at MITC, presented challenges that made it difficult to teach optimally and achieve the six outcomes outlined in the framework of Lucas et al. (2012). While it was not a focus of this study to determine specifically the socio-economic backgrounds of the automotive mechanics students or their level of achievement at secondary school, other research on who actually pursued vocational education, including a study conducted in Australia, indicates that those who studied at VET schools were likely to be from low socio-economic backgrounds (Barnett & Ryan, 2005). In the MITC context, the entry level of the students presented challenges in terms of what they were able to learn as some were slow, requiring the lecturer to repeat information many times. The lecturers gave examples of some of the challenges they experienced in this regard in their comments that the students could do the “wheels only”, the need for an automotive mechanic to use the internet to read specifications and the need to have a background in science and maths in order to use the micrometre. The question is at which of the six vocational outcomes of Lucas et al. (2012) does automotive mechanics training in Swaziland take place and what working competence is achieved? As shall be seen from the data, the first year lecturer pedagogy sought to achieve the vocational outcome of routine expertise. There however appeared to be restrictions in training towards outcomes like *resourcefulness, functional literacies, craftsmanship, business-like attitudes* and even *wider skills for growth*. These latter outcomes are integral to attaining working competence, and their limited pursuit at these institutions would compromise students’ vocational competence.

Four of the six participant lecturers, who were from the two institutions where maths and science were pre-requirements for studying automotive mechanics, were of the view that maths and science are necessary for learning automotive mechanics. I consider first the views of two automotive lecturers at the Swaziland College of Technology:

Transcription of interview	
Lecturer number: SCOT1	**Date: 12 August 2015**
Basically the requirements is 5 credits, including Science and Maths. You see the 5 credits is a requirement to get scholarship from government. For us really we need the credit in Science and Maths. English ...you just need a pass. Why do you need Science and Maths? You know these are key subjects to help you understand concepts in motor mechanics... or just engineering in general. You should have done well in Science and Maths. Here we do Calculus. You can't do Calculus if your Maths was bad. Why do you do calculus? For further learning you do need Calculus. You see your future should not be limited. So if one day you have a chance to do a degree, you can do it. Not many end up doing degrees, even HND, in Swaziland. But you see if the chance comes for one person, that person should be able to take up further study. Which work requires calculations in a car? Assembling an engine. There are torques, and there are clearances, where you can't use the naked eye. You need specific tools and Mathematics for the engine to work efficiently.	

SCOT1 was clear on the need for science and mathematics as these, he said, are key to understanding concepts in automotive mechanics. A student will need a good background in maths to be able to do calculus at the college, and calculus is key to opening up chances to do further study to degree level – for those few who will ever have that chance come their way. Again, Winch (2006; 2012; 2014) has relevance here. Even when working with a car there are torques and clearances that require mathematics.

His colleague, SCOT2, expressed this view:

Transcription of interview	
Lecturer number: SCOT2	**Date: 13 August 2015**
You need some background in Science and Maths, but really to be an automotive mechanic you don't necessarily need to have got credits in these. I don't believe that just because maybe you were sick when you sat your exam - and did not get a credit in Maths - then it means you can't study motor mechanics. If you have done some Science and Maths, you should be ok. But are there no written down requirements for one to apply to study motor mechanics at SCOT? Yes, the Science and Maths. Even when you design you need to base your design on Science principle. But even then should they be good credits? There's a grey area there. If I failed Maths does it mean I can't be an engineer? I can get a pass but have passion for Science and Maths, and one with a credit, does not have the passion. You may find that the one with the lowest pass in Science and Maths becomes the best engineer.	

Can that really happen?

You must follow these guys in industry. You find that the one who was not so good in Maths and Science is the best engineer. He is the best hands on; the other one with exceptional credits in Maths and Science is just thinking and doing the designs. The hands on guy is the one who runs and maintains the hands on day to day operations in the workshop.

SCOT2 believed that maths and science are necessary as automotive mechanics is based on scientific principles. For him a working knowledge of science and maths is fine, and there is no need for credits. With a working knowledge of maths and science a student may eventually become a good hands-on engineer, while the 'whizz kid' of maths and science is just thinking and doing the designs. This again resonates with Winch (2014)'s theory of epistemic ascent.

Now for a look at perspectives at the third institution, Gwamile VOCTIM:

Transcription of interview	
Lecturer number: VOCTIM1	**Date: 27 July 2015**
To be a mechanic you may just need to be literate… I mean be able to read and understand things. Some mechanics did not spend even 7 years in school. Here we have Form 5 requirement. This is different …it makes it easier to train these people. They are not to be just mechanics. They need elements of understanding how things work. Some of them will rise to be supervisors. They will run their own garages. They must be able to do further study. Some will need to study HR. Form 5 gives them the base to rise in the trade or to stay if they don't want to rise. Modern cars are complex. Mechanics now need to have more knowledge, and read books.	

Though VOCTIM1 made no specific mention of maths and science, which was a requirement at the institution, he reiterated the importance of literacy to read and understand "how things work" in order for students to be able to rise through the ranks to be supervisors and to do further study – as well as to be able to deal with changes in technology with respect to the complex mechanics of modern cars. His mention of the increasing complexity of cars and the greater demands that this places on mechanics points to the need for training programmes to include subjects such as maths and science which will equip them with the knowledge to cope with increasing degrees of complexity.

VOCTIM2 put it as follows:

Transcription of interview	
Lecturer number: VOCTIM2	**Date: 27 July 2015**
The car is becoming complicated. Form 5 is necessary. Cars use sensors… some consumables are dangerous, for example gases. We sometimes use gases. Maths and science is necessary in the entry requirements. You need to calculate, like this size of cylinder head should give so much power - that requires calculation. You need science to understand e.g. the properties of material, maybe under heat or after cooling.	

In his view, maths and science are at the core of understanding the work of an automotive mechanic as it involves the use of sensors, calculations and scientific principles governing how the different parts of a car functions.

Regardless of whether they were from an institution that included maths and science as pre-requirements for automotive mechanics or excluded them, all six lecturers saw the role of these two subjects as fundamental to a proper understanding of automotive mechanics, and as critical for opening avenues for students to progress to supervisory positions or continue their studies further.

5.3.2 The Need for Literacy

The two lecturers from MITC both emphasized the importance of literacy in order for someone to study to be an automotive mechanic. They both indicated they have at, at some point, been directly affected by this when they had to teach someone who was not literate. Sometimes they had to try to use the local language SiSwati to explain automotive concepts or science concepts that did not have an equivalent in the language. When teaching a student who was not literate and did not speak English, they were required to rely heavily on their own resourcefulness to support the student on the journey through the automotive mechanics programme:

Transcription of interview	
Lecturer number: MITC1	**Date: 22 January 2016**
This is difficult, but this year we did not have this case. You sit down and you try to interpret the question the best way you can, but it is difficult because you have no book to refer to that has these concepts in SiSwati. And many times when you are asking the questions – they are oral questions and in SiSwati – you find yourself almost leading the trainee because you have	

to explain and explain You are not sure if you are doing your best for the trainee to understand you. Sometimes the answer may end up lying somewhere in the words you are using when speaking to the trainee, and you don't want them to fail because of your inability.

This lecturer expressed the frustration he experienced as he struggled to convey the concepts to the learner. There are no SiSwati equivalents for some of the vocabulary used in automotive mechanics. He expressed that at times when he thought he was assisting the learner, he then realised he might have just be feeding the desired responses to the learner without facilitating genuine learning. He indicated that MITC could not use the same approach as other automotive mechanics training institutions in Swaziland or South Africa for the following reasons:

Transcription of interview	
Lecturer number: MITC1	**Date: 22 May 2015**
They teach Maths, Science, we don't want that. When we started many of our trainees did not have much education. Some could not write English. Now many have Form 3, even some have Form 5. Last year we had one who could not write English, and we used orals for his assessments. We are doing on the job training. They need to learn by doing. We do not do much theory.	

One lecturer also noted, however, that occasionally there were instances in which a student who left school at a level lower than his peers was able, through effort, to achieve more than his peers. Below, lecturer VOCTIM1 talked about a student he taught in the past at a time when the institution accepted students who had not completed high school:

Transcription of interview	
Lecturer number: VOCTIM1	**Date: 03 December 2015**
He would apply himself so much that if you explained something he would tell you in the face what you were saying was not correct. He really liked challenging what you were teaching him. There would be a big argument. He would tell you "but in that other book it is not like this." But he had only done Form 2, but he is a good mechanic.	

Such an exception is most likely if the student left school for reasons other than underachievement. He may have had a strong desire to keep learning even outside of formal schooling which may have given him a powerful motivation for learning automotive mechanics.

5.3.3 What Role Does a Student's Previous Knowledge of Automotive Mechanics Play?

What does a student who has some knowledge about automotive mechanics, maybe from working with a friend or relative, bring that may help his specialization into automotive mechanics? The lecturers indicated that on occasion they had a student who had had some experience with automotive repairs before enrolling for the automotive mechanics course.

5.3.3.1 Bad Habits versus Clean Slate

Three of the six lecturers expressed, in the interviews, either aversion to students having previous knowledge of automotive mechanics or the need for caution when building a student's knowledge on the foundation of previously learnt, and potentially unreliable, know how. The highlights in the following extracts are my own.

Transcription of interview	
Lecturer number: SCOT1	**Date: 12 August 2015**
Well…. Maybe someone may come knowing a little bit from having worked on a car once or twice. This [*knowledge*?] may help... or it may not help. A student may just want to shine, and it does not help the other students. But then when they work in groups doing Applications [*practicals*] this may benefit the group, but some knowledge may be wrong or even dangerous.	

Thus in this lecturer's view there was not much to be gained from such knowledge as it might be based on incorrect or even dangerous practices.

His colleague had a similar view:

Transcription of interview	
Lecturer number: SCOT2	**Date: 13 August 2015**
Those with a background: there are two sides. This can be good and bad. It depends if what you have seen conforms to the principles that we use in automotive mechanics. Out there you find that they use a jack to remove a wheel and then replace with another wheel. Here that procedure is wrong. We first use a jack to lift, then we support the car, then you can start working on the wheels. This is safety, so that the mechanic is safe, and the car is safe. One may be used to wrong practices. To remove this wrong concept takes a long time - and that student does not want to understand. Even when he writes, he wants to right the wrong things he learnt from out there, and this is not acceptable to engineering practice. You find sometimes that the bad practice is now within him; it is very hard to remove. A blank student is even better. He is a clean sheet. He learns concepts on a clean sheet and the concept sticks better. For instance, if you remove a battery from a car, you may find one student just putting the battery on the	

cement floor because he would do that out there. This is wrong - he has learnt a bad practice - but there are many dangers of incorrect practices.

This lecturer, SCOT2, said a "blank student" is even better as he is a "clean slate". He will learn new procedures and practices for the first time with an open mind, which assists in his learning automotive mechanics.

The third lecturer, VOCTIM1, said the following:

Transcription of interview	
Lecturer number: VOCTIM1	**Date: 27 July 2015**
I actually ask them one by one what experience they have about cars. When I teach I teach like they have no experience. Some of them you find they have worked with cars… I mean at home or somehow. They like asking questions and want you to explain things far ahead. I slow them down. I try control my speed. These can be used for helping others in practicals. You still need to guide them. Some know what a clutch is, but cannot explain all its functions. If you tell them the engine runs to give power and the clutch links the engine to the transmission, to let stationary parts move, you mention the functions of the clutch, they see what they know is little.	

This lecturer, like the other two above, said he would opt for a pedagogy that assumes nil background knowledge from the part of the student. He noted that if learners with some knowledge are included, they will need to be guided. This is similar to the ideas of guarding against bad practice or working to remove bad habits.

The next three lecturers indicated, however, that they made use selectively of learners' prior knowledge when they divide students into groups for practical group work:

Transcription of interview	
Lecturer number: VOCTIM2	**Date: 27 July 2015**
First I check the level of knowledge of the learners by asking general questions. Some have some knowledge about cars, others do not. I use those who have some knowledge when I form groups, and they help my teaching to build the others' basic knowledge.	

Transcription of interview	
Lecturer number: MITC1	**Date: 22 May 2015**
Yes, you start with simple identification of parts. Those who know something you can use when you divide students in groups, they will help the others.	

Transcription of interview	
Lecturer number: MITC2	**Date: 27 July 2015**
It does not help much. Some of the trainees are just sent here by parents, but once you know there is someone who knows a bit, it helps when you give them group work. You team them with someone who will help them.	

While MITC2 indicated that he might use these students to facilitate group work, he started by saying that this practice was not of much help.

5.3.4 Student's Educational Background and Prior Knowledge: Implications for Pedagogy

The various issues discussed above, including students having varying educational backgrounds, the exclusion of maths and science from training programmes, and contrasting views on the prior knowledge of students, together demonstrate that the students who study automotive mechanics in Swaziland bring with them backgrounds, attitudes and habits that affect the vocational training context. While at MITC the teaching was modified to respond to these challenges, the views of the lecturers were that this not only affects the level of competency which the trainees achieve, but also places limits on what is taught and how. This is a form of individualized instruction that seeks to teach content at the instructional level of students (Landrum & McDuffie, 2010), while in the case of students' prior knowledge half of the lecturers took the approach of assuming none of the students had prior knowledge while the other half sometimes used it to benefit group work. Sometimes in making the choices about how to teach, and in grappling with what means will help the learners understand, the learners were the losers. To this, I concur with the literature that there is no empirical support for the idea that matching method of content presentation to learning style results in better learning (Landrum & McDuffie, 2010); and that content is a more reliable factor for a teacher's method than individual student's preferences (Lucas, et al., 2012).

5.4 Exploratory Method

The exploratory method is not included in the list of vocational education teaching methods identified by Lucas et al. (2012). This method arose as one of the themes that were generated in the analysis as an approach that lecturers used in their pedagogical practices. As a broader approach, it involves some elements from the list of teaching methods for vocational teaching provided in Lucas et al.'s (2012) framework.

Table 5.2 Teaching methods from Lucas et al.'s (2012) framework which appeared in the exploratory method used by lecturers

Method Provided in Framework	Features
Learning by imitating	No direct and observable action provided, but learners to bring in aspects of previously observed actions to apply as part of solution to bigger problem.
Practice (trial and error)	Correcting own actions, playfulness in learning something new; doing it for real
Learning by reflecting	Self-examination, self-direction, self-directed learning, discovery of concepts
Learning on the fly	Involving self-directed learning and taking advantage of arising opportunities to learn

The lessons below illustrate the prevalent use of the exploratory method as a pedagogy that the lecturers used in specializing students into automotive mechanics. In this method, a combination of practices were used that support vocational education, and in particular practices that were identified by Lucas et al. (2012) as appropriate for the broader category of physical materials, such as *imitating, practising, and trial and error*. In addition, there were opportunities for using the exploratory method to involve other practices that supported experiential learning such as *reflection*, and *learning on the fly* (self-directed learning). Many times when this exploratory method was used by the lecturers there was uncertainty about what was being done and what it would lead to, yet eventually there was a moment of discovery that made the principle or concept clear in the student's mind. The field notes below, from a lesson on gear ratios, provides an example:

Field Notes

Lesson: Gear Ratios

Lecturer number: VOCTIM1 **Date: 8 February 2016**

Today trainees are taken to workshop to be shown a gearbox in order to determine gear ratios on a 4 speed gearbox.

Lecturer tells trainees they are going to determine gear ratios using the gearbox. They will mark the top side of the input spigot using chalk, as well as mark the output spigot shaft on the top side. They will then engage each gear starting at gear 1, and turn the input spigot shaft until the output spigot shaft returns to its starting point, observing how many times the input spigot shaft is turned for the output spigot shaft to return to its marked starting point.

The lecturer writes on the board the following:

Input	Output	
Gear 1	4	1
Gear 2	2.5	1
Gear 3	1.5	1
Gear 4		

Lecturer leaves without saying another word.

One trainee: How do we put in gear 1 without a gear lever?

Another trainee rushes with a screw driver, tries but with no success. Another trainee suggests that the cover for where the gear lever should fit should be removed.

Another trainee: What spanner size should it be?

Trainee 2: Let's try 10

Another trainee tries 10, and is able to remove the cover. He then tries his finger to move into gears... and with some success.

Another Trainee: Is that really gear 1? [laughs].

Yet another trainee: Clutch!

Trainee: There's no clutch here…it's a bicycle [all laugh].

A trainee turns the input spigot shaft, but another trainee stops him.

Trainee: Wait… how we will see where we started on the spigot shaft? Let's get some chalk to mark. [He takes some chalk to mark the starting points on the spigot shafts]

One trainee turns the input spigot shaft one time, the output spigot shaft still has not returned to the marked position, and he continues turning, and asks another to observe when the output spigot shaft returns to its starting position.

Trainee [turning input shaft]: one…two, three… four

Trainee [observing output shaft]: Yes, it's now in line

Another trainee: So the ratio is 4:1.

Another trainee: No, I don't understand.

The trainees turning and observing the spigot shaft signal they are starting again, and they redo the process.

One trainee notes on the board that for each gear, gear 1, gear 2, gear 3, one turn on the input spigot shaft results on the following turns on the output spigot shaft.

Another trainee indicates to the team he wants to try the gears also.

Trainee: Number 1…number 2...*ha ingena kamnandzi* [they just engage smoothly] … it's like a true car.

Another trainee: [looking at table on chalkboard]. I can see most of the drive is in gear 1.

	Input	Output
Gear 1	4	1
Gear 2	2.5	1
Gear 3	1.5	1
Gear 4		

[Lecturer comes, notes the progress, and does not comment on what the students have done].

Lecturer: Now engage gear 4.

[He checks as trainee engages gear].

Trainee [observing output end of spigot shaft]: [Exclaims] Ha! It also turns one time only?

Lecturer: Yes. That is why it is called top gear…the drive from the engine is equal to the drive on the final drive… the drive is smoother.

Another trainee completes the table:

Gear 4	1	1

Lecturer: We need to go to another gearbox with 5 gears forward.

[Trainees walk and mill around gearbox with 5 gears forward].

Trainee: Are we dismantling this one?

Lecturer: No… we will not dismantle… you have no reached that level. You are just in Grade 1.

Lecturer first demonstrates how the gears 1 to 5 are engaged, and how reverse is engaged on the gearbox.

1 3 5

2 4

He lets one trainee try them and to engage gear 5. The trainee engages gear 5.

[Lecturer instructs one trainee to mark the upside of the input and output spigot shafts. He asks one trainee to turn the input spigot shaft and the others to note how many times the output spigot shaft turns].

In one turn of the input spigot shaft the output turns one and a half times.

Trainees: [almost together] Ha!

One trainee: The output turns more than the input……so Sir is the ratio 1: 1.5?

Lecturer: Yes, the output is faster than the input at gear 5… that is why it is called overdrive. Each time you engage gear 5, the revs go down…engine wear is reduced.

The vocational outcomes that were achieved in this lesson are indicated below:

Table 5.3 Vocational outcomes from Lucas et al.'s (2012) framework identified in lesson on gear ratios

Vocational outcome	Yes	No	Example
Routine expertise	X		engaging gears
Resourcefulness	X		engaging gears without gear lever
Functional literacies	X		determining gear ratios
Craftsmanship		X	N/A
Business-like attitudes		X	N/A
Wider skills for growth		X	N/A

The lesson achieved the vocational outcomes of routine expertise, resourcefulness and functional literacies as exemplified above. However, the other three outcomes were not achieved. In terms of the exploratory approach, the lesson used imitation, practice and reflection, as shown below:

Table 5.4 Methods from Lucas et al. (2012) that lecturer used during observation of lesson on gear ratios

Method	Example
Learning by imitating	engaging gears
Practice (trial and error)	turning input/output shafts and counting turns; deciding spanner size
Learning by reflecting	engaging a gear without gear lever

Ten Point Decision Making Tool

To complete the triad on the pedagogical decisions made in the above lesson, the lesson reflected the decisions as below. These decisions, according to Lucas et al. (2012), depend on the lecturer's experience, the learners' background and the learning setting:

Table 5.5 Analysis of lesson on gear ratios using Lucas et al.'s (2012) ten-point decision making tool

Element of pedagogy	Choice		Example
Role of teacher	facilitative	didactic	Students take charge of own learning
Nature of activities	authentic	contrived	Actual gear box
Means of knowing	practice	theory	Actual gear box
Attitude to knowledge	questioning	certain	Students make own discovery
Organization of time	extended	bell-bound	No time set
Organization of space	workshop	classroom	Actual workshop activity
Approach to tasks	group	individual	Whole group assigned
Visibility of processes	high	hidden	Tangible processes
Proximity of teacher	virtual	face to face	Teacher on ground
Role of the learner	self-managing	directed	Learners engage gears and determine ratios

The lesson indicates a pedagogic practice more inclined to the left, which although omitting some important vocational outcomes, supports current thinking about pedagogic practice.

Note that the lecturer together with the students were in the workshop where there was a gearbox with 4 gears forward. It had no gear lever, and where there should have been a gear lever there was a cover that impeded access to where the gear lever input. The lecturer indicated to the students that in this lesson they were to determine gear ratios by watching how many times the input spigot shaft turned before the output spigot shaft returned to its original position. It should also be noted that the students were relatively new to automotive terminology having just begun classes about four weeks before. They had been learning to name and identify parts in their lessons, hence they took every

opportunity to put this into practice by using the names that they remembered and parts they identified. The lecturer wrote on the board but then walked away without saying anything to the students. As an observer, I was unsure at that point what the students were expected to do. For a moment I expected the lecturer to return and direct the process. The students, however, having heard the instruction, proceeded with the task, working together although appearing unsure of the way forward. They engaged in trial and error, reflection and interest in experiencing the action.

The students discussed how to go about trying to complete the task. One asked how they would be able to engage gear 1 without a gear lever. Another student tried to use a screw driver, but without success. Another had the idea that that the cover could be removed using a spanner. They were not sure of the spanner size, but someone suggested a 10, and it worked.

In the workshop, the students appeared to enjoy themselves as they worked, made mistakes, and subconsciously assimilated automotive mechanics concepts or made connections between them. Even those who could not drive appeared to realise on a subconscious level that before a gear is engaged the clutch should be depressed to put it in neutral. The students also competed for a chance to be involved in the practical aspects of the task. One student indicated he wanted to try the gears himself. He wanted to have a feel and experience for himself what he was observing. In this exploratory pedagogy, sometimes a student may note a key concept that might otherwise have slipped by. A student looked at the table on the board, and commented that he could see that most of the drive was in gear 1. As an observer I heard his comment and noted it – but at the time it did not register in my mind what he really meant. As I re-read and thought about the notes, it suddenly dawned on me what he meant: that the engine worked the hardest in gear 1, with the input shaft turning the most times for one turn in the output shaft.

The lecturer returned, made no comment, and instructed the learners to proceed to engage gear 4, checking in the process that it was indeed gear 4. The output turned one time, just in one turn of the input spigot shaft. The student observing the output shaft exclaimed in disbelief. The lecturer then explained, “that is why it is called top gear…the drive from the engine is equal to the drive on final drive…the drive is smoother”. When the students

moved to a gear box with gear 5, one student asked if they would be dismantling this one. The lecturer said, "You have not reached that level. You are just grade 1". This comment indicated that the lecturer had to make decisions about selecting what was to be taught and sequencing when it was to be taught. The lecturer was methodical as he instructed them that both the input and output spigot shafts must be marked before turning. As the output spigot shaft was turned, the result dismayed all of the students, and they shouted – almost together, as if in overdrive – "Ha!" The lecturer summed it, "Yes the output is faster than the input at gear 5...that is why it is called overdrive" … "the revs go down…engine wear is reduced". Thus the concept of overdrive was arrived at through experiential learning methods.

This pedagogy allowed the learners to discover the objectives of the lesson for themselves and to reinforce aspects of previously learnt material through methods like *imitation*, *practice*, *reflection* and *learning on the fly*.

The next sequence, some of which I captured on video, involved moving an old engine to prepare it to be dismantled so that the parts could be identified, after which it would be reassembled. The lecturer divided the students into different groups which took turns working on the engine.

Transcription of video from observation of workshop demonstration **Lesson: Dismantling (Lifting Engine for Dismantling)** **Video number: 2974** **Lecturer number: SCOT1** **Date: 9 September 2015**
Lifting engine for dismantling (Note 1 group of 4 on plugs, one group of 5 on lifting engine, one group of 4 putting back wheels on a car – all at the same time). The lecturer has instructed a group of 6 students to lift an old engine and have it placed on a work bench. This engine will be dismantled to allow students to name and identify parts, and will be reassembled later. The students are to use a mobile lift. One student tries to wind the handle of the hoist, while the rest of the students struggle with hooking and assisting the movement of the engine. The engine is quite huge and looks like an old truck engine. The lecturer has just given the instruction and left, and is attending to another group of students. Student: And this lecturer doesn't seem to care now … [*as they struggle and the engine does not move an inch*]. There is a lot of pushing and pulling as the students try to move the engine so as to assist the hoist which, telling from the effort of the one who is winding, is struggling with the load. Student 2: Why do you want a teacher? [To the one try to wind up the lift] ...Hey use more muscle there… [as the one winding tries hard but handle doesn't seem to turn].

Meanwhile lecturer returns:

Lecturer: Up you go…up you go. Hey, how have you hooked the engine?

[as he comes and looks more closely]. … Continue lifting…

Student on lifter: and here... I need another man [as he abandons lift]

Meanwhile another student tries to pull the work bench away from engine.

Lecturer: Wait a minute... [*he rushes to the lifter handle*]. Look how you have left the handle... if someone walks under it…it will just loosen with a big spin...hurting many people. Look here. It's a ratchet. You lock it here [*as he locks*]. Now it's safe. And when you lift…you remove like this. [*Looks at everyone*] [*Emphatically*]...Now do it… [*as he leaves again*].

One student winds the hoist as it becomes harder and harder with the engine hardly lifting. Suddenly...

Lecturer: What is happening?

Student: Hey...hey…it's going

Lecturer rushes back….

Lecturer: Going where? [Looks like the part the hook is holding on is slowly snatching away from the engine]

Student: It's going...

Lecturer: [*nonchalantly*] …serves you right... all of you. [*and pretends to go*].

Student: [*shouting*]…. It's going...

Lecturer: Going where?

Student: It's breaking this thing…

Lecturer: Ok...put it down. [*to one winding*] ...reverse...reverse!

[student appears confused]

Lecturer rushes to lower the hoist using the handle…as engine settles down again [two students appear to flee from the engine].

Lecturer: You still need to lift it…let me get a chain.

He later returns with the chain about 2 metres long and he gives to students to hook on the engine. One student fits in on parts of the engine and makes some knot.

Student: Hey…stop...why do you tie like it's a bundle of firewood? [others laugh]

Student who is tying ignores him and continues with his knot.

Another student: This chain will not come off.

Yet another student: It will be the first time I see a chain refusing to be untied...

Ok now let's lift.

As hoist is being wound, and engine slowly moves upwards.

Student: More power… what is this man doing?

The engine falls a centimetre or two, as chain appears to tighten and slackens a bit.

Student: *Aphi emanga ami*... [*Was I lying?]* [in reference to the chain tightening its knot].

Another Student: Let's continue lifting…

Student: This chain will come off.

Yet another student: it's now tight…see... *[as he pulls loose end*].

Student: It was closing a gap…. Come on lift… don't you know a chain? [but he continues to check the chain for tightness]

Student: I don't know it.

They now lift as another student holds the two loose ends of the chain as hoist is lifting, and the chain holds well.

Student: [*who has been complaining about knot*]: You see… now it's physics…all along you were using agricultural science.

Another student: It's now physical science.

Student: More power...

[as engine lifts and another student brings closer the work bench].

As engine is now above work bench, another student brings the bench under.

Student: But we have to turn the engine…so that it faces up...

Student: We want the cylinder head to be on top.

Another student: Yes... the tappet cover.

Student: Lower it slowly.

Yet another student: Now we can dismantle.

This lesson achieved the following vocational outcomes:

Table 5.6 Vocational outcomes from Lucas et al's (2012) framework identified in lesson on dismantling engine

Vocational outcome	Yes	No	Example
Routine expertise	X		using a hoist to lift engine
Resourcefulness	X		finding alternative way to tie engine
Functional literacies		X	N/A
Craftsmanship		X	N/A
Business-like attitudes		X	N/A
Wider skills for growth		X	N/A

This lesson did not do much in terms of achieving vocational outcomes, save for routine expertise related to lifting an engine, and some requirement to stop and reconsider (resourcefulness) how the engine could eventually be lifted.

Only one teaching method was used in this lesson:

Table 5.7 Methods from Lucas et al. (2012) that lecturer used during observation of Lesson on lifting engine

Method	Example
Practice (trial and error)	Finding a way to lift engine onto workbench in readiness for dismantling

Ten Point Decision Making Tool

The task that the students were given, though basic, involved the following decisions in terms of Lucas et al.'s (2012) ten-point decision making tool:

Table 5.8 Analysis of lesson on lifting engine using Lucas et al.'s (2012) ten-point decision making tool

Element of pedagogy	Choice		Example
Role of teacher	facilitative	didactic	Students to lift engine on their own
Nature of activities	authentic	contrived	Real engine, real workbench
Means of knowing	practice	theory	Learners to experience actual lifting
Attitude to knowledge	questioning	certain	Students to find way to lift on their own
Organization of time	extended	bell-bound	No time limit set
Organization of space	workshop	classroom	Real workshop activity
Approach to tasks	group	individual	Group of 6 students assigned
Visibility of processes	high	hidden	Real engine, real workbench
Proximity of teacher	virtual	face to face	Teacher present but observing
Role of the learner	self-managing	directed	Learners to find way to lift engine

In this video extract the lecturer, SCOT1, used an exploratory pedagogy that left the learners to explore solutions to a task, while he intervened minimally to ensure safety and

make some comments. The lecturer was overseeing this particular task as well as three other tasks that were being done by students on different cars all at the same time. He was responsible for handling practicals in a workshop with thirteen students, and used the method of dividing the students into groups while he rotated to observe them and give guidance. This is somewhat similar to what happens in a work situation when an experienced automotive mechanic gives an instruction to one or two workers on one car then proceeds to give instructions to another set of workers on another car – the difference here being that the lecturer decided how much guidance or liberty to gives to each group of learners, depending on the complexity of the task. A lesson like this might appear limited in terms of achieving only one vocational outcome (routine expertise), and none of the others; yet this is an example of many such lessons or situations in the teaching of automotive mechanics where students spend long hours on a task that achieves this outcome. Even in such instances, there are opportunities to develop other related aspects of routine expertise, and in this case the students reinforced their identification of parts of the engine, e.g. "We want the cylinder head to be up," … "Yes, the tappet cover." This, again, was done by the students recalling the names and subconsciously starting the identifying process in their heads while the lecturer was not in sight. The nature of the development of routine expertise, and the tendency of the lecturer to use the left side of Lucas et al.'s (2012) 10-point decision making tool provided opportunity for students to learn collaboratively and to initiate asking the lecturer for information about aspects that may not have been directly addressed in the lesson.

The students debated among themselves about which knot was appropriate to tie. They were moving into a specialized realm, but did have the advantage of the everyday – the bundle of wood. They brought the everyday to bear on the specialized task at hand, and this relationship eventually gave them a lifeline: at least someone had never seen a chain refusing to be untied. This again was from the everyday, but now moving to the task at hand. The chain was tied around the engine as if around a bundle of wood, and one student held the loose ends of the chain as the hoist lifted, with the result that the chain tightened on the knot. This on its own was a discovery that was derived from the pedagogy where the lecturer removed himself from his instructional role to enable the learners to take charge. Then the humour: 'You see, now it's physics! All along you were using

agricultural science!" – demonstrated the enjoyment the students experienced as a result of taking charge of their own learning in an environment that limited lecturer direction.

The next extract is from a lesson where lecturer MITC2 was in charge. The lecturer instructed students to help each other remove the drain plug, drain the old oil, replace the plug and fill the new oil to the correct oil gauge level. He then left the group to work alone and went to read in his office. The setup of this office was such that it had wide windows and allowed him to observe them in the workshop.

Observation Lesson based on Field Notes **Lesson: Removing and Replacing Ball Joints** **Lecturer number: MITC2** **Date: 27 July 2015**
Students proceed with task: they remove drain plug, drain oil into a metal container placed in the pit under the car, one student holds funnel while another pours in oil. Others giving some advice, and someone comments: "Pour the oil in small quantities at a time. The other group emptied all the oil in the car, and the teacher had to ask them to drain all the excess oil" … [*they laugh*]. Student [*laughing*]: "They wanted to choke the car". Lecturer checks the progress, okays it, then gives an instruction that the students prepare to replace ball joints by taking off the front wheels. Lecturer drives car out of pit area to flat area. He asks students to put safety first, block the car wheels, jack the car and use supports before working on it. Lecturer shows them the two control arms and their new ball joints. He asks them to identify these in the car. They do the identification by comparing the parts. He then asks them to remove the control arms, and he goes away. Students struggle to use spanners to loosen but fail to take off the ball joint from its fitting place in the car. After some time lecturer comes, sees the problem, quietly walks to another student who is not part of the group and asks him to show the group how to remove the ball joint from its place. Student takes two hammers, a big hammer and a small hammer, and he hits the ball joint such that one hammer hits and the other supports the ball joint (apparently to avoid bending the ball joint support when it is hit against). Finally, the ball joint comes out. Lecturer: Now that you have seen, [asks one student] ... remove the other ball joint. This time student uses same procedure with difficulty, but finally is able to remove ball joint. Two students in turn loosen the fittings for control arms, and remove them. Lecturer instructs that they fit new control arms with ball joints, and start from the ball joint. Students try ... have some difficulty, and with teacher's additional guidance finally fit in new parts.

This lesson achieved only one vocational outcome as follows:

Table 5.9 Vocational outcomes from Lucas et al.'s (2012) framework identified in lesson on removing and replacing ball joints

Vocational outcome	Yes	No	Example
Routine expertise	X		Identifying parts/removing and replacing control arms
Resourcefulness		X	N/A
Functional literacies		X	N/A
Craftsmanship		X	N/A
Business-like attitudes		X	N/A
Wider skills for growth		X	N/A

In terms of learning methods, the following were portrayed in the lesson:

Table 5.10 Methods from Lucas et al. (2012) that lecturer used on lesson on removing and replacing ball joints

Method	Example
Learning by watching	watching another student remove a ball joint
Learning by imitating	removing ball joint after watching another student
Practice (trial and error)	students trying and failing to remove ball joint
Learning by teaching and helping	student showing other students to remove ball joint

The use of another student who had successfully carried out the procedure of removing ball joints previously is in line with Lave and Wenger (1991) who assert that there can be circulation of knowledge among peers in a community of practice that need not necessarily be controlled or monopolised by the master.

Ten Point Decision Making Tool

In terms of Lucas et al.'s (2012) ten-point decision making tool, the following pedagogical decisions were reflected in this lesson:

Table 5.11 Analysis of lesson on lifting engine using Lucas et al.'s (2012) ten-point decision making tool

Element of pedagogy	Choice		Example
Role of teacher	facilitative	didactic	Teacher only gives instruction
Nature of activities	authentic	contrived	Actual control arm and ball joints
Means of knowing	practice	theory	Actual removal and replacement
Attitude to knowledge	questioning	certain	Learners not sure how it is done
Organization of time	extended	bell-bound	No time limit set
Organization of space	workshop	classroom	Actual workshop, actual ball joints
Approach to tasks	group	individual	Group assigned
Visibility of processes	high	hidden	A car and ball joints actually seen
Proximity of teacher	virtual	face to face	On ground
Role of the learner	self-managing	directed	students shown to compare parts before removing and replacing; shown procedure to remove ball joint

This lesson indicated a pedagogic practice more inclined to the left, but the lecturer sought to allow the role of the learner to be self-managing, only to find there was need to revert more towards a role that was directed. The lecturer gave the learners some leeway to perform these tasks on their own, to experience challenges and find ways around them – with the support of being able to fall back on his intervention when all else failed. The lecturer removed himself from the activity. He had instructed them to remove ball joints. After the initial check, they loosened the control arms, but try as they might, they failed. The lecturer did not intervene but let them try for a longer time. When he finally did intervene, he asked another student to remove one ball joint so that those who had not been able to could see how it was done.

The lesson which follows also exemplifies the use of the exploratory method for learners to take charge of their own discovery.

Lesson Based on Disassembly of Parts **Lesson: Fuel System Parts identification** **Lecturer number: VOCTIM2** **Date: 23 February 2016**
[Lecturer had the following instruction written on the chalkboard. The parts below are set out on work benches in workshop]. Identify the following parts: - tank - pump - filter - Carburettor Task 1 Disassemble, observe, and assemble the mechanical pump. Task 2 Disassemble, observe, and assemble the carburettor. Note: Special tools Safety and precautions Lecturer refers them to sketch in their books to identify the parts. The lesson involves learners discussing among themselves the parts that they identify as also shown in their sketch, dismantling to see the constituent parts and then reassembling. When dismantling lecturer emphasizes that they may take pictures so that they remember how parts fitted, and that they be cautious how and where they place the parts. He lets them proceed on their own on the exercise. He lets them struggle on their own in putting the parts together and to assist each other as they try – only interrupting late when they seem to fail to remember the positions of the parts.

Table 5.12 Vocational outcomes from Lucas et al.'s (2012) framework identified in lesson on fuel system parts identification

Vocational outcome	Yes	No	Example
Routine expertise	X		Identifying parts; disassembling/reassembling parts
Resourcefulness		X	N/A
Functional literacies		X	N/A
Craftsmanship		X	N/A
Business-like attitudes		X	N/A
Wider skills for growth		X	N/A

The lesson used the following learning methods:

Table 5.13 Methods from Lucas et al. (2012) that lecturer used during lesson on fuel system parts identification

Method	Example
Practice (trial and error)	students disassembling and reassembling

This lesson developed routine expertise through the method of learning by practicing through dismantling and reassembly with the student taking charge of his own learning in the workshop.

Ten Point Decision Making Tool

The above lesson was based on the following pedagogical decisions in terms of Lucas et al.'s (2012) ten-point decision making tool.

Table 5.14 Analysis of lesson fuel parts system identification using Lucas et al.'s (2102) ten-point decision making tool

Element of pedagogy	Choice		Example
Role of teacher	facilitative	didactic	Students take charge of own learning
Nature of activities	authentic	contrived	Real tank, pump, filter, carburetor
Means of knowing	practice	theory	Actual identifying, disassembly, reassembly
Attitude to knowledge	questioning	certain	Learners finding out on their own

Organization of time	extended	bell-bound	No time set
Organization of space	workshop	classroom	Parts set out in real workshop
Approach to tasks	group	individual	Each student on his/her own
Visibility of processes	high	hidden	Real parts
Proximity of teacher	virtual	face to face	Teacher on ground
Role of the learner	self-managing	directed	learner identifies, disassembles, reassembles

In the lesson which follows, the lecturer combined the exploratory method with an instruction or a pause for explanation or illustration at selected intervals while giving students an opportunity to practice and make errors, and to enquire and reflect about what was before them. Sometimes the lecturer allowed the mistake to remain until the end of a procedure only coming back when the students thought they were done to make an assessment, explain their error and let them start all over again. The lesson below not only shows this in practice, but also shows to what lengths students would go as they sought to augment their hands-on and part-identification skills:

Lesson Based on Observation notes from a practical lesson in workshop involving clutch fitting

Lesson: Clutch fitting

Lecturer number: VOCTIM1 **Date: 8 February 2016**

Notes: A customer had a car towed over that could no longer clutch. The gear could only engage the key was off. The lecturer had felt this would provide an opportunity for the trainees to relate the previous class on clutch and gear box closer to them.

I took the opportunity to ask the lecturer on the side what he suspected the problem to be, and he said most likely one of the torsion springs on the clutch plate was damaged resulting in the clutch plate not moving back.

The car is pushed and positioned on a two post stand. The lecturer asks two trainees to adjust the four under car arms of the two post stand and fit them on the suspension, the two at the front and the two at the back He asks if they have done so, and they say yes, and he tries to lift the car.

As the car is lifted the lecturer notices that one of the under arms is pressing on the exhaust pipe.

Lecturer: [to the two trainees] You see I told you to place the lifting arms on the suspension.

He then lowers the car and shows one trainee where to reposition the arm.

Lecturer: Disconnect the battery first!

One trainee: Give me number 13.

[Someone hands over the spanner and he starts loosening].

Another trainee: How do you know it is 13?

Trainee: I have been a spanner boy in one garage for about four weeks.

[Meanwhile the car is lifted again].

Lecturer: Get a centre punch…and a hammer…we need to mark 2 aligned parts of the prop shaft before we remove it.

One trainee brings a centre punch. The lecturer asks the learners to observe where he is marking.

He marks on one bolt where the prop shaft fits into the diff, and also the point on the diff with which the bolt aligns.

Trainee: Why do we do that?

Lecturer: In order to remove the gearbox, we need to remove the prop shaft. Now we need to put back the prop shaft exactly as it was positioned before…otherwise it may no longer be balanced and shake the car on the road.

The lecturer asks one trainee to remove the bolts on the prop shaft, and he shows the trainees how to remove the prop shaft as it is pulled out backwards from the engine.

Trainees appear to rush for the opportunity to remove the bolts from the gearbox.

The lecturer is standing at the back of the car with few trainees as most of them are observing closely the removal of the bolts.

Some of the trainees are interested in other parts of the chassis and appear to be touching and observing.

One trainee: [points to a plug hole on diff] What is in here?

Lecturer: It is where the diff oil is poured.

Trainee: …and what is this pipe for? [pointing to a pipe that goes to go the wheels at the back. Diff]

Lecturer: It has brake fluid for braking at the back.

Another trainee: But there is another pipe?

Lecturer: It is for ABS…. anti-lock braking system…it has a sensor which goes to the computer unit…the computer unit reads the speed of the car… and releases brake fluid to correspond to the speed of the wheel when braking.

Trainee: It's like a white man's witchcraft [all laugh].

[Meanwhile the dismantling of the gearbox is completed. The clutch plate, pressure plate, release bearing are taken out. The lecturer observes the clutch plate, and shows trainees a damaged torsion ring on the clutch plate as his previous diagnosis to me. He explains that is the reason why the clutch plate was not releasing].

The lecturer explains that he will now call the customer who owns the car to bring in a new and complete clutch kit so that the clutch plate can be fitted the next day.

This part of the lesson reflected the following vocational outcomes:

Table 5.15 Vocational outcomes from Lucas et al.'s (2012) framework identified in lesson on clutch fitting

Vocational outcome	Yes	No	Example
Routine expertise	X		disassembling prop shaft, and gear box safely lifting a car using 2 post stand
Resourcefulness	X		marking alignment of prop shaft and diff
Functional literacies		X	N/A
Craftsmanship	X		N/A requirement for putting back prop shaft in exact position as before
Business-like attitudes		X	N/A
Wider skills for growth		X	N/A

Apart from the outcome of routine expertise that was achieved through disassembly, the lesson sought to achieve the outcomes of resourcefulness and craftsmanship through taking care that the prop shaft alignment with diff is maintained, and following 'good practice' in reassembling, respectively.

The lesson made use of the following methods:

Table 5.16 Methods from Lucas et al, (2012) that lecturer used during lesson on clutch fitting

Method	Example
Learning by watching	watching a damaged torsion ring; marking alignment of prop shaft and diff
Learning by imitating	pulling out prop shaft backwards
Practice (trial and error)	removing gearbox to locate clutch plate, release bearing, pressure plate and torsion springs
Learning through feedback	lecturer shows students how the 2 post stand has not been used correctly to lift car
Learning through conversation	students learning about where diff oil is poured and how ABS works though 'side conversations' with teacher
Learning by real-world problem solving	real life clutch failure due to damaged torsion spring
Learning on the fly	students observing plug hole on diff for diff oil; and ABS pipes and noting function
Learning by reflecting	noting why the centre punch and hammer are used to mark prop shaft and diff alignment.

The lesson utilised multiple methods to achieve learning, mainly through the lecturer allowing exploration and allowing the learners to take charge of their learning. The result is that the use of these methods brought about awareness of more related concepts that the students would be interested in.

Ten Point Decision Making Tool

The above lesson is based on the following pedagogical decisions on the ten-point decision making tool:

Table 5.17 Analysis of lesson on clutch fitting using Lucas et al's (2012) ten-point decision making tool

Element of pedagogy	Choice		Example
Role of teacher	facilitative	didactic	Teacher directs, but learners dismantle
Nature of activities	authentic	contrived	Actual prop shaft, actual gearbox
Means of knowing	practice	theory	Dismantling prop shaft, gearbox
Attitude to knowledge	questioning	certain	Students discover a clutch problem n
Organization of time	extended	bell-bound	No time set
Organization of space	workshop	classroom	Actual workshop, actual car
Approach to tasks	group	individual	Whole group assigned
Visibility of processes	high	hidden	Actual gearbox, actual clutch
Proximity of teacher	virtual	face to face	Teacher on ground
Role of the learner	self-managing	directed	Learner directed what to remove and shown problem on clutch

Then following lesson, observed on the day following the previous lesson that was discussed, addressed the fitting of the clutch:

Lesson Based on Observation notes of a practical lesson in workshop involving clutch fitting **Lesson 2: Clutch fitting** **Lecturer number: VOCTIM1** **Date: 9 February 2016**
On this day, the lecturer has come with a new clutch kit for the car. He shows the trainees the new clutch plate, pressure plate and release bearing. He explains that the bulging side of the clutch plate is fitted into the release bearing. Lecturer: Do not make a mistake. Fit the bulging side into the pressure plate……otherwise the car will not clutch.

One trainee picks the clutch kit, and fits the clutch onto the pressure plate.

Lecturer: So you should all watch...the bulging side of the clutch plate is on the inside of the pressure plate.

The trainee continues to fit and align the clutch plate and pressure plate into the back of the engine. The gear box is lying on the workshop floor as it has been dismantled.

One trainee: *Nichachile [*you guys had the chance to dismantle*] ….* give me a chance to fasten now…. *nafa kusebenta nodvwa* [*you have been working alone all along].*

…Give me socket number 12…and ratchet.

Trainee then tries to fasten the pressure plate and clutch plate onto flywheel…trying to align it using the aligning plastic tool that came with the clutch kit.

Lecturer meanwhile asks some trainees to fit the release bearing into the gearbox.

Two trainees help each other and try to fit the release bearing, but seem to have a problem as it does not fit with the holding fork on.

Lecturer: Remove the fork that fits from clutch slave cylinder first…. yes… this one…. now fit in the release bearing on the fork before fitting the fork.

Lecturer observes and okays process.

Lecturer now moves to check fastening of the clutch plate. He finds that the bolts have so far been fastened half way. He loosens them.

Lecturer: Please look... I'm fastening the bolts diagonally…I am moving from one bolt to its opposite one….and when you fasten, you do it in equal bits on each bolt before moving to the next tighter level…. you do these on every bolt when tightening bolts in a car.

For the clutch…we want it to fit squarely…so we fasten bolts in stages and in opposites.

Trainee: So every time you fasten, you do it diagonally?

Lecturer: yes…so that what you fasten is not skewed.

Lecturer observes the clutch again

Lecturer: This clutch plate appears skewed. It is not straight. The spigot shaft from gearbox will not align, and may damage the splines in the clutch plate.

Lecturer asks one trainee to now take off the clutch so that it can be refitted and realigned.

Lecturer: Refit the clutch plate Remember the bulging side on the inside of the pressure plate.

[One trainee fits these components together].

Align the splines of the clutch plate.

[Lecturer watches and directs].

Hey...wait. Turn the clutch a bit to the right...not too much...stop.

Now insert the first bolt…yes…tighten by hand first…not too much...stop…. ok now fasten the opposite side.

Lecturer now checks alignment of clutch splines, and appears not impressed. He loosens some bolts, adjusts positioning of the clutch. He now fastens the bolts himself till he finishes.

Lecturer now asks the two trainees to bring the gearbox (with release bearing already fitted.

Trainee: Points to a spigot. Y*ini le? [*What is this*]?*

Another trainee: This one is inserted through the splines into the flywheel.

Trainee: But we must use the words we learnt in class…what is it?

Another trainee: It's the input shaft [apparently in reference to a word used when working on gear ratios].

Lecturer: Okay …now lift the gearbox...now push…twist it a bit…it is in now.

[*to a trainee*]: Now fit the bolts...remember opposite sides… bring number 14.

[one trainee fastens as lecturer observes and directs].

Bring the cross member to hold the gearbox.

Now bring the bolts for the cross member.

[The fastening of the gearbox, cross member and prop shaft approach completion.]

Lecturer: Now as we refit the prop shaft into the diff we should remember to align the mark on the bolt and that on the fitting hub.

The lesson on the actual fitting of new clutch plate encompasses the following vocational outcomes:

Table 5.18 Vocational outcomes from Lucas et al.'s (2012) framework identified in lesson 2 on clutch fitting

Vocational outcome	Yes	No	Example
Routine expertise	X		fitting clutch plate on pressure plate
Resourcefulness		X	N/A
Functional literacies		X	N/A
Craftsmanship	X		remembering to align mark on prop shaft with diff
Business-like attitudes		X	N/A
Wider skills for growth		X	N/A

Though the process of replacing a clutch plate is a long and laborious process, it achieved the vocational outcome of routine expertise, as well as addressing an aspect of craftsmanship in terms of ensuring that the prop shaft would be balanced and not cause the customer's car to shake on the road.

The lesson made use of the following methods:

Table 5.19 Methods from Lucas et al, (2012) that lecturer used during lesson 2 on clutch fitting

Method	Example
Learning by watching	watching lecturer fastening the bolts diagonally.
Learning by imitating	student refastening bolts diagonally
Practice (trial and error)	refitting skewed clutch plate.
Learning through feedback	students shown skewed clutch plate and result explained that spigot shaft will not align, hence damage splines on clutch plate
Learning on the fly	students identifying a spigot shaft

The above pedagogical decisions can be assessed as follows on the 10-point decision making tool:

Table 5.20 Analysis of lesson 2 on clutch fitting using Lucas et al.'s (2012) ten-point decision making tool

Element of pedagogy	Choice		Example
Role of teacher	facilitative	didactic	Teacher directs but lets learners carry out tasks
Nature of activities	authentic	contrived	Real clutch plate, pressure plate, real car
Means of knowing	practice	theory	Actual car, clutch plate
Attitude to knowledge	questioning	certain	Errors are made, clutch plate skewed n
Organization of time	extended	bell-bound	No time set
Organization of space	workshop	classroom	Actual workshop activity
Approach to tasks	group	individual	Whole group assigned
Visibility of processes	high	hidden	Real clutch, pressure plate handled
Proximity of teacher	virtual	face to face	Teacher on ground
Role of the learner	self-managing	directed	Teacher mainly directs, but checks and ensures clutch is aligned

While the lesson essentially introduced and built on the vocational outcome of routine expertise involving the dismantling and reassembly of a clutch from gearbox of a real car, and used methods that supported this outcome, the occurrence of mistakes provided room for trial and error that was used by the lecturer to direct routine to elements of craftsmanship. He introduced fastening diagonally for maintaining squareness, and he needed to align the clutch plate properly to avoid damaging the clutch splines or spigot shaft from the gearbox.

5.5 Demonstration Method

Like the exploratory, the demonstration method arose as one of the themes that were generated in the analysis as an approach that lecturers used in their pedagogical practices. It is an approach that interconnects the triad of the broader category of physical materials vocational working competences and the use of some of the pedagogic methods that support vocational learning. Demonstration is not identified as a teaching method that supports vocational education in Lucas et al. (2012). However, as a broader method it fast tracks the initial development of the desired vocational outcome of routine expertise through the use of selected methods that support vocational education. When a demonstration is used, students have to repeat the procedure on the same part or on similar part of a series. The demonstrations appeared to fall into two categories.

5.5.1 Demonstration Method 1

In demonstration method 1 the lecturer, in this case, demonstrated the whole procedure of setting valve timing, while at the same time explaining the instances in which this procedure might be made necessary in a real setting.

Lesson Based on Observation notes of a demonstration lesson in workshop on setting valve timing **Lesson: Valve Timing setting** **Lecturer number: SCOT1** **Date: 16 February 2016**
This was the first demonstration of valve timing setting to class. Lecturer has moved with the group of 16 students from the workshop into the demonstration workshop which houses two engines. The engine to be used is one that is partially cut away to show clutch assembly, cylinders, camshafts, prop shaft. *Lecturer [to technician]:* Please open the tappet cover...bring allen key…number 14.

The lecturer then turns the two cams at the top of the engine.

Lecturer: Here we have two camshafts. This one if for the exhaust…and this one is for inlet.

Today we are going to learn how to set the valve timing*. [He shows the students the timing belt].*

Many times when the timing belt is torn, the car will refuse to start.... what many drivers will do is keep starting the car many times hoping it will eventually start. What is happening when you do that from my experience, are the following:

The valves will bend...why? because the camshaft is not turning…when you crank you move the pistons and they hit against the valves which are not in synch. Remember the valves are moved by the camshaft, and the camshaft is moved by the timing belt...

If the valves have been fitted, you now need to set the valve timing.

First determine TDC *[top dead centre].* How did we say we do that*?... [all quiet] …* which pistons should be at the top? ...this is a four-cylinder engine*.*

Trainee: 1 and 4.

Lecturer: Remember most engines rotate clockwise when you are standing at the front…where I am standing… this way [*he demonstrates*]. But some engines like the Honda engine rotate anticlockwise.

Lecturer shows them the clutch.

This is the clutch.

He shows them the pressure plate.

This is the pressure plate…... we will come to these later in our training…for now we just identify them.

Lecturer loosens and removes the timing belt.

Trainee: Why don't we mark it first so that we know we know how it fitted*?*

Lecturer: Don't worry… but you are wise…remember I said you would rather be a fool once, than be a fool for the rest of your life. He [*referring to trainee*] is correct…I want us to assume the timing belt is torn so we will fit with a new one…. But the new one will be this same one that I have just removed.

Now time the engine… let's put theory into practice*…*

[Calls two students to come forward].

Bring piston 1 to TDC. Take that wire, and put it in the plug hole for piston 1…and you [*referring to other second student*] … turn the engine… to the left…now back a bit*.*

Trainee [holding wire]: We are at TDC.

Lecturer: Let me check [he checks the wire and turns the engine back and forth a bit] ... yeah it's at TDC…piston one is at the topmost position.

Now what I do is find this pointer *[timing mark] or* mark on the crankshaft pulley, and mark against the block where it is pointing using chalk…or tippex.

…But mechanics may grind off the pointer so that other mechanics won't know what to do… so that the owner may have to take it back to them *[laughs]…* in that case what I do…even if

you have grinded off all the marks... I pick one point on the crankshaft pulley, mark it…then I mark the point it aligns with on the block like here, and here *[marks].*

Now what do you do? [No answer].

Why do you mark TDC on the crankshaft pulley*?*

So that you lower the pistons halfway and can now work on the camshaft*.*

[Trainee who had been holding wire now attempts to turn the camshaft with the hope that the pistons will lower].

No…. you see the valves hit against the pistons*.*

NOW WATCH ME AGAIN*…*

Lecturer puts wire into plug hole for piston 1, turns crankshaft pulley until piston 1 is at TDC. He then marks the two aligning points on the pulley and on the block. He then relaxes the belt on the crankshaft pulley by pulling it backwards a bit, with the result that the timing mark on the pulley is no longer aligned. He then adjusts the camshafts and explains that the valves will not hit against the pistons as he lowered the pistons when he relaxed the belt on the crankshaft pulley. When he adjusts the camshafts, he says they should watch that when the exhaust just about closes, the inlet is opening bringing in the fuel mixture … that it is at induction. At this point, he explains, he has finished with the valves, and needs to now align the timing marks on the crankshaft pulley.

Lecturer: Bring number 13... [and he tightens tensioner].

[After this he now fits the timing belt and tensions it].

[He then explains that using this procedure there is no need to worry if there were timing marks on the pulley or on the timing belt].

Now the valve timing is correct…now we have done valve timing…. we will still have to learn ignition timing…once you have set valve timing, you have to set ignition timing for the car to be able to start.

So you see I want you to be knowledgeable mechanics…good mechanics…a bad mechanic will say he can't do valve timing because the timing marks were scratched and he can't see them…but a good mechanic needs no marks.

So you make your first set TDC, then you mark the timing making sure the mark on the crankshaft pulley is aligned with the mark you make on the block …. you then turn the pulley…you actually turn it 90 degrees backwards to lower the pistons…so that the valves don't hit the pistons when you adjust the valves from camshafts...and as the exhaust opens ...the inlet opens…now you align crankshaft pulley marks into position…you insert timing belt...you tension.

He asks one trainee to do the valve timing, and he watches like the others.

Lecturer [as trainee finally tensions timing belt]: Now fasten…not too tight...this is a demo engine…we do not want to destroy it.

[Lecturer checks belts, alignment of timing marks].

Not bad for a beginner.

One trainee: And out of 10?

Lecturer: One [all laugh]

Lecturer then asks each trainee to set the valve timing in turn, making sure the timing belt is first removed before each trainee begins.

This lesson supported the desired outcomes as follows:

Table 5.21 Vocational outcomes from Lucas et al, (2012) framework identified in lesson on setting valve timing

Vocational outcome	Yes	No	Example
Routine expertise	X		setting piston 1 at TDC; marking point in pulley and block, adjusting camshaft, fitting timing belt
Resourcefulness	X		'tricks of the trade' on how to set valve timing when marks are removed
Functional literacies		X	N/A
Craftsmanship		X	N/A
Business-like attitudes		X	N/A
Wider skills for growth		X	N/A

To achieve the primary outcome of routine expertise on setting a valve timing, the lecturer relied on these methods:

Table 5.22 Methods from Lucas et al. (2012) that lecturer used during lesson on setting valve timing

Method	Example
Learning by watching	watching lecturer determine TDC, set timing mark, adjust camshaft and set valve timing
Learning by imitating	student set valve timing
Practice (trial and error)	student tightening timing belt too hard
Learning through simulation	setting valve timing on model engine

The pedagogic decisions that the lecturer made in conducting this lesson show the following:

Table 5.23 Analysis of lesson on setting valve timing using Lucas et al.'s (2012) ten-point decision making tool

Element of pedagogy	Choice		Example
Role of teacher	facilitative	didactic	Teacher demonstrates and learners then do task
Nature of activities	authentic	contrived	Real engine
Means of knowing	practice	theory	Setting valve timing on real engine
Attitude to knowledge	questioning	certain	Learning procedure, still to develop precision
Organization of time	extended	bell-bound	No time set
Organization of space	workshop	classroom	Engine in laboratory
Approach to tasks	group	individual	Learners to work in turns
Visibility of processes	high	hidden	Actual engine, actual pistons and valves
Proximity of teacher	virtual	face to face	Teacher on ground
Role of the learner	self-managing	directed	Learner follows procedure shown

The setting of the valve timing was simulated using a model engine in the workshop and the lecturer selected a demonstration through which learners watched him demonstrate, before they imitated him individually, using practice and learning through simulation. The lecturer had to rely on his own resourcefulness to enable the learners to relate the simulated demonstration to reality. The snapping of a timing belt could result in a series of other mechanical problems which could be worsened by the actions and ignorance of the driver. Yet the lesson was not only about setting the valve timing; the explanation given by the lecturer aimed to create a broader context that included a setting where this procedure would be carried out. A torn timing belt is only a part of a large chain of events in the operation of a larger system. This is illustrated in Figure 1.

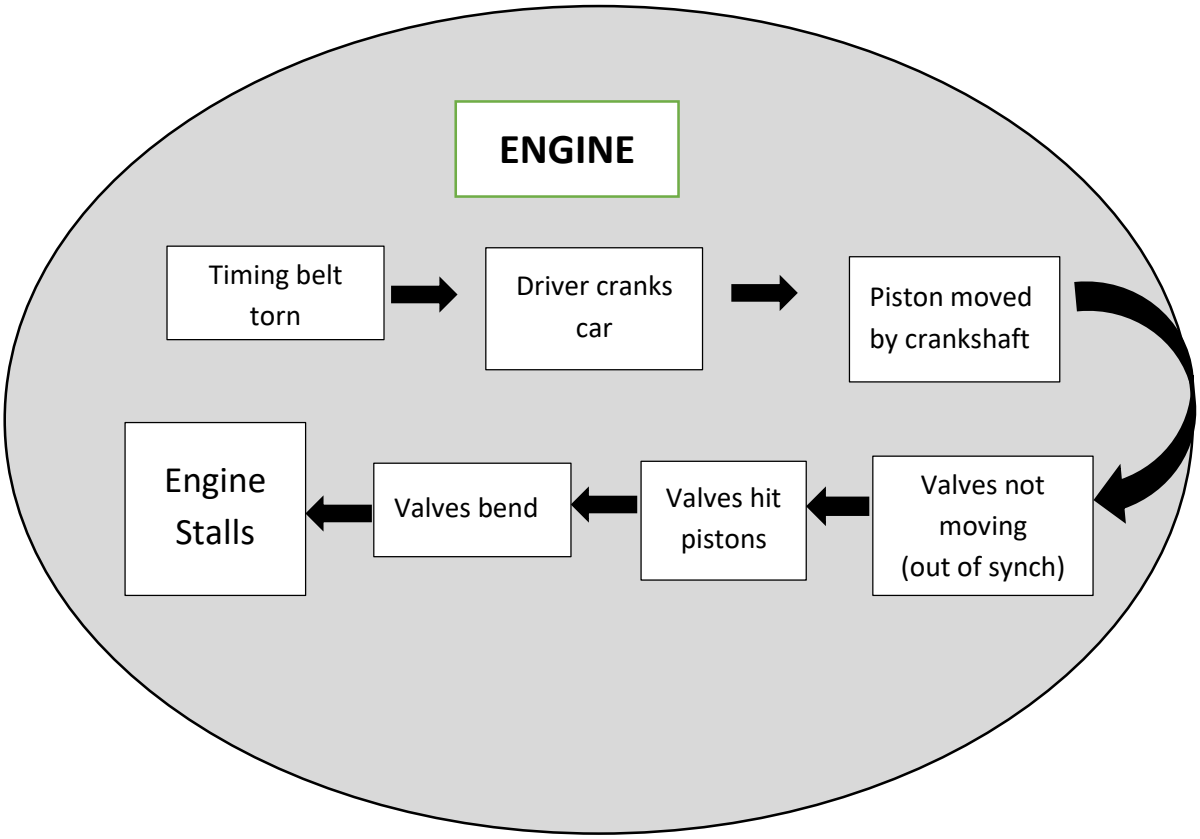


Figure 1 Series of mechanical problems caused by a torn timing belt

The students were then required to each repeat the procedure for setting the valve timing, with each of them removing the timing belt at the end of the session while being observed. They were repeating a procedure that had been demonstrated; for observant learners – in particular those whose turn came later – this created opportunities for greater learning by watching the procedure repeated by peers.

5.5.2 Demonstration Method 2

In this demonstration method the lecturer performed one part of a series and then asked a different student to perform each of the remaining parts, thus allowing each participating student to contribute to the completion of a bigger part.

The extract which follows was taken during the process of overhauling a customer's car that had been brought in with a seized engine, and deals with fitting rings onto pistons before the pistons are fitted onto the block and fixed into position.

Lesson Based on observation notes from a lesson in workshop on fitting rings

Lesson: Fitting rings on pistons

Lecturer number: MITC2 **Date: 20 October 2015**

Lecturer informs class that the piston rings have finally arrived, and that the work on reassembling the engine was to proceed. He asks them to:

(1) prepare a list of all the tools they will require and

(2) to set out on the working bench all nuts according to their sizes.

He emphasizes that they should remember safety and put safety first in everything they do.

Meanwhile lecturer sets out the ring sets on the work bench.

List written by trainees:

Toolbox

Socket box

Ring squeezer

Torque wrench

Oil can

Male sockets

Lecturer shows the trainees the rings packs, where each pack has three compartments numbered 1, 2 and 3. He gives them a handout showing a piston and the rings blown out as follows:

Top compression ring

Second compression ring

Expander and 2 oil rings

The order of the rings is as per a piston head that is facing upwards.

He explains the new ring packs as follows:

1st compression ring

2nd compression ring

Expander with 2 oil rings

Figure 2 Student fitting a ring onto a piston

He demonstrates to the trainees how to first fit in the expander and where to align its gap on the piston, to turn it around to ensure it moves freely, and to finally align its gap. He then fits in the oil rings one at a type, demonstrating the art of opening each ring slowly, slanting it a bit and fitting it.

He turns each ring around for fitting, and emphasizes that the gaps for both rings should never be in line.

He then instructs each of the five trainees to each pick a piston and fit expander and oil rings, as per his demonstration. He emphasizes that the marking on each ring should face upwards.

He watches as each trainee fits in the rings and checks their alignment.

Lecturer: Now each of you pick the 2nd compression ring and hold it in your hand.

[Trainees pick and hold the 2nd compression ring. One trainee bends the gap and tries to fit the ring and it breaks].

Lecturer: I asked you to hold them...not to insert them. Now where will I get the money to buy the ring that you broke?

I will now have to fit in all the rings myself… this is a customer car, and I can't tell the customer that his rings broke.

[Lecturer then fits 2nd compression ring slowly widening the end gap slowly, then slanting the ring a bit before slowly sliding it in. He does the same for the first compression ring, and he does this for all the 5 remaining pistons omitting the piston where a ring was broken by a trainee].

Lecturer: I have to make a call to Autozone [car parts supplier] to find how much the broken ring would cost……I do not know where I will get the money.

[He goes to make a call, and returns to say he needs some E165, and will be trying to source the money]. Meanwhile they will be working on the available pistons, but will wait for the rings before they can proceed to complete the work on fitting the pistons in the block.

Setting Gapping

The lecturer gives trainees a handout showing how to set gapping for the rings:

Each oil ring gap is 45 degrees on either left or right side of ring spacer provided they are not on the same side.

2nd compression ring gap is 45 degrees from the gap of the first oil ring.

Top compression ring gap is 45 degrees from the gap of second oil ring.

He demonstrates setting of gapping, and assigns the gapping of rings in the four remaining pistons to be done by each of the 4 trainees, as he observes them and checks their work.

Fitting of Big End Bearings

Lecturer indicates to trainees that the next process is to fit the big end bearings. He then demonstrates how to fit the bearing on the connecting rod, emphasizing that the bearing should only be held on the edge and not the body so that no dirt or grime is transferred onto the bearing, and to make sure the end fits well on the lug. He fits both bearings on the connecting rod of one piston. He then instructs 4 trainees to each fit the two bearings of one connecting rod, while he watches their technique to guard against touching the body of the bearing.

Lecturer: [to one trainee] see…now you have touched the bearing [*body*], and your hand has grease and particles.

[He then takes away the bearing and uses a clean cloth to wipe it].

Inserting of Pistons into Block

Lecturer: Now we have to lubricate the bore where each piston will be inserted… and also the crankpin.

[He then uses an oil can to apply oil to the 5 bores where the pistons will be fit, leaving out the bore for a piston without ring].

We will now have to start with piston 1 and 6…… if this was a 4-cylinder engine we would start with piston 1 and 4…. We hold the piston with the squeezer [as he fits piston 1 into squeezer, and hits head of piston and directs it into bore].

He asks another trainee to fit the big end cap at the bottom of the block, and to tighten the nuts by hand.

Lecturer: [to another trainee] Now use the squeezer on piston 6 and fit it like I did.

Trainee attempts to use squeezer.

Lecturer: Wait…let the squeezer go a bit further down the piston before tightening.

Trainee adjusts the squeezer on piston, hits the piston towards hole, but misses and hits the squeezer jacket.

Lecturer: You miss… and you may damage the bore.

[He helps trainee redirect piston and jacket, and asks him to hit smoothly at the piston head. The piston fits into bore like the first one].

Lecturer: We have started with piston 1 and 6, because the crankshaft pulley reads piston 1 and 6…and piston 1 and 6 should be up… and the crankshaft at TDC [top dead centre].

Lecturer then asks another trainee to fit big end cap bolts by hand for piston 6 at the bottom of the engine block. He then instructs three students in turn to follow procedure and fit in the three remaining pistons, leaving out one piston with broken rings. He observes them closely, correcting where he fears they may make procedural errors. Each student is helped by another one who fits in the bolts for the big end cap.

As can be seen in the lesson, the lecturer demonstrated each part in a series while the students were watching, and then had each student repeat the procedure for the remaining parts of that series. He started off by showing students the rings and how they differ: the first compression ring, second compression ring, and expander with two oil rings. He then demonstrated the fitting of the expander and two oil rings on one piston. There were five students and each had to do the same on a piston, as this was a six-cylinder engine.

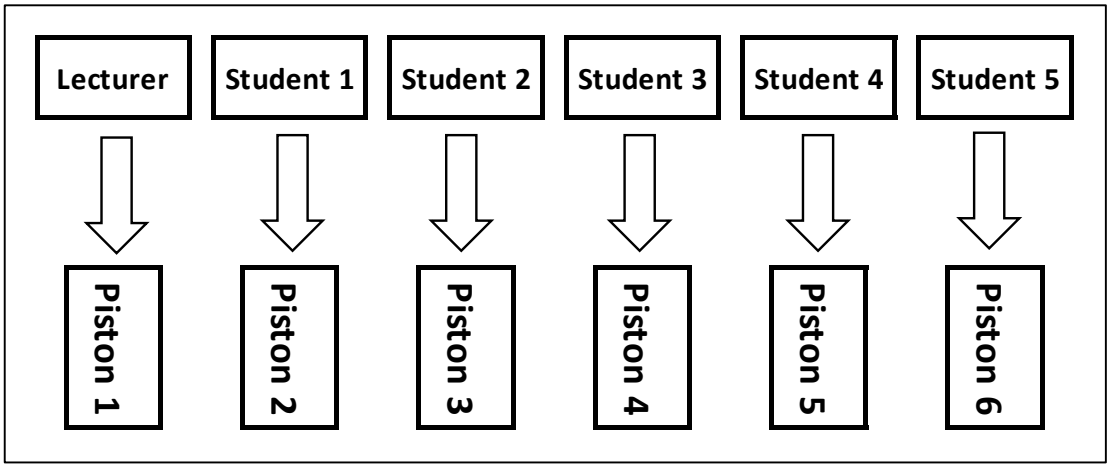


Figure 3 Use of demonstration method to allow individual students to fit rings on a piston

The vocational outcomes achieved in this lesson were as follows:

Table 5.24 Vocational outcomes from Lucas et al.'s (2012) framework identified in lesson on fitting rings on pistons

Vocational outcome	Yes	No	Example
Routine expertise	X		fitting of rings on piston and gapping the rings; fitting piston into block; and fixing the big ends
Resourcefulness		X	N/A
Functional literacies		X	N/A
Craftsmanship		X	N/A
Business-like attitudes		X	N/A
Wider skills for growth		X	N/A

This lesson was aimed primarily at teaching routine expertise and did not address any of the other vocational outcomes. To achieve its aim, the lesson made use of the following methods:

Table 5.25 Methods from Lucas et al.'s (2012) framework that lecturer used during lesson on fitting rings on pistons

Method	Example
Learning by watching	watching lecturer fitting expander and oil rings; fitting piston into bore
Learning by imitating	students fitting expander and oil rings
Practice (trial and error)	students fitting ring and one student breaking ring

The lecturer was observed making the following choices with regard to his pedagogy:

Table 5.26 Analysis of lesson on fitting rings on pistons using Lucas et al.'s (2012) ten-point decision making tool

Element of pedagogy	Choice		Example
Role of teacher	facilitative	didactic	Teacher particular about ring handling procedure due to nature of tasks
Nature of activities	authentic	contrived	Real rings, real pistons
Means of knowing	practice	theory	Learners replacing actual rings
Attitude to knowledge	questioning	certain	Particular procedure on ring handling
Organization of time	extended	bell-bound	No time set
Organization of space	workshop	classroom	Actual workshop real life activity
Approach to tasks	group	individual	Individual learner to fit rings and piston
Visibility of processes	high	hidden	Real tangible rings and pistons
Proximity of teacher	virtual	face to face	Teacher on ground
Role of the learner	self-managing	directed	Teacher closely monitors handling andfollowing of procedure

This kind of demonstration allowed the students the added benefit of having the lesson reinforced by observing peers doing the activity, and was immediate in that it involved a step at a time. The lecturer made the effort to involve as many students in the practical as possible in order to build their practice, but when a part broke, he worried about the implications and wanted the students to be cognisant of the fact that in a business environment such mistakes come at a cost. Some errors by students in the workshop had no cost implications, such as when a student touched a bearing with greasy hands, but in either case the error presented a learning opportunity for the students. The lecturer's approach was more strongly didactic in this lesson and his attitude to knowledge certain, given the nature of the task which involved brittle engine components which require precise handling, and belonged to a customer, not the workshop.

The next lesson involved students in their first practice of removal and replacement of plugs as part of a car service, and also followed a demonstration approach:

Video 2974	SCOT1	09 September 2015
First Practice for Removing Plugs		

Lecturer: If you don't do this next time you will have it tough……. [as lecturer removes high tension cables, he leaves one still to be done…. [to student] now remove this one…

[Trainee tries to remove remaining h.t wire but fails]

Alright … [as *lecturer now removes the h.t wire himself*] …now get a piece of cloth…and cover here…so that no dust comes in. Get a plug spanner…. I will remove just one…you will remove the three remaining [plugs]…you are 3 aren't you? [as he uses plug spanner to remove plug]

[Noise from another car in the workshop]

Lecturer: This spanner (referring to plug spanner) should have a rubber inside so that the rubber will hold the plug as you pull out the spanner…but the rubber is worn out. Now how shall we remove the plug? [No response]

…Right…we gonna use the same thing [referring to h.t fitting] [He tries to fit on the plug top, but plug does not come out] … alright [as he picks plug spanner again and straightens plug] …put the plug straight up…or get a magnet [as he finally pulls plug out using h.t fitting]. You see…I have taken it out [as he shows plug to students]. [As student returns with wet cloth to cover opening where air filter housing was removed].

Lecturer: You have washed it… go to Kenneth (workshop stores) and ask for a cloth…you must learn to ask for a clean cloth each time [as girl returns]. Ok … this is the plug. [*To students*] Now remove the other plugs.

One student takes plug spanner and attempts to loosen plug.

Lecturer: [*To another student*] what spanner size are we now going to use underneath [to remove sump bolt]?

Student: Number 10

Lecturer: It can't be 10

Another Student: 17

Lecturer: Seventeen? ... get me 17 and number 14.

Researcher asks quietly what are the spanners for, and lecturer says he wants to drain oil.

Meanwhile student loosening plug puts away plug spanner.

Lecturer: Are you sure it's loose?

Student: Yes

Student tries to use h.t cable fitting to remove plug, but it is too short, it doesn't reach. Lecturer pulls it out loose and gives it to student. Student tries to use it to remove plug, but fails.

Lecturer: It means the plug is not fully loosened… [as student tries again] …you see…it has not loosened, student picks plug spanner again and loosens.

Lecturer: … [says something inaudible] alright…

Meanwhile another student returns with cloth. Lecturer picks it and uses it to close engine top opening. The student now comes closer to see the student trying to remove plug.

Student A: What are you loosening? The other student continues working and does not respond.

He uses h.t fitting but still fails to pull out the plug. He again takes the plug spanner and tries to manoeuvre it to straighten the plug. He then picks the h.t fitting and is finally able to pull out the plug.

Another, student B, picks the plug spanner.

Student B: Where did you start?

[Student A does not respond].

Student B loosens plug number 3.

Student B: It feels loose…but how will I see? [*but she continues to loosen*]

student A: [Demonstrates by twisting right hand] …Do it like this.

Lecturer: [*Speaks to another student who was fastening wheels in another van*] Yes …tell the owner to cross check the tightness… because you are still learning.

Student B now carefully pulls out plug spanner vertically.

student A: The plug should be straight up.

The student now pulls out h.t fitting and gives it to girl…use this… [as student B fits in h.t fitting] push it in… turn a bit… now lift it [and suddenly plug comes out at first attempt]. First student takes out plug from h.t fitting and puts it next to other 2 plugs on to radiator top.

Student B: Why do you put them like this?

[As first student picks plugs and put them neatly in a box].

Meanwhile third student joins to remove plug. As he nears complete loosening, the first student who has previously removed plug intervenes.

First student: [*to student B]* straight...

Student tries to fit h.t fitting, and plug doesn't come out.

First student: straight [as student B tries to straighten]. First student finally uses h.t fitting and pulls out plug.

Lecturer holds two new plugs up.

Lecturer: See… [*to student B, as the other students stop and observe*] … look at this gap… the gaps look consistent… but most of the time… you use a filler gauge… and the data … the data book will tell you… because this plug can fall… fall by this [*pointing]* and you take it and put it into the car… and the car will have a problem…the plug is faulty. They come pre-set from factory [looks at all plugs again] …but these all look ok.

Lecturer: Look how you hold the plug like this…assist it… [*as he lowers it slowly into hole and lower straight into hole*]. You don't drop it…it might hit with the gapping when it falls.

Ok… now put in the plug…yes sister [as student B lowers another plug into hole]

Meanwhile another student picks plug spanner and fastens plug.

Lecturer: Not too tight.

Lecturer then checks each plug for tightness.

Table 5.27 Vocational outcomes from Lucas et al.'s (2012) framework on lesson on fitting of rings

Vocational outcome	Yes	No	Example
Routine expertise	X		removal and replacement of plugs
Resourcefulness		X	N/A
Functional literacies		X	N/A
Craftsmanship		X	N/A
Business-like attitudes		X	N/A
Wider skills for growth		X	N/A

This lesson primarily addressed the development of routine expertise and omitted all the other vocational outcomes. In developing the said outcome, the lesson made use of the methods outlined below:

Table 5.28 Methods from Lucas et al.'s (2012) framework that lecturer used during lesson on removing and replacing plugs

Method	Example
Learning by watching	students watch lecturer as he shows how it is fitted
Learning by imitating	student fitting plug after observing lecturer
Practice (trial and error)	lecturer initially asks student to remove plug on his own without showing him

The lecturer made the following decisions regarding his choice of pedagogy in this lesson:

Table 5.29 Analysis of lesson removing and replacing plugs using Lucas et al.'s (2012) the ten-point decision making tool

Element of pedagogy	Choice		Example
Role of teacher	facilitative	didactic	Teacher demonstrates but is particular on students following procedure to remove and replace plugs
Nature of activities	authentic	contrived	Actual plugs, actual car
Means of knowing	practice	theory	Actual plug removal, replacement
Attitude to knowledge	questioning	certain	Following of procedures to remove and replace plugs
Organization of time	extended	bell-bound	No time set
Organization of space	workshop	classroom	Actual workshop activity
Approach to tasks	group	individual	Each learner removes/replaces plug
Visibility of processes	high	hidden	Real plugs, real car
Proximity of teacher	virtual	face to face	Teacher on ground
Role of the learner	self-managing	directed	Teacher closely monitors procedure

In this example the lecturer adopted an attitude toward knowledge that was *certain* and *directed* the role of the learner to support the development of the students' routine expertise with respect to handling plugs when servicing a car. It should be noted that in procedures that require careful handling of a car's fragile parts, a lecturer may be required to adopt an attitude to knowledge that is certain, and direct the role of the learners.

The next section, section 5.6, looks at the theme of 'a parts pedagogy' that emerged in the study, which relates to the decisions and processes that the lecturers teaching automotive mechanics uses.

5.6 Part –Parts – System Pedagogy

As part of the decisions, practices and processes that constitute the lecturer pedagogy in automotive mechanics, the lecturers appeared to use a key pedagogic technique that breaks a car into parts, where the parts are worked with one by one before looking at how they work together in the larger system. Lecturer decisions on vocational outcomes,

teaching methods and pedagogic choices in terms of Lucas et al.'s (2012) 10-point decision-making tool, were all determined based on the part/s and systems to be taught.

In the following extract, lecturer SCOT1 indicated how his decision about what to teach was initially influenced by recurrent car problems in the context of Swaziland:

Transcription of interview	
Lecturer number: SCOT1	**Date: 14 June 2016**
I concentrate on the things that cause problems in cars – brakes, clutch, such things – things that wear fast. I start from such things before I let them concentrate on other less troublesome things. I want them to build confidence in attending to these common problems of cars.	

These are essentially the car parts which students had to develop confidence handling in terms of dismantling and reassembly; having a car with a real problem to work on was very handy.

In the extract below, lecturer SCOT2 emphasized how he selected what he would teach and what decisions he made with regard to sequencing:

Transcription of interview	
Lecturer number: SCOT2	**Date: 13 August 2015**
I follow the syllabus… in some areas I don't. It does happen there are areas where I decide on my own... I can start about airflows system first, before I teach carburettor, yet the carburettor is first in the syllabus. I can say... "let them understand the airflow system first before they see how the carburettor works" … or I can choose to teach the diesel engine system before petrol engine system… In other topics you find that you need to teach certain topics before others because this knowledge assists you to understand that. E.g. you may understand a diesel engine system better if you have done a petrol system engine. I can decide... like the finger has 5 fingers. I teach one finger and leave the other four fingers for higher stages or for the students to find on their own... in attachment or as they gain experience. We can't teach them everything about cars. We can't teach the whole car... others are working on tyres... others on carburettors, all these specialize.	

He then indicated how he used simple chunking in selection as the students were better off not knowing about other systems when dealing with one system:

Transcription of interview	
Lecturer number: SCOT2	**Date: 13 August 2015**
Some topics are so intertwined. You might find yourself transgressing a lot. You just tell that here is my hand it has 5 fingers. I will not talk about the other 4 fingers, but you as a lecturer you should have background knowledge on all 5 fingers. When you talk about a system to feed fuel into the engine, there is the carburettor, there is fuel injection... so if you talk about one system you don't go into the others. Otherwise they [the students] cannot take in the other fuel feeding systems. Sometimes they are better off not knowing about them.	

So at a high level, the lecturer had knowledge about systems of systems or combinations of wholes. Below that level there were systems; say system 1, system 2, and system 3. These were the wholes, where each system was a whole. Below each of these systems were the parts that constituted its operation. The lecturer broke the whole into its constituent parts, then taught them part by part before combining the parts into a system at the next level. He chose to do one or two systems to allow students to understand each system as a unit.

When a part was taught, the part was related to its function. Some part could also be made of other parts; in that case the part might be broken into the smaller parts to aid understanding. Eventually the part would link to another part, and still other parts, to make a system:

Transcription of interview	
Lecturer number: VOCTIM1	**Date: 27 July 2015**
I used to teach engine. Now I teach transmission. I said to you I teach clutch... clutch is simple. I ask them what do they see when a person gets into the car… to drive I mean? They will tell you he steps on pedals. I tell them about clutch and accelerator... but I always teach clutch first… what it does… link engine and transmission…why the car jumps when clutch is released quickly... the engine goes off because there is no smooth connection with transmission… I talk about the functions of the clutch... when you press clutch and stop car… you are breaking the drive from the engine…the pressed clutch helps the car not to go off. I then teach gearbox…this is gears in a box… they control the engine speed… the car can't go uphill or change speed without gear box…. the clutch when you press it separates engine from transmission, then you put the gear…when you slowly leave clutch, the engine connects smooth with transmission… then the car speed change. I said I teach clutch, gearbox and brakes… they work together.	

There was effort at all times to simplify into parts, thus gearbox became 'gears in a box' and were to be viewed first as individual gears before they could be linked to the other

gears in the 'box'; the role of each part was contained in its interconnectedness to other parts:

Transcription of interview	
Lecturer number: SCOT1	**Date: 16 February 2016**
When you crank you move the pistons and they hit against the valves which are not in synch … remember the valves are moved by the camshaft…and the camshaft is moved by the timing belt.	

Systems work at a higher level and were complex for learners to understand even if a lecturer introduced the parts of the system one by one. This not only affected comprehension, but the pacing of the lesson as well:

Transcription of interview	
Lecturer number: VOCTIM1	**Date: 27 July 2015**
Pace has to change. Topics are different – some very difficult, e.g. automatic gear box. Even the designer who wrote on the automatic gear box he never finished... some learners never understand it… you find the topic slowing you down... you try tricks to assist learners understand… if grasping is slow…you drag…others are delayed … those ahead help you teach the others... the learners understanding decides the pace for you. Many times you say I will give 6 hrs for this topic, and you spend 8 hours. You have to aid the teaching with models, take them to the workshop, tell them what you see in the book, you see it is this one. Let them see the parts, touch them… see how they link together, then slowly they grasp. You take them to the workshop show them the automatic system. I won't lie, some areas you may skip, because the learners are slow. You may want to come back to the topic later. These difficult topics like gear box… I aim for at least 70% understanding from learners….but simple topic like the clutch … 90%.	

There was increasing heaviness of concept as the lecturer moved from part to relationship between parts, and to system which dragged the pacing as the concepts become heavier. So when there was movement towards higher order concepts bordering on science, the students who had been following may suddenly become uncertain. The following extract of a lesson on fuel systems, taught by VOCTIM2, illustrates this:

Transcription of interview	
Lecturer number: VOCTIM2	**Date: 20 August 2015**
Student 3: Cars without a carburettor, do they over flood?	
Lecturer: You mean cars such as those with fuel injection…they have a method of delivering fuel inside the engine…. *[quiet]…* they can flood if fuel is not in vapour form…	

Student 4	…doesn't squirt...
Lecturer:	Good word …'squirt'...
Student 6:	What if a stone hits the fuel line and it is blocked?
Lecturer:	It can happen; hence fuel will not reach the carburettor.
Student 4:	Fuel injection or carburettor car – which one would you advise me to buy?
Lecturer: [*quiet - thinks]* ...All of them…. but fuel injection is an improvement from carburettor...	
Lecturer goes on to explain disadvantages of carburettor with respect to uneven mixture distribution, but mentions that fuel injection does not have the problem of uneven mixture distribution.	
Student 4:	Say I have a 1.6 fuel injection, and a 1.6 car with a carburettor, the fuel injection will be faster.
Lecturer:	Very good.
[Other students are now quiet].	
Lecturer mentions that in the fuel injection car all fuel is burnt. He goes into the science of it quickly mentioning catalytic converter.	
Students are quiet…as if baffled.	
Student 4:	So the fuel injection car chows in more fuel than the carburettor car?
Lecturer:	No… but I can't get into the details now.
Rest of the students appear lost.	

When student 3 asked the lecturer the first question in the extract above, the quietness of the lecturer had to do with the density of the terrain the question was leading towards. He gave an answer that made some sense to the learners but avoided moving into the science that was necessary to explain this. Another student, student 4, appeared to have been excited by the topic of fuel systems and asked prodding questions. The lecturer had to decide in the moment which question to answer and which to avoid, as he was aware of the heaviness of these concepts relative to the knowledge of the first year students, and that the majority of the class appeared to not be following. The lecturer selected not only which parts and which systems, but also how deep to go, and applied caution when a student sought to go beyond these parameters.

Yet it doesn't end with the system, as SCOT1 explains:

Transcription of interview	
Lecturer number: SCOT1	**Date: 12 August 2015**
We do 1 by 1. We look at each part alone, look at the next part, before we look at the parts as a system. Now each system links to the other system. You again look at each part of the next system... part by part... then the system…then look at how this system links to the other system.	

The relations and interrelations become protracted and complex, which could possibly account for why the first year in the specialisation centred around examining and identifying parts and only covered a bit on the systems but at a level which didn't go into much depth. It was when students returned to do their final year they moved more into the science of the systems, having completed a year of study and a year of attachment. Lecturer SCOT1 explained this as follows:

Transcription of interview	
Lecturer number: SCOT1	**Date: 12 August 2015**
But first year and attachment is a prerequisite. [In third year] you start learning some diagnostics... but you can't diagnose an engine if you don't know about an engine... this you slowly learn about in first year and on attachment. For example, if an engine has a knock, you need to have knowledge of the moving parts of an engine. If it is a metal knock or loose component, then you can diagnose if the knock is in number 1, 2, 3 or 4…do tests to see if it is a bearing that needs to be replaced… sometimes if it is a diesel car you can have a diesel knock… but in a diesel knock you may just need to first service the car... and the knock is gone. I always tell my students to start with the least costly option. There is no need to open a diesel engine just because there is a diesel knock.	

At a broader level, the use of the 'parts to system' pedagogy was a prevalent approach in all the institutions teaching automotive mechanics, suggesting that it was central to the decisions, processes and practices that lecturers made as they taught automotive mechanics. At a micro level, some lecturers appeared to want to link their use of this approach to the context on the ground in the teaching and workplace settings that exist, as the latter may sometimes have a worker deal with one part or aspect of a car. Using an approach that links teaching with existing or contextual workplace settings is in line with arguments that a vocational pedagogy may need to vary to respond to a country's requirements (Gessler and Herrera, 2015; Okoye and Arimonu, 2016). Lecturer SCOT1 indicated that he would rather concentrate on the parts that cause problems in cars, before moving on to less troublesome parts. As was the practice at MITC, where students were

taught through addressing the problems with customers' cars, this approach allowed students to learn some routine practice tasks related to identified car problems. Through this, those students who leave just after one year of learning automotive mechanics may land themselves work opportunities even though these may be restricted to the competencies they have. These are what Lucas et al. (2012) call the contemporary challenges that a vocational pedagogy may have to engage in a specific setting.

5.7 There is No Car Coming

There was, beneath the surface, a palpable systemic idiosyncrasy at the Manzini Industrial Training Centre that took me months to understand. What follows here, in terms of this particular phenomenon, may not qualify as an aspect of the pedagogy of lecturers that could be observed in the automotive mechanics programmes across all three institutions.

For quite a long time I had been asking for a copy of the teaching timetable in order to plan the times and days for my observation. Each time I asked, the lecturer would say that it actually depended on whether there was work to be done on a customer's car or not. There were two automotive lecturers, and both gave me the same kind of response. For some time I was of the impression that the lecturers were not comfortable with my observations. I couldn't have been more wrong.

There were many times that I arrived to conduct an observation only to be told that they were not doing any work that day or at that time because they were still waiting for a customer to come. At the times that I was able to conduct an observation there was either a customer's car to be fixed or, on some occasions, they would be busy with some kind of practice like using inside callipers to measure the bore of an old engine block or going through battery testing and recharging procedures. One day, when I had the chance to chat to the director of the institution, I told him that my observations were going fine but that I had not yet been able to obtain a copy of the teaching timetable. The gist of what he said was in this line, "You don't understand what we are doing. We are training on production. We train by doing work for customers, and it is the way we train our students by actual work." Slowly it sank in that if there were no customers, there was little for the lecturers and students to do.

Far from it – the lecturers would not be totally idle. They had to make the best of finding some work for the students to do, and one lecturer indicated in the pre-observation interviews:

Transcription of interview	
Lecturer number: MITC2	**Date: 27 July 2015**
We are two. We can't say, "You do this today, I will do that tomorrow" ... you will find that maybe you are not able to do what you promised to do… then the trainees are left behind. So we just go according to our turns. We have the file for the course content. Then the other ticks, showing now I was covering this. And I know what the other was teaching, because I ask. I also teach a little bit about auto electrics, because I like that. I ask if the other teacher has covered something, then I decide what to teach. Sometimes I decide on what we can do at the time. Sometimes we wait for the customer car, and see what we have to fix. We do training on production, so we concentrate on fixing cars that customers bring.	

In retrospect, I ask myself how I didn't see this and continued to request a teaching timetable even after these interviews. And MITC1 had made similar comments:

Transcription of interview	
Lecturer number: MITC1	**Date: 22 May 2015**
When we started many of our trainees did not have much education... some could not write English. Now many have Form 3, even some have Form 5. Last year we had one who could not write English, and we used orals for his assessments. We are doing on the job training. They need to learn by doing. We do not do much theory… we show them… people bring cars.	

Apart from an old engine that MITC 2 said he personally brought to the institution to assist his teaching, and the odd old engine or cylinder head, there were no teaching models in the workshop. Yet, despite these challenges, the lecturers found ways to specialize their students:

Transcription of interview	
Lecturer number: MITC1	**Date: 27 January 2016**
We wait for a car to be serviced, but if there is no car we use the few models we have…like the cylinder head there. We dismantle and reassemble, but after I have done a demonstration. Plan on my own what I want to do with the trainees...maybe I wanted to do brakes with the students. Then when a customer's car comes we end up attending to the problem of that car. When we dismantle we name, we identify, we describe a bit. When we are dismantling or reassembling I try to rotate learners in groups so that everyone has a chance.	

The problem we have here is that we are not able to let every trainee to do every practical task and to develop a lot of practice. You find that a car comes here, it has one problem...maybe brakes...you assign 6 trainees to work with you, the rest are not involved. You hope the next time you will give some of the others a turn but you find there is no car coming…or you find that a car that comes has a different problem.

In their quest to improve the specialization of students into automotive mechanics, the lecturers had ideas about how the institution should contribute:

Transcription of interview	
Lecturer number: MITC2	**Date: 22 January 2016**
The institutions should buy more teaching models. Technology is moving forward and there are newer engines that we have not been exposed to. Trainees can work on these models, dismantle and reassemble them many times. We also need a complete car for trainees to learn about the various systems of a car like brake boosters. One trainee who is on attachment with a garage came here the other day to complain. They asked him to work on a car with an air brake system and he had never seen anything like it… and he was saying why we not exposed them to this braking system. The other thing is the institution should buy us consumable workshop material like oil, distilled water and brake fluid...it should not be like this is a waste of money.	

The second lecturer, MITC1, when asked what changes the institution could introduce that would assist the automotive lecturers in specialising students, needed no time to think about the question. He said:

Transcription of interview	
Lecturer number: MITC1	**Date: 27 January 2016**
Grouping of trainees…Our entry requirements are too open. You can come here with Standard 5 or with Form 5. Maybe we should have two groups and train some at a lower level and others at a higher level… Also the numbers we train are too high. The leaders want money, so they want more and more learners, yet us we are doing practicals and we need to have fewer learners to give them more practice.	

Such issues as restricted resources, widely ranging student abilities and lecturers not having adequate access to newer cars with more advanced technologies, severely limited the pedagogic choices that the lecturers could make while teaching. They also impacted the level of skill and competency that the students would take with them when they completed their training and looked for work as automotive mechanics.

During the observations of lessons, there were a limited number of instances in which the pedagogy a lecturer was using would develop would achieve the outcomes *craftsmanship*, *business-like attitudes,* or *wider skills for growth.* The vocational outcome of craftsmanship appeared in the first lesson on clutch fitting. There were, nonetheless, some instances in which lecturers, as part of their pedagogy, involved a learner in making decisions that dealt with the social elements of the job, which constitute an aspect of *business-like attitudes*. The section which follows illustrates these.

5.8 Seeking to Build Business-like Attitudes

Business-like attitudes, as one of the essential vocational outcomes, involve being able to understand and to put into practice what Lucas et al. (2012) call the basics of running and working in an organization. These, they say, deals with such aspects as budgets, invoicing, bookkeeping, and estimating. They also include the ability to communicate effectively with a customer. At a broader level, they are about putting in the time and effort to provide customer service that exceeds the client's expectation.

The workplace is a different social environment where while the automotive mechanic plies his trade seeking to learn and enhance his practice, he has to contend with many forces that define the work space: Sometimes while lecturers were in the midst of teaching the students technical skills, they would comment on the expectations of customers in the workplace. In the observations of the pedagogy used by lecturers, there were some isolated instances in which a lecturer found an opportunity to practice dealing with a customer.

To put the next extract into context, the lecturer had been working with students servicing a Colt van.

Transcription of video	
Lecturer number: SCOT1	**Date: 8 September 2015**
Lecturer: Bring a spanner to check diff oil. We will next check gear oil…bring number 24…then we will check prop shaft and universal joints…. I will do it to show how it is done.	

Lecturer asks one student to remove bolt for diff oil.

Lecturer: Put in a finger in the hole.

Student: … there is some oil.

Lecturer: Good. Now close the hole…. put back the bolt. There is enough diff oil.

Lecturer: Look, we don't want a customer to come back after 2 weeks and say his diff is having a problem because there is no diff oil, yet the car is from service.

Lecturer: Always a customer must be happy to come to us.

Student: [interjects]…. because after all, we will charge him nicely.

Lecturer: [to a student putting back the nuts from the petrol filter]

Hey, use your hand first when putting the nuts…. Before fastening with a spanner.

Lecturer uses a hammer to hit the rear drum to check brake shoes. He then shows students how to scoop off cover and they continue.

Student: When is lunch?

Lecturer: Does it mean the gauge is low?

Student: It is already showing red, sir.

Lecturer now uses a screw driver to adjust the shoes in each wheel.

Another student: Let's go for lunch.

Lecturer: Let's say this is a customer's car… and the customer is paying. Will you tell him you are going for lunch? Will he ever come back?

As he says this the owner of the car who is sitting some four metres away smiles.

In this extract, the lecturer underscored the importance of doing all the procedural checks on the customer's car when it was serviced so that the customer would not be dissatisfied. He highlighted the importance of the customer to the work of the automotive mechanic, and the student added that, after all, the customer would be given a nice bill. When a student complained about being hungry around lunch time, the lecturer used the opportunity to emphasize that when a customer is waiting it is important to forgo some of your comforts and put the customer's interests first. These values are important in the workplace, and are observed when seeking to meet and exceed customer expectations.

In the extract which follows, the lecturer demonstrated how to handle new parts to be installed in a car and how to communicate with the customer. A group of five students were selected (according to a rotational system) to service a car. The car was a Honda Civic import model.

Transcription of interview **Lecturer number: MITC2** **Date: 27 July 2015**
Lecturer positions car on pit where oil drainage and under chassis observations are done. Informs students what work will be done on the car as per customer's request. The work to be done will be servicing, but will not involve brakes. The owner also wants his ball joints to be replaced. Lecturer: First, let us check the service parts if they match those in the car. Make sure your hands are clean when you hold the new parts. If they are wrong the owner cannot take them back if they are dirty. [Calls a student]: please open the bonnet…. Now [calls another student] ... take this new oil filter and check if it is the same as the one in the car. Student: Yes, sir, it is the same. Lecturer asks students in turns to check if the air filter, petrol filter and plugs are the same, and they each report the parts are correct, except that there is a problem with the air filter, it looks different, and the teacher confirms it will not be able to fit. The lecturer calls the customer on the phone, and the customer says they can leave out the air filter and he is still going to scout in many different places for it [the car is an import and import parts are not easily available in the country. Lecturer comments: This car engine is too dirty. We will have to wash it at the end. Student: Yes... and look there are mouse droppings all over the engine… [all laugh.] I think it comes from one of the mice infested slums in Manzini. Teacher instructs one student to take the old air filter out, and to use an air compressor to blow it out. Student: It's a bit cleaner, and maybe he can use it for a while he looks for the correct one.

What is noted here is that the lecturer tried to instil as part of practice that new car parts brought by a customer should be kept clean in case they need to be exchanged. He also demonstrated that it is standard business practice to note and, where possible, attend to other issues noted with the customer's car, such as washing the car engine after the service if it is dirty.

In the following extract, a timing belt snapped while being put back on an engine that had been overhauled and the lecturer instructs a student to tell the customer:

Transcription of interview **Lecturer number: MITC2** **Date: 22 October 2015**
Lecturer then picks the sprocket for timing belt, and asks one trainee to fit it.

[As trainee does so, the sprocket falls down].

Lecturer: I wonder what they will do at work about your carelessness.

One trainee: No one will fire you if you work under a tree [smiles knowingly].

Lecturer asks the trainees to fit the timing belt and to tension it as appropriate.

As one trainee tensions the timing belt, it snaps.

[Everyone is quiet. Lecturer appears disturbed but does not say anything].

Lecturer: [To one trainee] Take my phone (*hands him cell phone*). See this number…call the car owner and tell him the timing belt has just snapped… also tell him he did not bring the oil filter.

Trainee calls.

Trainee: We have been putting together your engine here at MITC… but the timing belt has just been torn.

[Reaction of trainee suggests the person on the other side is unhappy about this.]

Trainee: Sir, the belt was too old, so when we were applying the correct tension it tore away……you will need to come to pick the torn one to show them a specimen in the spares shop…so that you will also buy the oil filter…we need a new oil filter now.

Trainee returns and says the owner was first reluctant to be told to buy a timing belt.

One trainee: Uyafelela [maybe he is a miser]. [laughter].

The ability to communicate and converse with a customer is one requirement of business practice that is an aspect of the vocational outcome of *business-like attitudes*. The lecturer seized an opportunity to ask one trainee to report the torn timing belt, and in doing so allowed the trainee to gain hands on experience in conversing with a customer in a difficult situation. Other students were watching and learning. There was some tact involved in the lecturer's choice of who to assign this task, as the lecturer did not ask the same student who had broken the timing belt to talk to the customer.

Sometimes a lecturer noted behaviours by students that would not be appropriate in a business environment:

Transcription of interview	
Lecturer number: MITC2	**Date: 22 October 2015**
Lecturer: [*to one trainee*] You are very lazy. Why are you sitting down when we are all working? [*as trainee stands up*.]	

The lecturer saw it necessary to eliminate unacceptable habits such as relaxing when it was work time and there was a customer's car to attend to, as this did not fit in with the vocational outcome of *business-like attitudes.*

5.9 Towards a Signature Pedagogy for Automotive Mechanics

5.9.1 Vocational Outcomes of Automotive Mechanics in Lessons using the Exploratory and Demonstration Approaches

Lucas et al. (2012), posit that twenty first century vocational education should achieve six desired outcomes in order to attain the goal of developing competence. Below is a summary of the vocational outcomes identified by Lucas et al (2012) that were observed in the lessons using the exploratory and demonstration approaches that were presented in this chapter:

Table 5.30 Vocational outcomes identified by Lucas et al. (2012) achieved in lessons using the exploratory approach

Vocational outcome	Lesson 1	Lesson 2	Lesson 3	Lesson 4	Lesson 5	Lesson 6
Routine expertise	X	X	X	X	X	X
Resourcefulness	X	X			X	
Functional literacies	X					
Craftsmanship					X	X
Business-like attitudes						
Wider skills for growth						

Table 5.31 Vocational outcomes identified by Lucas et al. (2012) achieved in lessons using the demonstration approach

Vocational outcome	Lesson 1	Lesson 2	Lesson 3
Routine expertise	X	X	X
Resourcefulness	X		
Functional literacies			
Craftsmanship			
Business-like attitudes			
Wider skills for growth			

The preceding tables indicate that in the lessons that were observed exploratory and demonstration approaches were used by the lecturers to achieve the outcome of *routine expertise*. This outcome was the primary focus of both approaches. Half of the lessons addressed the outcome of *resourcefulness*, with half of these addressing *craftsmanship*. In general, the vocational outcomes of *functional literacies*, *business-like attitudes*, and *wider skills for growth* were observed less often in the pedagogy of the lecturers than the other three. However, there were notable instances in which lecturers seized opportunities to make students aware that a customer's expectations should not only be met but be exceeded, and to allow a learner to hold a work-related conversation with a customer. These were aspects of the vocational outcome of *business-like attitudes.*

5.9.2 Lecturer Teaching Methods in the Exploratory and Demonstration Approaches

The following is a summary of the teaching methods that lecturers used that related to the vocational outcomes of Lucas et al. (2012). Instances of the use of the exploratory approach were more frequent compared to the demonstrative approach. This could be attributable to variables in the context, such as the limited access to teaching resources like demonstration models.

Table 5.32 Teaching methods identified by Lucas et al. (2012) achieved in lessons using the exploratory approach

Method	Lesson 1	Lesson 2	Lesson 3	Lesson 4	Lesson 5	Lesson 6
Learning by watching			X		X	X
By imitating	X		X		X	X
By practicing (trial and error)	X	X	X	X	X	X
Through feedback					X	X
Through conversation					X	
By teaching and helping			X			
Real world problem solving					X	
By reflecting	X				X	
On the fly	X				X	X
Simulation and role play						

Table 5.33 Teaching methods identified by Lucas et al. (2012) used in lessons following the demonstration approach

Method	Lesson 1	Lesson 2	Lesson 3
Learning by watching	X	X	X
By imitating	X	X	X
By practicing (trial and error)	X	X	X
Through feedback			
Through conversation			
By teaching and helping			
Real world problem solving			
By reflecting			
On the fly			
Simulation and role play	X		

In the lessons using the exploratory approach, the lecturers used *learning by practicing* as the primary method for teaching, giving learners time to make mistakes and learn through trial and error. The exploratory approach allowed the students to take charge of their learning, and to also pick aspects that may not have been achieved if the lesson was more direct. Half of the time the students took advantage of a spontaneous opportunity to learn (*learning on the fly),* half of the time they also engaged in *imitation*.

In the lessons using the demonstration approach, the lecturers used the three methods of *learning by watching*, *learning by imitation* and *learning by practicing* (trial and error). These are demonstrative in that they involve students watching a lecturer demonstrating how a process is done, with the students then repeating what they have seen, and sometimes making errors in the process.

5.9.3 Lecturer Decision Making on the Ten Point Decision-Making Tool

Below is an indicative summary of the pedagogical decisions that lecturers made during the observed lessons. Lucas et al. (2012) make the point, however, that while these decisions do have to be made at the level of each lesson, they must also be made day-to-day and at the macro level (as determined by the various skills bodies), and at all other levels across the whole programme. This suggests that even if the lecturer's pedagogical practices were to use appropriate decisions, given the challenges in the vocational education and training system in Swaziland that are discussed in chapter 2, it would still be difficult to achieve an optimal VET system.

Table 5.34 Summary of pedagogical choices identified by Lucas et al. (2012) used by lecturers during lessons by number of times observed

Pedagogical element	Choice			
Role of teacher	facilitative	6	didactic	2
Nature of activities	authentic	8	contrived	0
Means of knowing	practice	8	theory	0
Attitude to knowledge	questioning	6	certain	2
Organization of time	extended	8	bell-bound	2
Organization of space	workshop	8	classroom	0
Approach to tasks	group	4	individual	4
Visibility of processes	high	8	hidden	0
Proximity of teacher	virtual	0	face to face	8
Role of the learner	self-managing	3	directed	4

The above choices of roles by the lecturers were in themselves a product of judgements they had to make which related to the lecturer's own expertise, the characteristics of the learners and the learning settings. At a broad level, their pedagogic practices were weighted to the left, and while this is reflected in the above summary, there are still significant pockets to the right as in numbers 7, 9 and 10. This relates to the context of automotive mechanics teaching in Swaziland with regard to emphasis for development of routine expertise mainly at this level, shortage of teaching resources, and possible limited capacity of the lecturer. When this is viewed in the context of the argument made by Lucas et al (2012) that twenty first century VET should essentially be positioned to the left, it appears the contexts of VET in Swaziland were not close to achieving this.

5.9.4 A Signature Pedagogy in Automotive Mechanics?

The examples of the pedagogy used by lecturers which have been discussed in this chapter may contribute to the identification of practices used across the board that could be considered part of a signature pedagogy for automotive mechanics. This pedagogy involves the lecturer breaking a car down into parts and using exploratory and demonstration as core approaches for teaching and learning. In the former the direction of a lesson is relaxed, and the lecturer allows the students to take charge of their learning, while in the latter procedures or part procedures are first illustrated before students

practice them. These are broader approaches that also depend on vocational teaching methods as identified in Lucas et al.'s (2012) theoretical framework. The breaking down of a car into parts is a pedagogic decision intended to provide routine practice in the disassembly and reassembly of individual parts before relating these to other parts and systems. The parts approach and the exploratory and demonstrative approaches are outside the framework of Lucas et al. (2012). These approaches themselves depend on VET teaching methods as identified in the framework for Lucas et al (2012).

The focus on routine expertise was supported through parts identification, disassembly and reassembly mainly in a real life setting involving a car part or a customer car. This focus abandoned the outcome of *wider skills for growth*, and apart from some aspects of the outcome of *business-like attitudes*, the development of the other vocational outcomes was limited. The development of routine expertise was premised on exploratory and demonstrative approaches, but these relied on the methods of:

Learning by practicing (trial and error)
Learning by watching, and
Learning by imitation

These methods may signal a signature pedagogy that targets the vocational outcome of routine expertise, which appeared to be a focus of the first year of automotive mechanics training. However, in the broader categorization of vocational education, Lucas et al. (2012) indicate that these (categorizations) help narrow the odds in terms of what the best kinds of pedagogical decisions are for each are. They constitute the methods associated with the learning methods of physical materials as:

Physical materials: use imitating, practicing, trial and error as part of real world problem solving.

These methods, as witnessed in the observed lessons, emerged as a pedagogic repertoire used by lecturers of automotive mechanics to build routine expertise in the first year. The use of these methods correlates with the tool that identifies specific methods suitable for the category of *physical materials* in which automotive mechanics falls. These methods were at the heart of the first year signature pedagogy to build routine expertise.

A first year pedagogy that uses and is focused on routine expertise can be indicative in showing the inclination to exclude the other vocational outcomes that a vocational education should achieve. Yet the achievement of all six vocational outcomes is presented by Lucas et al (2012) as a project that should be pursued by twenty first century vocational education. This project would mean a vocational education that is relevant as to time and purpose. In this respect, a pedagogy not pursuing all the six vocational outcomes at any or all levels may not fully ascribe to a VET expected of the twenty first century.

5.9.4.1 Epistemic Ascent in First Year Automotive Mechanics

Although the framework put forward by Lucas et al. (2012) advocates for all vocational education to be directed at the achievement of six vocational outcomes as a targeted end, it does not consider that there are levels of expertise that a student may attain as he or she progressively develops working competence. This idea that a vocational learner who moves into an occupation starts off at a lower level and eventually builds up greater capability by bringing together practice and knowledge, is what Winch (2014) calls *epistemic ascent,* as previously discussed in chapter 3. Learner's capabilities at the end of the first year, in this case, were based on what vocational outcomes the lecturer pedagogical practice developed, as well as on lecturer perceptions of anticipated competence of students at this level emanating from the semi-structured interviews. It is also noted that first year was an exit point in automotive mechanics at MITC, while at VOCTIM students had the option to return after the one-year industrial attachment to complete their diploma. In the latter case, first year students obtained a certificate, while those who returned obtain a diploma. However, a small number of students were not able to return for the diploma owing to financial constraints, among other reasons. In the case of SCOT, there was only the diploma certificate awarded after completion of three years, where the second year was on industrial attachment.

Given that both the exploratory and demonstrative approaches that the lecturers used as broad approaches to their pedagogical practices were directed primarily at achieving the vocational outcome of routine expertise, there are some observations to be made

regarding the framework proposed by Lucas et al. (2012) and the concept of epistemic ascent put forward by Winch (2014). First, with regard to the former, vocational education should ideally aim to achieve all six vocational outcomes regardless of whether students are at various levels in their vocational development and possess varying vocational competencies. With regard to the latter, while Lucas et al. (2012) outline the capabilities that go with each outcome, it would be valuable to see how this framework relates to the epistemic ascent model developed by Winch (2014).

First, I suggest that where a vocational education endeavour has addressed all six vocational outcomes in Lucas et al.'s (2012) model in terms of the pedagogical processes and national VET systems, it can only, at best, correspond to what Winch (2014) calls *transversal abilities* for a student becoming a worker at entry level. Other students not reaching this level may fall to the level of *skill* depending on their individual level of attained competence. For a student to reach *project management* abilities will require that such a student has attained transversal abilities. In a way, though *project management abilities* are implied in the six vocational outcomes, those students who have not developed *transversal abilities* would not attain *project management abilities*. These *project management abilities* are characterized by competence in planning, execution and accomplishment of complex tasks at a high level, requiring a high level of autonomy from a worker. Both *skill* and *transversal abilities* become a prerequisite for *project management abilities*.

Winch (2014) says that *project planning ability* is about the creation of an ability that is transferred to another sphere of activity, and is not just putting an acquired skill or 'trained competence' into routine practice. It depends on the development of personal characteristics that can benefit from both *skill* and *transversal abilities*, which both are developed and honed in the contexts of vocational education and workplace practice.

A vocational education that has focused on the development of the entire six vocational outcomes identified by Lucas et al. (2012) will achieve varying levels of epistemic ascent, from technique to transversal abilities, but a student will need competency in all the first

three levels of epistemic ascent in order to move to the next level of project management abilities. This is illustrated below.

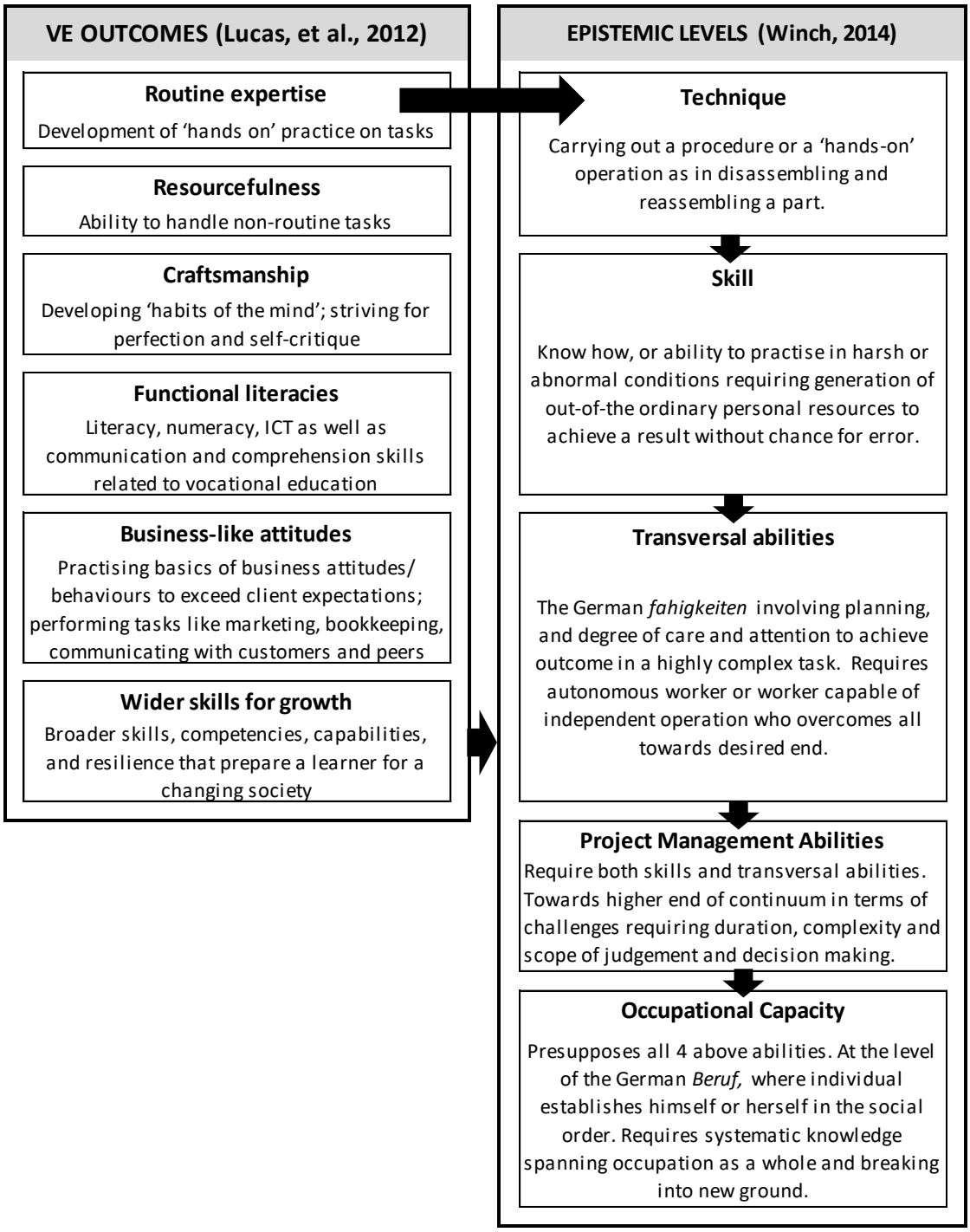


Figure 4 VE outcomes corresponding to Winch's (2014) levels of epistemic ascent

Lucas et al. (2012) argue that achieving the six outcomes in their framework should be a fundamental requirement of vocational education in the twenty first century vocational worker. I suggest that achieving these outcomes can accelerate a student's attainment of the higher epistemic levels of *project management ability* and *occupational capacity*. The outcomes may not, on their own, achieve these higher epistemic levels, but provide the foundation on which these can be premised.

Though the pedagogical practices of lecturers in automotive mechanics used the methods of *learning by practicing (trial and error)*, *learning by watching*, and *learning by imitation*; which are methods that Lucas et al. (2012) suggest are key to vocational education programmes which fall into the 'materials' category, which include automotive mechanics, these do not address all six vocational outcomes. Instead, during the first year, learning activities focused on developing routine expertise, with limited opportunities for the outcomes of *resourcefulness* and aspects of *business-like attitudes* to be achieved. Routine expertise is, in a way, a misnomer, in my opinion. That which is routine is at the level of *technique* which is the first epistemic level in Winch's (2014) model. Technique itself is the lowest level in a progression from *novice* to *expert*. Maybe the use of *routine capacity* rather than routine expertise would be useful.

The methods that the automotive mechanics lecturers used were not in themselves determinants of the vocational outcomes achieved or the epistemic level reflected, as they were only the main methods associated with the category of physical materials. It was those vocational education outcomes that the lecturers pursued, together with an informed selection and application of methods to achieve the same that determined what capabilities students attained. Other significant contributors to vocational outcome were the contexts defining who the vocational education learners were, the capacity of the lecturers, and the contexts of the institutions in which the training took place. It may be appropriate to add, also, that the extent to which lecturers have been exposed to researched vocational education pedagogy can contribute significantly to what they can bring with them to their teaching.

The epistemic ascent levels that first year students studying automotive mechanics attained reflect in the use of the tool by Lucas et al (2012) in analysing data in this study,

as well as in the observations made by the lecturers which were captured in the interviews in this study.

The comments by lecturer SCOT1 below suggested that some first year students even failed to attain the lowest capabilities.

Transcription of interview	
Lecturer number: SCOT1	**Date: 12 August 2015**
But you are a lecturer you know... you ask a group of students to dismantle... some stand at the back... and are not interested…some are just backbenchers and avoid even jacking a car…and you are a mechanic?... and me I have worked hard trying to help them see the parts in units ……then being together…. then being a system, then linking to another system... this is long and slow sometimes… like the engine... it has many parts... just to know them takes time... now how you link them, how they function and how they combine to be a working system.	

SCOT1 had found that some students remained uninterested in developing their capabilities as automotive mechanics. A learner who stands at the back and avoids developing routine practice restricts his or her own competence even at the lowest level. The lecturer even suggested that students who come to study automotive mechanics without wanting to involve themselves in what mechanics do may not end up as mechanics at all:

Transcription of interview	
Lecturer number: SCOT1	**Date: 06 October 2015**
And I tell my students when they first come… just now they are 13 in class. I tell them look… you are thirteen in number. By the time you leave, maybe only 3 of you will be mechanics…only these three will eventually become good mechanics. They laugh when I say this…I do it each time we have a new group....and then at the end…when they complete their training…I take each one of them... and say you are now a manager; you want to employ a mechanic…. take this piece of paper and write down the name of who in this class you will want to employ. Every time you will find they write down the same names… it is 2 or 3 people in the class. They have been working with them... and seeing them. You will see the ones who will not be mechanics at all. Each time you give a practical task, they stand at the back…they watch…you are not even sure they are watching…but they are at the back. Don't you see them when you are in the workshop with us?	

In the example of the students identifying the 'best mechanic' they might want to employ, the lecturer enabled the students to develop business-like thinking. Yet this example also played a dual role of typifying or identifying the 'skills sets' that make a good mechanic.

The development of *technique* forms the basis on which the other higher capabilities are built, but requires practice on many parts. To be a good mechanic even at this level requires an eye for how the parts fit together:

Transcription of interview	
Lecturer number: SCOT1	**Date: 06 August 2015**
But if you are a good mechanic, you try and understand how the parts fit together –even if it takes you a long time. A good mechanic will try to understand how the parts work together. You will have things that you know.... like me when working with a car, there are things that I just know. I still don't know everything. But the things that I know I know. A good mechanic will have things he knows about cars. He won't know everything, but he has to know certain things …and the more problems you meet when working on a car the better you will be. And it works to consult other good mechanics when you have a problem [*about a car*].	

SCOT1 indicated that to be an automotive mechanic one needs to develop practical abilities through a range of exercises involving technique, and that problem solving abilities are sharpened by learning through mistakes. Yet, as lecturer VOCTIM2 noted, this development of technique needs to be done under some guidance:

Transcription of interview	
Lecturer number: VOCTIM2	**Date: 27 July 2015**
Those who have completed the certificate [year 1] still require to work under direction for some time. They can service a car; they can change brakes. They can generally identify parts… remove and replace general parts like clutch plate... they can identify some faults but require more guidance and experience before they can identify or solve non routine problems... these are problems that do not just relate to servicing or brakes. Like I said, those who have done the diploma are capable of complex tasks… their knowledge is higher, they can solve many problems faster… they have been exposed to the science of how a car works… the cooling system, the electrics... the lubrication system... they can supervise others because they have learnt the science and the technique, and have been exposed to how to work with others. Some run their own garages, others are promoted to supervisors. If you go to Carson Wheels or CTA many of the mechanics and supervisors have been here to do the diploma…and when I get there … now everybody says this one was my motor mechanics lecturer.	

Compared to those who proceed to third year and achieve the levels of *skill* and even *transversal abilities*), first year students require close guidance in order to build experience. It is on this that the capabilities to do complex tasks that involve the science and theory of how a car works will be built later. Those who proceed to third year will have been exposed to the science and theory that informs the practice, as well as had more

practice on different aspects of a car. They will have also worked with different people in a work setup during the second year workplace attachment, and this experience places them in a better position to work in different situations. As a result, they will be able to solve problems faster, with the capacity to work at higher levels such as in supervisory positions, in the garage.

Achieving the level of *technique* is not a given; just by going through exercises to build routine capacity a few items does not mean you have attained *technique*. To the contrary, one may work at developing adeptness in the routine but be said to have not yet fully attained the level of technique. MITC2 elaborated on this:

Transcription of interview	
Lecturer number: MITC2	**Date: 27 July 2015**
One should be able to do some little reading... but the policy here is that you can come and study even with no formal schooling…but today it would be Standard 5, Form 3 or Form 5... should be able to read and write. You speak to customers, so you should be able to talk to them. You should be able to read some specifications. But maybe some place can give you a job to do just engine reassembly only... but even that is difficult…you would end up doing wheels only … maybe take them off... or remove the drums every day… you don't handle the challenging parts. Today's cars... you need to refer to the internet…. See what the specifications of the car are in the internet, and attend to the car problems. If you can't read... then you can't do this. … [*laughs*]…yah we had a problem last year… this trainee could not read… it was last year... we gave an assignment, he passed, friends had done it for him. We later gave a test, he could not write... then we talked to him... we had to use oral... but he was very weak... he could not understand anything... he won't be a mechanic…he could not learn to be a mechanic [my emphasis] …he was just not able to understand what he was learning… but others, you find they can write a bit, and if they work hard, they can learn a little bit. In the past we would train for 2 years and not a year, so those who could not read could slowly picked up, and some …but they were a few of them … they could do some little work done by mechanics… a year is too short…if you can't read the year finishes before you understand anything.	

This example presented the challenge of a student without the ability to read and write, and the limitations this placed on him in terms of his ability to make sense of what he was doing even at the level of the routine. In the view of the lecturer, this student could only be used in dismantling and reassembling the same item everyday as he would not be able to expand his or her routine capacity to other aspects of the car.

In addition, both lecturers gave a dim account of the context or setting in which automotive mechanics training took place at MITC. According to Lucas et al. (2012), physical settings can enhance or limit pedagogic choices as they determine the cultures in which vocational learning occurs.

Transcription of interview	
Lecturer number: MITC1	**Date: 27 January 2016**
The problem we have here is that we are not able to let every trainee to do every practical task and to develop a lot of practice. You find that a car comes here, it has one problem...maybe brakes...you assign 6 trainees to work with you, the rest are not involved. You hope the next time you will give some of the others a turn but you find there is no car coming…or you find that a car that comes has a different problem. Also the numbers we train are too high. The leaders want money, so they want more and more learners, yet us we are doing practicals and we need to have fewer learners to give them more practice.	

When you have an environment where the lecturers feel they are made to teach high numbers of students just because the institution requires numbers to break even, and there is a very limited number of cars on which to practice, the vocational outcomes will be limited. The lecturers indicated that they were aware of what was needed in order to improve their teaching:

Transcription of interview	
Lecturer number: MITC2	**Date: 22 January 2016**
The ideal would be for each trainee to have lot of exercises involving servicing a car. Overhauling a car…that one is too far from them…so I will not talk about that. And with servicing they require to be familiar with different types of servicing…they should be able to service many different cars... and to do that they should have serviced a lot of cars. You find that they have worked only on one car...and you can't say they know about servicing a car. If a different car may come you will find that they will not know what to do. Many of them cannot service a car that uses ignition coil [MITC2 22 January 2016].	

This situation placed limitations on the degree of development of the routine capacity of the students, thus relegating the graduates to restricted work roles:

Transcription of interview	
Lecturer number: MITC2	**Date: 27 July 2016**
The companies make them do basic mechanic tasks like take off wheels, take off and replace exhaust all the time, to give them low pay…they pay them E1000 per month, and do not let them learn new things.	

When asked specifically what automotive processes and skills the graduating learners are capable of, lecturer MITC2 responded:

"Mnnh…things like changing oil, and working on brakes."

These, admittedly, are practical abilities that constitute only a small part of *technique* in that *technique* in automotive mechanics should include many varied procedures. This suggests those students who are only able to carry out restricted processes will take longer to develop sharpen technique and to eventually have passage from this epistemic level to the next.

5.9.4.2 Hedge on Assessment

As indicated in section Chapter 4, I had initially also intended to look at how assessment was used in the pedagogic processes of lecturers teaching automotive mechanics. However, I found that in general there was a veil of secrecy surrounding the topic of assessment: lecturers referred me to administrative structures such as the Academic Boards, only to have them send me back to the lecturers in a roundabout fashion. I eventually abandoned this part of my research endeavour. I did, however, explore whatever aspects related to assessment I encountered, attempting to do so in a way that was not overtly intrusive.

To begin with, the following comment by lecturer SCOT1 put into perspective some of the issues that arose pertaining to assessments:

Transcription of interview	
Lecturer number: SCOT1	**Date: 14 June 2016**

Some of the tests we would do practically… I try to prepare them for Internship…they do the practical and then write down a report of what they did. In internship they do the same thing…so I try to prepare them for internship…the steps to service the vehicle... you don't just service… you don't just drain the oil… you first warm the engine …then drain the oil…step by step…at the end of the day wash the engine…there are steps that you follow. So the report must indicate the steps…so that if the report is given to someone that person may just follow the steps and be able to carry out the task.

These comments were consistent with the general approach used by the lecturers to emphasize the building of routine capacity even through assessment, and to view assessment not in a strictly academic sense during their teaching. The emphasis on practicals as a form of assessment supported their objective of students learning to identify, disassemble and reassemble parts with a growing ability to identify problems associated with parts. Lecturer MITC1 made the following comment:

Transcription of interview	
Lecturer number: MITC1	**Date: 27 November 2016**
For me I did not give formal tests. Like I said my work is mainly practical… even when I do measurements I give them that they should measure, and I give mark on their precision. I have to train them many times, and it is when they improve that I can give them marks. But these marks are just to see progress…otherwise I give the phase tests at the end for practical exercises.	

This comment was made at the end of the year, and this lecturer had not given the students a written test throughout their programme; his reason was that the programme is mainly practical. This is in line with the approach of building 'hands-on' capacity which enhances routine capacity. Even in practical assessments the lecturer only gave a mark after he had trained the students over a period of time and had witnessed an improvement. This suggests the automotive mechanics lecturers rather focus on encouraging 'hands-on' competence than conducting assessment to evaluate if the teaching /learning objectives were met.

A similar approach was noted during the practical phase tests that were conducted at the end of the year. These phase tests were conducted in two institutions, SCOT and VOCTIM.

Transcription of observation of phase test

Lesson: Practical (Phase) Test (Oral Assessment)	
Lecturer number: VOCTIM1	**Date: 12 October 2015**
1200-1:00pm	Student 3
Lecturer:	Give me the functions of a clutch?
Student:	…gear changing, … gradual take-off from rest, torque…from engine to gear box, to provide temporary neutral.
Lecturer:	Show me two types of clutch?
Student:	[Student selects 2 clutch plates from trailer where parts are displayed] this one…it is flexible… and this one…this one is rigid.
Lecturer:	What is flexible or rigid with the clutch plates you have shown?
[no response]	
Lecturer:	What are the two types of pressure plate?
Student:	[picks 2 pressure plates] this one is the diaphragm and this one is the coil.
Lecturer:	What is the difference between the two?
Student:	[points to the coil one] This one is serviceable, … and this one is not.
Lecturer:	Show me the release bearing.
[student looks but fails to identify it.]	
Lecturer:	Ok... show me what it looks like.
[student looks around, and finally points to a release bearing].	
Student:	This one.
Lecturer:	But that is a release bearing…it is not something like a release bearing.
Lecturer:	Tell me what adjustments can be made to a clutch?
Student:	free play
Lecturer:	Now give me three functions of a gearbox
[student is quiet for some time]	
Student:	Let me please go and study.
Lecturer:	Ok, go. You will come back when you are ready.

In this phase test, the lecturer attempted to evaluate if a student could physically identify selected parts and their functions. When a student failed to identify a part, as in the example of the release bearing, the lecturer assisted him by at least showing him something that looked like it. This action, taken together with the lecturer's decision to let the student go away and study again before returning to take the test again, is supportive of building a directed competence as well as ensuring that the student would eventually obtain a pass mark that would count towards his City and Guilds practical

assessment mark. While, in the end, the City and Guilds result would reflect performance on the theory papers as well this phase test, the lecturer endeavoured to allow students time to pass their phase tests before sitting for the theory examinations, which also covered parts identification and functions. There was apparently no limit to the number of times that lecturers would allow students to repeat the phase test.

Transcription of interview	
Lecturer number: VOCTIM1	**Date: 31 February 2016.**
There was too much forgetting on the part of the students… You'd find that in the class [of 24], only 16 were ok. The other 8 were forgetting, and I had to keep sending them back to prepare again…go and read again or ask from other trainees. I did not know what caused that.	

There were occasions, however, when some of the lecturers gave written assessments as method for helping the students prepare for the formal examinations:

Transcription of interview	
Lecturer number: VOCTIM2	**Date: 09 March 2016**
Every topic has a test. I have taught 6 topics. I have been setting the short answer type as well as the multiple choice which is the exam type of questions (City and Guilds). Then the last assessments I give them the full exam paper…I give them the complete paper. All the other tests were topic tests…now the last assessment are like examination...they include everything [VOCTIM1 31 February 2015]. I gave 1 test, and 1 end of term test. The end of term test combined everything. They do well you find maybe 2 getting just below the pass mark. But this mark does not affect their passing in the external examination. The marks and the questions help them when they study so that they see where they are not deficient.	

These lecturers used written assessments as a method to enable students to develop familiarity and confidence with the material before sitting for their final examinations.

5.10 Conclusion

The pedagogic processes that lecturers in automotive mechanics used to train students during their first year were the product of the lecturers' own background in the field, the background and capabilities of the students that elected to study automotive mechanics, and the context on the ground, and access to the resources required for optimum training. The backgrounds of the lecturers in this study reflected that although the entry requirements to study automotive mechanics were different at each of the three

institutions, the pedagogic methods used focused mainly on developing students' routine expertise during first year. This needs to be understood within the context of the lecturers' own trajectory from automotive mechanics students to automotive mechanics lecturers, in terms of their lack of exposure to researched vocational pedagogic practices and newer automotive technologies. The effect of learners' background on the pedagogic processes could be seen in the case of MITC, where the limited background of the learners results in only rudimentary and repetitive forms of routine expertise being attempted, where a learner may be involved in doing 'brakes only'. The context on the ground, characterised by limited resources, prevented the optimal use of pedagogic processes to develop the full range of desired vocational outcomes at this level.

The pedagogic processes that the lecturers were found to favour during lessons was an approach of breaking a car down into parts as well as the use of exploratory and demonstrative approaches to lessons, relying on the use of learning by practicing (trial and error), learning by watching and learning by imitation. The reliance on these methods may suggest that they form part of a signature pedagogy for automotive mechanics that focuses on developing routine expertise in first year. It appears, however, that the framework of Lucas et al. (2012) used here provides a decision-making tool that seeks to optimise vocational learning, which presupposes a targeted end for all vocational learners. It does not provide for, or account for, vocational education that fits with progressive expertise in an occupation as suggested by Winch (2014).

Section 5.9.4 highlighted aspects of this study that looked at levels of competence as part of a trajectory towards the epistemic ascent of an automotive mechanic. It is, however, worth observing that the pedagogical practices of the first year lecturers all focused on the achievement of what Lucas et al. (2012) call the vocational outcome of *routine expertise,* with limited opportunities to pursue the outcomes of *resourcefulness* and aspects of *business-like attitudes*. Lucas et al. (2012) stress the necessity of vocational education addressing all six of the vocational outcomes in their framework. In terms of linking this framework to the epistemic ascent of Winch (2014), I used descriptors of each level of epistemic ascent to demonstrate that even if the lecturers achieved all six of the outcomes in Lucas et al.'s (2012) framework, the highest level of epistemic ascent that could be achieved by the students would be to have mastered *transversal abilities* at the

point of entry into the workplace. However, the pedagogical practices used by first year lecturers, as determined during observations focus almost exclusively on achieving the single outcome of *routine capacity* in Lucas et al.'s (2012) model, which corresponds to Winch's (2014) first epistemic level – *technique* – by providing repeated 'hands-on' practice in dismantling, reassembly and identification of the parts that constitute a car. This forms the basis on which those students who will go on workplace attachment at second year will build, and which third year theory and practice will later augment. However, where the vocational training culture restricts even the development of students' routine capacity, it can be expected that in the workplace these students will only be given work involving a single, repetitive operation (like 'brakes only') as in Gamble's (2012) typology of the labour process. In terms of epistemic ascent, then, even the basic level of *technique* is not fully achieved under such conditions. Such a graduate will have to undertake a journey in the work place of amassing enough practice working with different car parts that eventually he or she will reach the level of *technique*.

The next chapter discusses apprenticeship, which was done during second year for SCOT and VOCTIM students, and represents a pedagogical practice which enhanced the routine capacities that the lecturers had been building.

Chapter 6: Apprenticeship of Automotive Mechanics

6.1 Introduction

Apprenticeship in automotive mechanics as a theme in this research arose inductively as it was an issue touched on by the automotive mechanics lecturers at all three institutions in connection with their pedagogical processes. While the research sought to determine the pedagogical practices of lecturers during first year, the lecturers viewed their practices as preparation for the second year when students would obtain actual workplace attachment and gain hands-on practice that would enhance their capacity. In this way, the lecturer pedagogical practices were seen as providing the foundation on which workplace attachment processes would build. Lecturers who themselves have trained when there were better apprenticeship opportunities, looked to the workplace to provide the real world context to bring relevance to and consolidate what had been taught. Apprenticeship works better as a form of training contract for a vocational student involving vocational education in a training institution and in the workplace to build rising competence in an occupation. However, in the Swazi context, the shrinking industry base and sluggish economy have resulted in fewer formal apprenticeship opportunities, creating challenges for automotive mechanics students needing practical experience in their trade. This chapter explores these issues and how, to some extent, the reliance of the automotive lecturers on workplace attachment as a premise for their pedagogical practices could restrict learning.

6.2 Apprenticeship, and Positioning Apprenticeship, in Swaziland

An integral part of the specialisation of students pursuing automotive mechanics, like many other Technical and Vocational Education and Training specialisations, is apprenticeship. Apprenticeship is learning that takes place in the workplace, bringing in workplace practice to complement and build into practical abilities and theory developed in training institutions. Clarke and Winch (2004) see apprenticeship as contained in a belief in knowledge, including theoretical and technical knowledge as the underpinning of practice, rather than merely learning by doing. It refers to learning based in the workplace, and in England refers to the system that developed from the nineteenth century involving “a rudimentary assertion of the right of the workman to instruction, to

participate in technical knowledge" (Lee cited in Clarke and Winch, 2004). This apprenticeship should be treated as distinct from collectively bargained apprenticeship which became a source of cheap labour in the nineteenth century, as it involves placing a student in the workplace under an employer or group of employers, and spending a substantial amount of time in education through a system of block release (Clarke and Winch, 2004).

Despite this distinction, apprenticeship remains a contentious issue (Gamble, 2012; Clarke and Winch, 2004). Pointing out the long and venerable history that apprenticeship has as a pedagogic tradition with a valuable legacy of building knowledge and skill for transition into work for the training of crafts and trades, Gamble (2012) indicates that some see this mode of pedagogy as anachronous to the concept of 'flexible change' or 'flexible specialisation'. Young and Moodie (2012) use the term *de-differentiation;* they argue that by blurring the lines between occupations, workers gain the flexibility to move between sectors, which they see as a source of innovation and growth. De-differentiation is realized through emphasis on generic skills that apply to different sectors than specialist skills and competencies; and through National Qualification Frameworks based upon a single definition of a qualification. 'Flexible change' works in tandem with the practice of many vocational education and training institutions to have students study aspects of other specialisations as a means to broaden their 'relevance' as a future worker. As a result of the view of apprenticeship as antithetical to flexibility, almost all countries have seen a dramatic fall in the numbers of apprentices in recent years. In England, for example, Clarke and Winch (2004) note that employers are showing increasing reluctance to take on trainees, with the construction sector being able to attach only some 38% of trainees to an employer. The reasons that Clarke and Winch (2004) give for declining apprenticeships are that some companies use advanced technologies; training expenses on workers that may be difficult to recoup; and also that some companies could only offer narrow activities that fail to match the array of skills associated with a particular occupation. Various other researchers (Maguire, 1999; Kraak & Hall, 1999; Kupfer, 2010) point to the continuing decline in trade apprenticeships in many countries.

The situation in Swaziland is even more challenging. While in other countries, such as England, there are government subsidized apprenticeship schemes (Winch, 2013), or remission of taxes for companies offering apprentices, there exists no such benefit in Swaziland. A training levy to which companies and government contributed at the inception of apprenticeship in the early 1980s stopped when government needed to raise funds for revenue through taxes, as companies that made contributions to the training levy had been given tax rebates. Swaziland is a small country with few industries; they consist mainly of those in the sugar industry, such as Royal Swaziland Sugar Corporation, and a few companies in the Matsapha industrial area. From the mid-eighties through the mid-nineties many of these companies experienced growth and consequently took the training of apprentices on as an investment in order to build manpower that could be used to sustain operations. However, when the credit crunch hit, with the prices of sugar on the downward spiral - and the country lost its eligibility for preferred trade in the textile sector with the United States through the American Growth Opportunity Act - apprenticeship opportunities began to dwindle. To give a sense of the economic challenges in the country, the national budget for the fiscal year 2016-2017 had a shortfall of E7 billion which was expected to be met through internal and external borrowing. One of the lecturers in this study, SCOT2, gave an indication of the extent to which those involved in vocational education have come to accept this as a way of life:

Transcription of interview	
Lecturer number: SCOT2	**Date: 13 August 2015**
But like I said apprenticeship is 5 years. If you have been here for 3 years, then you do the balance... 2 years...in apprenticeship... for those who are lucky to be apprenticed. So, you have done 5 years, they give you Grade 2...then you work for 2 more years and test for Grade 1.	

"…those who are lucky to be apprenticed" are indeed 'lucky' in the prevailing economic conditions in Swaziland. His statement suggests that there are now very few companies offering apprenticeship; underlying this, what is not said is how this limits the extent to which vocational students are able to fully benefit from vocational training and the workplace in their learning.

Another lecturer, SCOT2, although interviewed separately, had much the same to say on the subject:

Transcription of interview	
Lecturer number: SCOT2	**Date: 13 August 2015**
Well… if you have apprenticeship, you are automatically awarded a Grade 2 Test Certificate…then you work for 2 years I think…then test for Grade 1… Apprenticeship is 5 years with a company… there are not many companies in Swaziland… so our students have no apprenticeship**.**	

When vocational students are unable to obtain an apprenticeship, there is a gap in their training which compromises their level of competence.

For a student from a vocational training institution – or any trainee who intends to learn a craft or trade either for eventual employment or even self-employment – apprenticeship provides an important avenue to learn in a work set up what a trade really involves, and provides the building blocks that will underpin their proficiency in that trade. Following the decline in apprenticeship opportunities in Swaziland, in their search for an opportunity to break the poverty barrier through vocational education and training, many students in automotive mechanics have even begun to volunteer informally without pay at automotive mechanics garages just to build their skills. The few companies or garages that have been sympathetic enough to stretch their budgets to pay these volunteers a stipend are regarded with respect by students, who have coined the term 'soap money' for the scanty income that can be made this way. In fact, the apprenticeship officer at the Directorate of Industrial and Vocational Training indicated in an interview [4 August 2016] that many companies feel there is more to lose than gain if they involve themselves in pool apprenticeship training from which future employers may source their workforce. Beneath all this, companies still want workers to have skills, or what Winch (2013) calls abilities, that are oriented towards performing technically or manipulatively demanding tasks within the workplace. Yet as Winch (2010) indicates, this is no simple matter as developing such skills requires a thorough understanding of the relationship between theory and practice and many opportunities to exercise those skills in operational conditions. Hence the limited chances of attachment for the automotive mechanics

students restrict opportunities to exercise skills in operational conditions. To this extent, this research may only scratch the surface in that its focus is more on the pedagogy of lecturers, and only raises indirectly those issues that affect apprenticeship or workplace learning. However, if we see skill as a function of a person's character, performance, diligence, and attention to detail (Winch, 2013), it becomes clear that the development of skill transcends even the development of multiple techniques.

If the work on situated learning and constructivism in general views apprenticeship as a social activity – and knowledge as constituting the development of practical competence by allowing learners or newcomers to begin moving towards fully participating within a community of practice, and to eventually become part of that community (Lave & Wenger, 1991) – Bockarie (2002) sees a link between Lave and Wenger's work and Vygotsky's Zone of Proximal Development (ZPD). The latter not only views development as a continuous process that links a learner's networks of association with new experiences gained through contact, observations about and activities of everyday life, but sees learning itself as a lifelong process through which learners are constantly constructing, deconstructing and reconstructing their knowledge base and skills to function in the world (Bockarie, 2002). Apprenticeship would therefore provide the context and culture (Lave & Wenger, 1991) to eventually enter in a community of practice.

Apprenticeship can be likened to a journey where an experienced adult or the journeyperson represents an embodiment of know how that the apprentice aspires to. Hence, according to Lave and Wenger (1991), while the apprentice is learning new knowledge through the journeyperson, he/she develops the problem solving skills of a journeyperson to the point that he/she can construct meaning for him/herself while progressively building the same competence. I find the definition of apprenticeship provided by Clarke and Winch (2004, p. 509) useful:

> Our understanding of apprenticeship therefore covers the situation where a student, though based in a workplace and bound to an employer or group of employers, spends a substantial amount of time in education through a block release.

This view of apprenticeship is in line with Gamble (2012) who indicates that the formal apprenticeships brought into South Africa in the 1700s and 1800s by Dutch, French, German and British immigrants brought features of apprenticeships often described as 'traditional' in that they provided workers with an opportunity to work into all aspects of a trade, under the supervision of an artisan or journeyman, with the master artisan also taking responsibility for the moral welfare of the apprentice. The aspect of a block release or some form of time where the apprentice alternates his time 'indentured' and some time in vocational education and training setting is central to our definition of apprenticeship. This typically takes one of three forms in the situation of Swaziland:

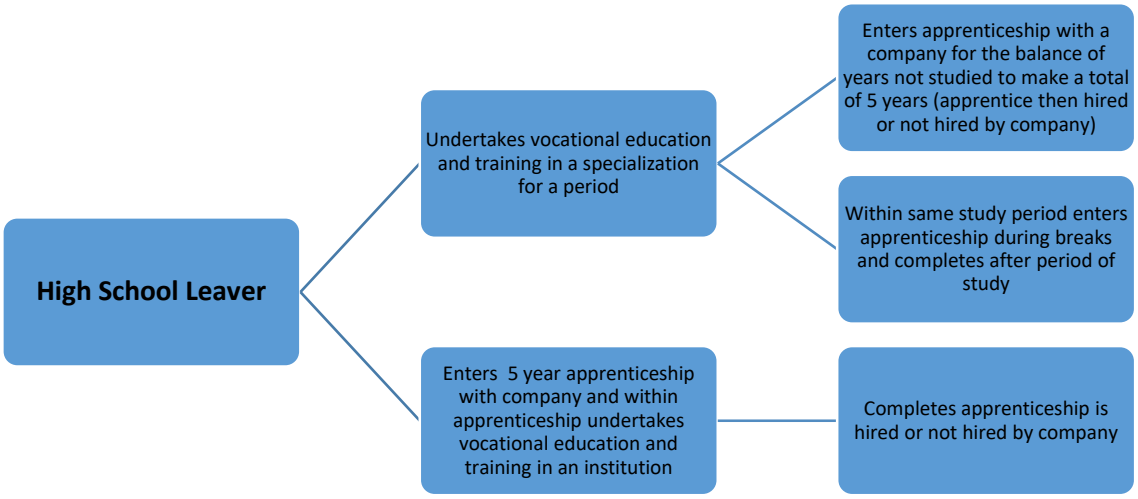


Figure 5 How Apprenticeship Interlinks with Vocational Education

In all three types of apprenticeships, an apprenticeship certificate is issued at the end of the period by the Directorate of Industrial and Vocational Training (DIVT) under the Ministry of Labour and Social Security), together with an automatic Grade 2 testing certificate. The DIVT has an apprenticeship officer who liaises with companies requiring apprentices and vocational education and training institutions on behalf of government, and is responsible for arranging the placing of students or trainees and following them in their indentures every three months, to ensure that they are moved through the various aspects of the trade, with records kept of what they have done and when. In automotive

mechanics this would involve ensuring that at the end of the five years the apprentice has, for instance, done brakes, engine, transmission and auto electrics, among other things. This would have been the ideal when apprenticeship opportunities were still readily available, yet however still applies in those few instances where they do still exist.

The idea of setting up an apprenticeship system that brings employers, worker organisations and the state together, that Swaziland models after is an approach used elsewhere:

> Successful apprenticeship systems rest on strong corporatist features with close cooperation between different social partners, such as employers, worker organisations and the state. A move towards collaborative structures would create a number of important conditions that would, ultimately, not only improve the quality of the apprenticeship experience (and employers), but also lead to a re-evaluation of the value of apprenticeship as a legitimate post-secondary education option (Lehmann, Taylor, & Wright, 2014, p. 587) .

While the intention of Swaziland in seeking to involve industry in VET training through apprenticeships may have been noble, the reality is that the country has fallen short of achieving what one could call 'corporatist features' and strong 'collaborative structures' that would make apprenticeship a worthwhile experience and 'investment' for everyone. To this end, while there may be other interventions to be pursued, the role of government could be more active than just overseeing apprenticeships and issuing apprenticeship and grade testing certificates, while in other countries there are benefits from government that accrue to companies that offer apprenticeships, such as subsidized apprenticeship schemes (Winch, 2013).

This next section navigates apprenticeship within the training of automotive mechanics in Swaziland through the lens of the lecturers who participated in this research. These lecturers sought to have their students' first year training augmented by workplace practice in second year as part of training. In the context of this discussion, I must reiterate the paucity of apprenticeship opportunities that has resulted in many students doing

attachments in challenging private garage environments, and some barely managing to secure this kind of 'opportunity'. This sheds light on some of the respondents' observations that may putatively negate the role that 'apprenticeship' should contribute in creating experiences that develop a novice into an expert.

For the above reasons, and for the purposes of this research, the word *apprenticeship* will be used to refer to the arrangement where a student is based at a workplace and bound to an employer or group of employers through an indenture that allows him or her to attend a vocational education and training institution for grounding in theoretical and practical and/or simulative practices that inform the occupation or trade to which the student aspires. This *apprentice* builds his/her know how under a journeyperson who should guide him or her through the development of problem solving skills as he/she moves towards constructing meaning for himself and attaining the confidence of his journeyperson. In the context of Swaziland, it is necessary to bring in the words *industrial attachment* and *attachment.* *Industrial attachment* is used to refer to the process where a student, during the course of his/her vocational training, spends part of his/her vocational education and training time in a work setting within his *trade* where he is anticipated to 'get a feel' of the community of practice in an actual setting. Two of the automotive mechanics training institutions in this study, VOCTIM and SCOT, require the specializing students to do one year within the institution and the second year away at an automotive mechanics work setting before returning to complete the third year for the diploma. This *industrial attachment* differs from apprenticeship in that it is more a cooperation to provide some temporary placement in the form of a practicum, rather than an indenture with an 'obligation' to develop a student's know how towards that of a journeyman. Although over time, the phrases *industrial attachment* and *attachment* have come to be used interchangeably in Swaziland, in the past there was rather a thin line between the two where, with respect to automotive mechanics, the former would be used to refer to more formally organised garages with advanced practices in the trade, and the latter would refer to a garage that was not so formally organised.

6.3 Apprenticeship in the Specialization of Automotive Mechanics

In the extract which follows, lecturer SCOT2 explained what students experience when they undergo attachment during second year before returning to complete their studies in the third year:

Transcription of interview	
Lecturer number: SCOT2	**Date: 13 August 2015**
They get the exact taste of what motor mechanics is about. They meet real car problems. When they come back for third year they share these experiences, and are able to learn something from each other... so when they have to do a project in third year they do a project that has meaning.	

As the above extract shows, the attachment presents a real *community of practice environment* through which the student slowly develops his or her occupational know how by encountering "real car problems." These are not simulated but have to be solved in a manner that will bring satisfaction to the customer. The various experiences that different students have will serve as a repertoire from which student-to-student sharing of ideas will occur when they return in third year. This concurs with Lave and Wenger's (1991) suggestion that mastery lies within a community of practice rather than in the master, and corresponds to Lucas et al.'s (2012) *learning by teaching and helping* method. This, on its own, is likely to contribute to scaffolding, as when a student happens to be more capable in a particular context his sharing may lead to internalisation of concepts and more capability to perform independently for both himself, as a source of know-how, and for his peers, who will want to emulate him.

Another lecturer, VOCTIM2, explained the following about what workplace attachment has to offer:

Transcription of interview	
Lecturer number: VOCTIM2	**Date: 27 July 2015**
It helps a lot… they [students] learn skills to tackle problems of cars... they work with people with experience who help them … they learn different approaches…they advance their depth of skill.	

It is from the experienced 'others' within the community of practice that students are able to learn different approaches that they may not have encountered within a vocational education institution and through this will gradually advance their know how.

Both respondents at MITC gave fairly negative accounts of what transpires when their students go to do attachment after their training course. MITC1 reported the following:

Transcription of interview	
Lecturer number: MITC1	**Date: 22 May 2015**
We write them letters in December to take to companies for attachment... they get working experience... and how work feels…. its requirements. They see their capabilities, their likes… what they don't like… They can decide … no… employment is not for me…last year one student came to complain they were making him do brakes every day on attachment.	

In situations such as the one described by MITC1, where a student sent on attachment is not guided properly by the journeyperson so that he/she gradually becomes exposed to the various aspects of automotive mechanics in practice but is made to work on brakes every day, then there is not much done to build the student's practice or to complement institutional learning. The comment by MITC2 strikes a similar chord:

Transcription of interview	
Lecturer number: MITC2	**Date: 27 July 2015**
Once you are out, you are out. Who supervises attachment? Who knows ... many of the trainees do not even get attachment… very few get attachment... I can't say attachment helps them... it depends where they attach… they may make them do one thing every day… they may not teach him anything. But it may help them if we made our trainees return after attachment, maybe we could see where they develop interest, and train them more… so they can see, if I understand something better... or I like working with what, and may take it from there. …mmm... not many of our trainees are able to start their own workshops… or to have good	

motor mechanics jobs…... I think ...I remember 1 or 2…. These I used to take with me on weekends when doing weekend piece motor mechanic jobs… they worked hard… and did learn something… now they work in South Africa on their own.

"Once you are out, you are out" sums up the predicament that the students find themselves in: after being trained for a year they are then asked to find attachment, with no further training or follow up provided by the institution. The section in bold in the quote above speaks to the lack of attachment opportunities for the students, as well as to the disconnect between the students' aspirations to practice under experienced guidance, and the 'reality' of the situation where the garage has them do the same thing every day. While companies focus on production, and are bound to be more concerned above staying above break-even point during business slumps, the result can be negative for those on industrial attachments or apprenticeships. There are two other considerations that may account for this state of affairs in the case of students at MITC. One relates to perceptions of their practical abilities – actual or imagined – and the other to the perception that it is a 'time saving' practice to have an apprentice concentrate on only one task, similar to the way in which setting up a line operation in a factory contributes positively toward meeting company targets.

Another lecturer, SCOT2, indicated that the workplace is sometimes hostile:

Transcription of interview

Lecturer number: SCOT2 **Date: 13 August 2015**

How does the attachment help the trainees from SCOT?

Gives hands on experience... expose them to life in the workshop. Here we go once a week and maybe only 4 hours... out there you start work at 6am and work for a full day. Here we work in room temperature, there is cover... but out there you work in the sun, the car comes it is hot all over... but you have to change the oil. It is life you can't experience here. Us here we are careful of the language we use... *asibetfuki* [we do not insult them] … out there they use any language... and they can use insults that stick... they have to learn how to survive. We don't use the language they use out there. They can be promised a fist now… how do they survive... they have to learn on their own. They have to decide if this is for them. Will they be motor mechanics...will they work with the hostile environment…the harsh people? Out there they hire you now and fire you now…. You learn how life is. Of course... they learn the latest that we may not have here... some may attend short courses which are relevant… ...they are exposed to other workshops… some things we don't have here…. they may learn new systems of cars... some of this knowledge helps us when they come for third year.

There are conditions that the attached student encounters in the workplace that he or she would not normally experience in a class or college workshop situation. He/she works a full day, sometimes in the sun, where the language may not be so controlled – yet still may benefit from short courses and exposure to new technology. These are what Winch (2014) calls contextually relevant conditions, which may include factors such as commercial, financial and temporal constraints and even the need to work with colleagues and customers – and are factors commensurate with the concept of apprenticeship as a way of entering a community of practice. Though the attachment that the lecturer SCOT2 referred to above is not apprenticeship as it should be understood, it highlights aspects that do arise within a community of practice.

This picture of the situation that automotive mechanics students face as they seek to acquire workplace practice within the country contrasts starkly with the experience of apprenticeship that their lecturers would have had fifteen or more years ago, during the era in which the big sugar companies within the country were experiencing growth that looked as if it would continue indefinitely. At that time, companies would even advertise for school leavers who wanted to enter their apprenticeship programme. The opportunities were varied to allow each apprentice to find the area that suited him best, following a basic engineering course during which his strengths were identified. This apprenticeship would involve immersion as well as concept building within a vocational education training institution. This approach to apprenticeship stressed the importance of rather broad occupational knowledge before narrowing to a specific trade. In this way, companies built a reservoir of skilled workers from which they would choose the best to specialise in some area, sometimes for eventual employment but also with the option to leave. This was done without concern for recouping their investment in individual training, which is considered paramount today. This kind of approach may be similar to Germany's approach to apprenticeships which emphasizes broad occupational knowledge as opposed to the English system of emphasizing task-specific skills (Lehmann, Taylor, & Wright, 2014).

6.4 Conclusion

The automotive mechanics lecturers continued to use pedagogic practices for first year training that were intended to feed into, and benefit from, an organized apprenticeship system or workplace attachment to build students' capability, while the situation on the ground suggested a reduction of workplace attachment opportunities and a weakening of workplace training mechanisms. These pedagogic practices had not shifted or adapted to the prevailing workplace attachment challenges. While lecturers were cognisant of the role that workplace attachment or apprenticeship should bring to augmenting trade competence, and overtly identified the existing challenges in workplace attachment for students, this was not met by any effort to explore or pursue alternate means that would narrow this gap. Without a comprehensive understanding of the outcomes that vocational education should achieve and the methods and decisions that will have to be made, a disconnect between the real and the idea is inevitable. This does not, however, mean that constraints in terms of resources the learning environment, background of the learners, and pedagogical or vocational education teachers do not play a role. It is one thing to determine the teachers' pedagogical processes, and yet another to determine who are these vocational education teachers – and this may require a commitment and players at policy level. This might point to a need to develop corporatist features and strong collaborative structures between different social partners, such as the state, employers and worker organisations in order to strengthen vocational education, as advocated for by Lehmann, Taylor and Wright (2014).

In a nutshell, the contribution of workplace attachment to automotive mechanics training requires scrutiny so to ensure that its role as part of the pedagogical practice of lecturers is effective; at the same time, lecturers need to have access to pedagogic practices which are research informed in order to be able to achieve the full range of vocational outcomes that students require, as Lucas et al. (2012) advance. These will, in turn, build the capacity of workers or mechanics to begin a trajectory of *epistemic ascent* in their competence, as advanced by Winch (2014).

Without this, the real dangers that have encroached upon apprenticeship and industrial attachment as a means to bring workplace experience and learning to the automotive

mechanics student, point to barriers and opportunities to apprenticeship that Fuller and Unwin (2003) call restrictive approaches with little boundary crossing, limited opportunities for reflection and limited chances of progression. These are due to economic imperatives that may inevitably drive companies to redefine and reconstruct their apprenticeship or industrial attachment programmes. On the continuum from restrictive to expansive approaches, countries that move towards more expansive approaches will create a stronger and richer learning environment with deeper learning opportunities than the restrictive approaches offer (ibid).

The next chapter provides the conclusion of the findings as detailed in chapters 5, and 6 as well those that arise from chapter 2, particularly in relation to attempting to understand vocational education and training in Swaziland within the context of existing theory.

Chapter 7: Conclusion

This thesis has explored the pedagogical processes used by lecturers in the teaching of first year automotive mechanics students as the entry point into the occupation of automotive mechanics in Swaziland. It has used the framework of vocational pedagogy developed by Lucas et al. (2012), Winch's (2014) theory of epistemic ascent, as well as other works that touch on other theoretical considerations on vocational pedagogy that arose as subsequent themes in the study.

The Swazi vocational education and training system owes its origins to Britain and Germany, though it shows a more pervasive British influence owing to its links to Britain as a former protectorate. On this basis, the system can be said to be Eurocentric. Despite this, the system fails to fully align with Northern European models of skills development as described by Wheelahan et al. (2015). It only inclines to an 'education logic' in its not having strong links between education and work, but fails to fit within this model in that it has no strong links with tertiary education. It also does not fit with the 'employment logic' exemplified in vocational education systems of Germany where there are strong institutional links between work and education. It is possible that a classification system could be developed in which countries with Eurocentric VET systems could reflect a type of Eurocentrism that fits with their economic development positions.

In terms of a vocational pedagogy, Lucas et al. (2012) introduce a framework for vocational education with broad categories – *physical materials*, *people*, and *symbols* – that correspond to appropriate learning methods. Automotive mechanics falls into the category of physical materials on the basis of the medium through which its work is expressed, as it essentially deals with working with car parts or components. Lucas et al. (2012) identify learning methods appropriate for this category which include, for example, imitating, practising and trial and error as part of real world problem solving; the other two categories play a less central role as part of what constitutes the broader work environment.

Lucas et al. (2012) argue that vocational education should, through every activity and process, build up the capabilities that constitute working competence for a vocational worker in the twenty first century. They identify six vocational outcomes which produce these capabilities: *routine expertise*, *resourcefulness*, *functional literacies*, *craftsmanship*, *business-like attitudes* and *wider skills for growth.* No proposal has been made as to how these capabilities might relate to a vocational worker progressing from lower levels to higher levels of competence. Lucas et al.'s (2012) framework provides a list of primarily 'experiential' methods appropriate to vocational education from which vocational education providers can select appropriate combinations, together with a ten-point decision making tool for selecting the modalities of where and how to conduct the lesson.

During observations of the pedagogical practices used by lecturers in this study, exploratory and demonstrative approaches to teaching emerged as themes. These approaches are not identified in Lucas et al's (2012) framework, however as broader pedagogical approaches they provided the lessons in which the framework was applied to determine the lecturer pedagogies.

Analysis of the data collected during observations found that the teaching methods used by the lecturers when using both the exploratory and demonstrative approaches focused principally on achieving the vocational outcome of *routine expertise.* While *routine expertise* proved to be the primary pursuit, about half of the lessons also touched on the vocational outcome of *resourcefulness*, and another half on *craftsmanship*. There were also instances in which the lecturers also touched on some aspect of the vocational outcome of *business-like attitudes*, most notably in terms of raising students' awareness that a customer's needs must come first and expectations must not to be just met, but exceeded. Sometimes a lecturer required a student to hold a conversation with a customer. In general, the vocational outcome of *wider skills for growth* and *functional literacies* did not appear to feature, while those of *resourcefulness, craftsmanship and business-like attitudes* were addressed infrequently.

The teaching methods that the lecturers used to achieve the vocational outcome of *routine expertise* were embedded in the exploratory and demonstrative approaches that they used, and included *learning by practicing (trial and error)*, *learning by watching*, and *learning by imitation.* The exploratory approach uses as its core method *learning by practicing*, in which students are given time to make mistakes through which they learn, while the demonstrative relies on the core methods of *learning by watching*, *learning by imitation*, and *learning by practicing (trial and error)* which all constitute forms of demonstration.

The methods used by the lecturers to teach first year automotive mechanics, though aimed primarily at achieving routine capacity, were in line with the methods indicated by Lucas et al. (2012) as appropriate for using for the broad category of *physical materials.* These categories help to identify pedagogical methods that are appropriate for the training field. The methods that Lucas et al, (2012) identify as appropriate to the *physical materials* category are: *imitating, practicing* and *trial and error* as part of real world problem solving. However, the use of these methods, alone, does not constitute an optimal pedagogy for vocational competence.

I propose that a universal pedagogy for development of routine capacity in the teaching of automotive mechanics may exist that is premised on exploratory and demonstration approaches and which could be considered a signature pedagogy. In this pedagogy, the lecturer essentially breaks a car down into parts and uses the exploratory and demonstration approaches to develop routine practice, where the breaking down of the car is a pedagogical decision to enable routine practice in identifying, disassembly and reassembly of parts that will ultimately build into systems. Though the exploratory and demonstration approaches are not part of Lucas et al.'s (2012) framework, their methods that correspond to the *physical materials* category – *learning by watching*, *learning by imitation*, and *learning by practicing (trial and error)* – constitute the pedagogical repertoire used by the lecturers in this study to achieve the vocational outcome of routine expertise.

The lack of attention in the lecturer's pedagogical practices to the vocational outcomes which Lucas et al. (2012) argue need to be pursued at all levels of vocational education suggests that the vocational education provided to automotive mechanics students' needs improvement. Not only does the pedagogical repertoire of the lecturers need to be expanded, but all levels that support vocational competence must be enhanced. There is need for those involved in vocational teaching not only to have themselves achieved the six vocational outcomes, but to model them and set them as central outcomes of vocational education and training. The structures of industry and the policy and regulatory bodies need to be part of the researched vocational pedagogy equation as well.

I have attempted to relate the framework developed by Lucas et al. (2012) to the concept of epistemic ascent, by which various kinds of knowledge create avenues for a worker to progress from a level of novice to expert, as advanced by Winch (2006, 2010, 2013 and 2014). I propose that where vocational education pursues all the six vocational outcomes and the pedagogic processes and support systems to support a twenty first century vocational education system, a vocational worker will, at entry level, correspond most accurately to the level of *transversal abilities*, with some only attaining the level of *skill*. The next level, *project management abilities*, *which* presupposes the attainment of both *skills* and *transversal abilities*, requires patience and resilience in creating an ability that is transferred to a new sphere of activity. The six vocational outcomes therefore can be seen as providing the foundation on which to establish the higher levels of *project management abilities* and *occupational capacity*, which involve the mastery of systematic knowledge spanning the entire occupation, and leading to the breaking of new ground.

In relation to epistemic ascent, as conceptualised by Winch (2014), the pedagogical processes that the lecturers used in teaching first year automotive mechanics in Swaziland were at the first level of technique as supported by a focus on the development of routine capacity. This, in a way, seeks to provide the ground on which apprenticeship or workplace attachment will build in the second year of internship. The routine capacity is, in a way, also a product of the contexts that Lucas et al. (2012) identify as influencing a country's capacity to pursue meaningfully competence that fits in with the six vocational outcomes. These include the backgrounds of the lecturers, in terms of their own

vocational education and awareness of research informed pedagogies; the kinds of learners who study automotive mechanics; and the context on the ground of limited resources available for vocational training; as well as the employer/government policy and regulatory terrain challenges.

While the routine capacity that was developed by lecturers' pedagogical processes in first year training was poised to be enhanced within a community of practice in the workplace attachment at second year, the current downturn in the economy of the country has meant there are fewer companies that offer apprenticeship opportunities. This leaves mainly smaller automotive repair workshops, whose contribution in terms of taking students on workplace attachment is met with challenges in keeping afloat in a business sense, and in offering meaningful workplace practice opportunities. When the workplace offers limited opportunity for practice across the full range of automotive mechanics, and limits some learners to repetitive tasks, this may slow down attainment of vocational competence. There is thus need to prepare the ground in terms of bringing about a shift in the areas of vocational education for lecturers and their awareness of research informed pedagogies; developing strong collaborative structures involving social partners, such as the state, employers and worker organisations (Lehmann, Taylor and Wright 2014); and providing vocational education settings that enhance vocational education.

In closing, I refer to Voss et al. (2002) who indicate that because case research is without the rigid limits of questionnaires and models, it brings out creative insights. To me as a researcher and to those in Swaziland or elsewhere who may eventually have access to this work, there will be benefit in being exposed to the issues and insights of the lecturers on the ground on automotive mechanics training in Swaziland. Furthermore, to me as a professional in the field of VET in Swaziland, I should be able going forward to contribute to the field from a better informed perspective.

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APPENDIX A: INTERVIEW SCHEDULE (PRE-OBSERVATION)

This interview schedule is a tool to collect data for research on how lecturers train students to become automotive mechanics. The research is towards a PhD at the University of KwaZulu Natal. No information will be used to identify participants, and participants will be given notes on the researcher's interpretations for their views and input.

Participants are at liberty to take part in this research, and do reserve their right not to take part.

1. I am grateful for your time, please tell me how long you have been a lecturer in automotive mechanics, and what training and experience you had before becoming a lecturer. Have you done any training on teaching or have you done education and has it been of any benefit?
2.
3. Are there specific requirements for a student to train to be a mechanic here, and in your view how do these help? Please give examples.

4. In your teaching, do you determine if the students have some knowledge about automotive mechanics, and is this information used in your teaching? If yes, how?

5. What are the subjects that are taught in Automotive mechanics, and which of these would you say are key to train mechanics, and in what way?

6. Which subject or subjects do you teach [are you going to teach] to the first year students this time?

7. (a) How do you teach your first years? Can you explain how you structure or arrange what you teach automotive mechanics to the first years? You can give examples or specific instances of what you emphasize and how.

   (b) How do you choose (select) what you teach? Do you just follow what is written down in the curriculum (syllabus)? Explain.

   (c) How do you decide the order of your topics, and have you found that you use the same order every time?

   (d) When you teach what happens? Do you find you find yourself using one pace on the different topics? Explain.

8. What assessments will you give, and how will you decide on them? Comment on their frequency.

9. What (automotive mechanics) processes and skills are your students expected to carry out by the end of first year?

10. In your view, and to your knowledge, how does the industrial attachment that follows training benefit trainees?

FOR VOCTIM

11. How does the second year training (for those returning for the Diploma) differ from first year training in Automotive Mechanics?

12. What subjects are done in the second year, and which of these are a strong requirement for training at this level, and in what way?

13. What skills and jobs in the automotive mechanics trade are students who have completed second year capable of, that those at lower levels (or who have completed industrial attachment) are not capable of?

14. Explain how the Grade Testing system conducted by the Directorate of Industrial and Vocational Training (DIVT) fit students trained at VOCTIM in Automotive mechanics, until they obtain Grade 1.

FOR SCOT

15. How does the third year training differ from first year training in Automotive Mechanics?

16. What subjects are done in the third year, and which of these are a strong requirement for training at this level, and in what way?

17. What skills and jobs in the automotive mechanics trade are students who have completed third year capable of, that those at lower levels (or who have completed industrial attachment) are not capable of?
18. Explain how the Grade Testing system conducted by the Directorate of Industrial and Vocational Training (DIVT) fit students trained at SCOT in Automotive mechanics, until they obtain Grade 1.

FOR MITC

19. Explain how the Grade Testing system conducted by the Directorate of Industrial and Vocational Training (DIVT) fit students trained at MITC in Automotive mechanics, until they obtain Grade 1.

APPENDIX B: INTERVIEW SCHEDULE (POST-OBSERVATION)

This interview schedule is a tool to collect data for research on how lecturers train students to become automotive mechanics. The research is towards a PhD at the University of KwaZulu Natal. No information will be used to identify participants, and participants will be given notes on the researcher's interpretations for their views and input.

1. I am grateful for your time, please tell me how in your view this year's training in automotive mechanics progressed, and how you would compare it to other years.

2. How did you structure or arrange what you taught, and what changes did you have to make and why?

3. Which areas (topics) did you spend the most time on when teaching or working with the students? Did you have to repeat some areas (and why?)

4. Did any of your trainees have some background on automotive mechanics when coming for the first time? If so how was this used?

5. What aspects in the entire training would you say have been key in producing the quality of trainees that you set to produce when the training started?

6. What assessments have you given in the year, and what would say about the performance of students on these assessments?

7. How did you decide what to include or not to include in your assessments?

8. Do you think when a student passes (the tests or examinations) this is an indicator that he will be a good mechanic? Why?

9. What (automotive mechanics) processes and skills do you think your students are now capable of carrying out? Are they capable of doing automotive mechanics work on their own, and which work can you say they with confidence that they can do.

10. What processes and skills will they be capable of when they finish third year, and do you think they will be good mechanics then?

11. What would you like to see happening in the institution or elsewhere that can improve the quality of automotive mechanics that you produce?

APPENDIX C: Derivation of Themes from Transcription Data Sets

Phrases	Key term	Bigger Theme
Pre-observational data		
Scot1 120815 -Apprenticeship...was like an induction course...you were exposed to different machinery and equipment	-apprenticeship	Apprenticeship and Industrial attachment
-HND was more theory...more manufacturing...more design	-epistemic ascent? /the need for literacy	
-we need the science and maths…you see your future should not be limited…you can take up further study	-Science and Maths	
-A student's previous knowledge about cars…[he] may just want to shine...the knowledge may be wrong or even dangerous	-dangerous knowledge	Signature pedagogy of Automotive mechanics
-in motor mechanics you break a car into parts...and you teach these parts	-Parts/whole	
-I first work with the individual parts...before we see how the parts fit together -applications...bring words to form mental picture	-practicals bring Mental picture	Grade Testing- and contestations?
-the steam engine… pistons...to car engine...to clutch … to gearbox... to diff...to wheels	-whole, part, whole (system)	
-we do 1 by 1, we look at a part alone, look at the next part and we look at the parts as a system...then how this system links to other systems (dismantle and reassembly)	-how this system links to other systems Whole, part system/semantic density/ signature pedagogy	
-I don't have to follow the syllabus…no one can select for me what I should teach (and when)	Changing knowledge base	

-it is good…but you see at the bottom there is a disclaimer -I decide what I should start with before what…I can start with the clutch ...another time I can start with the gearbox -they can't handle a spanner…not know the size of a bolt -I want them to have a little black note book…to take a picture using their phones -the teacher has the power…you are worried about the teaching of students…admin wants the marks -Some are just backbenchers -sometimes a student in third year asks you a tough question form experience in industry…you have not had this experience -industrial attachment...they meet the real car problems…when they for third year they share these experiences -Are third years good at diagnosis: we are not saying they are accurate... they still need to do apprenticeship… [for] more experience...to work under some guidance -build on capabilities to be able to rise to supervisory positions -Grade Testing: The Ministry of Labour grades this informal learning…our students do not require grade testing…but we do it to increase our chances to survive	-selection, sequencing -tools -follow steps, procedure signature pedagogy -selection Some are just backbenchers Epistemic ascent Changing times, changing technology -attachment: the real world out there - apprenticeship for more experience...more guidance attachment: the real world out there -rising: Epistemic ascent -Grade Testing politics -changing times, changing technology and the tough questions	Changing times, changing technology Epistemic ascent
Phrases	Key Term	Bigger theme
Scot2 130815 -Did attachment for 1 year...and apprenticeship for 2.5 years -My B Tech was in motor mechanics manufacturing …more about body design.	-apprenticeship -epistemic ascent?	

- if I fail maths does it mean I cannot be an engineer? You may find the one with lowest marks in maths and science becomes the best engineer. -one may be used to wrong concepts...wrong practices..., many dangers of incorrect practice -we are now introducing electronics, the use of computers -or teaching is not coordinated…no smooth flow -can start on airflow then carburettor yet carburettor is first in syllabus -can teach one finger and leave the other 4 fingers...some topics intertwined -after1st year: for their own good they need supervision…tight supervision -industrial attachment: taste of what mechanics is about...real car problems...can now learn from each other when they return for 3rd year. -out there they use any language…hostile environment -they learn the latest...we don't have here. -was in -10 now has moved to +6 After 3rd year: should be able to do 1 or 2 things by himself... 4 mistakes... all the 6 he should get them right	-science and maths -Bad habits/clean slate -work place out there - changing times, changing technology -teaching not coordinated -selection from abstract to concrete -selection Novice vs expert -industrial attachment/apprenticeship -Shift from training to work place changing times/changing technology -Novice to expert? -novice to expert?	Prerequirements for auto mechanics -epistemic ascent/ -Teaching not coordinated/ Signature pedagogy apprenticeship
Voctim1 250515 -did VID	-automotive lecturer pedagogy -levels (epistemic ascent)	

-to be a mechanic you just need to be literate...with form 5 requirement they will not just be mechanics -some will rise to be supervisors -they see what they know is very little -we want students to do AutoCAD…they say it is not motor mechanics…some just want to be mechanics -gearbox: gears in a box ...clutch gearbox brakes...they work together -baby you start with NAN -pace has to change...grasping slow you drag -new subject **Electronics …** some think this is not motor mechanics -after attachment: they know more about problems of different cars -those with certificate remove and fit...those with diploma...more exposure...can rise to supervision	-little knowledge epistemic ascent -changing times, changing technology (vs epistemic ascent) -from part to function and into system -from parts to wholes to systems Pacing changing times, changing technology -apprenticeship or attachment -epistemic ascent?	Signature pedagogy/ More **Semantic density** (Karl Maton) than semantic gravity
Voctim2 270715 -cars becoming complicated, use sensors...form 5 necessary Maths and science necessary -garage: may work at reception...read job cards, write properly -from components to function...from simple to complex -I change the order of topics -if they don't understand, I repeat...slow down -attachment: they learn different approaches	changing times, changing technology -the workplace: need for literacy -signature -Sequencing -Pacing Apprenticeship	

-after diploma: their level of knowledge is higher…can work at higher levels...complex tasks -certificate: can work under direction...can remove and replace	-epistemic ascent	
Mitc2 270715 -I learnt as I worked with people -if you asked him to show you information he wanted money -assemble an engine without a torque wrench -a mechanic needs to know ...even the auto electrics -today's cars you need to refer to the internet -we use customer cars…we do training on production -if they can't write, and they work hard they can learn a little bit -on attachment: they may make them do one thing every day -the garages make them do basic mechanic tasks...replace exhaust all the time to give them low pay -they tell trainee if he goes for Grade testing he should not come back	-learning by immersion -the work place out there -the work place out there Changing times, changing technology Changing times, changing technology -Learning on the job -Literacy -The workplace out there -the workplace out there -Grade Testing contestations	-Automotive lecturer background training
SCOT1 Good mechanic interview 6 Oct. 2015 -they are good in theory -that man…his own car he takes it to other mechanics -they stand at the back…they watch	-*theory/practice* -Teaching not coordinated Signature?? -the mechanic who is not mechanic/ epistemic ascent	*Theory/ practice*

-they want to try…to make the mistakes -**it's by fluke**…you don't know anything	 -make the mistakes -the 'good mechanics' Walking the road 'living the signature' -the 'good mechanics' 'living the signature' Walking the road	-epistemic ascent *Theory/practice* -epistemic
Scot2 13815 -B Tech …more about body design [the one with maths and science] …is just thinking and doing the designs -that procedure is wrong -He is a clean sheet -you find you need to teach certain topics before others -some topics are *intertwined* -sometimes they [trainees] are better off not knowing about them [other systems] -for their own good they need supervision -pick these steps and repeat them -if he made 10 mistakes in first year…now he should make 4 mistakes.	 -epistemic -Maths/science science and maths -epistemic *-bad practice/clean slate* - living the signature' Walking the road -Selection -selection Chunking/selection -epistemic -make the mistakes -the 'good mechanics' Walking the road 'living the signature'	 -epistemic -
Mitc2 270715 -…he was stingy…stingy with information -you would end up doing wheels only…maybe take them off -he could not write…he won't be a mechanic -many of the trainees do not even get attachment	 -immersion/*theory-practice*/ the workplace -- apprenticeship?/the need for literacy -epistemic ascent?/the need for literacy -apprenticeship chances decline	 Automotive lecturer background training

-they pay them E1000 per month and do not let them learn new things -very few go for grade testing... it is those who give up after attachment	epistemic ascent/ apprenticeship politics -Grade Test politics	
Post Observations		
Voctim2 301115 -I start with the simple topics…before moving to the complex ones -now there are too many cars…especially Asian cars -All the components constitute a car -City and guilds plays with one and the same question -at certificate level...they do minor repairs…can't do engine work because it is more critical -the teachers are old and using old technology -they run their businesses…hardly concentrate in their work	-sequencing - changing times, changing technology -the bigger system (car) (compare with perception engine is most important) -assessment -no go area*** - epistemic ascent -the bigger system (car) (compare with perception engine is most important --changing times, changing technology *Theory/ practice* - Teaching not coordinated Signature??	
MITC 1 27116 -we wait for a car to be serviced -I always start with the simple to the simple to complex -the others have to wait	-Teaching not coordinated - the workplace Training on production model -sequencing -Teaching not coordinated - the workplace Training on production model	

-for me I did not give...tests-...I have to train them many times -I decide on my own what is important -But theory? -you hope the next time you will give others a turn…you find there is no car coming -the leaders want money...yet us...need fewer learners -the answer may end up lying somewhere in the words (on the use of SiSwati for those not literate)	-assessment/exams No go area -selection *Theory/ practice* Teaching not coordinated - the workplace Training on production model - Teaching not coordinated Training on production model -epistemic ascent?/the need for literacy	
Mitc2 220116 -you cannot depend on the cars of customers -I have developed this order -one former trainee came to complain. [At attachment] they asked him to work with an air brake system he had never seen	Teaching not coordinated Training on production model -sequencing changing times, changing technology	
VOCTIM1 031215 -I follow the torque -I normally tell the students…you have now chosen a trade...you know how this thing works...practice -go, read or ask other trainees -He had only done Form 2, but he is a good mechanic…he developed his practice in the work place	-selection, sequencing - make the mistakes -the 'good mechanics' Walking the road 'living the signature' -assessment signature' -literacy -make the mistakes -the 'good mechanics' Walking the road 'living the signature'	

-you only need to love what you are doing -the good ones… are the first to pick a spanner -this one is too clever ...he will cause us problems (garage employer on why he employed a bad mechanic) -starting up there is not good ... we should continue teaching the old way -sometimes trainees come here (from attachment) with better knowledge -look teacher with this car you now do this and this	-make the mistakes -the 'good mechanics' Walking the road 'living the signature' -make the mistakes -the 'good mechanics' Walking the road 'living the signature' - the workplace - changing times, changing technology changing times, changing technology changing times, changing technology	
Observations		
VOCTIM 1 08 Feb 2**0**16 -clutch replacement (practical) -lecturer notices under arm presses against exhaust -get a centre punch...and a hammer...we need to mark 2 aligned parts of the prop shaft before we remove it -some of the trainees are interested in other parts of the chassis -it's like a white man's witchcraft (humour) -lecturer explains that he will now call the customer.to bring a new clutch kit VOCTIM1 09 Feb 16 -You guys had the chance to dismantle…give me a chance to fasten now	-*theory/practice* -mistakes, signature - the signature', the steps the procedures and reason -related parts --changing times, changing technology; humour how workshop functions -the workplace	

-I am fastening the bolts **diagonally**…from one bolt to its opposite - [the clutch plate] is not straight, the spigot shaft will not align, and may damage the splines in the clutch -But we must use the words we learnt in class -Gear ratios practical we will not dismantle	-all compete for practical experience, walking the road -the signature' -unpack the jargon -corrects, elaborates, repetition to correct mistakes -naming, identifying, the signature -exploratory methods signature	
Videos		
2976/2978/2979/2980/2984/2990,2991/2997 scot1 090915 - Up you go…up you go. Student: Hey...hey…it's going Lecturer rushes back…. Lecturer: Going where? [Looks like the part the hook is holding on is slowly snatching away from the engine] Student: It's going... - You see… now it's physics…all along you were using agricultural science... -...now this spanner is a bit loose, it is the wrong size.	-walking the road, making the mistakes, signature walking the road, making the mistakes, signature -the tacit -humour -tools	The tacit

Video 2974 Now the 4 students crowd around the left front disk of the van. The girl student and a boy student are squatting while the two boy students are bent over [scot1 09.09.15]	-The unsaid	
- [Trainee tries to remove remaining h.t wire but fails]	-The unsaid	
-It feels loose…but how will I see?	walking the road, making the mistakes, signature	
-Now the 4 students crowd around the left front disk of the van. The girl student and a boy student are squatting while the two boy students are bent over	- walking the road, making the mistakes, signature	
-The time this one comes…this other one comes towards it	Illustration for the novice Relating everyday/ specialised	
-Student: You use the gauge…so gestures with right hand like he is pulling up something with the fourth finger.	- *theory/practice*	
	-relating *theory/practice*	

APPENDIX D: National Trade Testing Standard for Motor Vehicle Mechanic Grade 3

SWAZILAND GOVERNMENT

NATIONAL TRADE STANDARD
APPROVED BY THE INDUSTRIAL TRAINING BOARD
FOR TRADE TESTING IN THE TRADE/OCCUPATION
OF
MOTOR VEHICLE MECHANIC

(a) Practical Skill Requirements Grade III

Every applicant must be able to:

1. Observe all safety precautions - personal and equipment.
2. Use simple measuring instruments common to the trade.
3. Use and maintain in good condition the tools in common use in the trade.
4. Carry out repairs such as brake adjustment, gearbox removal, unit replacement, etc.
5. Carry out a minor service on a petrol and/or diesel engine vehicle, including changing of filters, cleaning the fuel system, etc, working from manufacturers service charts.
6. Check and clean contact breaker points and sparking plugs and make correct gap clearances.
7. Decarbonise a cylinder head and grind in valves.
8. Use split pins and other looking devices.
9. Fit and adjust all chasses components such as springs and shackles, etc.
10. Adjust brakes and clutches, change brake shoes.
11. Set the firing orders of 4 and 6 cylinder in-line engines.
12. Fit and remove tyres, mend punctures and inflate tyres of light vehicles to the correct pressures.
13. Check battery acid levels and use a hydrometer.
14. Check and adjust toe-in.
15. Identify metals in common use in the trade.
16. Identify components from exploded diagrams.

(b) Tools and Equipment Requirements Grade III

Every applicant should have in his possession and/or be able to use tools and equipment supplied as follows:

Spanners	Hammers	Pliers
Feeler gauges	Punches	Screwdrivers
Torque wrench	Allen keys	Soldering iron
Hacksaw	Files	Cold chisels
Side cutters	Vice-grip	Rule
Hand drill	Power drill	Pipe wrench
Oil can	Rubber mallet	Suction cup
Calipers	Grease gun	Valve lifter
	Hydrometer	Socket spanners
		dividers.

Plus any allied equipment required to carry out the practical skill requirements satisfactorily.

(e) Related Knowledge Requirements Grade III

Every applicant must have a knowledge of:

1. Safety precautions - personal and equipment.
2. First-aid treatment for electric shock and minor workshop injuries.
3. The common simple measuring instruments and devices used in the trade and their various applications.
4. The various types of fire extinguishers and their different applications.
5. Mechanical and hydraulic brake systems, gear boxes, starter motores, etc.
6. The working principles of internal combustion engines and vehicles layout.
7. The logical sequence to be followed when carrying out minor servicing on petrol and diesel engines.
8. Gap clearances in relation to contact breaker points and sparking plugs.
9. Valve clearances.
10. Various locking devices and their application.
11. All major chassis components and their locations on a vehicles.
12. The firing orders of 4 and 6 cylinder in-line engines.
13. Tyres, tyre pressures and wear patterns and their effect on vehicle handling.
14. Manufacturers service charts and how to use them.
15. Wheel alignment.

APPENDIX E: National Trade Testing Standard for Motor Vehicle Mechanic

SWAZILAND GOVERNMENT

NATIONAL TRADE STANDARD
APPROVED BY THE INDUSTRIAL TRAINING BOARD
FOR TRADE TESTING IN THE TRADE/OCCUPATION
OF
MOTOR VEHICLE MECHANIC

(a) Practical Skill Requirements Grade II

In addition to fulfilling the Grade III requirements:
Every applicant must be able to:

1. Use and read a micrometer.
2. Use drills, taps and dies.
3. Remove and replace broken studs and seized nuts.
4. Carry out repairs to fuel pumps, simple carburettors, filters and fuel lines and adjust a simple carburettor.
5. Locate and diagnose faults in an engine, gear box, axle, steering and transmission on conventional motor vehicles.
6. Trace defects in ignition circuits.
7. Dismantle and reassemble clutch units.
8. Fit new bearings, bushes, rings and pistons with the required clearances for these components.
9. Overhaul fron and rear axle assemblies and fit new king pins and bushes.
10. Use a valve refacing machine.
11. Set and check valve timing with marks.
12. Use and read correctly vacuum and compression gauges and cylinder bore gauges.
13. Read and use manufacturers service charts and workshop manuals.
14. Carry out simple electrical faults diagnosis and repairs.
15. Overhaul and set up crash, constant-mesh and synchro-mesh gear boxes with the aid of a service manual.
16. Replace and time a phased injector pump and replace injector nozzles.
17. Carry out a complete overhaul of hydraulic brake systems.
18. Carry out a complete top overhaul.

(b) Tools and Equipment Requirements Grade II

Every applicant should have in his possession and/or be able to use tools and equipment supplied as for Grade III plus any other tools and equipment required to carry out the practical skill requirements satisfactorily.

(c) Related Knowledge Requirements Grade II

In addition to fulfilling the Grade III requirements:
Every applicant must have a sound knowledge of:

1. Types and uses of power tools used in the trade and the safety precautions applicable to their use.
2. The uses, care and maintenance of precision gauges used in the trade.
3. Fuel pumps, carburettors, filters and fuel lines and the logical sequence to be followed when diagnosing faults in these components.
4. Engine, gear box, axle, steering and transmission layouts.
5. Ignition circuits and the logical sequence to be followed when diagnosing faults in ignition circuits.
6. Clutch units of various types.
7. Front and rear axle assemblied of various types
8. Valve and cylinder clearances.
9. Manufacturers service charts and mechanical drawings and their interpretation.
10. Motor vehicle electrical circuits.
11. Diesel injector pumps and injectors.
12. Hydraulic brake systems.
13. All types of bearings in common trade use including adjustment and clearance and adjustment and pre-load where necessary.

APPENDIX F: National Trade Testing Standard for Motor Vehicle Mechanic Grade 1

SWAZILAND GOVERNMENT
NATIONAL TRADE STANDARD
APPROVED BY THE INDUSTRIAL TRAINING BOARD
FOR TRADE TESTING IN THE TRADE/OCCUPATION
OF
MOTOR VEHCHLE MECHANIC

(a) Practical skills requirement Grade 1

In addition to fulfilling the Grade 11 and Grade 111 requirements:
Every applicant must be able to:

1. Diagnose and locate any fault in an automotive or similar motor vehicle.
2. Carry out a complete overhaul of any motor vehicle and make any necessary repairs or adjustment.
3. Carry out a complete vehicle test and prepare a serviceability report.
4. Estimate repair times.
5. Service and/or overhaul a servo assisted braking system.
6. Grind tappets and rocker arm faces accurately to prescribed limits.
7. Demonstrate a specialist skill in at least one of the following:
   Automatic transmissions, fuel injection equipment P.I. or Diesel, air conditioning, electric diagnostic equipment, cylinder boring, crankshaft grinding, air braking systems, general hydraulics, power steering.

(b) Tools and equipment requirements Grade 1

Every applicant should have in his possession and/or be able to use tools and equipment supplied as specified for grade 11and Grade 111 plus any other tools and equipment required to carry out the practical skill requirements satisfactorily.

(c) Related knowledge requirements grade 1

In addition to fulfilling the Grade 11 and Grade 111 requirements:
Every applicant must have a sound knowledge of:

1. Clearances and fits in relations to pistons, rings bearing, crown wheel and pinion, steering assemblies and differentials.
2. The principles and function of servo assisted brake systems.
3. The electrical system of an automobile or similar motor vehicle.
4. Fuel injection equipment.
5. Automatic gear boxers and torque convertors.
6. The procedures to be followed for a complete vehicle test and preparation of a serviceability report.
7. The calculation involved in the estimation of repair times.
8. His chosen specialist skills.

APPENDIX G: Apprenticeship Job Training Guide

MINISTRY OF LABOUR & SOCIAL SECURITY
DIRECTORATE OF INDUSTRIAL & VOC. TRAINING

APPRENTICESHIP JOB TRAINING GUIDE Trade-Motor Vehicle Mechanic

Sections	First Year	Second Year	Third Year	Fourth Year
Engine Shop	Dismantling of engine and clutch. Cleaning and checking parts for serviceability	Refacing of valve seat, grinding of valves overhauling clutch pressure plate	Overhauling of engine measuring of cyl. bores, Pistons and crankshaft for wear. Replacement of sleeves	Testing of injector and timing of pump, Testing of engines
Transmission and suspension	Removal and installation of gear box, axle shaft, shock absorbers and springs.	Dismantling of gear box and rear axle. Testing and replacing of shock absorbers. Overhauling front axle.	Testing and repairing of hydraulic suspension, overhauling of mechanical gear box and rear axle.	Servicing automatic gear box, servicing air suspension.
General Repairs	Dismantling and assembling of brakes, Removal and installation of gear box, propeller shaft rear axle and engine.	Overhauling of steering box, wheel cylinder, master cylinder and bleeding and adjusting brakes and clutch	Reconditioning of carburettors, fuel, feed pumps, water pumps. Engine compression leakage test.	Engine turning using stroboscope dwell angle meter Exhaust gas analyser (where facilities exist) faults diagnosing- mechanical
Electrical	Cleaning, testing and resetting of spark plug. Battery servicing. Replacing fuses bulbs Head lamps adjustment	Removal and replacing of electrical accessories. Removal and installation of starter motor generator and wiper motor.	Testing of motors, alternators, ignition coils regulators and distributors.	Electrical faults diagnosing and repairs.
Tyre Repair and wheel alignment	Inner tube and outer cover repair, correct tyre inflation, changing of wheels. Repair of tubeless tyres.	Wheel balancing. Wheel alignment using mechanical gauge.	Wheel alignment using optical gauge Electronic wheel balancing .	Repeat as from previous years
Maintenance	Changing of oils. Cleaning of filters, elements and engine compartments.	Lubrication. As per routine service manual (where applicable)	Flushing of cooling system and testing of radiator for leak.	Repeat as from previous years
Body Repairs including blacksmithing	Gas welding, soldering and brazing.	Arc Welding.	Repair of radiators and petrol tanks.	Minor body and chassis repairs including fixing of doors, locks and windscreen glasses.
Tool Store	Identification of general and special tools. Correct use of tools and equipment. Maintenance and storage of tools and equipment.			

APPENDIX H: Certificate of Completion of Apprenticeship

SWAZILAND

SIYINQABA

THE INDUSTRIAL AND VOCATIONAL TRAINING ACT 1982

CERTIFICATE
OF
COMPLETION OF APPRENTICESHIP

This is to certify that

.....

has completed an apprenticeship as a

.....

From ..... *To* .....

Under a Contract of Apprenticeship with

.....

Date at Mbabane this ..... *day of* .....

Reg. No. .....

.....
DIRECTOR OF INDUSTRIAL AND VOCATIONAL TRAINING

.....
CHAIRPERSON
INDUSTRIAL & VOCATIONAL TRAINING BOARD

WEBSTER PRINT ☎ 404-0048

APPENDIX I: City and Guilds Practical Competence Assessment form for Engine Systems 1

Unit 1 Engine Systems 1
Petrol/Diesel Engines and Fuel Systems Module (a)

Practical competences

The candidate must be able to do the following:

1.1a	Collect information identifying the engines used in motor vehicles.	☐
1.2a	Inspect vehicle systems and prepare a report identifying typical petrol/diesel engine components and their functions.	☐
1.3a	Collect information identify the operating principles of petrol/diesel engines.	☐
1.4a	Inspect vehicle systems and prepare a report identifying petrol/diesel fuel systems in standard forms and locations.	☐
1.5a	Prepare a report identifying the main petrol/diesel fuel system components and their functions.	☐
1.6a	Collect information identifying the operating principles of petrol/diesel fuel systems.	☐
1.7a	Carry out under supervision routine vehicle checks and basic schedule servicing as recommended by the vehicle manufacturer, using general and specific tools.	☐
1.8a	Use safety, mathematics and science in the above Practical Competences.	☐

This is to confirm that the candidate has successfully completed the above tasks:

Candidate signature _____

Candidate name (please print) _____

Instructor signature _____

Instructor name (please print) _____

Completion date _____

APPENDIX J: City and Guilds Practical Competence Assessment form for Chassis Systems 1

Unit 2 Chassis Systems 1
Braking, Steering and Suspension Systems Module (b)

Practical competences

The candidate must be able to do the following:

2.1b	Collect information identifying braking systems.	☐
2.2b	Inspect vehicle systems and prepare a report identifying the main components of braking systems and their functions.	
2.3b	Prepare a report identifying the operational principles of braking systems.	☐
2.4b	Prepare a report identifying the health hazards associated with braking systems.	☐
2.5b	Collect information identifying steering systems.	☐
2.6b	Inspect vehicle systems and prepare a report identifying the main components of steering systems and their functions.	☐
2.7b	Prepare a report identifying the operating principles of steering systems.	☐
2.8b	Collect information identifying suspension systems and wheels/tyres.	☐
2.9b	Inspect vehicle systems and prepare a report identifying the main components of suspension systems, wheels/tyres and their functions.	☐
2.10b	Prepare a report identifying the operational principles of suspension systems and wheels/tyres.	☐
2.11b	Carry out under supervision routine vehicle checks and basic schedule servicing as recommended by the vehicle manufacturer, using general and specific tools.	☐
2.12b	Use safety, mathematics and science in the above Practical Competences.	☐

This is to confirm that the candidate has successfully completed the above tasks:

Candidate signature _____

Candidate name (please print) _____

Instructor signature _____

Instructor name (please print) _____

Completion date _____

APPENDIX K: City and Guilds Practical Competence Assessment form for Engine Systems 2

Unit 21 Engine Systems 2
Petrol/Diesel Engines and Fuel Systems Module (a)

Practical competences

The candidate must be able to do the following:

21.1a	Carry out safe working practices using tools, equipment and consumable materials in the maintenance and testing of petrol/diesel engines and fuel systems.	☐
21.2a	Identify the operating principles, main constructional features and operation of main components for petrol/diesel engines and fuel systems.	☐
21.3a	Carry out routine maintenance and system adjustments on petrol/diesel engines and fuel systems.	☐
21.4a	Carry out a vehicle inspection identifying the effects of incorrect adjustments/faults on petrol/diesel engines and fuel systems.	☐
21.5a	Carry out systematic testing procedures using test equipment on petrol/diesel engines and fuel systems.	☐
21.6a	Use vehicle manufacturers' specifications in the maintenance and testing of petrol/diesel engines and fuel systems.	☐
21.7a	Use mathematics and science in the above Practical Competences.	☐

This is to confirm that the candidate has successfully completed the above tasks:

Candidate signature _____

Candidate name (please print) _____

Instructor signature _____

Instructor name (please print) _____

Completion date _____

APPENDIX L: City and Guilds Practical Competence Assessment form for Chassis Systems 2

Unit 22 Chassis Systems 2
Transmission Systems Module (b)

Practical competences

The candidate must be able to do the following:

22.1b Carry out safe working practices using tools, equipment and consumable materials in the maintenance and testing of vehicle clutch, gearbox, propeller/drive shafts and final drive/differential units. ☐

22.2b Identify the operating principles, main constructional features and operation of main components for vehicle clutch, gearbox, propeller/drive shafts and final drive/differential units. ☐

22.3b Carry out routine maintenance and running adjustments necessary on vehicle clutch, gearbox, propeller/drive shafts and final drive/differential units. ☐

22.4b Carry out vehicle inspections identifying the effects of incorrect adjustments/faults on vehicle clutch, gearbox, propeller/drive shafts and final drive/differential units. ☐

22.5b Carry out systematic testing procedures using test equipment for vehicle, clutch, gearbox, propeller/drive shafts and final drive/ differential units. ☐

22.6b Use vehicle manufacturers' specifications in the maintenance and testing of vehicle clutch, gearbox, propeller/drive shafts and final drive/ differential units. ☐

22.7b Use mathematics and science in the above Practical Competences. ☐

This is to confirm that the candidate has successfully completed the above tasks:

Candidate signature _____

Candidate name (please print) _____

Instructor signature _____

Instructor name (please print) _____

Completion date _____