Work-integrated learning in Civil Engineering: an activity theoretical study

by

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DECLARATION

I, Joseph Victor Bronkhorst, declare that the contents of this thesis represent my own unaided work, and that the thesis has not previously been submitted for academic examination towards any qualification. Furthermore, it represents my own opinions and not necessarily those of the Cape Peninsula University of Technology.

……. **……..**
Signed **Date**

ABSTRACT

The aim of this research is to present recommendations for knowledge and practice relations between Further Education and Training (FET) colleges and Civil Engineering (CE) workplaces, and to present a work-integrated learning (WIL) model that could assist with the preparation of CE students for the workplace.

Recently, FET colleges have been under the spotlight in terms of student preparedness for the CE workplace. Many questions have been posed by students studying at FET colleges and by CE workplace supervisors in respect of whether the current CE curriculum adequately prepares students for the workplace, or whether the curriculum has become obsolete in terms of knowledge and practice relations. The CE industry is of the opinion that students are insufficiently prepared in terms of skills and knowledge. In the light of this uncertainty, I researched the learning taking place at FET colleges and CE workplaces. I examined similarities and differences in the learning environment of the students.

The research provides a theoretical overview of Activity Theory (AT) and its principle of contradictions. The lens of AT and its contradictions provide a versatile tool to enquire into various aspects of WIL, taking into account individual and institutional perspectives, as well as changes over time. Activity Theory and its principle of contradictions provide insights into how transformation may occur within Activity Systems (ASs) in a CE context.

The study was conducted over a number of years with participants from three ASs, namely, the classroom, workshop/college yard and workplace. During the research, this study proposed a conceptual framework, rooted in AT, and substantiated by empirical evidence, for describing and analysing the learning taking place in the FET college sector and within the CE workplace environment. The analysis focuses on the perceptions of learning taking place in the ASs. Results reveal a knowledge and practice divide, mediated by AS elements of mediating artefacts, object, subject, division of labour, community and rules.

Through a particular focus on the contradictions of the elements of an AS which occur, the objective for this study was to determine 'knowledge and practice relations'. The components of knowledge and practice are extremely isolated, and by bringing the argument and the empirical findings together, the findings propose:

- Links between *knowledge*('*the classroom*') and practice('*the workplace'*)

The surfacing of the disconnect between knowledge and practice between the FET college sector and the CE workplace supports the idea of establishing links between these two sectors. This collaboration could be the turning point in better preparing students for the workplace.

- Policy formulation and implementation

The need for policy review to enhance the integration of knowledge and practice relations in the sector has become apparent. Colleges are expected to undergo a radical transformation and to make major contributions to policy. However, these institutions are new and fragile, and are based on historically weak predecessors. Much of the reform process is oblivious of the connections between college and workplace.

The research has established that both CE industries and FET colleges should ensure that they increase their involvement with and participation in the provision of adequately preparing students for the workplace in the Western Cape Province.

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LIST OF ACRONYMS/ABBREVIATIONS

AS	Activity System
AT	Activity Theory
CE	Civil Engineering
CEOs	Chief Executive Officers
CETA	Construction Education and Training Authority
D.O.L	Division of labour
DHET	Department of Higher Education and Training
DoE	Department of Education
ECSA	Engineering Council of South Africa
EL	Expansive Learning
FET	Further Education and Training
FG	Focus Group
GET	General Education and Training
HE	Higher Education
JN	Junior NATED student
NATED	National Technical Education
NCV	National Certificate Vocational
NQF	National Qualifications Framework
NSF	National Skills Fund
PDAs	Personal Digital Assistants
SAQA	South African Qualifications Authority
SETAs	Sector Education and Training Authorities
SN	Senior NATED student
WIL	Work-integrated Learning
WPS	Workplace supervisor

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF GRAPHS

CHAPTER ONE: INTRODUCTION, PROBLEM STATEMENT AND AIMS OF THE RESEARCH

1.1 INTRODUCTION TO THE STUDY

This study aims to make a contribution to the understanding of the current realities and challenges the FET college sector is facing. Specifically, my study examines the relationship between learning practices at different sites – college classroom, yard/workshop and workplace currently undergone by Further Education and Training (FET) college civil engineering (CE) students. The relationship between the three sites of learning is investigated in order to help answer the main research question: *"Does the FET college adequately prepare the CE student for the workplace?"* The study does not just focus on a curriculum analysis, but the curriculum is identified as one of the factors affecting the relationship between the three sites. Thus what is in fact analysed is the whole system at different sites, which includes the curriculum.

The demand for work-ready graduates, who are familiar with workplace practices, is increasing, and so the need for better prepared CE graduates is a growing concern for the FET college sector and the industry. Both the college and the workplace engage students in various educational activities; however, do these educational activities provide a meaningful experience within the workplace that is intentional, organised and recognised by the institution, in order to secure learning outcomes for the student that are both transferable and applied? (Stephenson & Weil, 1992).

With the establishment of FET colleges in 1994, knowledge and practice have become core strategic issues. However, many challenges exist in the process of the integration of learning and work in both environments. The challenges that do exist are, for example, the diverse focuses of the college and the workplace. The college's focus is mainly on knowledge in the classroom, rather than practical experience in the workshop/college yard, while the workplace focus is mostly on the practical component as a form of production for profit.

Harvey (1999) writes that the primary purpose of education and training is to transform students by enhancing their knowledge, skills and abilities. The interface that Harvey (1999) refers to is seen as the integration of knowledge and practice for the purpose of this study.

1.2 INTRODUCTION TO THIS CHAPTER

This chapter focuses on the South African context and, in particular, the way in which knowledge and practice have been planned and implemented, initially in the technical colleges and, more recently, in the FET college sector and the civil engineering workplace. It begins with a brief history of technical colleges in South Africa and the changes to FET colleges. The purpose of these institutions is described, along with recent changes in legislation. Attention is then given to the current learning model across the different sites, and the research problem and questions are foregrounded.

1.3 THE ESTABLISHMENT OF TECHNICAL COLLEGES IN SOUTH AFRICA: 1867 – 1994

This section describes the history of technical colleges and the developments which led to tensions between college and work, with special reference to the disparate domains of knowledge and practice.

South Africa's technical education can be traced to the early development of the South African economy – specifically to the discovery of diamonds in Kimberley between 1867 and 1875, and the later gold rush in the Witwatersrand and Mpumalanga (the then Eastern Transvaal), with the concomitant need for railways to transport the labour force into remote areas of the country. These developments created a demand for technical training in the fields of civil, mechanical, and electrical engineering. The first technical training classes for railway workers commenced in 1884 in Durban and similar classes started in Cape Town and Pretoria in 1902 (Abedian & Standish, 1992). These technical classes were based on mandatory practical training, whereas the theoretical

knowledge was acquired on an ad-hoc basis. Already there were indications of knowledge and practice disconnect.

When De Beers dominated the gold and diamond mines in the country, and made the attendance of training classes compulsory in 1896, a school of mines opened in Kimberley. During the early 1900s, interest in technical education continued to grow, and in 1902, the High Commissioner for the Transvaal and the Orange River Colony convened a conference for the heads of the various colonies. A resolution was passed that technical schools should be established in conjunction with higher education institutions (Pittendrigh, 1988; Sooklal, 2004). The Transvaal School of Mines was established in 1904 and all the students in Kimberley were transferred to this school.

Between 1906 and 1916, a number of new technical colleges emerged. These included the Pretoria Polytechnic and the Durban Institute, which opened in 1906 and 1907 respectively, and the SA Cape College in Cape Town. By 1994, there were 152 technical colleges in the country.

With the promulgation of the *Apprenticeship Act of 1922*, state regulation of the apprenticeship system was introduced. The Act introduced a second component into the apprenticeship curriculum, namely mandatory knowledge classes in technical education to be undertaken at a technical college. The theoretical component is referred to as the National Technical Education (NATED) programmes N1 – N6. This only formed one part of the apprenticeship programme. Besides the theoretical component, the apprentice students completed all practical training at their places of employment (McGrath, 2004). The apprenticeship contract between student and employer regulated this phase of the apprenticeship system. However the employer relationship became more distant, owing to the compulsory attendance of classes for students at technical colleges.

Prior to 1994 there was a shared responsibility between the college and the workplace, for example, even though students were contracted by the employer as apprentices, it was compulsory for the employer to send the student to college

for three months of the year to engage with theoretical knowledge, while the employer was responsible for practice in the workplace. Two programmes were offered in technical fields, the National Technical Education (NATED) programme, which was ‘knowledge based’, and the apprenticeship programme that was ‘practically based’. On the basis of undergoing knowledge and practice training, students became qualified civil engineering artisans.

After the election of the current government in 1994, the focus shifted from technical education to higher education and training; this brought about a decline in the number of apprentices trained. With the decline in the number of apprenticeships, the institutional level of apprenticeship training was transformed from one where apprentices were sponsored by industry, had the status of employees and were trained by means of day- or block-release, to one where most students studied full-time, with no employer sponsorship, and therefore little or no opportunity was available for practical, on-the-job training (Gamble, 2003). In other words, colleges service two kinds of students: the students who are connected to a company who attend three months per year at the college and another group of students who attend a full year without being connected to a company. This effected the change in the way knowledge and practice were offered and the way in which students were prepared by the college for the workplace.

1.4 FROM TECHNICAL COLLEGES TO FET COLLEGES (1994)

New legislation

During the existence of technical colleges, many challenges regarding the training programmes, as well as the training of students, were experienced by the colleges and the workplace. The challenges which technical colleges experienced were also experienced by the FET colleges and workplaces, even though the focus had now shifted from technical education to higher education and training.There was also a decline in the number of apprentices trained. Change was required, through new legislation, and with the assistance and cooperation of various state departments.

The Department of Education and Training and the Department of Labour played a significant role in changing the nature and direction of education and training in South Africa. One of the main aims was to close the gap between the knowledge and practice divide in the FET college sector. The *White Paper on Education and Training* (RSA, 1995), the two Further Education and Training Acts (DoE,1998; RSA, 2006), and the *Skills Development Act* (DoL, 1998), envisaged that significant legislation would shape the character of future education and training provision in South Africa. However, as Tsolo (2001:83) writes, “the FET colleges immediately felt the impact of this legislation in areas of organisation, management and governance”. With all these policies in place, the DHET hoped for better integration of knowledge and practice.

The central aim of the Further Education and Training Acts of 1998 and 2006 was to create a single, coordinated system of education and training. Not only did the FET Act of 1998 see the clustering of 152 technical colleges to form 50 mega FET colleges, but a distinction was made between the professional management of FET colleges and their governance, thereby offering a sound framework for the functioning of the colleges. The Acts stipulate that certain governance functions be performed by an FET college council, while the guidelines provide for the professional management of an education and training institution, and include functions that the head of a college is required to perform. In other words, more flexibility was given to the colleges to try to establish links with industry for the enhancement of knowledge and practice relations.

FET colleges are learning sites, and the types of learning that are to take place within this environment are described as, “knowledge, skills and values that are transferable to different work and learning contexts” in the *Education White Paper 4* of the Department of Education (RSA, 1998a:21). This White Paper also states that the Ministries of Education and Labour have taken it upon themselves to provide education and training pathways for young people and adult workers, and to develop more effective linkages between training and work. The introduction of learnership programmes into FET colleges is an important development in this regard. The programme funding is made available to these institutions through

the Sector Education and Training Authorities (SETAs) and the National Skills Fund (NSF).

According to Moran and Rumble (2004), Government views the FET colleges as ideal platforms through which the national skills development priorities can be achieved. These authors argue that a 'transformed' Further Education and Training college could be considered an important investment for the future. A number of policy reforms have been introduced in order to streamline this sector. Both the Department of Education and the Department of Labour have managed to put policies such as the Further Education and Training Acts (DoE, 1998; RSA, 2006) and the *Skills Development Act* (DoL, 1998), in place. Powell and Hall (2002), in their review of the South African technical colleges, support these policies where issues of specific reforms are spelled out.

Since the demise of the apartheid regime, the Government has tried to implement a strategy on the vital role skills can play in building a better future for all South Africans. In addition to this, serious consideration has been given to the development of skills programmes for economic and social growth. Unfortunately the programmes introduced at FET colleges were more theoretical than practical. In other words, the college focus was on teaching students to pass the examinations in theoretical knowledge, as this is what they were assessed on. Later, the evolution of attitudes towards the skills required by the labour market and the exigencies of the economy resulted in a seriously dysfunctional skills development system. This resulted in the *Skills Development Actof 1998*. This was thought to be a solution, but then became problematic in the way knowledge and practice were dealt with.

With the introduction of the *Skills Development Act of 1998*, workplace education and training were also affected negatively because of unclear guidelines with regard to knowledge and practice relations. The subsequent confusion arose because of the vague policy guidelines for students undergoing mandatory workplace practice. In other words, the policy does not state that students must undergo practical training in the workplace and that the workplace should conform to specific norms and standards. Colleges acknowledged that if students

were given proper access to workplace training, this would lead to a skilled and experienced workforce.

The purpose of FET colleges

The FET college sector constitutes a large, diverse and critically important part of the education and training system, costing the country over R10 billion annually. The Department of Education (DoE, 1998) highlights the fact that the purpose and mission of the FET strategies is to respond to the human resources needs of South Africa for personal, social, civic and economic development. A transformed, high-quality, responsive FET system is seen as a vitally important investment in the future of South Africa and its people. In essence, the purpose of the FET policy is to take a strategic view of how education and training can rapidly change the technological, social and economic environment. These policies should be met through the provision of appropriate skills and knowledge in a range of activities.

The re-entry of South Africa into the competitive international market has created an imperative for FET colleges to develop a skilled, innovative and technologically competent labour force, taking cognisance of the collapse of the youth labour market in South Africa (RSA, 1999). The Department of Education (RSA, 1998a) acknowledged that globalisation might have negative consequences for vulnerable and marginalised groups and communities. This meant that companies in South Africa would have the financial backing of Government through the Sector Education and Training Authority (SETA), but the people at grassroots most likely would not have the skills (owing to a lack of practical training) to grow the economy as anticipated by Government. These skills could be developed through a skills strategy and the assistance of FET colleges in South Africa.

The *Green Paper* (RSA, 1998b) argues that the challenge for the FET strategies is to respond to the demands of global economic competition, as well as to the local challenge of meeting basic needs. It sees local needs and priorities shaping

interaction with the global economy through the implementation of equitable, relevant and effective policies related to the development of resources.

The Department of Education provided initial clarification regarding FET in its *Green Paper on Further Education and Training* (RSA, 1998b). It describes FET as a specific band, located between General Education and Training (GET) and Higher Education (HE), both of which draw a wide diversity of groups of learners and stakeholders into one qualifications framework. These groups include pre-employed, employed and unemployed youth and adults. FET is not compulsory education and, by definition, it has no age limit. Its goal is to promote lifelong learning and on-the-job education. Thus, the Education Ministry's commitment is given to the development and expansion of high-quality, innovative, flexible FET colleges, based on the principles of open learning and responsiveness to the needs and demands of all post-15-year-old learners (RSA, 1998b).

Nkosi et al. (2000) point out that most students enter FET from the GET band on their way to higher education or work. In future it is anticipated that increasing numbers will retrace their steps, turning from employment or unemployment to the FET system to provide either retraining, 'second chance' learning opportunities, personal development or leisure courses. Furthermore it is anticipated that higher education graduates will turn to FET as a means of changing career direction, acquiring career-orientated training or meeting a range of community and personal needs (RSA, 1998b).

For years, many learners at school who could not keep up academically were directed towards the vocational colleges, which were widely regarded by parents and communities as a second option to academic studies at universities. This began to change in the 1990s, when the Government, together with the Department of Education, took several steps to overhaul career and technical education. This allowed FET colleges to establish stronger ties with industry. The stronger ties which were established assisted in the recruitment of more skilled lecturers and instructors with expertise in specific fields. They also allowed students to find employment during their studies and after they had graduated.

Through this process students also became more focused on their particular career choices.

1.5 THE CONTEXT OF THE CIVIL ENGINEERING COURSE AT FET COLLEGES AND CHALLENGES FACED

The National Department of Higher Education and Training (DHET), FET colleges and the CE industries' involvement within the CE programme operate in environments which should involve the integration of knowledge and practice. The context in which these operate is therefore described.

FET colleges present the CE curriculum to students and the CE industries engage the students in workplace training while simultaneously progressing towards enhanced work-integrated learning. The programmes offered are apprenticeships, learnerships, National Certificate Vocational programmes (NCVs), and the National Technical Certificate (N1 – N6) programmes.

An apprenticeship is a non-unit-standard-based registered qualification which is governed by sections 13 – 29 of the *Manpower Training Act* (56 of 1981) and falls within NQF level 4. It comprises the integration of workplace and institutional learning and culminates in a national qualification. Students who are registered for the apprenticeship programme sign a contract with the company with which they are employed. This contract could be anything from two to four years. Apprentices are sent by their employer to an FET college for one trimester (equivalent to three months) per annum. During their time at the college they are taught various knowledge components of the trade and this allows them to complete the N1 – N2 course. The apprenticeship aims to provide a firm foundation for those wishing to pursue a career in CE, in trades such as carpentry, plumbing, bricklaying and painting. The intention is to allow students to build on their natural aptitudes and interests in an organisation of their choice, and gain valuable experience in the organisation while learning related vocational subjects, such as trade knowledge, mathematics, building science and building drawing, which are taught to them at the college. The division of tasks is visible in

the two components that are offered separately, which causes a problem for knowledge and practice integration.

A learnership is a vocational education and training programme which falls in the NQF Levels 2, 3 and 4. It combines knowledge and practice, culminating in a qualification that is registered with SAQA under the *Skills Development Act* (DoL, 1998). The CE learnership programme was introduced to provide students with a sound understanding of skills associated with CE techniques, as well as entrepreneurial industry skills, with the opportunity to make the transition from college to work. Through this experience, students should be able to make a more informed career choice, as well as gaining the opportunity to develop into mature and responsible young adults. This programme should work well if implemented correctly for the integration of knowledge with practice.

The National Certificate course is a knowledge course which is linked to NQF levels 4 and 5. The course was introduced at technical colleges (now known as FET colleges) from N1 – N6 (the 'N' indicating that it is a National Technical qualification). These courses are linked to the apprenticeship programme. In this programme it is assumed that students are equipped with relevant theoretical skills for the workplace. The course intends to prepare students for a career in engineering, with options of vocations such as engineering technicians, industrial engineers, project engineers, maintenance engineers, mining-related careers, certified engineers and artisans.

The National Certificate Vocational (NCV) programme is registered under the *FET Act 11 of 2006*. The course is a new and modern qualification at NQF levels 2, 3 and 4. It gives Grade 9 learners a vocational alternative to an academic Grade 10 – 12 by offering industry-focused training. The main aim of the NCV programme has been to ensure that FET colleges meet the growing need for vocational and technical training in the country. It has provided students with an opportunity to experience work situations during their period of study.

Of the four civil engineering programmes offered at FET colleges, it is only the 'N' programme, in, for example, the various theoretical subjects, that does not cater

for practical training at college sites. The other courses, such as the NCV, learnerships and apprenticeships, have a practical component built into the curriculum. However, many FET colleges do not expose their students to the practical component of those CE courses. No work experience is a problem, and Gamble (2003) suggests that workplace training offers more opportunities to students. This is because the student can be developed in work-related knowledge and skills, including knowledge in and about the workplace that is not usually written down or spoken about. She also contends that students should be provided with positive opportunities that will expose them to the contemporary problems in a hands-on way, as they will be working with new machines and equipment.

Students are trained in one of the CE programmes which include the 'N' subjects, learnership or NCV at FET college sites to carry out various activities, such as interpreting civil engineers' plans and the construction of all types of buildings, houses, industrial plants, bridges, roads and railways, waterways and water reservoirs.

However, despite the CE programmes offered at FET colleges as described above, the FET college sector is characterised by various challenges, such as the integration of theoretical knowledge and practical skills, varying from levels of provision of resources, vague policy, quality of offerings and limited opportunities for collaboration with the labour market (Gewer, 2002), as well as the fact that the public attitude tends to favour 'academic' rather than 'vocational' education (RSA, 1998b).

The main challenge is, as Gamble (2003) suggests, that this is not just a question of classroom training or practical training on their own, but of bringing the two together so that students can reflect on both practice and knowledge in order to solve problems. This is what is meant by 'competence' or more correctly 'applied competence' (SAQA, 1995).

1.6 A MODEL FOR LEARNING ACROSS DIFFERENT SITES IN THE FET SECTOR

Work-integrated learning (WIL) comes in many shapes and sizes. It has always formed a significant component of educational processes, particularly in the FET college sector. The reason for this is that there have always been components of knowledge and practice which are integrated in the civil engineering course. There have been many different opinions on whether the FET colleges or the workplace should be responsible for WIL, and where WIL experiences should take place. Dillenbourg and Betrancourt (2006) contend that the WIL experience can be off- or on- campus, real or simulated, depending on the discipline, but should involve clearly stated outcomes and assessment which are consistent with quality teaching and learning.

For the purpose of this study, WIL is understood to refer to civil engineering educational activities that integrate knowledge learning with practical application, both in the college and in the workplace. These civil engineering educational activities provide a meaningful experience for students in the workplace, and are organised by the FET colleges and recognised by industry. When these activities take place, they ensure learning. FET college students that are involved in WIL should encounter learning experiences that expose them to a culture of theoretical knowledge and workplace practice.

In the FET colleges and CE workplace sectors there are three levels of WIL: the knowledge WIL 1, the practice WIL 2, and the CE workplace WIL 3. The civil engineering knowledge aspects such as learning about construction drawings and the specifications of concrete columns are taught to the students by the lecturers. In WIL 1, the weighting of theoretical knowledge is large, and the practical end product, such as the concrete column, is only imagined. Winberg et al. (2011) therefore suggest that a curriculum should reflect the integration of work knowledge and skills, and include more knowledge at all levels.

On the other hand, WIL 2 is an extension of the knowledge leading to practice, for example, the students are taught all aspects of constructing a concrete

column in the workshop or in the yard of the college. They are monitored, guided and assessed by the senior students and lecturers. The simulated practice and construction of small models in WIL 2 outweigh the knowledge acquired in WIL 1. In this case, the knowledge becomes progressively internalised and is used as the basis for constructing simulated models of concrete columns.

In WIL 3, practice is done at a real civil engineering workplace. The workplace supervisor takes over the responsibility of the college lecturer. He or she ensures that the knowledge and practice that was taught by the college is embedded through the practical component. Although the focus is solely on the workplace in WIL 3, it is still educational.

An example of how the theoretical knowledge and practice in the FET colleges and the CE workplace operate.

Figure 1.1 is a typical example of what students learn in the knowledge classroom at the college. This is a worksheet of knowledge pertaining to formwork for concrete columns. It contains knowledge notes as well as drawings of a concrete column. Students are expected to draw and learn the knowledge and the methods of constructing concrete columns. After the learning has taken place, they are assessed on the knowledge aspect, for example, by having to complete a sketch of the formwork for a concrete column. The focus is not on the concrete column itself, but rather on the formwork into which the column will be constructed.

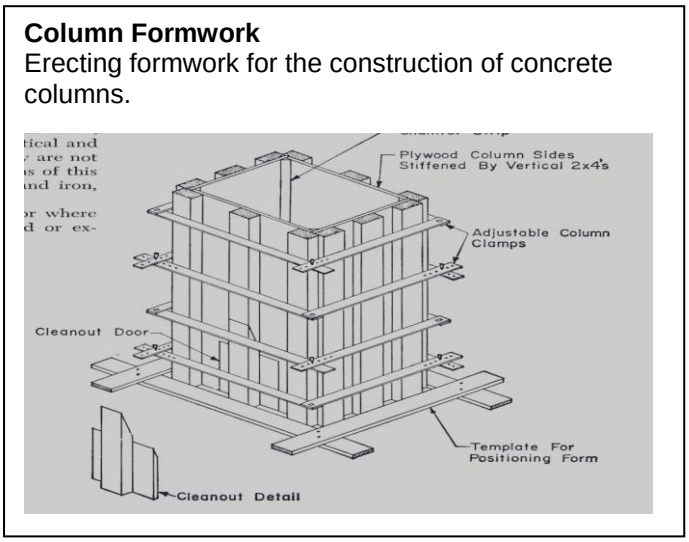


Figure 1.1: The knowledge notes for constructing a concrete column

Figure 1.2 illustrates how the students apply the theoretical knowledge in a practical task. According to the specifications, they must construct the formwork for a concrete square column and make a simulated model. As can be seen, the student is constructing this column at the college in the workshop. Although the students are exposed to the practical skill, it is, however, done on a smaller scale compared with the same exercise in the workplace. They are exposed to simulations, rather than to the actual tasks. The exercise is for the student to link knowledge with practice.

Figure 1.2: A student constructing a simulated concrete column in the workshop

Figure 1.3 is a picture of concrete columns that were constructed by students under the supervision of the workplace supervisor. The real completion of such a

task brought together the knowledge and simulated models done by the students at the college. This is where they are exposed to real work situations. More practical learning takes place on site. On completion of the task, the lecturer visits the site and assesses the students' work. If the students are found to be competent, the task will then be signed off as completed in the students' logbooks.

Figure 1.3: Newly constructed concrete column constructed on site

As can be seen from the above WIL activities, WIL lends itself to many opportunities to develop educational tasks to support the process of student learning, as well as students' understanding of the demands of employers when they enter the workplace. Students come to realise the necessity of being properly skilled in order to be competitive individuals in the workplace.

The theoretical knowledge in the classroom (WIL 1), simulated practice in the workshop or the yard of the college (WIL 2), and workplace practice on site (WIL 3) integrate with one another. As well as integrating, these three WIL experiences also depend on one another. All activities move across boundaries between the activities in WIL 1, WIL 2, and WIL 3.

At the workplace, students are expected to exercise their professional, ethical and technical skill judgement to the best of their ability. Although some organisations will not be able to offer an extended work experience or an

adequate work space in which to carry out the student project, such organisations may still offer valuable opportunities. In such cases it is important that the student honestly assesses his or her ability to work independently without constant supervision.

In the Apprenticeship programme, students spend three months at the college in the classroom and workshop, doing WIL 1 and WIL 2. The rest of the year they spend at work under supervision of the workplace supervisor, doing WIL 3. The cycle continues until they graduate after four years.

The integration of the three WILs allows the students to experience an easier transition from college to workplace. These two worlds, the college and the workplace, are linked by a relationship formed through interaction between the college lecturers, students, and workplace supervisors. The pictures in Figures 1.1, 1.2, and 1.3 give an indication of what students do and how WIL 1, WIL 2, and WIL 3 operate in the FET college sector and the workplace.

The college should therefore ensure that students are required to focus on the integration of theoretical knowledge with practice that allows them to connect college or disciplinary learning with workplace application by recognising that workplace practice, together with theoretical knowledge, can be used as a catalyst for integrative learning. Interpretation of and reflection on the experience of professional practice and application of knowledge in context should be at the heart of learning experiences for students in WIL (Sanders, 2005).

1.7 RESEARCH PROBLEM AND QUESTIONS

There are considerable variations in the way that knowledge and practice and the relationship between them are understood in the field of civil engineering. Traditionally, the idea has been that practical skills are supported by knowledge, but current debates by the students, lecturers and workplace supervisors are centred around the knowledge and practice divide in the CE programmes at FET colleges.

According to various researchers (Fisher et al., 2003; Hawthorne, 2004; McGrath, 2004), the vocational needs of the civil engineering industry have neither been met, nor have FET colleges been able to meet their clients' needs or have they responded effectively to the civil engineering delivery requirements. In this section I shall focus on the theoretical perspective of the relationship between knowledge and practice at FET colleges and the workplace.

According to Hull et al. (2000), the role of vocational education in the new system is clearly not job training as provided in the past (that is, simply skills around the workings of a particular machine or procedure), but vocational education should now attempt the integration of knowledge and practice between the college and the workplace. Hull et al. (2000) also posit that this education in the new system cannot be accomplished by lecturers working in isolation from the workplace, but will require that lecturers with particular interests in the field be grouped together with workplace supervisors who are teamed to create and deliver the curriculum.

Barnett (2006) suggests that an academic curriculum differs from a vocational curriculum because an academic curriculum faces only one way, as its purpose is to induct students into a disciplinary field of knowledge. In contrast, in a vocational curriculum, the purpose is to induct students into a field of practice, with the theoretical knowledge that underpins practice as the basis for integration of the two components. If there is no integration, then there is a disjuncture.

According to Martinez and Badeaux (1994), FET colleges need rigorous work-integrated learning (WIL) programmes that integrate knowledge and practice to meet the future needs of a young population by addressing workplace realities and the changing world of technology. One of the great challenges of curriculum planning for FET colleges has traditionally been the integration of academic competencies into vocational education curricula. For these reasons, they also face challenges to constantly examine course content, strategies and implementation, as well as to update course curricula, and explore new areas to include in the overall CE curriculum.

Young (2004:16) argues while all jobs require specific knowledge, “many jobs also require knowledge involving theoretical ideas shared by a community of specialists” located within disciplines. He also believes that workers need to be able to use theoretical knowledge in different ways, and in different contexts, as their work grows in complexity and difficulty. Apart from knowledge, there are also qualifications that should provide students with the disciplinary requirements to study at higher levels within their field, in addition to immediate occupational outcomes. Young therefore suggests that an engineering curriculum needs to provide students with access to both types of knowledge, the theoretical knowledge that underpins practice within a specific field. But an exclusive focus on learning in the workplace only also denies students access to disciplinary systems of meaning. He has a strong sense of knowledge and practice relations between the institutions of learning and the workplace.

On the other hand, Gamble (2003) describes how many college graduates in South Africa complete their programmes of study without having had access to practical on-the-job training which is deemed vital for occupational preparation (Kraak & Hall, 1999). Her views are that procedures and facts are not good enough; a strong practical component at the workplace should support these facts and procedures. For this very reason work-based learning has therefore become not only a desirable but an essential core element of FET college provision. Work-based learning in some of the CE programmes offered at these colleges is absent, hence the reason for my argument for closer links between knowledge and practice. For Gamble, this is also a process of integration that would give students the opportunity to function much better and be more productive in the workplace.

As has been indicated in the history and purpose of FET colleges, the main intent of vocational education is the preparation of students for work. However, as various theorists have indicated, there are possible tensions between teaching and learning practices in the college environment and related practices at work, and such integration is necessary for successful vocational education. This is a challenge for the FET sector and has led to my research question:

"Does the FET College adequately prepare the CE student for the workplace?"
This question is followed by three sub-questions.

1) What is the relationship between knowledge and practice with particular reference to CE at FET colleges and the workplace?
2) How can Activity Theory address the learning community at the various FET sites?
3) What are the current practices of learning in the college and at work, and what are the emerging differences within and across the three sites with particular reference to knowledge and practice?

In order to address these questions, I need to deal with the relationship between knowledge and practice at the different sites of learning.

As I shall be comparing different sites (colleges and workplaces), I shall use Activity Theory (AT) which will allow me to compare different systems. This is more fully discussed in Chapters 2 and 3.

1.8 LIMITATIONS OF THE STUDY

As this study was limited to four FET colleges in the Western Cape, the results cannot be generalised. The research study foregrounds description of the practices, challenges and outcomes, providing tentative conclusions which could serve as hypotheses for future studies. Owing to time constraints and safety aspects, only eight civil engineering sites were visited; seven workplace supervisors allowed me to interview them and completed a questionnaire.

1.9 STRUCTURE OF THE THESIS

The thesis is divided into eight chapters. Chapter 2 provides a literature review of current practices between the FET college sector and the CE workplace, and how these influence the functioning of FET college students on site. Consideration is given to the elements in which WIL operates in the context of

the CE course. The chapter also speaks to the theoretical framework for WIL and begins with an adoption of Vygotsky's AT triangle (Vygotsky, 1978). The AT model provides a powerful tool/framework for illustrating how the use of various tools across different contexts impacts on students and lecturers from FET colleges, as well as on workplace supervisors.

Chapter 3 specifies the methodological strategy and design, the sample, the method used to collect data, the data analysis and the interpretation of the findings. The following three chapters cover the presentation, analysis and interpretation of the findings of the civil engineering students' learning in the classroom at the FET colleges (Chapter 4), learning in the workshop/college yard at the FET colleges (Chapter 5) and learning at the workplace on site (Chapter 6). Chapter 7 deals with the analysis of the findings from the collected data within the context of the theoretical framework and literature overview, while Chapter 8 presents conclusions to the study and makes recommendations based on these.

CHAPTER TWO: LITERATURE REVIEW AND THEORETICAL FRAMEWORK FOR UNDERSTANDING LEARNING AT DIFFERENT SITES

2.1 INTRODUCTION

This chapter incorporates the literature review with the theoretical framework. It describes the knowledge and practice in the context of civil engineering (CE) courses at Further Education and Training (FET) colleges and in the workplace. It outlines how Activity Theory (AT) addresses the learning community at the various sites and what the current practices at colleges and workplaces are. It further examines the emerging differences within the three sites, with particular reference to knowledge and practice, and the transfer of learning in the sector. Activity Theory, the work of Vygotsky and Engeström, and how others have used the theory, are adumbrated. In summation, I also propose my vision of AT as an analytical framework.

For the purpose of this study, 'work-integrated learning' (WIL) is regarded as the integration of knowledge and practice in college and the workplace. Huber (2005) note that WIL is learning that results from an integration of workplace experience, knowledge and practice. The phrase 'work-integrated learning' is also used to describe curricula designed to bring about this kind of integrative learning in different environments. Stephenson and Weil (1992) contend that WIL is the term used to describe educational activities that integrate theoretical learning with its application in the workplace. My WIL research experience is based upon Stephenson and Weil (1992) where I refer to it as educational activities which integrate knowledge and practice.

Dillenbourg and Betrancourt (2006) refer to WIL as a term used to describe educational activities that integrate theoretical learning with its application in a workplace, profession, career or future employment. The concept of WIL can be applied to a broad range of programmes and can be recognised through student assessment in these programmes. The WIL experience can be off- or on-campus, real or simulated, depending on the discipline, but should involve clearly

stated outcomes and assessment, and be consistent with quality teaching and learning.

However, in the FET college sector, WIL has a long history dating to 1903 when it was first introduced at Sunderland Technical College for architectural and engineering students (Franks & Blomqvist, 2004). To date there has been little research on WIL in the FET college sector but considerable WIL research has been done in higher education and in non-formal education. From the research there are clear lessons for the FET colleges and the CE workplace. The knowledge and practice divide is prevalent both in the college and workplace, which makes it difficult for students to be successful in both environments. If a workable WIL model is applied in both these settings, there could be benefits for the students, colleges, and workplaces.

There have been repeated calls for FET colleges to be more responsive, accountable, relevant and accessible (Kraak & Hall, 1999). This could imply a possible disjuncture between policy objectives and the ability of FET colleges to deliver on their mandate. According the *Skills Development Act* (DoL, 1998), the mandate of the colleges is to prepare students for the workplace. Discussion documents and debates on a human resource development strategy, along with the *South African Qualifications Authority Act* (SAQA, 1995) and the *Skills Development Act* (DoL, 1998), offer opportunities to allow FET colleges to focus on the integration of knowledge and practice in the FET college sector. Whether this is happening in the sector remains to be seen.

On the other hand, Case and Light (2011) have argued that there is a very close link between engineering education and higher education, where external influences, particularly from professional bodies and industrial concerns, play a significant role in determining what is valued. The same cannot be said from an FET perspective. My argument is therefore mainly focused on the relationship between knowledge and practice with the FET sector. In other words, are FET colleges preparing CE students for the workplace? I shall focus on the various ASs at each site. The curriculum is just one focus within each system. However Case and Light (2011) contend that some external influences provide on-going

fuel to the curriculum debate in engineering education, largely focusing on a concern about what graduates can actually ‘do’ when they enter the workplace. The debate has been endemic in the circle of FET contemporaries.

According to ECSA (2012) there is currently a misconception that college education in engineering subjects is an alternative to university or university of technology engineering programmes. Further Education and Training colleges are involved in artisan education and engineering-support occupations. ECSA (2012) believe that FET colleges should ensure that the engineering curriculum remains relevant and responsive to the demands of professional practice and the needs of business in a changing world, and flexible enough to cater successfully for a diverse student intake. In addition, the salient point is the relationship between knowledge and practice, which is part of this flexibility.

Gamble (2003) argues that FET colleges in South Africa are often admonished to be more responsive to the needs of industry and commerce, as well as to the needs of local communities. This is indeed their curriculum task, but they cannot fulfil this task if they are not responsive on their own terms, as educational institutions that serve the public well. FET colleges owe it to themselves to build a strong and independent educational identity that shows that the shift from technical colleges to FET colleges is indeed more than a name change. The success of engineering in the future of South Africa is the mandate of government, industry and professionals.

2.2 WORK-INTEGRATED LEARNING ACTIVITIES IN THE FET SECTOR

At FET colleges, students gain the theoretical knowledge of setting out a building, but when they proceed to the workplace, the knowledge is integrated with practice, which in many cases is the ‘real work’ which the students must deal with. In the FET college sector, WIL is described as a means of preparing civil engineering students to work in a field of practice. One of the reasons why WIL is perceived as ineffective in the FET college and workplace environment could be the lack of knowledge and practice integration; on the other hand, possibly WIL is not actually executed.

2.2.1 Current WIL model in the college and workplace

Figure 2.1 is related to WIL in CE to demonstrate that the student's learning environment is combined with his or her past and current knowledge, and plays a crucial role in meaning making, since the student integrates the knowledge with the practice. Students move across the three WILs over time to attain certain goals and ultimately qualify as CE artisans or technicians. The three WIL layers describe what learning takes place in each of these layers, namely, WIL 1, WIL 2, and WIL 3. Each of these layers also represents an activity system as described in my theoretical framework.

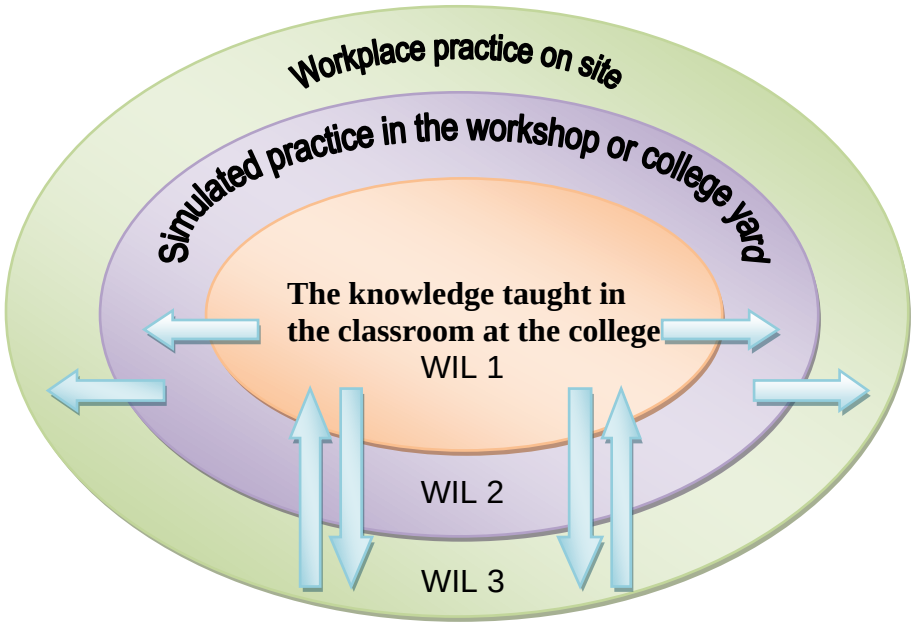


Figure 2.1: The integration of the three WILs

Figure 2.1 will be used to further unpack and illustrate how the three WILs operate separately but work together for the students to qualify as CE artisans or technicians. In the FET college, there are two levels of WIL: WIL 1 refers to the civil engineering knowledge aspects, such as construction drawings and specifications of concrete columns that are taught to students by lecturers. This is only classroom text and various descriptions of making concrete columns. This is not only knowledge; WIL is taking place because it actually focuses on instructions, principles and steps for constructing the column. WIL 1 is about

learning work-related subjects in the classroom, and the student being an active or passive participant in the teaching-learning process.

Barnett (2006) describes how the content of vocational subjects should be drawn from the current workplace practice. If it is not done in this way, the content may become out of date or obsolete. WIL in CE is derived from a selection of relevant content knowledge, and should be based on an understanding of the workplace. If there is no workplace involvement, or not much understanding, then the curriculum will not allow for knowledge gained in the classroom to be transferred in appropriate ways to other WIL sites.

The traditional subjects within the CE course have various elements of mathematics and physical science. For example, some of the elements, such as strength of materials, stress and strain from the physics, and areas and volumes from the mathematics, are used to determine the strength of the volume of a concrete slab which is constructed in the workplace. Since the inception of vocational subjects such as bricklaying, concrete works, and carpentry, these subjects have been considered pertinent to the workplace, and are still in operation. The college curriculum is designed using ideas from work, and where these *may* be the wrong ones, then there is a *possibility* of their being outdated. According to the Barnett (2006) model, if a curriculum is out of date, it could make the knowledge irrelevant or obsolete.

WIL 2 draws on the learning experience of the student in WIL 1 because this comprises the college unit. If WIL 1 is not properly executed in the classroom, students come with little or no experience to the workshop or college yard, which makes practical teaching and learning extremely difficult for the lecturer and student in WIL 2. The knowledge experience from the classroom is paramount for the students, for they can draw on it when they are confronted with construction problems. This links with Dewey's (1963) contention in 1938 that 'learning by doing' is more effective. Knowledge is assessed by performance, for example, if the student is required to build a simulated formwork for a concrete column, on completion the lecturer will know that the student has an understanding of the force of concrete, proper securing methods and the reinforcement of steel.

In WIL 3, fully operationalised practice is done at a proper civil engineering workplace. The workplace supervisor takes over the responsibility of the college lecturers. He or she ensures that the knowledge and practice taught by the college is enforced through the practical component. According to Stevens and Richards (1992), experiential education is the process of actively engaging students in an experience that will have real consequences; therefore they believe that students need to make discoveries and experiment with knowledge themselves, instead of hearing or reading about the experiences of others. The students also reflect on their experiences, thus developing new skills and attitudes, and new theories and ways of thinking. For example, the student sees a picture of a concrete column and then imagines what the construction will look like. Developing workplace skills in a workplace context will need to take into account the diverse cultural and social norms which are specific to the student body of each site. Work-integrated learning therefore needs to acknowledge the particular requirements of the wider cultural setting of workplaces in addition to the cultural settings of each institution of learning (Sanders, 2005). It is important to bear in mind that some students may have been more exposed to real learning situations than others.

WIL 3 allows students to produce knowledge and skills based on their classroom and workshop/yard experiences. This makes them develop new outlooks, rethink what was perhaps once misunderstood in classrooms or in the workshop, and evaluate what is important, ultimately altering their perceptions of the workplace. Workplace supervisors at workplace sites should challenge students by making them effective critical thinkers. They should not merely be workplace supervisors, but also mentors, and coaches (Talbot, 2005).

Learning in WIL 3 is seen as an active, rather than a passive process, which reflects on the construction of new ideas and concepts grounded in current and past experience and knowledge in a social and cultural context. Employees who have the opportunity to use their skills within their work role have also been shown to have more job satisfaction (Morrison et al., 2005), which ultimately increases the business performance of the organisation.

What business ultimately wants to see is engagement between the FET college and employers, assisting in developing professional/workplace skills and networks, developing and reinforcing the relevance of academic study to life goals, providing experiential contexts for the development and application of conceptual knowledge, and thereby reinforcing learning. This would enable the creation of new knowledge through the application of existing knowledge to new problems, enhance the reciprocal flow of knowledge and its application between the FET college and the workplace or within community settings in which students experience practice, and improve professional/workplace opportunities for students.

Since the beginning of 1997, scholars have proposed a number of WIL models which could be utilised in various higher educational institutions. None of these models refers to FET colleges. However, the two models receiving the most attention are briefly described below. Both could have an influence on the way that WIL 3 could operate.

In proposing his model (see Figure 2.2), Franz (2000) recognises the need for WIL curricula to be developed and implemented in context; that is, within a cultural context that acknowledges all the stakeholders and newly emerging philosophical, educational, social and economic needs.

He further states in response to an increasingly complex world, that practice is becoming more diverse. Students working in a multidisciplinary practice have a better opportunity than in the university environment "...[to] go beyond the isolated facts, the student can explore more in the workplace than in college because it is [such a] 'hands on' approach [to] make connections across the disciplines" (Franz, 2000:67). For example, at the workplace there are many other artisans such as plumbers, carpenters, painters, and electricians with whom that connection can be made to help shape a more coherent view of knowledge and a more integrated, more authentic view of life. There are more people available on the spot to assist one and give advice on current work practices.

In all, the work environment provides for active, creative, collaborative learning, supported by practitioners and academics in mutually inclusive and complementary educator/researcher roles. The reason for describing this model is that it focuses on the workplace, which I have described in WIL 3.

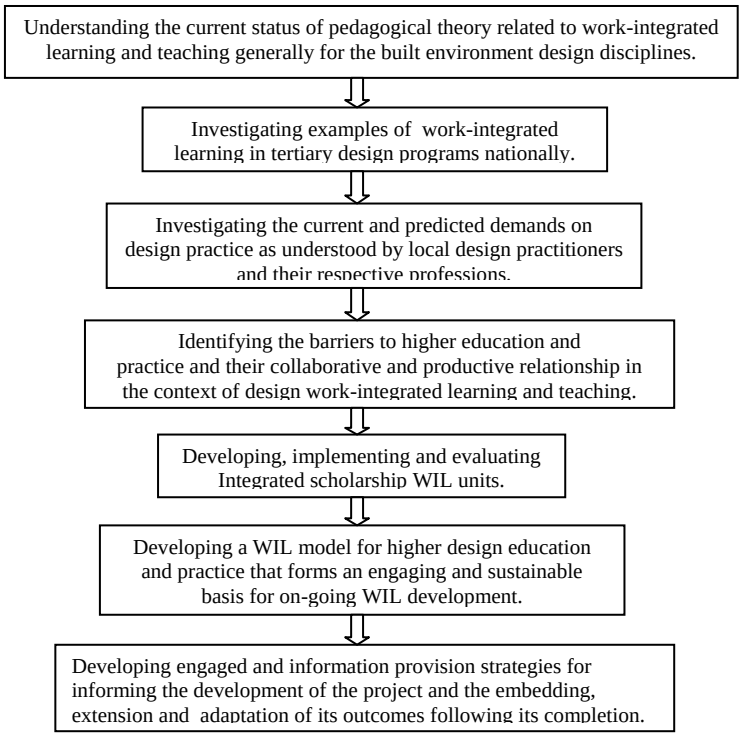


Figure 2.2: Franz's (2000) WIL model

Figure 2.2 summarises the main types of models currently in use in WIL programmes in tertiary institutions across the world. Its purpose is to reveal the variety between working WIL programmes; however it should be recognised that in reality, "workplace learning programs do not lend themselves to such neat compartmentalisation" (Hawke et al.,1998:16). There is considerable overlap between models, with certain benefits and shortcomings common to many. It is from these commonalities that we can learn how to design the best WIL model for FET colleges, with the flexibility for wider application across the sector.

Pre-course experience	Work experience as a prerequisite for entry.
Sandwich course	Periods of work experience between years of a course: students usually complete a 12-month 'thick' sandwich or two 6-month 'thin' sandwiches.
Co-operative programmes	Periods of work experience that may be integrated into the overall curriculum, designed both to integrate theory and practice and improve graduate employment.
Cognitive apprenticeship or job shadowing	Emphasis on observation and absorption of organisational culture of the workplace.
Joint industry/university courses	Courses jointly developed with and funded by an enterprise. Uses enterprise staff as teachers/assessors.
New traineeships and apprenticeships	Flexible arrangements based on a registered training agreement and structured on-the-job or off-the job training.
Placement or practicum	Extended periods in work settings to learn skills and gain experience of requirements of future work.
Fieldwork	Short periods (e.g. one day a week) of fieldwork in an agency to observe and learn about the organisational culture of the workplace.
Post-course internship	Work experience after completion of the course

Table 2.1: Martin's (1997) WIL model

As Martin (1997) describes, WIL has the potential to provide direct and significant benefits for students, workplaces, and universities, and in turn, the wider community. With the appropriate development of a WIL programme into a degree programme, and possibly across the FET sector, will allow for the integration. This initiative covers both WIL 1 and 2 and will not only enable FET college students to undertake a new and valuable learning experience, but also has the potential to develop valuable links with industry.

In conclusion, both Franz (2000) and Martin (1997) use their models to design a model for WIL in institutions of learning. Franz focuses more on WIL in the workplace and what the outcome means for the student: how the activities at the workplace can broaden the horizons of the students and how they can learn more at the workplace than at the college. Martin (1997), on the other hand, proposes various models which can be implemented between the college and the workplace. With this, the element of experience of learning in both the environments is also enhanced.

Kolb and Fry (1975), on the other hand, refer to cycles in which individuals can learn; for example, a learning cycle can begin at any of the four points as indicated in Figure 2.3, and it should be approached as a continuous spiral.

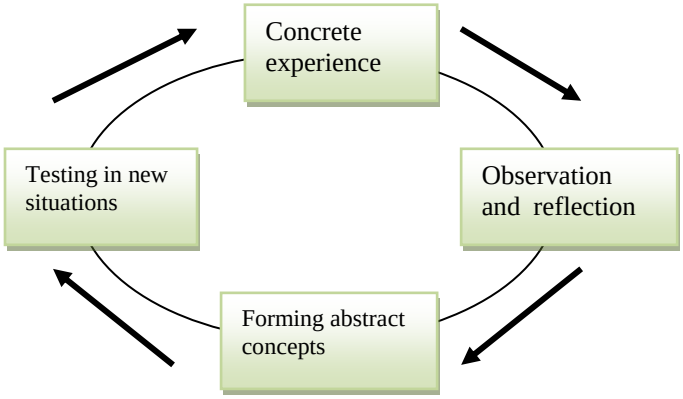


Figure 2.3: Kolb and Fry's (1975) learning cycle

Kolb and Fry's research found that people learn in four ways, with the likelihood of developing one mode of learning more than another. As shown in the 'experiential learning cycle' model above, learning takes place through:

- concrete experience, in other words, a student has carried out a similar task previously and therefore does it better the second and third time around;
- observation and reflection, in other words, observing how others are performing a task and then learning through observation;
- abstract conceptualisation, in other words, students think through first what should be done and then implement it; and
- active experimentation, in other words, a trial and error process – if the student does a task and it has worked, he or she often does it the same way again.

The learning process often begins with a person carrying out a particular action and then seeing the effect of the action on the particular situation. Should this be followed, the second step is to understand these effects in the particular instance so that if the same action were taken in the same circumstance, it would be possible to anticipate what would follow from the action. In this pattern, the third step would be to understand the general principle under which the particular

instance resorts. Kolb and Fry (1975) claim that students who have learned in such a way may well have various rules of thumb or generalisations about what to do in different situations.

Kolb (1984) developed a model for 'experiential learning' which could have a profound effect on work in the workplace if applied correctly. Many academics, teachers, managers, and trainers acknowledge his work. He believes that learning is cyclic and involves both practical doing and reflection on the doing. We learn not by experience alone, but by reflecting on what was experienced. Kolb (1984) is of the opinion that extensive learning takes place by students who are given a chance to acquire and apply knowledge, skills and feelings in an immediate and relevant setting. Kolb believes that experiential learning thus involves a direct encounter with the phenomena being studied, rather than one's merely thinking about the encounter, or only considering the possibility of doing something about it (Kolb, 1984).

Some authors critique Kolb's learning cycle and refer to some issues that arise from this model.

Boud et al. (1985) believe that while Kolb's model has been useful in assisting in the planning of activities, it does not help to uncover the elements of reflection itself. As Tennant (1988:91) comments, "even though the four learning styles neatly dovetail with the different dimensions of the experiential learning model, this does not necessarily validate them". Anderson and Adams (1992) argue that the inventory has also been used within a fairly limited range of cultures.

As indicated, students become involved in WIL 1 and WIL 2 at the college by integrating knowledge and practice. In WIL 3 the focus is solely on the workplace but it is still educational. The knowledge in the classroom (WIL 1), simulated practice in the workshop or the yard of the college (WIL 2), and workplace practice on site (WIL 3) integrate with one another. Figure 2.2 indicates how the three WIL experiences integrate with and depend on one another. All activities fall within this elliptical shape and move across boundaries. This is an ideal situation where the 3 WILs can work together.

An ideal situation is where the integration of the three WILs allows students to experience an easier transition from college to workplace. These two worlds, the college and the workplace, are linked by relationships formed through interaction between the college lecturers, students, and workplace supervisors. In this process, learning experience is gained by individuals in these settings. However, Billet (2001) points out that it is important to consider how the learning in these environments can be best structured, organised and refined for the benefit of a well-designed and complete WIL model.

Figure 2.4 serves to highlight some of the aspects that contribute to a supportive learning environment both at college and in the workplace. It is here that the three activity systems provide an overarching framework for WIL in the FET colleges and the CE workplace. The outcome is that the students should gain knowledge and skills to be adequately prepared for the workplace.

The figure further highlights that there is a separation between the classroom and the workshop/college yard. Knowledge and practice occur separately at the different sites. However, the workshop tries to integrate the knowledge from the classroom with the practice in the workshop/college yard.

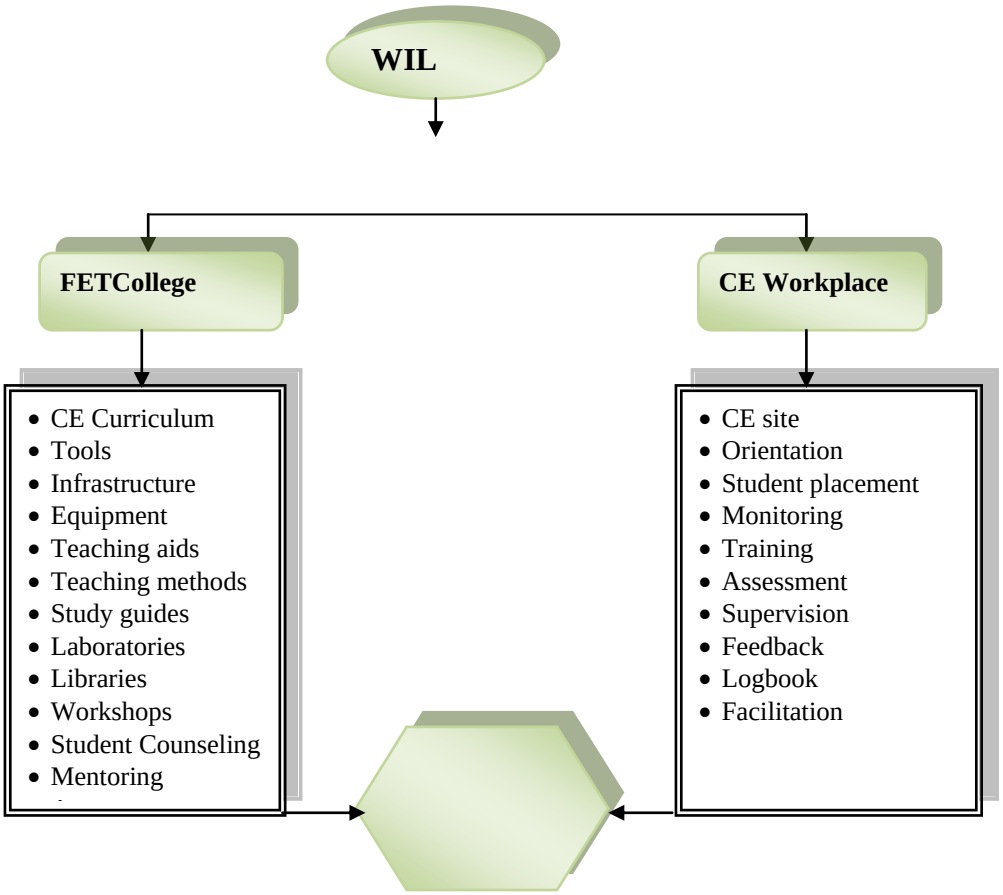


Figure 2.4: Supporting learning environment

This discussion identifies various WIL models which could be beneficial to the FET college sector and the CE workplace. The college and workplace are seen as different learning environments but could be developed as one WIL model.

2.3 KNOWLEDGE AND PRACTICE IN THE COLLEGE AND WORKPLACE

With increasing demands from industry and individuals for closer alignment between FET colleges and the workplace, academics at FET colleges are challenged to develop new teaching and learning approaches to close the gap between them. Johnston and Hawke (2002) argue that the increasingly competitive nature of the economy and demographic, occupational and workplace change have had a significant impact on the nature of the workplace and institutions of learning. This call for alignment is a shift from the traditional knowledge environments to an environment where knowledge and practice are

shared, and which will benefit the student and the workplace. According to this research, both the CE industry and students prefer the learning challenges to be based on real work circumstances that overtly add to the business of the company and students qualifying as CE artisans. According to Symes & McIntyre (2000), for FET colleges to overcome this challenge, they need to move beyond the traditional, paternalistic offerings to a more integrated way of learning, so that the knowledge is indeed integrated into the workplace.

Dewey (1963) believed in the power of learning by doing; he promoted interaction between environments for learning, providing a continuing framework for practice. The learning in the classroom, workshop/yard and the workplace that Dewey suggests is not happening as it should be and therefore there is a disjuncture between knowledge and practice. Dewey's concerns were in assisting individuals to develop the capacities to be effective in their preferred occupations. This includes understanding how best integration of all experiences in knowledge and practice can contribute to occupational expertise. He argues that in order for learning to be meaningful, students should have the necessary knowledge and apply this knowledge into doing. This knowledge is obtained in the classroom setting at the college. If this is what is happening, then there is alignment between the college and the workplace. The CE student who has the theoretical knowledge of constructing a concrete staircase should apply this knowledge by '*doing*' in order for it to become learning. The CE course then ideally becomes an integrative exercise with knowledge and practice, in the sense that it becomes a '*hands- on'* approach.

Tensions exist in the FET community between knowledge and practice issues – tensions such as whether the knowledge that is taught by college is sufficient to prepare students for the workplace, or whether a greater practical component should be incorporated with the knowledge and whether the workplace should focus only on practical aspects, or whether there should be a theoretical component built into workplace training. As I later suggest, the disconnect between the college and workplace has developed through a visible lack of knowledge and practice integration. Currently there are no clear guidelines for the initiation for knowledge and practice integration in the FET sector. It is really a

question of combining college theoretical knowledge with workplace practice through a possibility of transfer.

Linking knowledge and practice is not straight forward. This linkage requires substantive changes in recontextualising knowledge from academic to work contexts as outlined by Layton (1993). Using the example of moving between school science knowledge and technology in order to solve a technological problem, he suggests that firstly, a student needs to understand the complex reality of the problem and secondly, is required to pick and choose from available scientific knowledge sources:

The problems which people construct from their experiences do not easily map on to existing scientific and pedagogical organisations of knowledge. What is needed in solving a technological problem may have to be drawn from diverse areas of academic science at different levels of abstraction then synthesised into an effective instrumentality for the task at hand.

Solving technological problems means building back into the situation all the complexities of real life, reversing the process of reductionism by recontextualising knowledge (Layton, 1993:58-59).

Gamble (2003) supports Layton's idea by saying that any future FET curriculum needs to be informed by an adequate perspective of a past curriculum. FET colleges have rich histories and traditions. These traditions have converged, or combined, to set up pathways in the technical and vocational curriculum: one that binds knowledge and skills, the other that separates skills from the formal knowledge base. It is for this very reason that an integrated approach to education and training may not be easily attainable. What may result is the quest for a closer relationship between knowledge and practice. Gamble further states that owing to the lack of knowledge practice relations, employers in many countries complain that their country's education systems do not supply them with the labour force that has the skills they need. Wolf (2002) provides an important insight into the nature of such employer demand. She refers to England's promotion of core or key skills, compared with the traditional academic

skills, in the mid-1990s. These core skills are the major focus of FET colleges in the 21st century, even though very little is being done to establish a solid relationship between the skills/practice and the knowledge/theory. The issue of integration of knowledge and practice has even emerged as a political issue.

According to Gamble (2003), many college graduates in South Africa complete their programmes of study without having had access to practical on-the-job training which is deemed vital for occupational preparation (Kraak& Hall, 1999; DoE, 2001). For this very reason, students gain very little or no practical training before entering CE sites. Work-based learning has therefore become not only a desirable, but also an essential core element of FET college provision. Work-based learning in some of the CE programmes offered at these colleges is absent, hence the reason for my argument for closer links between knowledge and practice. This would give students the opportunity to function much better and be more productive on site. However, there might be some implications arising from this.

Gamble (2003) notes that any curriculum that leads to a qualification requires a mix of different forms of knowledge drawn from everyday life. She further states that practical work does not stand on its own; it is rather the reflexive link between task performance and the ability to understand and explain the grounds for action that provides the basis for problem solving in new and unfamiliar situations.

Gamble (2003) further states it has been suggested by SAQA (2000) that most learning programmes do provide learners with proportional knowledge or foundational competence. However, with this knowledge, learners should also be offered opportunities to gain practical competence, not only in controlled and defined environments, but also outside the safety of the classroom, in real work contexts where they will be required to adapt and re-contextualise their learning to function successfully in complex and unpredictable circumstances.

2.4 INTEGRATION OF KNOWLEDGE, PRACTICE AND TRANSFER

Integration of knowledge and practice in the FET college and the workplace is about transferring knowledge from one AS to another. Transfer of learning can be seen as the application of skills, knowledge, and/or attitudes that were learned in one situation to another learning situation in the CE classroom at FET colleges. In the CE course where I once taught, I had a piece of equipment named the Abney Level to measure height. The students would learn about the Abney Level in the classroom; when they entered the workplace they transferred the theoretical learning to the workplace by measuring actual heights of buildings. Thus knowledge and practice came together.

The integration of knowledge and practice is increasingly viewed in terms of a broader system involving CE workplaces, FET colleges, individuals and a variety of government and community organisations. The main objective of this integration of knowledge and practice is to provide more skilled artisans and technicians to meet both the market and societal demands (Gamble, 2003).

On the other hand, the first, but not the only place to practise integration of knowledge, is within the classroom and workshop/college yard. This makes it much easier to transfer new skills and knowledge to the job. Transfer of learning is the influence of prior learning on performance in a new situation. If students do not transfer some of their skills and knowledge from prior learning, then each new learning situation would necessarily start from scratch.

Mestre (2002:10) defines the transfer of learning as the “ability to apply knowledge or procedures learned in one context to a new context”. In other words, one has the ability to use what was learned in one setting to a different one, as well as the ability to solve novel problems with the knowledge initially acquired. The knowledge that students learn in school will transfer to situations and problems encountered outside of school. We know that schools do teach the basic skills of reading, writing and reasoning. When students enter the workplace, many of them still cannot meet the requirements and this, therefore, hampers their ability to advance in the workplace. There is also the attempt to

learn too many topics too quickly, which may also hamper transfer since the student may simply be memorising isolated facts with little opportunity to organise the learnt material in any meaningful fashion or link it to related knowledge.

Barnett (2006) poses the question “can we transfer what we learn?” He refers to how similar the learning context has to be before it can be applied. Knowledge transfer is a process through which one unit (individual, group, or department) is affected by the experience of others. He cites Singley and Anderson (1989) who define knowledge transfer at an individual level as “how knowledge acquired in one situation applies (or fails to apply) to another”. Although knowledge transfer in an institution involves transfer at the individual level, Argote (1999) refers to a particular challenge in assessing transfer through measuring changes in the performance of groups.

Billett (2001), on the other hand, explains that the problem of integrating knowledge and practice has traditionally been approached as a problem of transfer. Traditional approaches to transfer are based on the notion that knowledge is transferred from task to task in the school context. This static notion of portable knowledge has been challenged by theories of situated learning, notably by arguing that learning and knowing are processes of participation and apprenticeship in communities of practice (Wenger, 1998). Traditional approaches to transfer do not provide the conceptual tools for theorising the collaboration between school and work, because they concentrate either on individual learning in the school context or situated learning at the workplace.

It is important that the integration of knowledge and practice (or transfer of training) is thought of not only in terms of ‘the classroom to the job environment’ but also in terms of ‘task variation’ within the classroom. That is, practising a variety of tasks serves to enhance and quicken the learning process. Also, students become accustomed to using their newly acquired knowledge and skills in novel situations, thus encouraging transfer of learning to the job (Perkins, 1992).

Young (2003) argues that all kinds of reforms are taking place in transfer; however the aim is actually to increase the likelihood that students on FET programmes will have the relevant knowledge and skills and be able to apply them in the workplace. However, despite the advantages, they take for granted the actual process of transfer of knowledge and skill from college to workplace. It is assumed that students learn how to transfer knowledge and learning from education to work and that their employability is improved. Furthermore he contends that transfer is seen as a largely one-way mechanical process in which students acquire knowledge in vocational colleges and apply this acquired knowledge in the workplace. Young (2003) is therefore suggesting a possible disjuncture owing to the inefficiency of the process.

Kant (1992) makes the same point as Young (2003), noting that the process for connecting the theoretical and practical worlds requires effort and a deliberate road map for the college and the workplace. He further elaborates by saying, “since this challenge of connection is not unique to any specific realm”, he chooses to “look to other professional fields, such as medicine, law, or politics, to seek answers” (Kant, 1992:78). Sadly, each of these fields faces similar disconnects on the organisational and individual levels; therefore, they fail to provide any concrete solutions to the knowledge and practice divide.

Eraut (2004) speaks of workplace knowledge as being largely context-bound; for example, real workplace practice is only done in the workplace. The culture of the workplace and the unpredicted situations to which the student must adapt are enormous to students coming from college. Most work which students are exposed to at the workplace introduces novel situations. Eraut points out that the key difference between work and academic knowledge is the difference in purpose to which the knowledge is to be put. At work, knowledge is essentially used to enhance the productivity, innovativeness and skills base of the firm, whereas in the academy, it is concerned with the mastery of disciplines and their (possible) application in the world.

Yeh and Deng (2004:46) argue that theory can be understood in two ways: on the one hand, “it denotes something already proven or well established”, for

example, students learning about setting out a building applying the 3:4:5 method. This method has been proved over and over again, attesting to its working. As for practice, it indicates a condition of a routine activity and it can refer to the condition of gaining skills. After the students have gone through the learning of the method, they enter the workshop/college yard and practise the method physically to understand the knowledge-practice relationship. In this specific task, this is where WIL is implemented between the FET college sector and the workplace.

Moore (2004) posits that work is based on a conceptualisation of transfer, which he refers to as 'developmental transfer'. In this view, meaningful transfer of learning takes place through interaction between activity systems. The school and workplace engage in collaborative interaction in which both activity systems learn something from each other. What are transferred are not packages of intact knowledge and skills; instead developmental transfer involves an active reconstruction of the skills and knowledge to be transferred. Teachers and students are used as change agents in the transformation and redesign of projects and work organisations. Thus, students and their teachers act as mediators and boundary crossers between the school and workplace.

Le Maistre and Paré (2004) argue that the chief aim of professional education is to prepare new practitioners to ease the passage to professional practice by recreating it under controlled conditions from school to practice. They closely examine the assumption that students will carry the knowledge gained in the school into the workplace. They use AT as an analytical tool for their study, and according to them, school and work are radically different activity systems, with quite distinct objectives.

2.5 PURPOSE FOR USING ACTIVITY THEORY

According to Nardi (1996), the purpose for using Activity Theory (AT), is that it is a powerful and clarifying descriptive tool. Engeström (1987) explains that the strength of the theory lies in recognising that contradictions can emerge in an

activity system through its historical and cultural roots; these can be worked with and often provide the engine for change in organisations.

Previous studies, such as that of Le Maistre and Paré (2004) point out that AT is a powerful tool to compare school and work.The theory has allowed me to examine work and learning in the different communities of the college and the workplace, to explain the interaction between the elements of Activity Theory, as well as to illustrate the differences in the sub-systems as Mwanza-Simwami (2009) describes. The sub-systems that she refers to are the small triangles within the big activity system triangle that could show up differences in the various elements. The theory also amalgamates strong notions of mediation and cooperation, and assists in constructing learning processes for this study. These notions could be located in the knowledge and practice relations between the FET colleges and the workplace.

This study focuses on the learning activities at the college and the workplace and compares the three activity systems with one another. Le Maistre and Paré (2004) have used AT in a similar fashion in the context of comparing activities in university programmes with those in workplace settings. They argue that university and work are radically different activity systems with different objectives. This study has one main objective, 'student learning', be it in the classroom, workshop/college yard, or the workplace. Therefore, I shall compare the different sites of learning that are referred to as Activity Systems, how the communities operate, in what way they are linked and where disjunctures have surfaced. With the avowed purpose for using AT, the following discussion unpacks Vygotsky's and Engeström's views on AT.

2.5.1 Vygotsky's theorising

The ideas presented in AT have their origins in the Vygotskyian concept of tool mediation and Leontiev's notion of activity. Vygotsky (1978:34) originally introduced the idea that human beings' interactions with their environment are not direct ones but are instead mediated through the use of tools. His theory of learning describes learning "as a movement from an initial less systematic

approach to one that is more systematic and abstract". Vygotsky's (1978:64) view is that "since children learn much through interaction, curricula should be designed to emphasize interaction between learners and learning tasks".

Vygotsky (1978) adds that with appropriate adult help, children can often perform tasks that they are incapable of completing on their own. He uses the term 'scaffolding' to refer to where the adult continually adjusts the level of his or her help in response to the child's level of performance. This is an effective form of teaching. Scaffolding not only produces immediate results, but also instils the skills necessary for independent problem solving in the future.

According to Vygotsky (1978), the two primary means of learning occur through social interaction and language. Language greatly enhances humans' ability to engage in social interactions and share their experiences. Initially, a student's new knowledge is learned through interaction with others, on the social level. Later, this same knowledge or skill is mastered on an individual level. The civil engineering course is a typical example of how students in most cases learn externally, first in groups, when measuring with a theodolite instrument. By acting socially in groups, they learn from others externally and then internalise the learning. This gives the student the confidence to take the learning forward to other students who cannot use the instrument and at the same time make use of the instrument perfectly in the workplace.

Vygotsky (1978) initially advanced a model that included a subject and his or her object of activity. The subject cannot act directly on the object but rather employs tools of mediation to carry out cognitive functions. For many years this model served as the point of departure for many theoretical discourses and experimental research programmes. In a certain sense, the theoretical movement in cultural-historical activity history depends to a certain degree on improvements of this triangle. Vygotsky's diagram is used to illustrate this relationship in the basic triangle in Figure 2.5.

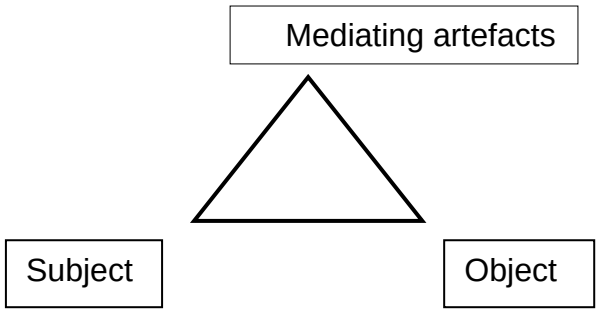


Figure 2.5:Vygotsky's (1978) Basic Mediation Triangle

Leontiev (1978) takes Vygotsky's work a step further by describing activity in terms of three constituents: the subject, the object, and tools which operate on three levels – collective activity, group or individual action, and automatic operation. He explains that learning occurs within a broader social setting than defined in Vygotsky's triangle.

2.5.2 Engeström's theorising

Drawing on the works of Vygotsky (1978) and Leontiev (1978, 1981), Engeström (1987) developed a model enabling the study of collective work activities, in which he expanded on Leontiev's (1978) notion of activity, which, according to him, did not fully represent the collective and societal nature of human activity. Engeström (1987) developed Vygotsky's basic meditational triangle to represent more fully the essential social relations that teachers and designers need to account for. I shall be using the method of the activity system drawn from activity theory as a tool to examine work and learning. The basic structure of an activity system was formulated by Engeström (1987), which includes the interacting components of subject, object, tools (instruments or artefacts), division of labour, community, rules, and outcome.

Engeström (1987) and Nardi (1996) explain that activity theory is more of a descriptive framework. It helps to describe the activity by making use of the elements embedded in the activity system. Furthermore, it considers an entire work/activity system (including teams, organisations, etc.). It accounts for the

environment where the activity is taking place, the history or background of the person or the subject, their culture, the role of the artefact, motivations, and the complexities of real-life activity.

Figure 2.6 suggests the various elements of an activity system and their connecting relations according to Engeström (1987). A brief description of the elements is given here which will be elaborated upon in the theoretical framework (Section 2.7).

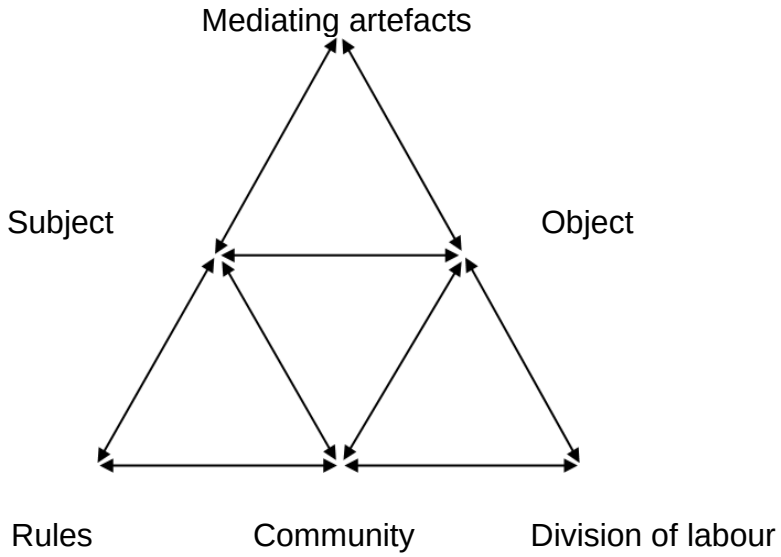


Figure 2.6: Engeström's (1987) Activity Theory Model

Engeström (1987) proposes an interpretation of the interrelationships between the elements of the activity triangle. He believes that there are relationships between the elements through mediation; for example, the relationship between the subject and the community is mediated by the rules shaping the community and the object is mediated by the division of labour among members of the community.

Activity systems (ASs) have a *subject(s),* an individual or subgroup engaged in various activities in the classroom and the workshop prior to constructing the formwork. It is crucial to remember that each of them participates and brings a different history of diverse involvement to a particular activity system.

The concept of object is difficult to pin down in activity theory research. On the one hand it can be seen as the purpose or driving force of the activity, and on the other hand as a moving target or developmental object; these are not, however, distinct definitions. As Engeström (1987:79) points out, the object can provide direction as well as be partially 'shaped' by the mediating effects of the elements of the system as the subject works on or towards it.

Mediating artefacts are understood as anything that mediates subjects' actions upon objects. Like other species, humans act purposefully to meet biological needs. But unlike other species, human behaviour may differ radically among groups because we use tools or cultural artefacts; for example, in this thesis, the curriculum is used as a tool to mediate learning.

The subject is part of a larger *community*, which conditions all the other elements of the system. The student, lecturer and workplace supervisor are engaged in an activity of learning and they act together on an object with a common motive for students to qualify as CE artisans. In this activity, the community constitutes the students, lecturers and workplace supervisors, all of whom have a part to play in executing the activity.

Moreover, activity systems, according to Engeström (1999) also have a *division of labour* (D.O.L.) that shapes the way the subject(s) acts on the object (and all the other elements of the system, potentially). D.O.L. in Engeström's model refers to organisational divisions. Daniels (2001) has extended this original idea of divisions to include divisions and different relations of power between different types of knowledge.

Activity systems also have *rules*, broadly understood not only as formal, explicit rules, but also as unwritten or tacit rules that are often called norms, routines, habits, and values. The rules shape the interactions of subject and tools with the object. Further to the development of Engeström's AT model, he outlines five principles that underpin his approach to AT.

2.5.3 Engeström's five principles of activity theory

Engeström (2001) outlines five principles which underpin his approach to activity theory. Here, I discuss the principles in relation to my study.

- Activity systems as the prime unit of analysis
- Multi-voicedness
- Historicity
- Contradictions as sources of change and development
- Expansive cycles of learning

Activity systems as the prime unit of analysis

In his drive to develop a model enabling the study of collective work activities, Engeström (1987) expanded Leontiev's (1978) notion of activity, which according to him did not fully represent the collective and societal nature of human activity. The basic structure of an activity system is defined in relation to the six elements as they stand: object, subject, mediating artefacts, community, rules and division of labour. However, in this section I shall describe two of the elements, 'mediating artefacts' and 'subject', as the other elements will be explained in detail in the methodology chapter.

Dick and Williams (2004), define an Activity System as a basic structure which consists of elements listed in the diagram. It requires actions and information flows. The information must flow through the activity system in order for the desired result to be achieved. An Activity System is a basis for the structural analysis of a team or an organisation, or of a programme and its work.

Mediating artefacts in this study can be technical or physical tools, such as equipment and machinery, or soft tools such as the curriculum, posters, pictures and textbooks. Over time these tools have been culturally constructed to suit the needs of those who have worked with them. Kuutti (1996) argues that tools and artefacts participate in the transformation of the object into an outcome, which can be desired or unexpected. The tools mediate the relationship between the

subject (individual or team) and the object of the activity. They empower the subject, whose actions can be enabled and enhanced by their use. However, they can also be limiting by obscuring some aspects of the object of the activity. An example of the limitations is the out-datedness of the physical tools that are used, which could mean that a certain task could not be carried out or that there might be a delay in carrying out a specific task.

The ‘subject’, which is the CE student in this study, is not acting in isolation but is a part of a community of lecturers and workplace supervisors, which is shaped and defined in relation to the common object. The relationship between the subject and the object is mediated by explicit and implicit rules, in other words, rules of the institution and of the CE industry. The relationship between the community and the object of the activity is, in turn, mediated by a division of labour, which encapsulates both the horizontal distribution of tasks between peers and the vertical distribution of power between participants. Therefore, an activity system is a systemic formation and mutual relationship that exists between all its constituents.

The task of a CE lecturer teaching in an FET college classroom is to make sure that the students learn, so that they are fully prepared to pass the examination. The outcomes include the intended development of the students in order to qualify as CE artisans. The division of labour determines the tasks and decision-making powers of the lecturer, the head of department, the Chief Executive Officers and other employee categories. Finally, the rules regulate the timetable and the use of time within a period, as well as the assessment criteria for learning outcomes.

The first activity theoretical principle voiced by Engeström (2001) stipulates that the activity system, such as the classroom, can be taken as one of the prime units of analysis, rather than individual or group actions, and should therefore be interpreted against the background of entire activity systems. The learning in the classroom as an activity system could later be compared with the learning in the workshop/college yard and the workplace.

However, a particular activity system does not exist in isolation but interacts with other activity systems. The students' learning in the classroom activity system illustrated above is part of a network of interacting activity systems, such as the learning in the workshop/college yard, and the learning at the workplace. The activity systems under study must therefore be seen in context and in terms of their relationship to other activity systems.

Multi-voicedness

According to Engeström's (2001) second principle, activity systems are also multi-voiced and embrace multiple viewpoints, traditions and interests. Participants carry their own diverse histories, and the activity system itself carries various forms of history in artefacts and rules. Within the community of lecturers, students and workplace supervisors, each group may have different conceptions of the purpose of the college or even the purpose of learning to become a CE artisan.

The different communities in the CE environments bring with them different histories, which, in turn, will shape their motives and goals for learning CE. Within the classroom, it could be that students engage in different activities while performing the same task. From the perspective of activity theory, it is not necessarily the case that all the students in the classroom have the goal of gaining knowledge; the reason for this is because they have different motives for being in the class. It doesn't matter that in the operational domain they are all engaged in the same overt behaviours, for example, listening, completing written tasks, and engaging in group-work activities.

Engeström's principle of multi-voicedness recognises the significance of individual histories while highlighting the dynamic, flexible, and, at times, conflicting, construction of the object. The CE learning in the classroom activity illustrated earlier may thus look different if seen from the point of view of other subjects in the community. For example, each CE student brings his or her own learning history and cultural background to the activity. Students' relationships with their fellow students may be governed by less formal rules than the

lecturer's, and they may use a different range of artefacts and methods to help fellow students develop their learning skills.

According to Engeström (2001:136), the multi-voicedness of activity systems is "a source of trouble and a source of innovation, demanding actions of translation and negotiation". In other words, the different constructions of the object by different subjects in the community will thus lead to a transformation of the activity system, often through retrospective reflection (Lektorsky, 2004). Understanding an activity system thus requires an understanding of its historical evolution, which constitutes Engeström's third principle.

Historicity

The existence of mutual relationships between elements of an activity system along with the mutli-voicedness of activities means that activity systems are not static but constantly evolve over a long period of time. What initially appears as an object may soon be transformed into an outcome, and then turned into a tool, and perhaps later into a rule (Engeström, 1996). For instance, an unusual collapse of a concrete column on a CE site may first appear as a problem. If transformed into a successful diagnosis, this can be used as a model for other similar cases, and is gradually made into a rule requiring certain procedures in all cases that fit the category. On the other hand, rules may be questioned, reinterpreted and turned into new tools and change the object.

Engeström further posits that activity systems' problems and potentials can only be understood against their own history (2001:136). The history of an activity system is not only embedded in its internal structure and organisation, but also in the global history of the tools, procedures, concepts and principles which have become mediators of the activity. Keeping with the example of learning in the classroom activity system discussed thus far, the procedures and tools employed by the lecturers have been accumulated over a long period of time, not only as a result of the historical evolution of the country's education system and of the organisation of the school operations, but also in response to changes and

advances in pedagogy and in educational technologies (Levy, 1997; Warschauer & Healy, 1998; Chapelle, 2001; Tammelin, 2004).

Contradictions

Engeström's fourth principle, and probably the most important in the context of this thesis, concerns the role of contradictions or tensions as sources of change and development (Engeström, 2001:137). The term *contradiction* is not to be understood as a problem, obstacle, conflict, or communication breakdown. Contradictions are historically accumulating structural tensions within and between activity systems (Engeström, 2001). The object in different activity systems may be different in a particular study, even though the activity systems work together on the same object to achieve the outcome. If the outcome has not been achieved, there could be contradictions among the different objects or even among the other elements of the activity systems.

Contradictions characterise activity systems and trigger innovation and change, according to Engeström (1987, 2001); Helle (2000); Barab, Barnett and Squire (2002). It is for this reason that contradictions in this study are seen as having a developmental purpose, to develop one common object for all three activity systems. According to Barab, Barnett and Squire (2002), understanding the underlying contradictions of an activity system is therefore crucial to understanding the activity system itself. In the context of work practices, contradictions, "manifest themselves as problems, ruptures, breakdowns, clashes" (Kuutti, 1996:34), or as disturbances, which "interrupt the fluent flow of work" (Helle, 2000:87-88).

According to Engeström (2001:137), there are two levels of contradictions, which he refers to as the primary contradictions and the secondary contradictions. The discrepancies in learning in the three different environments provide an example of a primary contradiction. The primary contradiction is in the object. The object is 'student learning', where the lecturer assists with the learning of the student in the classroom and the workshop/college yard with the focus on an examination-driven curriculum. At the workplace, the workplace supervisor appears to be

focused on the learning of the students but the main priority is production and profits at the workplace. According to the 'object' of activity systems, there appear to be contradictions.

The secondary contradictions appear between elements of the activity system as a result of new elements entering the activity system from the outside and creating an imbalance. For example, when a new object enters the CE learning activity, such as students with learning disabilities or students who are at a more advanced level than the norm, conflicts may arise between the needs of these students and the range of teaching materials or facilities currently available.

These two levels of contradictions could bring about conflicts and misunderstandings between different activity systems. The contradictions may also emerge as a result of different instructional traditions, such as the adoption of different teaching methodologies in the different activity systems of the classroom, the workshop/college yard and the workplace.

Expansive cycles of learning

The two levels of contradictions discussed above can be seen as triggering transformations in an activity system, which can lead to the creation of a new activity. The earlier examples, which were drawn from a CE teaching activity, can be brought together to illustrate these transformations. The lecturer, who becomes conscious of the existence of new workplace needs in relation to the CE competence of the students, may start questioning the teaching practice at the workplace.

In this way, a new cycle of transformations begins. The formation and the resolution of internal contradictions in activity systems provide a basis to analyse what Engeström (1987, 1999a) calls 'expansive cycles'. Activity systems move through relatively long cycles of qualitative transformations. As the contradictions of an activity system are aggravated, some individual participants begin to question and deviate from its established norms. In some cases, this escalates into collaborative envisioning and a deliberate collective change effort. An

expansive transformation is accomplished when the object and motive of the activity are reconceptualised to embrace a radically wider horizon of possibilities than in the previous mode of the activity (Engeström, 2001).

Expansive cycles are not repetitive but “lead to the emergence of new structures” (Engeström, 1999), through processes of internalisation and externalisation. These processes could open up learning spaces. Both processes are interconnected and present in the expansive cycle of the activity system under study.

2.5.4 Other researchers’ views of using Activity Theory

Researchers use AT to study how people engage in all kinds of activities, from learning at an institution, to working in a manufacturing company, to shopping in a grocery store – these sites are called Activity Systems (ASs). Researchers use AT to understand the relationships among people participating in activities, the tools people use to accomplish their activities and the goals that people have for the activity. In addition, researchers use AT to understand how historical and social forces shape the way people participates in activities and how change affects activities. This section describes some of the research that has used AT.

Mwanza-Simwami (2009) offers an operationalisation of Activity Theory in an organisational context, using an expanded triangle model which incorporates the community and other mediators of human activity, namely tools, rules and divisions of behaviour. She applies this to a case study of an organisation using computer tools such as a call-tracking system to promote organisational learning. She reports on her experience of using the notational structure to generate suitable questions for the interviews conducted with workers. She identifies problems particularly in relation to time and some dimensions of temporary relations within and between the teams.

In AT the various components are seen as a unified whole. All elements interact with one another, working towards a desired outcome. However, something that is lacking in AT is a theory of learning. For this reason, in her study, Mwanza-

Simwami (2009) used AT together with the theory of Expansive Learning (EL), where activities normally take place, and within this she examined new knowledge. Students first interact with the object, and then new expansive forms of learning occur. Mwanza-Simwami (2009:18-26) is of the view that the educational concepts within EL differ from those of traditional types of learning namely:

“The outcomes of EL are not knowledge in text, but rather new forms of practical activity and artefacts constructed by the subject; it is learning what is not yet known.”

In the case of the CE student in workplace learning, the student goes to the workplace for the first time with some form of practical knowledge but always learns new knowledge through practical activities.

“The learning is driven by genuine developmental needs and the existing practices are questioned.”

Most students are often enthusiastic and want to learn more at the workplace because that will put them in good stead to find employment when they complete their studies. The students feel they need to be one step ahead and therefore question most of the activities that are done on site.

“Learning occurs in complex cycles in which new objects and motives are created and implemented.”

Students move between the classroom, workshop/college yard, and the workplace. The exposure that the students get, allows them to generate new ideas and knowledge and see things differently in each of the environments.

In my research I compared the learning that takes place in the various activity systems. For each of the activity systems, I used Mwanza’s (2002) Eight-Step Model to guide my analysis, which poses questions as follows:

1. What sort of activity am I interested in? → Activity
2. Why is this activity taking place? →Object(ive)
3. Who is involved in carrying out this activity? → Subjects
4. By what means are the subjects carrying out this activity? → Tools
5. Are there any cultural norms, rules or regulations governing the performance of this activity? → Rules
6. Who is responsible for what, when carrying out this activity, and how are these roles organised? →Division of labour or roles
7. What is the environment in which this activity is carried out? → Community
8. What is the desired outcome of the activity? → Outcome.

Using this model allowed me to unfold the contradictions forthcoming in each of the activity systems. Originally, I treated the CE student learning as the object of activity. Subjects and communities interacted with it in ways mediated by rules, tools and divisions of labour. But I soon realised that the learning that was taking place was different in each activity system and therefore one common object would have to be determined.

Kuutti (1996) suggests that AT is a framework for studying different forms of human practices as developmental processes, with both individual and social levels interlinked at the same time, because it sees all human actions, especially mediated actions, as configurations of influences, both social and individual, within a dynamic system. This social event of activities also involves outside factors, such as the 'workplace', as much as the factors inside the 'classrooms'. These factors may involve prior workplace experiences, perceptions and values of the target culture, curricular orientation, and administrative policy of the college. Thus, investigating WIL through activity theory as an analytical tool, which encompasses relevant contexts, should enable the reader to understand thoroughly the dynamic sociocultural activity setting such as WIL in the classroom, workshop/college yard, and the workplace.

While McMillan (2008) argues for two communities of practice interacting via one activity system, she claims that when there are two intersecting activity systems,

each has an identifiable object, and as they work together on a common project, the object becomes transformed. Unlike many other researchers using AT as an analytical framework, she mainly works on three elements of the activity theory framework, namely the *tools,* such as books, talk, computers and schedules, the *community* which comprises the students, lecturers and the community, and the *object*, which is service learning as a form of social responsiveness. Her focus is on learning as a way to understand the social practices between the two communities, namely the university and the people in its community. She argues that 'border-crossing' *when one activity system moves into the other*, is an important element for the two to come together.

For the purpose of this study, the following section deals with contradictions between activity systems. Contradictions are inevitable occurrences in every collective activity and indicate emergent opportunities for the activity's development. Contradictions are seen as a sign of richness in the activity system, not weakness, and of mobility and the capacity of an activity to develop rather than function in a fixed and static mode.

2.6 CONTRADICTIONS BETWEEN ACTIVITY SYSTEMS

The purpose of introducing contradictions in this study is to determine, according to my main research question, whether the college prepares students for the workplace. In so doing, my study produces three Activity Systems; they are interrelated as well as providing one another with input and serving as instruments for one another. Contradictions are inevitable, occurring within and between activity systems and they can lead to transformation of the processes. Activity constantly develops as a result of contradictions and instability, and because of the construction of new needs. Activity theory understands human beings in motion recreating their own environments. Subjects, on the other hand, create the environment through activity.

Contradictions are present in every collective activity. They indicate emergent opportunities for the activity development. Contradictions are not weakness, but signs of richness, and of mobility and the capacity of an organisation to develop

rather than function in a fixed and static mode. They are not points of failure or deficits within the activity system in which they occur. They reveal the growing edge of the activity system, the place where growth buds are able to expand and expansive development takes place (Foot, 2001), and they are starting places, not ending points.

Engeström (2001) defines contradictions as historically accumulating structural tensions within and between activity systems. In order to analyse an activity system's development, it is important to identify contradictions. By identifying the tensions and interactions between the elements of an activity system, it is possible to reconstruct the system in its concrete diversity and richness, and therefore explain and foresee its development (Engeström, 1999).

In his review of AT, Kuutti (1996) points out that it uses contradictions between different activities to indicate a misfit between elements, between different activities, and between different developmental activities or between different developmental phases of the same activity. Contradictions show up as problems or breakdowns and activities are almost always in the process of working through contradictions.

Contradictions emerge as disturbances, which are visible manifestations of contradictions (Capper & Williams, 2004). According to Berge and Fjuk (2006), contradictions are "problems, ruptures, breakdowns, clashes" in activities. Contradictions are important, not in and of themselves, but because they can result in change and development (Engeström, 2001). Engeström and Miettinen (1999) posit a view of contradictions as "the motive force of change and development". Owing to contradictions that appear in the various elements of the activity systems, the contradictions may assist in developing a system that can be beneficial to the entire community in the different activity systems.

Barab, Barnett, Yamagata-Lynch, Squire and Keating (2002) used the AT model in a course from the point of view of students. They portrayed contradictions within individual elements, such as a contradiction they found in the subject (the student) in the context of their study, in terms of passive recipient versus

engaged learner. Their study also portrayed contradictions between elements of the system, all of which revolved around the object of learning astronomy. The distribution of tasks between students in one group, which was found to be a good practice for accomplishing tasks as a team was, however, "not as successful for fostering the development of a broad understanding of astronomy" (p. 99). This was because some learners did not learn concepts that other team members had been responsible for.

The studies of Barab, Barnett, Yamagata-Lynch, Squire and Keating (2002), and Dippe (2006), were premised on the importance of examining change and innovation in activity systems. The examination of change is facilitated by the investigation of how contradictions are approached and resolved. For example, Dippe (2006:23) contends the “success or failure of a system depends on the ability to resolve contradictions". Barab, Barnett, Yamagata-Lynch, Squire and Keating (2002) explain that examining the interplay of contradictions, which they refer to as *systemic tensions*, can help understand and support the continued innovation of an activity system.

Hardman's (2005:12) study of a mathematics teacher's use of technology in a rural school suggested that reliance on AT and contradictions helps to identify ‘dynamic forces of change’ as well as to illustrate how transformation can be tracked. Her use of contradictions was premised on the notion that they are indicative of change as follows: "We can anticipate that the introduction of the computer as a novel tool may indeed lead to shifts in pedagogical practice."

As the contradictions of an activity system in the FET colleges sector are aggravated, some individual lecturers, students and workplace supervisors begin to question how activities are performed and sometimes deviate from the established norms of the curriculum. For example, if the knowledge in the classroom is off-target to the lecturer in the workshop, the lecturers will do what they think is right for the student to learn for the workplace.

Despite the potential of contradictions to result in transformation in an activity system, this transformation does not always occur. In fact, contradictions can

either enable learning to progress, or they can actually disable it, depending on whether or not they are acknowledged and resolved (Nelson, 2002). Additionally, in order for systemic contradictions to lead to innovation, their resolution cannot occur at the individual level "because contradictions are in social/material relations among groups of people and the tools they use" (Wardle, 2004:14).

Activity Systems that human beings create are constantly subject to change. The version of AT that I am describing, sees these changes as driven by contradictions within and among activity systems. An activity system "is constantly working through contradictions within and between its elements" (Engeström, 1987:26). In this sense, an activity system is “a virtual disturbance and innovation producing machine" (Engeström, 1990:35). A change in any element of the activity system may conflict with another element or/and could put people in conflict.

Contradictions can emerge between the same elements and among Activity Systems. Let me illustrate using an example. Figure 2.7 demonstrates how a compactor is used as a tool for learning. The classroom as an activity system is where the lecturer demonstrates to CE students using miniature tools and pictures to explain the workings of a compactor *(a tool).* When the student enters the workshop/college yard, the lecturer demonstrates a real, out-dated petrol compactor, and when the student enters the workplace for workplace training, he/she is expected to operate the latest hydraulic driver compactor. Thus there is a misfit in the *tools* element used in the college and that of the workplace. This therefore produces a *contradiction* between the tool elements of the Activity Systems. The actual contradiction is that the new technology, the ‘hydraulic compactor’, clashes with the old technology, the out-dated ‘petrol compactor’. That the students in the classroom are not exposed to the real technology, but rather to pictures and miniature tools, is also a contradiction.

compactor

Hydraulic

Petrol compactor

Miniature & pictures of a compactor

Figure 2.7: Compactors used in the learning environments

Contradictions can also arise between elements within an Activity System. The *object* of the CE course for the students is 'the purpose of using the tool' – if the students are then taught with the incorrect or out-dated tools, then there are tensions or contradictions between elements of different Activity Systems.

Contradictions may also arise when participants from different activity systems have different objects. For example, the classroom and workshop/college yard Activity System objects might be different from those of the workplace Activity System object. The object of the students and lecturer was the students' purpose for learning CE and preparing them for exams. The workplace supervisor, on the other hand, may have an object of production, quality and profits. If this is so, there could be a great deal of conflict that emerges. It is therefore important that continued innovations within and between activity systems are paramount for the development of learning and working in a CE context. The CE industry is ever growing and changing; new developments, methods, and techniques are constantly being introduced, and if these innovations are not supported by the college sector and the CE industry, the economy will ultimately suffer.

2.7 THEORETICAL FRAMEWORK OF MY RESEARCH STUDY

My research is based on the central role of contradictions as sources of change and development. The contradictions are historically accumulating structural tensions within and between ASs, as indicated. The primary contradiction in this study is knowledge/practice relations. This was brought about by the introduction of different objects in the various ASs.

In my research I will follow the Eight-Step-Model, as previously indicated by Mwanza and Engeström (2003), based on Engeström's third generation of AT. I have operationalised AT and the ASs into my analytical framework. In this study, the AS theoretical framework is also a tool which is used to interrogate each of the systems and which I use to organise the data of this study. I will use the AS as an analytical tool, and to make comparisons in respect of the different elements and sub-systems of the different ASs across all three learning sites, namely the classroom, workshop/college yard, and the workplace settings. I will make use of Engeström's (1987) AT model in this study in order to describe how the elements mediate the way the subject acts on the object.

The information in Figure 2.8 demonstrates how the six elements, namely, subject, object, mediating artefacts, rules, community, and division of labour, are used in arranging the data collected from the findings and analysis of the three activity systems in a college classroom, workshop/yard and workplace context. The outcome is to '*produce workplace-ready civil engineering artisans and technicians*' and is standing outside of the AS but is common to all three of the ASs.

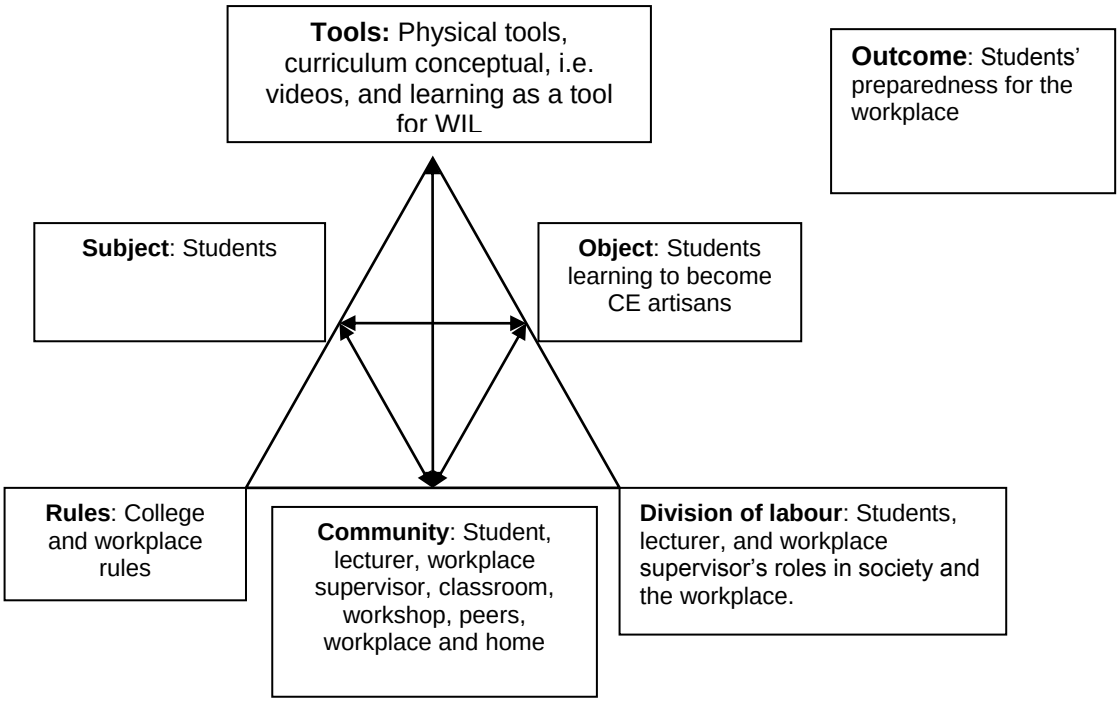


Figure 2.8: Application of Engeström's (1987) Activity System

My analysis, in Chapter 7, demonstrates how the six elements are used to determine the comparisons of the three activity systems in (1) a college classroom, (2) workshop/college yard, and (3) workplace context. There are a lot of similarities and continuities in each of the systems. For example, the activity of interest as object is students' learning. In the tool element the students learn about all the tools in all of the environments. They learn about the rules in the classroom but must apply these in the workplace. Students are therefore exposed to both environments. According to Le Maistre and Paré (2004), the movement of the students between college and work allows them to bring back the practical experience from the workplace to the classroom.

Subjects: The student 'subjects' are included in all three of the activity systems. There is a similarity in all three systems in that learning is taking place. However the differences that exist relate to the type of learning in the classroom – the knowledge content, that is, the learning in the workshop and college yard, is both knowledge and practical but more practical than knowledge, while the learning at the workplace is only practical, and reference is made by the supervisor to what was taught at the college.

Mediating artefacts: The tools that are used in the three systems are very different from one another. The tools in the classroom are soft tools, such as textbooks, notes, black and white boards, pictures, posters, and videos. In the workshop and college yard, there is a combination of soft and physical tools; the soft tools in the workshop will be, for example, a video that will be screened to students while the lecturer demonstrates various tasks, and the physical tools will be those they physically work with, such as levelling and measuring instruments. At the workplace, where 'real work' is taking place, students work with physical tools such as compactors, grinders, shovels, measuring equipment, and levelling instruments.

Object: This is the knowledge and practical content of the CE course that is taught. The object in all the systems is the same: student learning. The classroom is the knowledge component upon which the practical is based, the workshop/college yard is a combination of the knowledge and practical, and the workplace is the practical, based upon the knowledge. The object is supposed to reach the desired outcome. If there are differences in the object, the outcome cannot be reached.

Division of labour: The only similarity is that each of the role players (the student, lecturer, and workplace supervisor) has a role to play. The difference is that each has a different role to play. The students learn, the lecturer teaches the knowledge, the lecturer teaches the practical in the workshop/college yard, and the workplace supervisor demonstrates the workplace skills to the students. One important aspect of difference which arises in this research is between knowledge and practice. So I have included the division between knowledge and practice in my definition of D.O.L.

In the classroom, there is knowledge content taught which is often seen as more important than other content, such as mathematics and building science. Lecturers believe that this knowledge content is more important than the trade and drawing subjects. Students learn about the force that formwork should absorb to with stand the pressure of the concrete when poured into the formwork.

For students to experience this on a site visit has more value than learning about it in the classroom.

Community: This consists of the college community such as the lecturers, management and administrative personnel that play a major part in student learning. Once the student enters the workplace, the community of practice differs significantly; the student mostly works with the workplace supervisor and other professionals, such as architects, civil engineers, clients of the project and employers.

Rules: General rules, such as adhering to deadlines, studying and working hard, being punctual, respecting others and their belongings, are common to all three of the activity systems. The rules of safety are taught in the classroom but not enforced. It is only when the student enters the workshop or college yard that the rules are enforced. Engineering rules and safety regulations are strictly enforced in the workplace. All tasks should be strictly adhered to because people's lives are at risk.

The rules can also change, tacitly or explicitly, with changes in any of the other nodes in the system, but the rules allow the system to be stabilised-for-now but can change over time. In the CE course, explicit and tacit rules are applied throughout the course, and even when students enter the workplace and throughout their careers. In the CE context, one can take this a step further by saying the CE content rules in the classroom may differ from those of the workplace, for example, the rules for constructing the formwork for a staircase with correct specifications such as the 'stabilising of such a structure' could be different. And thus the two sets of rules do not always allow for the smooth implementation of knowledge and practice. There should be a link between what is happening at college and at the workplace.

Mwanza-Simwami (2009) uses the technique to generate research questions to operationalise what she refers to as 'sub-activity triangles' resulting from the decomposition process to support data gathering and analysis from an AT perspective. She uses the sub-activity triangles to analyse the interaction and

mediation of an activity as well as identification of contradictions or problems in an activity. For this study, I use the term ‘sub-system’ instead of ‘sub-activity triangles’. In the sub-system within that of Engeström’s AT triangle, it shows that within an activity of CE the interconnection between the subject, object and the community. All three elements do meet at some point when various activities are carried out. These sub-systems are linked through a common object of the main activity system. The common ‘object’, student learning, is what each activity system strives to achieve.

2.8 SUMMARY

My research draws on that of McMillan (2008), where I shall make a comparison between the activity systems, unpacking each of the six elements in the three activity systems to determine where there have been contradictions. I am of the view that AT is a workable tool for innovation and transformation of instruction. Through analysis of various aspects of instruction, AT can assist lecturers and workplace supervisors to improve the integration of knowledge and practice, despite the contradictions that may or may not arise between the activity systems.

In summary, I have explained activities in the classroom, workshop/college yard, and CE workplace in the light of a WIL perspective. AT was used to encompass all relevant factors that involve the subjects in their endeavour to work on the object to accomplish the outcome. The outcome is *students’ preparedness for the workplace.* It is clear that there is a relationship between the ASs, but there is a measure of uncertainty as to how they interact to adequately prepare students for the workplace.

It is clear that an AS is not just a research framework, but also a ‘discovery’ model for supporting innovation. Therefore, it is appropriate for the activity in the classroom, workshop/college yard and workplace to be investigated in the light of the learning that is taking place. Engeström’s (1987) model of activity theory with its six elements can be used for describing and analysing any activity in progress.

My efforts are to categorise the research according to how the ASs are enveloped in an educational context.

AT, through the use of ASs, provides a useful conceptual framework with WIL for understanding learning in an FET college and workplace environment. It provides a clear focus and the conceptual tools to determine the important elements and relationships in the process of human actions during the data collection and analysis phase of this study. The element of uncertainty between the activities remains: *What role does each of these systems play in preparing the student for the workplace? Does the 'object' meet the 'outcome'?* Chapter 3 outlines the research methodology used and the design and approach to execute the research project.

CHAPTER THREE: RESEARCH DESIGN AND METHODOLOGY

3.1 INTRODUCTION

The main purpose of the study was to examine civil engineering (CE) students' preparedness for the workplace. The major question that guided this study was: *'Does the FET college adequately prepare the CE student for the workplace?'* In clarifying the methodology, I initially begin with an explanation of the rationale for using Activity Systems (ASs) as a tool of analysis; It then present the research design, data collection methods, and procedure for capturing the data from the different sites for analysis. Ethical considerations are also addressed. Against the background of the first two chapters, this chapter provides the methodological process followed to ascertain the situation in the Western Cape with regard to the role that FET colleges play in preparing civil engineering students for the workplace.

3.2 RATIONALE FOR USING ACTIVITY SYSTEMS AS ANALYTICAL TOOL

Referring to my research question: *'Does the FET college adequately prepare the CE student for the workplace?'*, I have used ASs to compare differences in the three systems by examining the elements and sub-systems in order to identify the disjuncture across the ASs. There are three types of learning environments/settings which students are exposed to, namely: (1) the learning in the classroom, comprising the theoretical knowledge aspects, (2) the learning in the workshop and college yard, which is a combination of knowledge and practice, and (3) the learning in the workplace, which is practical, and production and profit driven.

Mwanza and Engeström (2003) adapted the concept of AS components into a research interview questionnaire. For example, they took the 'mediating artefact' element and posed the question: 'What types of symbolic and material tools do the lecturers have at their disposal to work on the curriculum?' They used the data-capture methodology called the 'eight-step model' in empirical research on different engineering classrooms to better understand the activity in question.

Drawing on the research of Mwanza and Engestrom (2003), who used the 'eight-step model' and Paré and Le Maistre's (2006) methods of coding and themes, I shall use AT as an analysis tool in the following section.

3.2.1 How I have used ASs as units of analysis

I have divided my data collection into six main sections, based on the elements of AT, set out by Engeström (1987) as indicated below:

- Subject deals with the activity of the students
- Object focuses on the learning that is taking place in each AS
- Mediating artefacts are the tools and equipment for learning
- Division of labour involves the division of tasks and roles of members
- Community refers to all participants involved in the study
- Rules are the norms that regulate the actions of the student

Various activities occur in the three settings where the research is conducted. I have therefore identified three compelling reasons to use the ASs as an analytical framework for this research: firstly, to understand what is happening at each site of learning, secondly, to locate inconsistencies within the AS, and thirdly, to compare the three different ASs using AT as the framework for investigating any activity in context (Engeström, 1996; Kuutti, 1996; Lantolf & Pavlenko, 2001; Lantolf & Genung, 2002; Thorne, 2003).

Having to focus on my research question, I firstly had to understand what was happening at each site of learning as an AS, secondly to make a comparison of the elements of ASs, and thirdly to make a comparison of the sub-systems of ASs. I'm of the view that this should give me an understanding of what the relationship is between knowledge and practice at the college and at the workplace as my main argument for this study. The next section will therefore give some indication of the activities in the various ASs. For me to make a

comparison, I have broken the ASs down into constituent parts, such as the elements and sub-systems.

1. What is happening in each Activity System?

In this section I shall describe how I have designed my research, using ASs. Here, I shall investigate each of the elements of the ASs, for example, the classroom, workshop/college yard and the workplace. Each of the ASs is object oriented, for example, its focus is student learning in each of the learning sites. Figure 3.1 indicates each site of learning, as well as the main activity of learning as described. Even though there is a smooth movement between ASs, there are challenges of knowledge-practice relations.

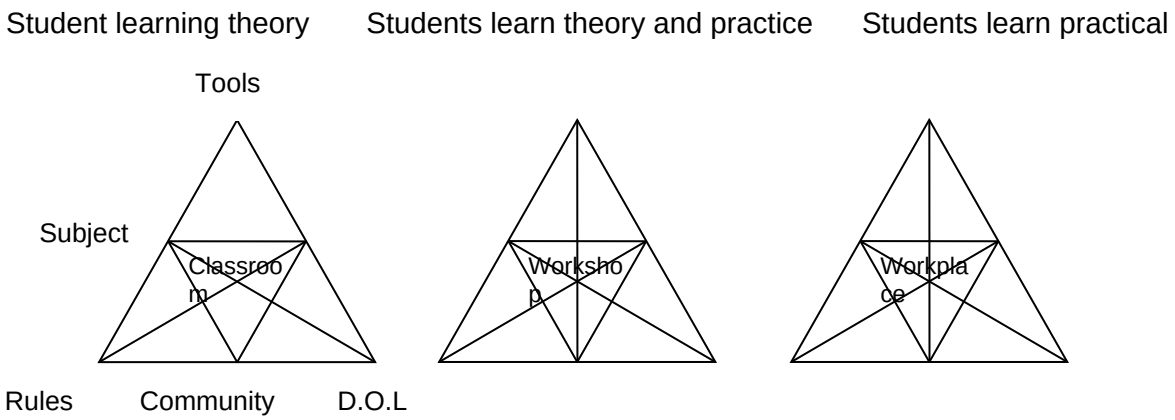


Figure 3.1: Learning that takes place in each Activity System

In the classroom AS, the lecturer takes the leading role in the process of teaching and learning, as an example of the Division of Labour (D.O.L). In most cases the students listen and observe, owing to the dominant role of the lecturer. In this environment, there are four different theoretical knowledge-based CE programmes that are offered, with various subjects such as mathematics, building science, trade theory, building drawings, construction, land surveying, quantity surveying, and building administration. Learning as a tool in the classroom drives many small activities, where students work in groups, in pairs, or as individuals. This necessitates an element of responsibility, leadership, and the ability to cope with pressure among individuals. Students interact with the theoretical content in the classroom and learn about various concepts. The

students take notes, ask questions, complete assignments, and write tests and examinations. The learning comprises theoretical knowledge only, with no practical component.

The workshop or college yard AS is an extension of the classroom knowledge that leads to practice. The CE curriculum is compiled in such a manner that students learn practical activities in the workshop and college yard. This is an example of the ‘object’, the construction of a concrete column. The ‘tool’ element constitutes the physical tools or knowledge used to construct the concrete column. The ‘subjects’, that is, the students, are monitored, guided and assessed by the senior students and the lecturer who forms part of the community.

In the workshop environment the simulated practice and construction of small models outweigh the theoretical knowledge done in the classroom. Students are in a more relaxed environment, compared with the classroom, where learning is rigid and formal. The workshop lends itself to a more hands-on approach, where students are given various opportunities to exercise various practical activities. The tools that the students work with are physical, such as the operation of machinery and equipment. Simulated activities are used most of the time, and small models are constructed, which later are destroyed to make space for other models.

At the workplace AS, practice is done at a real civil engineering site. In terms of learning, the workplace supervisor should assume the responsibility of the college lecturers. The workplace supervisor should therefore become responsible for the integration of the knowledge from the classroom, the practical from the workshop/yard, as well as the practical on site. The learning that takes place in the workplace should then be seen as an active rather than a passive process, which reflects on the construction of new ideas and concepts grounded in current and past experience in the classroom, workshop and college yard. Some of the knowledge content taught by the lecturer is then reinforced by the workplace supervisor. The knowledge and simulated experiences become a reality when the student engages in making the real product. The primary task of the lecturer here is to visit the workplace and assess whether the student is competent in

carrying out various practical tasks. Once the student is found to be competent, the task is signed off in his/her logbook.

In the following section I explore contradictions/inconsistencies in the elements of an AS. This will also be used as the first level of analysis in this study.

2. Comparison of the elements of Activity Systems

Discrepancies, inconsistencies, uneven quality or performance can be a challenge when a large team is working to reach a desired outcome. For example, when individuals in a soccer team are inconsistent, it can cause the team to be unsuccessful. Likewise in the CE industry, when FET colleges are inconsistent in delivering a curriculum which meets the demands of the industry, the industry could fail to deliver. I shall discuss some of the discrepancies/inconsistencies that exist between the elements of an AS in the CE course.

Mediating artefacts: The teaching methods as a tool element used by the lecturer in the classroom and workshop/college yard, and the workplace supervisor on site, do not always benefit the learning style of the students. Inconsistency arises when the lecturer teaches the student theoretically how to prepare a wall for painting, in that there are certain steps to follow before applying the paint to the wall; the lecturer in the workshop, on the other hand, will omit some of the steps, for example, neglecting to sand the wall before applying the paint. When the student goes the workplace, the workplace supervisor will instruct the student to only sand the wall once and not to apply a primer coat, because too much time is spent on the process. Thus the lecturer in the classroom teaches the student the correct way; however the lecturer in the workshop wants to economise on sandpaper, whereas the workplace supervisor wants to save on labour and material. These inconsistencies in teaching the correct procedures create confusion among the students.

Object: Student learning is the object. The inconsistency which exists is the knowledge and practice divide, for example, one AS focuses more on knowledge,

whereas the other one focuses more on a combination of both knowledge and practice, and the third focuses on practice only.

Division of labour: Priority is given to certain subjects such as mathematics and building science over others, for example, trade theory and drawing subjects. When students go to the workplace they don't engage directly with mathematics and building science, but rather with the trade-related subjects such as plumbing, bricklaying, and carpentry. The trade subjects are the ones that allow the students to do the real work, whereas the other knowledge subjects assist the students with the calculations of certain tasks.

The discrepancies/inconsistencies that are forthcoming in the AS are clear indications that there are disparities in the system, as indicated by the lightning bolt in Figure 3.2. There appear to be disparities between the tools, object and division of labour.

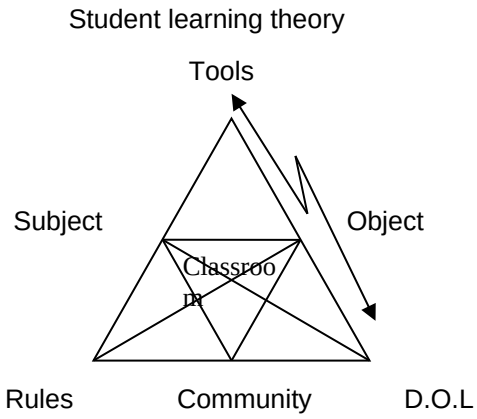


Figure: 3.2: Learning that takes place in one Activity System

In the next section, the three ASs are compared, with a focus on the learning that takes place in these systems.

3. A comparison of the sub-systems of Activity Systems

This phase enables me to look across Activity Systems, for example, the classroom, workshop/college yard, and the workplace. At the same time, I shall examine the decomposition of an AS to compare the sub-system triangles within an AS, for example, 'tools, object and subject' and 'subject, object and community'. With the decomposition of the AS, I shall stand back from the data and gather my ideas and thoughts on how the data will be analysed from an AT perspective, which Mwanza-Simwami (2009) refers to as 'detail abstractions'.

Contradictions may arise within the elements in relation to the 'object' of the activity system. For example, the lecturer expects the students to follow the proper procedure 'rule' to construct the formwork for a concrete column 'tool'. When the lecturer goes to the workplace to assess the student on the procedure, he discovers that students have followed the workplace supervisor's method of constructing the formwork, resulting in a contradiction between the 'rule' element and the 'tool' element in relation to the 'object'. The main point is to determine how the lecturer and the workplace supervisor mediate the subject to act on the object that influenced the AS.

Even though there are constant contradictions within ASs, providing the opportunity for change and development of an AS, I am of the view that AT is a workable tool for innovation and transformation of instruction. Through analysis of various aspects of instruction, AT can direct lecturers and workplace supervisors to how they can improve their method of teaching and demonstrating.

Figure 3.3 presents the decomposition of the AS into sub-system triangles used to compare the different ASs with one another. This analysis is the second level after the first, where only the elements were compared in an AS. This form of analysis is at a higher level, as I did not simply look at the elements, but at how the elements interact with one another.

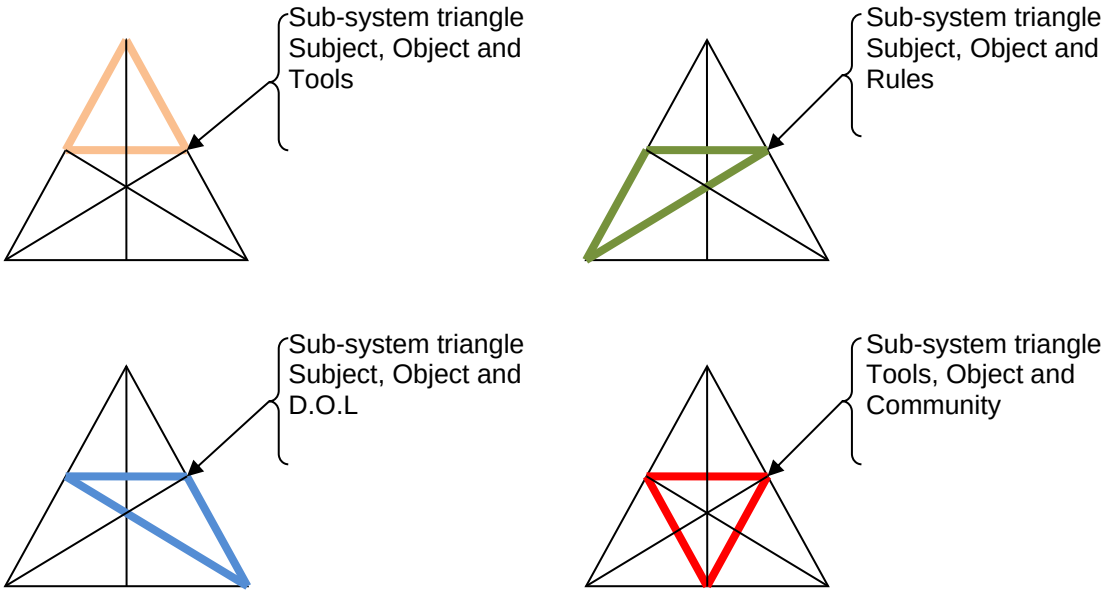


Figure 3.3: A comparison of the sub-system triangles

I proceeded as follows: I commenced by looking at how others have used AT and ASs in the context of existing practices. Secondly, I compared the elements within ASs. Lastly, I introduced the decomposition of ASs into sub-system triangles, which assisted me in reducing the complexity of the data into smaller and more manageable components.

3.3 RESEARCH DESIGN

Combining Mwanza-Simwami's (2009) eight-step model and Engeström's (1987) AS model, will assist me in describing knowledge and practice integration in the FET college classroom, workshop/college yard and the workplace, in order to better understand what contributes to success or failure in these environments. The analysis is done according to Mwanza's previous work, based upon two levels: 1) a comparison of the elements of ASs, and 2) a comparison of the sub-systems of ASs. The elements and sub-systems are analysed to determine what the similarities and contradictions among them are.

Mwanza's first step: ***What is the activity***?

The activity is in the classroom, workshop/college yard, and workplace, where CE students learn about the theoretical and practical elements of constructing formwork for a concrete staircase. Within this activity there are a number of different elements that constitute a whole, and are described below.

The Mwanza and Engeström (2003) model allowed me to build these steps into my study to analyse the data according to the various elements of the ASs; the data was gathered from surveys, interviews, and observations. Below each of the steps, I give an example of the types of questions posed to students and lecturers. The steps are:

Step 1 *Activity of interest*: What is the sort of interest for the activity?
What activities do you do in the classroom, workshop/college yard and workplace?

Step 2 *Objective:* Why is the activity taking place?
What are the reasons for learning in the classroom and doing practical in the workshop?

Step 3 *Subjects:* Who is involved in carrying out this activity?
How will the learning in the classroom and workshop assist you in the workplace?

Step 4 *Tools:* By what means are the subjects performing this activity?
Are the tools used in the classroom and the workshop adequate for the workplace?

Step 5 *Rules* and *regulations:* Are there any cultural norms, rules or regulations governing the performance of activity?
Could you apply the CE rules that you have learned in the classroom and workshop at the workplace?

Step 6 *Division of labour:* Who is responsible for what, when carrying out the activity and how are the roles organised?
What are the main activities you, as the students and lecturers, do in the classroom and workshop?

Step 7 *Community:* What is the environment in which this activity is carried out?
What impact does the environment have on the learning in the different communities?

Step 8 *Outcome:* What is the desired *Outcome* from carrying out this activity?
What are your expectations of the CE course?

This project involved a comparative study that was conducted at FET college sites in the classroom, workshop/college yard and civil engineering workplace. Data was collected from a specific target group in the Western Cape at four FET colleges, with 137 civil engineering students, 16 civil engineering lecturers, eight workplaces, and seven workplace supervisors. The data was then compared with the intention of understanding relationships between ASs, to enhance alignment. Table 3.1 is a summary of the comparative research at FET colleges as AS 1 and 2, and the workplace as AS 3.

Table 3.1: A summary of the data sources and methods at FET colleges and the workplace

FET college sites: classroom, workshop/ yard	**Civil engineering workplaces**
Student and lecturer surveys	Workplace supervisor surveys
Interviews with students and lecturers	Interviews with workplace supervisors
Observations of students and lecturers in the workshop	Observations of students and workplace supervisors

In order to conduct the investigations, I used the mixed-method approach using surveys, interviews, and observation schedules. Gay and Airasian (2003) refer to this type of research as QUAN-QUAL, integrating simultaneous qualitative and quantitative methods. Qualitative methods are referred to by Jacob (1988) as collecting detailed data that is gathered through open-ended questions that provide direct quotations. The interviewer is an integral part of the investigation. This differs from quantitative research, which attempts to gather statistical data to

provide information about relations, comparisons, and predictions. The advantages of using a mixed-method study, according to Frechtling and Sharp (1997), are that combining the two approaches sharpens our understanding of the research findings.

3.4 RESEARCH SITES AS ACTIVITY SYSTEMS

The research sites that will be used here are the FET college sites, for example, the classroom and workshop/yard, and CE workplace sites, whereas the sources or participants' selection includes the CE students, lecturers, and workplace supervisors.

3.4.1 FET college sites with two Activity Systems

All four FET colleges in the Western Cape participated in this study: one at which I taught, and three other FET colleges in the province, as they met the basic requirement of the study, namely, a civil engineering course currently in operation. I have just recently been employed at the college where I currently serve as the Campus Rector, and therefore have not been engaged in any activity in respect of the civil engineering course; this eliminates bias in the selection of the colleges. This allowed for the completion of surveys, interviews, and observation of stakeholders, consisting of students and lecturing staff. In addition, I had relatively easy access to all the stakeholders, although the consent of all the parties was nevertheless still required and obtained. The selection of each of these stakeholders was based on legislative and institutional requirements.

The institutions are public FET colleges, offering Western Cape Education Department (WCED) accredited programmes: these are accredited and non-accredited skills programmes as well as the National Civil Engineering Certificate and Diploma offered by the Department of Higher Education. Although all four FET colleges participated in the study, the selection criteria for the sites included: 1) sites where the civil engineering programme was offered, 2) sites that included students who use a variety of South African first languages (e.g., isiZulu,

isiXhosa, English, and Afrikaans), 3) sites that included workplace training in civil engineering programmes, and 4) sites that gave permission for surveys to be distributed, interviews to be conducted, and observations to occur.

I had requested clearance to disclose these FET colleges in the study. The WCED provided a consent letter (see Appendix A). The FET colleges were located in four areas of the Western Cape (see Appendix B). I obtained written clearance to conduct the research at FET colleges (see Appendix C).

3.4.2 CE workplace sites as one Activity System

During the time of this study, CE students embarked on workplace training in a wide variety of fields at small, medium and large companies. Contact details of small, medium and large companies that employ students for workplace training were provided by the human resource departments at FET colleges. In some instances students contacted the companies themselves, in others, the college contacted the companies on behalf of the students and made the necessary arrangements for the workplace training to take place.

Nine workplace civil engineering supervisors were asked to participate in the study and eight agreed to complete the surveys, be interviewed, as well as observed when interacting with the students. This provided an opportunity to view the students applying the civil engineering skills acquired during the first, second and third years of the civil engineering course.

Written clearance was obtained from these companies in the study (see Appendix D). The companies either responded by post or by email.

3.5 DATA COLLECTION METHODS

To gather the data for this research, surveys, interviews, and observational methods and tools as recommended for the mixed-method approach were used. The rationale for the use of a mixed-method approach research design relates to the proposed investigation of WIL in terms of its conceptualisation, purpose,

location, implementation, and experience by students that study at FET colleges and are involved in workplace training in the civil engineering industry. As the boundaries between the phenomenon 'WIL', FET colleges and CE workplaces (historically why WIL is needed, what it is intended for, how it is implemented within the institution, and employer/industry input) are not evident, this makes the mixed-method approach particularly relevant.

The approach attempts to bring together methods from different paradigms. For example, a large-scale survey was carried out with students, lecturers, and workplace supervisors, followed by a series of structured interviews with two smaller groups of students, individual lecturers and workplace supervisors, followed by observation in the college workshop and on site.

3.5.1 Survey data

The survey method is a very valuable tool for assessing opinions on WIL, and trends in the FET college sector and civil engineering workplace. Surveys, according to Babbie and Mouton (2001), are the respondents' reports on their own attitudes, opinions, or beliefs about something. For example, I used students, lecturers, and workplace supervisors, who rated themselves on their own interpersonal skills such as experience and knowledge. Surveys are very useful for many research purposes; it was important for me to be mindful that self-reporting was a good method for determining WIL at FET colleges and the workplace. The surveys were followed by focus group interviews.

The surveys were, in fact, an operationalisation of the eight-step model of Mwanza-Simwami (2009) discussed in the theoretical framework to orientate the data. In other words, what the theoretical framework posited as the learning by students at FET colleges and the workplace was probed by means of the survey. Questions were formulated in a way that would verify my contentions of the factors that influence knowledge and practice in FET colleges and the workplace. For example, a question was posed to students: 'What were the kinds of experiences gained prior to the CE course?' This type of question was linked to the background of the student, and to the subject.

Three different surveys were designed (Appendices E, F and G). One survey was designed for the students (E), one for the lecturers (F), and another one for the workplace supervisors (G). The three surveys covered six elements, with the focus on the learning of the students in the different ASs.

The student surveys were administered through the assistance of some colleagues at various campuses; however, I administered the lecturer and workplace supervisor surveys through personal interviews. Each survey took approximately 45 minutes to complete.

3.5.2 Interview data

After the survey method was used to gather data, the interviews were used to allow for deeper probing into the initial responses from the survey to gain a more detailed answer to the questions where necessary. The richness of the data was therefore dependent on the interviewer.

Frey and Oishi (1995:24) regard interviews as "a purposeful conversation in which one person asks prepared questions (interviewer) and another answers them (respondent)". This is done to gain information on a particular topic or area to be researched. Interviews are a useful tool that can lead to further research using other methodologies such as observation and experiments (Jensen & Jankowski, 1991).

Open-ended interviewing was adopted in collecting data. Interview questions were posed to two focus groups, leading to discussions of the CE course, how they felt the course was preparing them for the workplace, and how they thought the course had shaped their learning. The objective was to induce and entice them to elaborate, since language and social cues reveal attitudes, morals, and beliefs, as well as opinions and feelings (Kendall & Kendall, 1993). Furthermore, open-ended interviews are most suitable for questions of ‘how’, because they are explorative in nature. The interviews were followed by observations.

Individual formal interviews were conducted face-to-face during my visits to FET colleges with the lecturing staff, and with workplace supervisors during my visits to workplace sites. Although formal, interviews were largely interspersed with informal conversations as part of my investigating project. In a typical scenario, I would start the interview in the office of the lecturer or workplace supervisor, and then we would find ourselves in the classroom, workshop, or workplace, continuing the discussion along the corridors or on site.

The interviews were conducted after the completion of the surveys to provide further clarification and explanations to which the students, lecturers, and workplace supervisors had not properly responded in the surveys. The interviews were used to obtain multiple responses to set questions and to allow for detailed responses. The duration of the interviews varied from place to place, depending on factors such as time, work commitments and working conditions, and were conducted over a period of three weeks.

Prior to the interviews, an interview schedule for students, lecturers, and workplace supervisors was compiled. This was a list of questions that I had asked the interviewees, with follow-up questions prepared before the interviews were conducted. The interview schedule started with more open questions that allowed the interviewees to respond in their preferred way. I was then ready to ask for more accurate information pertaining to the study. At this stage I used more closed-type questions, based on the interviewee's answers to the open questions.

The interview schedules (Appendices H, I, & J) for students (H), lecturers (I), and workplace supervisors (J) comprised a section dealing with general questions requiring the interviewees to provide information on their student identities, work experience, whether they were enjoying the course, if they attended their classes regularly, differences in the college approach from that of the workplace, and what their best experiences pertaining to the civil engineering course were.

For the lecturers, questions were asked such as: ‘How many years of experience do you have in the CE industry?’ and ‘Do you prepare students adequately for

the workplace?' For the workplace supervisors, the focus was on the workplace training for students and questions were asked such as, 'Are students adequately prepared for the workplace when they come to site?' and 'Do they have the knowledge and skills to operate the latest equipment on site?'

Informal interviews were also conducted with experts such as deputy chief executive officers and programme managers in the CE fields at FET colleges. Their comments pertaining to policy and closer working relations between the college and industry were valuable and were added as expert opinion later in the thesis.

Each participant was afforded the opportunity to describe his/her own experiences pertaining to the college and the work set up. All interviews were audio-taped, with the permission of the participants, and later transcribed. Mulder (1996) points out that "this allows for the capturing of the actual spoken words of the participants to be used in the investigation as there is no substitute for raw data of actual quotations spoken by the interviewees".

3.5.3 Observational data

According to Langley (2000), observations involve looking and listening very carefully. We all watch people sometimes, but we do not usually watch them in order to discover particular information about their behaviour.

Observational research methods solely involve the researcher or researchers making observations. There are many positive aspects of the observational research approach. Observations are usually flexible. For instance, before undertaking more structured research, a researcher may conduct observations in order to form a research question. Observational research findings are considered reliable in validity because the researcher is able to collect considerable depth of information about a particular behaviour. In the workshop or college yard, not only the students were observed, but lecturers as well, to determine how actively the lecturer was involved with student learning.

I employed direct observation instead of participant observation. The observations were only done in the workshop/college yard and the workplace; the classroom was excluded. An observation schedule (Appendix K) was developed to capture the data recorded during the observation periods. Students were observed in the workshop/college yard and the workplace. This data was systematised in order to show frequency and other patterns in activities. The observations were captured as a way of triangulating data from surveys and interviews. Permission was obtained from the students, lecturers and civil engineering employers.

The observation was to determine whether there was a relationship between knowledge and practice and what form of learning took place between student and lecturer, and student and workplace supervisor? This was then recorded as 'yes', 'no', or' seldom'. Space was provided in the last column of the schedule for any comments related to the question. All this information was linked to the AT theoretical framework. Photographs were also taken to substantiate comments made in the schedule. These were taken with the permission of the participants.

Two double periods of between 30 – 45 minutes per period at each FET college were selected for observations while students were taught civil engineering skills and knowledge. An unobtrusive, direct observation in a natural environment allows for data to be collected by recognising and noting behaviour, objects and occurrences. Some of the limitations of this method are: it is very difficult to observe things such as attitudes, motivation and intentions; also, if people know they are being observed, they tend to behave differently, and it may be perceived by some people as an invasion of privacy (Struwig & Stead, 2001).

At campus A, first-, second- and third-year civil engineering students have five periods of 45 minutes per week. One double period is utilised for practical skills training and this is when the first-year students were observed. At campuses B and C, first-, second- and third-year civil engineering students are required to attend four periods of 45 minutes per period, and the entire Friday is devoted to the practical workshop for skills training. One hour was used to observe the second-year students at campus B, and the following week the students at

campus C were observed. At campus D, first-, second- and third-year civil engineering students are required to attend five periods of 30 minutes per period; on Tuesdays and Thursdays after the lunch break they attend the practical workshop for practical skills training. The third-year students were observed on a Thursday for two 30-minute periods.

The details of the participants at FET colleges and the workplaces were entered on the observation schedules. The photographs were examined and the schedules completed on site.

3.6 DATA CAPTURE AND ANALYSIS

The FET college data comprises data obtained from an analysis of student and lecturer surveys, interview data and observational data. The workplace data comprises data obtained from the student and workplace supervisor survey data, interview data and workplace observations. All the data were captured and analysed under the heading of AT.

3.6.1 Capture and analysis of survey data

These data were captured in Microsoft Excel™ spreadsheets for the quantitative and qualitative data. Appendices L, M, and N provide the information of how the qualitative and quantitative data were captured.

Qualitative survey data, derived from the comments and explanations of students, were captured using Geisler et al. (2002) method of recording students' comments, where keywords such as *practical experience gained through the building of houses*, and then codes such as *site experience* were identified and allocated. The data from the students, lecturers, and workplace supervisors were captured after they had responded to a question such as, 'What kind of experience have you gained in the civil engineering industry?' A number was assigned to each of the senior students in the NATED programme (SN01, SN02, etc.), junior students in the NATED programme (JN01, JN02, etc.), lecturers (L01, L02, etc.), and workplace supervisors (S01, S02, etc.); next to these

numbers were the responses from the respondents. The idea was to develop the unit of analysis in a very systematic way as illustrated by Paré and Le Maistre (2006).

Paré and Le Maistre (2006) used the unit of analysis as persons learning to engage in activity. They developed coding categories and these categories were later organised into themes, for example, a theme that emerged was: 'initial impressions of participation in professional practice'. From the survey data with students, I developed themes such as: *improving the integration of knowledge and practice; providing sufficient equipment; work placement for civil engineering graduates; establishing links between FET colleges and universities of technology; improving on site visits; combining practical and theory; links between college and site; studying civil engineering because of career opportunities; and applying the safety measures on a site.* While working from the concept of AT, I remained alert to references from the elements of the AS.

Quantitative survey data were analysed using percentages and frequency tables. The responses to related questions were analysed together, for example, questions 5 and 6 related to the students' self-evaluation of their experience in the civil engineering industry and what programme they were registered for, questions 7 and 8 related to the grade they had previously passed and how long they had been studying at the college.

3.6.2 Capture and analysis of interview data

Interviews were conducted with two focus groups of students from the civil engineering course. These interviews focused on the application of the theoretical knowledge of their courses to a practical skill on site. The interviews were tape- recorded and the transcripts analysed according to recurring patterns and perceptions.

The participants were allocated a number and the data attributed to an individual student identified by 'focus group' (FG) followed by a number; for example (FG03) is the third student of the focus group. Lecturers and workplace

supervisors were also interviewed and were identified as (L) for the lecturer, followed by a number, for example (L4), which identified the fourth lecturer of the group's comments. Workplace supervisors were identified as (S), followed by a number, for example, (S07), the seventh workplace supervisor of the group's comments. The responses were captured in the column next to the number of the student, lecturer, or workplace supervisor, key words were identified from the various responses, and later coded and analysed.

From the interview data with students, lecturers and workplace supervisors, I developed themes such as: *Insufficient examples; inadequate class explanations; lack of practical experience; dedicated lecturers; too few practical examples; need for integration of knowledge and practice; collaboration between the college and the site; upgrade student facilities; proper and latest machines and equipment; and greater interaction between the colleges.*

3.6.3 Capture and analysis of observational data

Observations mostly took place in community settings; in this case the college workshop/college yard and work place environment, in locations believed to have relevance to the research. The method is distinctive because I approached participants in their own environments. Generally speaking, I engaged in observation, trying to learn what life is like for an 'insider', while remaining, inevitably, an 'outsider' (Bakeman & Gottman, 1997). While in these community settings, I made careful, objective notes about what I saw, recording all accounts and observations as field notes on an observation sheet.

The observations were done to look at interaction and learning taking place between students, lecturers, and workplace supervisors, what tools were used to perform various tasks, and whether students were able to apply knowledge in a practical setting.

3.7 RELIABILITY AND VALIDITY OF THE DATA

Data collection instruments have to comply with the standard criteria of reliability and validity (Treece & Treece, 1986). According to Rossouw (2003), reliability of a measuring instrument demonstrates the consistency of the measurement. In other words, a measuring instrument is consistent if it produces equivalent results for repeated measurements. Brown and Keep (2000) describe the validity of a measuring instrument as the extent to which such an instrument serves the purpose for which it is intended, or the extent to which it measures what it was designed to measure.

In the present case, reliability and validity of the questions within the instruments were ensured in the following ways:

Firstly, I formulated the items only after a careful study of the literature, including relevant policies, making sure that the items used standard terminology and could be interpreted in the intended way by respondents familiar with the subject matter. In this way, content validity of the questions was addressed. Secondly, a type of qualitative convergent and discriminant validation was done by inspecting the recorded data for inconsistencies in the responses to items that should have evoked similar responses, and similarities in responses to items that should have elicited divergent responses.

3.7.1 Participants

I wanted to examine the thoughts and opinions of students, lecturing staff, and workplace supervisors who played a role in the civil engineering course and record their real experience and perceptions of how the civil engineering course prepared students for the workplace.

All first-, second- and third-year students at the four FET college sites in the civil engineering departments, 16 fulltime academic staff members who lecture civil engineering subjects and seven workplace supervisors were included in the study.

Surveys were distributed to 140 students at four FET colleges. Students were asked to voluntarily complete the surveys and were allowed to ask questions of clarification. Only 137 students responded to the surveys. Later two groups of eight students in their first, second, or third year, following the Apprenticeship, Learnership, NCV, or the NATED civil engineering programmes, were approached to form focus groups to probe the questions in the survey.

An invitation was extended to all 22 lecturers at all four FET colleges to form part of the study, but only 16 agreed to participate in the study. The 16 lecturers were individually interviewed and asked to complete surveys.

3.7.2 Pilot testing

A draft version of the student survey was pilot tested in a third-year civil engineering class in the first trimester of 2006. These students had similar backgrounds to the target participants for this study. The pilot study participants were all in a class that had knowledge of the civil engineering course. After completing the survey, ten students were asked to comment on the survey questions.

The pilot survey was also distributed to several civil engineering lecturers, along with initial versions of the research questions; these lecturers then provided commentary on the structure of the survey. The lecturers also discussed how they felt each of the survey items could be used to address the research questions.

Using the feedback from the students and lecturers, several survey items were revised to clarify the wording. Several items, which did not directly provide data that pertained to the research questions, were also removed. In addition, this pilot research work was used to revise some of the research questions and to clarify and refine the sub-questions.

3.7.3 Triangulation of the data

Triangulation is typically perceived to be a strategy for improving the validity of research or evaluation findings: "...triangulation is supposed to support a finding by showing that independent measures of it agree with it or, at least, don't contradict it" (Miles & Huberman, 1984:235). It is essentially a strategy that will aid in the elimination of bias and allow the dismissal of plausible rival explanations so that a truthful proposition about some social phenomenon can be made (Campbell & Fiske, 1959; Webb et al., 1966; Denzin, 1978).

Triangulation is understood to involve data from more than one source, using more than one collection and analytical method (Denzin, 1978). In this research I have used three data sources and three data collection methods, and the analysis was done according to the elements of AT to compare the learning sites.

3.8 ETHICAL CONSIDERATIONS

The essence of ethics within research is that researchers balance the pursuit of information, for their own purposes, with the rights of those who took part in the study (Cohen et al., 2000). In no way should the position of any respondent be prejudiced through, for example, divulging sensitive information or expressing an unpopular opinion.

I did not envisage much risk to the respondents for the following reasons:

- It was an anonymous process – their names were not used.
- Confidentiality was rigorously observed.
- Respondents were not asked to comment on one specific person within the college.

According to Cohen et al.(2000:51), “Informed consent is an important component of ethical considerations. This includes four aspects: competence, voluntarism, full information and comprehension.” High ethical standards were adhered to in this study and confidentiality was guaranteed.

3.9 LIMITATIONS OF THE STUDY

Hofstee (2006) argues that all methods have limitations. Like any other enquiry, the issue of bias and generalisability quickly come to the fore. Regarding the issue of bias, the argument is that personal experiences, beliefs and value-laden narratives are biased and subjective. However, within the postmodern qualitative and quantitative research framework, subjectivity is permissible, because truth is relative. Focus was on the depth and quality of information provided by respondents pertaining to civil engineering learning, with major emphasis placed on the uniqueness of each particular contribution.

The research design was intended to produce outstanding results that account for or predict the behaviour of a wide classification of people such as students, lecturers, and workplace supervisors. It would have been ideal to visit sites outside Cape Town, but budget limitations made it very difficult to access more sites beyond the greater Cape Town area.

Some of the workplace supervisors were unavailable on the day I had scheduled the interview. Some were not always readily available to attend an interview and to complete the survey. In some cases I had to make two or three different appointments to meet with them.

Students are only accommodated on site during the June college vacation and therefore the observation could only be done during that period and at no other time. When the data was collected, it was reported by the colleagues who assisted me in its collection that some of the first-year students were very immature in their attempts to complete the surveys, and this could be detected in the manner in which they responded to the questions. When the focus groups interviews were conducted, seven of the students withdrew at the last minute because they had lectures. I then managed to form two groups of eight students per interview. I also detected that most of the students I interviewed were very nervous. Future studies might consider that only final-year students be used for such a study, because they would have a certain amount of experience and maturity.

3.10 SUMMARY

This chapter describes the processes and provides the guidelines that directed the research approach. It was shown in this chapter that the nature of the research undertaken required a mixed-methodapproach. This chapter has explained that the qualitative and quantitative methods in the data collection were applied by the use of Activity Systems. The elements of AT were used to analyse and present the data. One survey was administered to civil engineering students and another to lecturers in civil engineering at FET colleges, while a third one was conducted with the workplace supervisors of civil engineering companies. Interviews were also conducted with students, lecturers, and workplace supervisors. Observation schedules were completed to determine the interaction between students, lecturers, and workplace supervisors.

In this chapter the research approach and design for the research were discussed, and a description was given of how data collection and analysis were carried out. The sampling procedure was clarified as well as the justification for the chosen sampling strategy. Details of how I proceeded to gain access and collect data were given. The methodology section also clarified how the issues of validity were dealt with.

The next chapter (Chapter 4) deals with the presentation of the results and findings in the classroom by students and lecturers at FET colleges.

CHAPTER FOUR: STUDENTS' AND LECTURERS' PERCEPTIONS OF THE CLASSROOM ENVIRONMENT

4.1 INTRODUCTION

In Chapter 2, the prominence of knowledge (or what is called 'theory') and practice relations and activity theory (AT) in the literature in respect of similar studies was highlighted. Subsequently, in Chapter 3, I substantiated AT as a suitable theoretical framework for this study.

As my argument is based on the relationship between knowledge and practice at FET colleges and the civil engineering workplace, I was most interested in student perceptions of the relationship between knowledge and practice in the classroom environment, although I also refer to responses made by the lecturers in the classroom. The main objective of this chapter is to present the findings of students' learning in relation to knowledge and practice in the classroom as an activity system and to respond to the principal research question: '*Does the FET college adequately prepare the CE student for the workplace?'* These findings are presented within an activity theory framework and organised according to the AT elements:

1. **Subject**: the civil engineering student
2. **Mediating artefacts/Tools**: learning material that allows for knowledge and practice integration
3. **Object**: the purpose of students' learning CE
4. **Division of labour**: students' roles in the college classroom
5. **Community**: students, peers, lecturers, and family members of students
6. **Rules**: college rules, general rules, CE rules,

AT thus provides a platform for determining similarities and/or differences in the knowledge and practice relationship between the elements of the various activity systems. An Activity System, with its elements, thus facilitates a holistic interrogation of the CE students' learning in the classroom. In addition,and more importantly, it magnifies each element to be examined individually and with equal

attention. Hence, AT enabled me to explore the relationships between the six elements in an AT system as they pertained to the research question.

The role of the college classroom is to provide knowledge that integrates with practice in the workshop/yard and the workplace. FET colleges are seen to be the prime means of providing students with formal skills qualifications such as the CE qualifications for the industry.

4.2 ACTIVITY SYSTEM OF STUDENT LEARNING IN THE CLASSROOM

The findings of each of the six elements in the activity systems are reported separately. This section deals with students' views, firstly as represented in the survey data, and secondly, in the interview data on the activities taking place in the classroom. I begin with a profile of the students who represent the 'subject' in this study and then present the findings according to the elements of AT.

Subjects: The civil engineering students

A profile of the subjects was obtained from the quantitative and qualitative sections of the students' questionnaires in which they were asked to identify their gender, language, age and schooling history (refer to Appendix A, Questions 1, 2, 3, 4, 6, 7& 8). This data provided a profile of the civil engineering students as predominantly male (see Table 4.1).

Table 4.1: Gender (N=137)

Gender	Male	Female
Frequency	88	49
Percentage	64%	36%

Students are predominantly drawn from the three major language groups of the Western Cape: Afrikaans, English and isiXhosa. As the course is open to students nationally, there are two smaller groups of speakers of isiZulu and other languages. Table 4.2 shows the different languages of the respondents. IsiXhosa

and Afrikaans speakers were strongly represented, as can be seen from Table 4.2.

Table 4.2: Language (N=137)

Language	Afrikaans	English	isiXhosa	isiZulu	Other
Frequency	43	34	49	3	8
Percentage	31%	25%	36%	2%	6%

Table 4.3 gives an idea of the diverse range of ages represented on the civil engineering programme. The average age of the students is 18 – 20 years. It is unlikely that these students would have any or much work experience.

Table 4.3: Age (N=137)

Age	18 – 20	21 – 22	23 – 24	25 – 26	27 & over
Frequency	94	20	5	4	14
Percentage	68%	15%	4%	3%	10%

Students were asked what grade they had previously passed at college. Students were placed in a particular grade at the college, according to their school-leaving qualifications. A grade is the level of a qualification which FET colleges offer to students. For example, if students had passed Grade 10 at school, they qualified to start with the National Certificate 2 (N2) or National Certificate Vocational 2 (NCV 2), which is regarded as equivalent to a school Grade 9 at FET colleges.

Table 4.4 illustrates that only 10 percent of the students indicated they had not passed any grade as they were new students at the college. For a student to have passed a grade, he/she would have been studying at a college for at least six months or longer. Ninety percent of the students currently enrolled for the civil engineering course had passed certain grades, and therefore had been enrolled at the college for some time. All of the students had been exposed to the theory, and some of them might have been exposed to some form of practice, either in the workshop/yard or at the workplace.

Table 4.4: Grade previously passed (N=137)

Grade	N2	N3	N4	NCV 2	L/S 1	None
Frequency	52	9	14	24	24	14
Percentage	37%	7%	10%	18%	18%	10%

Students from across the civil engineering department were asked what programme they were registered for in the department. Not all responded; however, there was a balance between the various groups that responded. Table 4.5 indicates that the largest group was that of the junior national certificate students.

Table 4.5: Programme registered for (N=137)

Programme	**Senior N4 – N6**	**Junior N1 – N3**	**Learnership**	**NCV**
Frequency	26	62	24	25
Percentage	19%	45%	18%	18%

Table 4.6 shows the duration of study of the civil engineering students. Most of the students had been studying at the FET colleges for one year. This could suggest that many of them had very little or no workplace experience.

Table 4.6: Duration of study (N=137)

Duration	**1 year**	**2 years**	**3 years**	**4 years**	**4 & more**
Frequency	102	18	15	-	2
Percentage	74%	14%	11%	-	1%

Mediating artefacts/tools: These are the teaching and learning tools and physical tools used in the classroom that connect knowledge and practice.

The classroom activity in this study is one of the activity systems under investigation. In other words, the study is examining what activities take place in the classroom as well as observing the physical environment of both students and staff. The students sit in rows, each one at his/her desk, waiting for the lecturer to teach and impart the theoretical knowledge. A college classroom

environment is often conducive to learning, owing to the interaction and activities taking place between the student and lecturer. However, the tools used, such as teaching, learning, and physical tools, differ substantially from those of the workshop/college yard and workplace.

The physical tools used in the classroom are small models or pictures of real machines and equipment shown to the students by the lecturers. This teaches them to identify the various parts and their working. The idea is to introduce the students to various tools, even though they have had no experience of working with the real tools. The set up of the classroom does not allow for large tools to be brought into the classroom, because students are seated in a very formal way in class, and in most cases there is no space for large equipment in the classroom environment.

Likewise, the teaching and learning tools also differ from those in the workshop/college yard and workplace. In the classroom and workshop/college yard, a more hands-on approach is exercised with students: they are asked to complete knowledge exercises and practical simulated tasks, but at the workplace they are instructed to complete a task in a specific manner and in a specific time that often contradicts the knowledge learnt in the classroom.

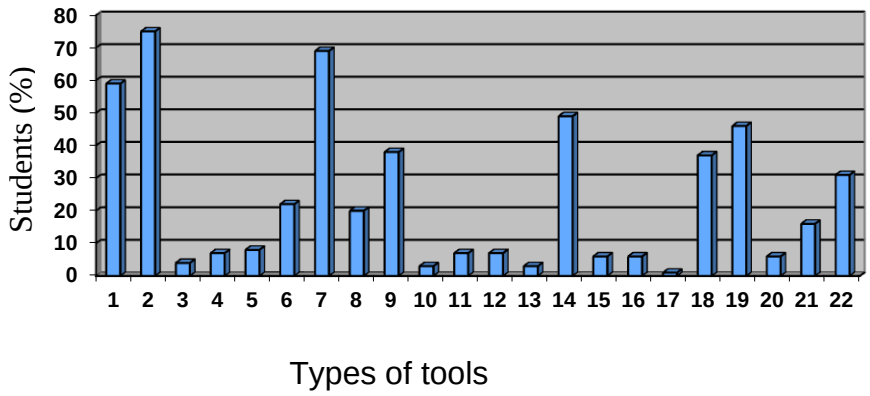
Students use a variety of tools in the classroom environment that should allow them to make the link between knowledge and practice integration. In other words, what knowledge is important to apply in practice in the workplace. They engage in various activities and therefore deal with various kinds of equipment, curriculum content and material. In this section, I describe the students' attitudes towards the tools used by the lecturer for teaching and learning, what students' perceptions are regarding teaching and learning aids as tools, the methods used for teaching and learning, the study and working methods used by students which form part of their repertoire as developing civil engineering artisans, and the curriculum as a tool which is used to prepare them for the workplace.

The data that was gathered first was by means of surveys. In some instances, where the data appeared to be somewhat shallow, I made use of the interview

data to substantiate some of the responses from the students. From the data that was gathered, a few themes emerged which will form the basis of the 'tools' elements in AT. The tool element in each of the activity systems will be compared, to determine the differences and similarities in each of the activity systems.

Physical teaching and learning tools used in the classroom

Students were asked in Question 13 of the survey which of the following tools they had used during exercises and activities in classroom. An analysis of the responses indicated that the five most used tools were: spirit levels (75%), tape measures (69%), dumpy levels (59%), hammers (49%), and water levels (46%). These are generally the most basic tools used by lecturers to demonstrate elementary principles such as measuring and levelling techniques. However, in the interviews, some students indicated that they were also required to use other tools, as indicated in the graph. The use of other tools is very limited in the classroom. These findings are represented in Figure 4.1.



Legend

1. Dumpy level
2. Spirit level
3. Abney level
4. Compactors
5. Graders
6. Theodolite
7. Tape measure
8. Plane table
9. Machines
10. Front loaders
11. Tilting level
12. Boning rod
13. Land chain
14. Hammers
15. EDM
16. Traveller
17. Planimeter
18. Chisels
19. Water level
20. Range rod
21. Setting out rod
22. Drilling equipment

Figure 4.1: Physical tools used in the classroom

Miniature tools and posters of tools are used in the classroom. It is expected that all students train and familiarise themselves with all the parts and their uses. The graph indicates nine out the 22 specified tools are frequently used by students in the classroom. The figure is very low. Many of the model tools which are used to

perform various tasks in the civil engineering industry are high-tech tools and in most cases, students and employees must undergo training to familiarise themselves with the use and safety precautions of such equipment. The tools which are used in the workplace, such as compactors, theodolites, chisels, and drilling equipment, are different from those of the classroom. Even though the principles governing the use of these tools are the same, the way in which they are operated is different.

Many of the electrical and pneumatic tools' work rate and performance change every third or fourth year, owing to constant wear and tear and industry's demand for better equipment. As Bill Decker (2010) from Decker Homes explains, some of the most significant civil engineering and construction changes in the last decade have occurred in the tools used both on site and at institutions of learning. As these tools are highly sophisticated, workers must undergo extensive training to operate these machines. Some students suggested in the focus interviews:

> "The college should get us the real tools to work with, then we will be confident in operating with [*sic*] the tools" (FG01).
>
> "The lecturers must take us on site if the college does not have the necessary tools to teach us with" (FG05).

These sentiments were also reflected by some of the other interviewed students. The results revealed that some students were negative towards the classroom environment because of what they perceived as the inadequacy of the tools; this impeded good knowledge and practice relationships.

Students' perceptions of teaching and learning aids as tools

Students were asked in Question 14 of the student survey to indicate the various teaching aids that their lecturers used during their lecture presentations. An analysis of the responses indicated that 76 percent of the students indicated white boards were used, 64 percent said books were used, 50 percent indicated the chalk board was used, and 38 percent indicated that overhead projectors

were used. One student indicated that drawings were also used. These findings are represented in Figure 4.2.

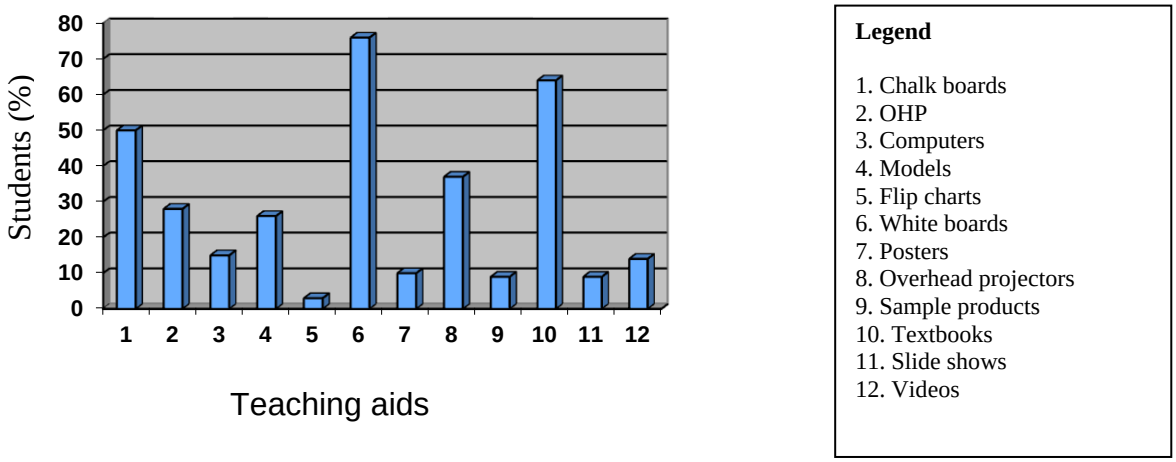


Figure 4.2: Teaching aids used in the classroom

When the students were asked in the interviews how the lecturers used these aids, they responded:

> "The lecturers use the white/chalk board to write the content of the lesson and sometimes they will ask us to do certain mathematical examples" (FG02).
>
> "They ask us to do some free-hand sketches, for example, the construction of a foundation" (FG03).
>
> "These are often done to see if we understand the content of the lesson. All students possess their own textbooks and sometimes the lecturers will refer to sections in the textbook which they are about to discuss" (FG06).

The fact that the textbook is the second most used teaching aid used summed up the situation when students made comments such as:

> "Each of us must have our own textbook, otherwise we are not allowed into the classroom" (JN12).
>
> "We are not allowed to share textbooks in class" (JN43).

The fact that students must each have their own textbook is an indication that the lecturers prioritise theoretical knowledge.

Figure 4.2 shows that lecturers do not make use of all teaching aids during lessons. Although the focus is on the chalk board, white board, textbooks, and overhead projectors, there is also other equipment lecturers could use to enhance learning. Over the years, the situation has remained the same; the more rudimentary equipment has been used as teaching aids, rather than the more sophisticated equipment, such as overhead projectors, models, computers, and sample products.

Stakeholders in the FET sector, such as the lecturers, management, and students, know that teaching aids should assist students to make the link between theoretical knowledge and practice. Lecturers and students commented that students needed to be exposed to a variety of teaching aids. One lecturer responded:

> "Allow the students to interact with a variety of teaching aids" (L06).

A greater variety of and more creative and sophisticated teaching aids could bridge the knowledge and practice divide.

Teaching and facilitation methods used during teaching and learning

In a classroom context, lecturers are expected to use different teaching and facilitation methods. This is a means of allowing students to be active participants in class, and at the same time for them to understand that knowledge assists with practice. Owing to time constraints, it is not always possible for lecturers to exercise all the methods. They have a curriculum to complete within a specific time frame, since students write external examinations.

Students were asked in Question 15 of the student survey (Appendix: A) to identify which teaching/facilitation methods were used by lecturers on a regular basis. Four of the methods most used were: tests (69%), lectures (57%), classroom activities (50%), and group work (33%), while two percent of the students indicated 'others' as homework and competitions. These findings are represented in Figure 4.3.

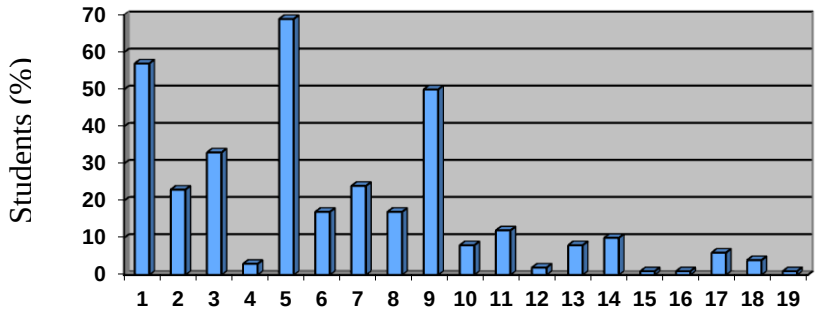


Figure 4.3: Teaching/facilitation & media methods

During the focus group interview with the students, I alluded to their responses regarding the methods used. I specifically asked them what they did when they engaged in '*group work*'? They responded by explaining that often they were given group assignments to see whether they could work in groups and come up with various answers to different challenges, for example, they were given a task to investigate the various roof covering materials for a normal dwelling. Some members in the group would do the research, collecting samples of roof covering material, then typing up the project and presenting it to the class. The size of the groups varied from 4 – 6 students. The reason for indicating 'group work' and 'group assessment' is that when students work in groups they are most likely to be assessed in groups depending on the individual students' preference. '*Pair work'*, on the other hand, is when two students work together on an assignment where less research and presentation are required. Some students prefer to work in pairs rather than in groups, as indicated in the focus group interviews:

> "I don't like to work with too many students because some are doing nothing in the group" (FG04).
>
> "Sometimes I learn more if the group is smaller, for example, when we work in pairs" (FG06).

One student (FG07) regarded group work as very interesting and said it gave her the opportunity to interact with others and ascertain their opinions on the tasks to be executed.

The graph depicts the teaching and facilitation methods used by the lecturers who offer the civil engineering course. The most common methods used are tests, lectures, classroom activities, group work, pair work, and practical work.

The reason for the lecturers' emphasis on group work, pair work and practical work could indicate their commitment to preparing students for the workplace. Very often in the workplace, students work in groups. This could be one of the methods of closing the gap between theoretical knowledge and practice, where students have the opportunity to assist one another with work activities.

Teaching and learning methods students use when working/studying

As previously indicated, lecturers use different methods when they lecture. Similarly students use a variety of ways when they work in class or study at home. The reason for this question was to determine what influence teaching and learning methods have on the way students adapt in the workplace. In Question 18 (Appendix: A) of the student survey, students were asked to indicate what methods they used when working or studying. More than half the students indicated that they made use of individual study, 52% indicated by attending lectures, 47% of the students said teamwork, 34% said by means of pair work, 23% indicated it was problem solving, 20% said it was practical, 8% felt it was project-based learning, and 2% indicated 'other' being 'mind maps', 'doing previous tests' and 'summaries'. These findings are represented in Figure 4.4. Raygor and Wark (1970) explain that study methods are used in organising and systematically recording and reviewing notes. It is an easy format for highlighting major concepts and ideas. And it saves time and effort.

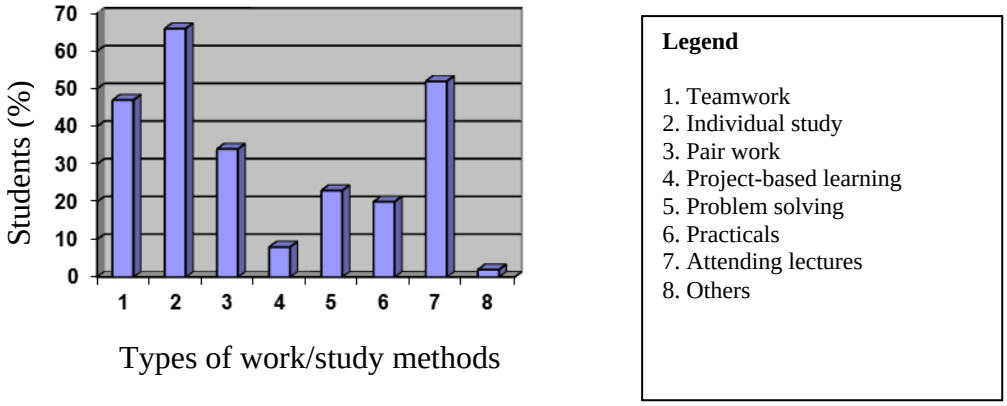


Figure 4.4: Methods used when students work or study

The impression gained from Figure 4.4 was that students employed practically all the work and study methods. However, they focused mainly on individual study, attending lectures, and teamwork. When students are away from college, they tend to work and study on their own because most of the work is knowledge based and very little practical work is involved. Another reason could be that they don't have easy access to peers, as they do in the classroom.

There were some students who said they made use of other methods, such as project-based learning. This method is at the heart of good instruction because it brings together intellectual enquiry, rigorous standards and student engagement in relevant and meaningful work. This is a means of bridging knowledge and practice. It is an instructional model in which project work is central to student understanding of the essential concepts of the curriculum. It engages and builds on students' interests and passions, allows students to take the lead, make critical choices and decisions, and requires students to develop and demonstrate essential skills and knowledge. However, even though the method is so highly regarded, students indicated that individual study was the method most used.

Students' perception of the CE curriculum as a tool

A curriculum is pivotal to any course. The content in the CE curriculum should play an important role in preparing students for the workplace. The main focus of this research is whether it is, in fact, doing that. The curriculum comprises

knowledge, practice in the classroom and in the workshop/college yard, and workplace training. Whether there is knowledge and practice integration between the ASs is a relevant question. The CE curriculum can fit into the AT framework as an 'object' or as a 'tool'. For the purpose of this study, the CE curriculum is seen as a tool that acts upon the object. What students are taught in the classroom is the knowledge component that needs to be simulated in the workshop/college yard, and both knowledge and practice are taken to the workplace for real work.

So the question remains whether these components prepare students for the workplace. There is a perception among many industry participants that the content is out of date and therefore does not serve the needs of the industry. However, more than half (55%) of the students had different views and responded that the curriculum did fulfil the needs of the civil engineering industry. Within the current CE curriculum it is not mandatory for students to undergo workplace training. The college management and lecturers try to link students with the workplace for practical exposure. This is a further indication of knowledge and practice divide.

In Question 10 of the student interview schedule, students related good experiences with the supervisors on site during the focus group interviews. For example, a student in his third year alluded to a request from the supervisor to set out the foundation levels for a warehouse to be built. He indicated, "I had no problem in completing the task without supervision because of the teaching I received from my lecturer in the workshop" (SN24). Table 4.7 represents the findings.

Table 4.7 Students' perception of the curriculum (N=137)

Curriculum	Yes	No	Partly
Frequency	76	12	35
Percentage	55%	9%	26%

During the focus group interviews, students responded more freely by indicating why some of them claimed the curriculum was not preparing them for the workplace:

> “My dad was surprised that the same content and method that was taught to him are still being taught to me today” (SN06).
>
> ”Even though many changes have been made in the industry, the same content is still being taught” (SN09).
>
> “The tools and equipment the college is using are outdated and old” (JN16).
>
> “Some of the lecturers teach us old methods and techniques of performing various tasks” (NCV07).

From the students’ own experiences, they related that various activities that were done on site were done differently from those at college, for example:

> “There are much quicker ways of doings tasks on site” (SN25).

Even though the principles may differ slightly in performing the tasks more quickly, at the end of the day it is production and profit that matter. A fan float is used to level and smooth a concrete slab, but the college still teaches students to do floating by hand, because this is what the curriculum prescribes. So when the students get on site, many of them see this piece of equipment for the first time and only later learn what it is used for. The CE curriculum helps students to make sense of their learning experiences (Miholic, 2003). It should therefore assist students in acquiring the knowledge and skills to perform various real CE activities on site.

Object

The‘ object’ is defined as the target of a goal-directed action (Lantolf &Thorne, 2006). It can be a material or psychological unit. It captures the mental or physical efforts of a subject to reach desirable outcome(s) in an activity system. In this study, the *object* motivates the students in a specific direction. For example, *objects* of the goal-directed *actions* may be to attend the lectures regularly, complete an examination, and ultimately pass the examination, or to

learn the knowledge and apply it in a practical context, for example, to master the setting-up procedure for a dumpy level rule.

Students are well aware that they need to accomplish many tasks such as attending lectures regularly, writing a number of knowledge tests and completing a number of practical assessment tasks in the workshop and on site before they can qualify as artisans. For the students, since they have registered for the course, there is an incentive for their work. The incentive is, that upon successful completion of the course, they will receive a recognised qualification allowing them to work on any CE site as a qualified CE artisan.

Originally when the students started the course, there was only one object and that was to complete the course. When I started with this research, I soon realised that the students, lecturers and workplace supervisors had different opinions regarding the object. For example, for the student, securing a qualification would be the object; the lecturers' object would be to teach knowledge and practice so that the students could successfully complete a final examination. For the workplace supervisor, the focus of the object would be to complete projects on time and to make a profit for the company. As the course progressed, the analysis of the surveys and interviews revealed that new objects emerged. Thus, for the students, there were main reasons/motives that constituted the *objects* of this course:

- Learning to become civil engineering artisans
- Learning about career opportunities
- Creating a passion for the industry
- Academic success
- Contributing to improving the course

The following were the themes that emerged from the students' and lecturers' responses. These themes could act as integration between knowledge and practice and ultimately serve as a bridge between the college and the workplace.

Learning to become civil engineering artisans

The students in this study are defined through the relations they have with others, or through their function and what they do in reaching the object. In this way, I address the question of who they are and what they learn through the relationships they have with others, but more so through their relationships with knowledge and practice. They have desires, values, important issues, standards, opinions, and aspirations, all of which motivate or demotivate them to learn.

In the student interview schedule Question 4, students provided some data on how they compared learning in the classroom to 'enjoying' the civil engineering course. Students used words like 'passion' (SN 04, SN 15, JN 09), 'interesting' (SN 18, JN 47, JN 48, LS 14), and 'learning opportunities' (LS 02, LS 03, JN 45) to describe the course. As can be seen in Table 4.8, with reference to Question 16 of the student survey, most of the students did enjoy the civil engineering course for which they were registered, with only 12 percent of the respondents indicating that they did not enjoy the course.

> "Education is not just about transferring 'chunks of knowledge' but about establishing meaningful relationships between lecturers and students which will make the institution an important place to study" (JN14).

From the information in Table 4.8, it is clear that some students dislike the course for a number of reasons such as "lecturers being unprepared" (SN04, SN12, JN15), or "lecturers were unqualified" (NCV20, NCV21, LS22), or that there was "too much theory and too little practical" (JN01, JN10, LS02), or "that there were no libraries to do research" (LS04, JN09, NCV19)..

Table 4.8: Enjoying the course (N=137)

Enjoying the course	Yes	No
Frequency	120	17
Percentage	88%	12%

The majority of the respondents indicated they were studying civil engineering for reasons of interest in the civil engineering field, for example:

"I'm interested in learning [about] the design of buildings" (SN05).
"I like designing, knowing how structures are constructed" (SN06).
"From a small age I liked design of roads and bridges etc." (SN09).
"Interested in creativity" (JN41).
"Because it's interesting for a lady" (JN46).
"I find civil engineering interesting" (NCV13), or
"I was always interested in building houses" (NCV18).

However there were also less positive comments from students who indicated that there was a need for the staff to "treat all students equally" (LS11) and for "more women to be allowed to come into the civil engineering industry" (LS16).

Academic success

Very often in my career I meet with students who do not have any vision for the future. However, while I was undertaking this research, I did not come across a student who was not hungry for academic success. The enthusiasm among the students I interviewed and requested to complete the surveys was very evident. During the interview a student commented:

"For the past three years since I have been studying here I have been very successful academically; I've never failed one subject" (FG07).

Many of the students indicated that their academic success was their best experience at college:

"When I got my test results it was the best thing ever "(SN08).
"When I obtained a distinction for my Building and Structural Construction" (SN25).

Passing a certain level at the college also indicated academic success to students (JN34). For some of the new students, passing their first test was a great achievement (JN45). Motivating oneself to achieve certain goals was also important for some students:

"Motivating myself to become one of the top ten students on campus" (JN57), and "When I passed my NCV level 2 course" (NCV10).

According to Brown (1999), beyond work and wages, academic success is important because workers will need higher levels of education to tackle the technologically demanding occupations of the future. Furthermore, the number of jobs industry requires will increase, since industry is expected to grow more than twice as fast over the next ten to twenty years (Fleetwood & Shelley, 2000; Rentner & Kober, 2001). Academically successful students will have more employment opportunities than those with less education. Thus, academic success may mean the difference between working at a job merely because it pays the rent and working at a job that one enjoys (Rentner & Kober, 2001). Academic success may also foster better knowledge and practice relations. Students may be more eager to learn more practice after the knowledge learned at the college.

How knowledge can improve the course

In this section, it will attempt to determine what elements constitute the core knowledge aspects for the CE course. The responses were clustered into three main themes: content (subject area), skills (civil engineering specifics) and students' perceptions of general skills acquired. Many of the respondents indicated more than one of the three aspects. An analysis of the responses indicated that 38 percent felt that the course addressed content, 29 percent thought the course addressed specific skills, and 33 percent were of the opinion that the course addressed general skills. The responses inform us of the low levels of knowledge and practice integration in the classroom, workshop/yard and workplace. These findings are represented in Figure 4.5.

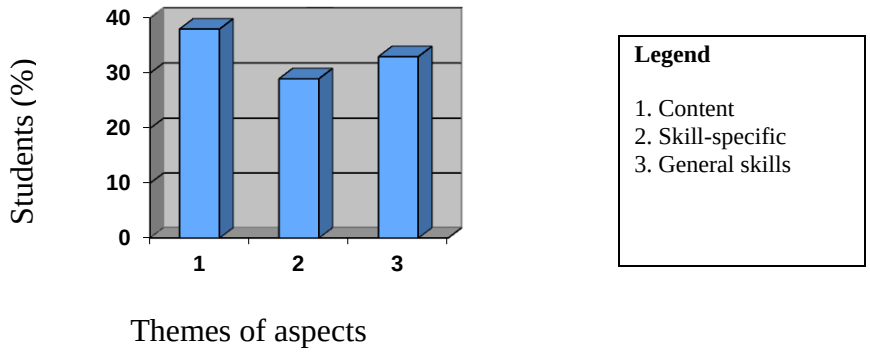


Figure 4.5: Aspects the civil engineering course addresses

From the afore-mentioned responses, I elicited ideas from students about how the college could improve the civil engineering course. This was to give students an opportunity to make suggestions for the course's improvement. These suggestions could be the means of bridging the gap between knowledge and practice as well. The students responded in the following manner:

> "The college must allow the students to do more site visits and show us the tools that are used to construct a house" (SN01).
>
> "Make sure by integrating the practical and theory, because it's better to see and do the stuff you learn (SN02).
>
> "The college must employ more lecturers and also start a course for draughting" (JN20).
>
> "Purchase the correct materials and equipment for cleaning the toilets, and make sure that the learnership people are treated with respect" (LS11).
>
> "Purchase the correct textbooks and tools and equipment, and employ proper lecturers" (NCV10).

The focus of this activity was to determine what the civil engineering course addressed and what students felt the course should address. The responses indicated the relationship between knowledge and practice was problematic. In other words, there was very little or no relationship between the two aspects.

Division of labour (D.O.L)

In this section, the question is posed, "Who is responsible for which activities and how are the activities organised"? Chiefly within the classroom, the lecturer, for example, teaches the content of the curriculum, while the students take notes and complete various knowledge exercises and assessment tasks.

However there is more happening than meets the eye in the classroom. The analysis allowed me to identify a few themes to indicate how students view their roles:

- Integration of knowledge and practice
- Students' preparedness for their role in the workplace

- Students gaining knowledge to perform various tasks

Integration of knowledge and practice

Many of the students indicated the importance of the integration of knowledge and practice and strongly felt the need for improvement in its integration. For example, the students responded as follows:

> "By mixing the practical and knowledge components, because it's better to see the stuff you do" (SN02).
>
> "By doing practical in the same year" (SN17).
>
> "Combine practical and theory, maybe two days practical and three days theory" (JN41).
>
> "By using practical and theory at the same time" (JN51).
>
> "By changing the course to 50 percent theory and 50 percent practical" (NCV12).
>
> "Just give theory in the morning and practical after lunch" (NCV24).

The focus group interview with students suggested that there should be integration between the two, as the responses indicated:

> "What I learn in class, I should be able to apply in practice, yes that's right, when theory is completed then practical must start" (FG01).
>
> "Three months' theory and two months' practical will improve technical skills" (FG02).
>
> "Practical and theory should be done simultaneously, learning experience, learning the skills" (FG03).
>
> "Two years' practical experience after the theory, experience in the practical field" (FG06).
>
> "Yes, it's important, have facilities available, three days' theory and two days' practical" (FG16).

Students' preparedness for their role in the workplace

Students are becoming more aware of their preparedness for the workplace and are therefore engaged with and appreciative of their learning experience. They

remarked that during their studies, they gained a great deal of knowledge. Later on, this knowledge was converted into certain expectations which they would like to see realised.

Students acknowledged that they had a role to play in the workplace that formed part of the D.O.L and therefore responded as follows:

> "I would like to improve my technical skills and do a lot better for myself" (LS06).
>
> "To do the work as a professional and be able to teach others" (LS19).
>
> "I will be able to build houses, roads and bridges for society" (NCV12).
>
> "Learning how to read plans, knowing how to build roof trusses, and all about safety aspects" (NCV25).
>
> "What is the equipment to be used for various tasks" (JN02).
>
> "Would be able to apply my skills as a project manager" (JN41).

<u>Students gaining knowledge to perform various tasks</u>

Lecturers teach students various concepts and skills; these skills can then be applied during their training period at the college. Students felt that their role in the classroom was important to gain substantial knowledge to be fully equipped for their future roles. The students' perceptions of the skills and knowledge they had gained during the period of study included: team work and how to react to problems on site (SN09), safety on building sites (SN10), surveying, levelling (SN11), use of site instruments and team work (SN23), and surveying, management and drawing plans (JN06), as well as:

> "You have supervisory skills you can apply and you can set out work and help people with problems" (JN05).
>
> "I will know the do's and don'ts of building and know what some equipment is used for" (LS13).
>
> "I would apply people skills and supervisory skills to people which will help me with my communication" (LS14).

Communities

The community refers to the group of people with an interest in the object in which the activity is carried out, namely the classroom. The participants in this community share the same *object*. The *community* in this study includes the lecturer, college management, and CE professionals such as engineers, peers and parents. These people determine to what extent the college can bridge the gap between knowledge and practice in the community by adequately preparing the students for the workplace.

Although parents are not in the immediate classroom community, they seem to play a role in influencing students' orientation to the course. The lecturers appear to play four major roles: those of lecturer, facilitator, friend (as an encourager), and mediator scaffolding students' learning. The following were the themes that emerged about what the participants said about the community's links with college and workplace, students' interaction with other people, the role of the lecturers, learning about community development, and the college management structure.

<u>Links between communities, the college and the workplace</u>

The establishment of links between these two sectors allows a much better integration of work and study. It also gives students access to the workplace if those links do exist. Students requested better links because it would allow them access to sites:

> "The management of the college should establish dialogue so that we can go to site more often" (FG06).
>
> "We don't have to arrange our own workplace training sessions if it can be done via the college" (FG07).
>
> "At present the workplace supervisors don't treat us well because there is no mediator between the college and the workplace" (FG10).
>
> "The workplaces don't even pay us properly" (FG12).

Students meeting other people

Several students indicated that for them, the main activity in the classroom was meeting other people and seeing new faces, and it was not so much about the work itself:

> “All the new people I met and all the knowledge I gained” (SN20).
>
> “Making new friends with fellow students” (SN26).
>
> “Meeting new people and making friends” (JN08).
>
> “Meeting new people and learning new things” (JN10).
>
> “Meeting with different kinds of personalities, different people and all the intelligent people” (JN53).
>
> “Gaining experience by meeting new people” (LS09).

Meeting other people for the first time in a classroom could create a sense of belonging since students realised they would not work on projects by themselves but either in pairs on in groups. For some students this was some form of inspiration. As Rogers and McClelland (2005) noted that wanted over the years wanted to meet people who can inspire me.

Learning about community development

Students expressed their feeling of wanting to assist with community development. Many of the students felt there was a need for building houses in the community and “to alter the situation in the community by building and developing the community” (SN11). Some of the students also indicated that they wanted to make the country a better place to live in and at the same time build houses for the homeless (SN16). Improving the lives of other South Africans was also something the students referred to:

> “I want to improve the lives of others by using bricks and cement” (JN12).
>
> “Create buildings and roads to assist others” (JN26).
>
> “To assist people when they build their houses” (JN35).
>
> “Because I like building houses for my country” (JN39).

Among the students there were also those who wanted to be involved in assisting with civil services such as:

> "Help the community in fixing the drains" (LS19).
>
> "Teach the community to do things for themselves" (NCV22).

I referred to the community as the people working in an AS; however the students in their responses had a different view of the community. They saw the community as being the community they live in. This could also belong with the object of the activity. This could be what motivates or guides the students to do the work they are doing.

College management structure

There was a distinct cry from many of the students to improve the management structure of the college. Students felt that they did not know to whom to complain if they had issues on campus. They were of the view that not enough was done to make their voices heard:

> "Our complaints are never heard; we don't know where to lodge our complaints" (FG08).
>
> "We don't have an HOD in the department to assist us when we want to complain about the lecturer" (FG12).

This could mean that if the college management were more visible and committed, students would be more dedicated towards their studies. Students felt that they were not properly taken care of in the classroom. The management structure exists to support students academically. This support also means adequately preparing students for the workplace.

Rules

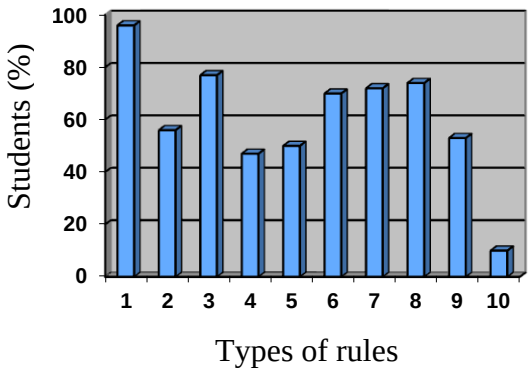
In this study, *rules*, including behaving properly in class, following task directions (task rules), attending lectures, handing in assignments, and applying CE rules were the order of the day. There are also rules of doing the right thing according to the CE norms and standards. Through the analysis of the survey data and my

observations, I found that most participants realised that they had to abide by the rules in class. For example, they needed to have an 80 percent attendance record and a 40 percent class average on all assessments before they were allowed to sit for the final examination.

In any institution of learning, rules are common practice and should create an environment conducive to learning. Students are required to adhere to rules such as punctuality, adhering to deadlines for tasks and assignments, wearing safety equipment when doing practical work and respecting others' belongings. The rules that are laid down by the institution should not in any way limit the students' development. Rules are intended to create a framework for developing, implementing, and maintaining the required safeguards at an institution. They are designed and implemented to identify, control, and assess systems in place (Berger & Bachinger, 2003).

Rules students must adhere to when they are in class

In Question 19 in the student survey, students were asked to indicate which rules they had to adhere to when in the classroom. An analysis of the responses indicated that 96 percent of students indicated *punctuality*, 77 percent *respecting others' belongings*, 74 percent *acceptable behaviour*, 72 percent said they must have an 80% *attendance*, 70 percent *handing in class work*, 56 percent *meeting assignment deadlines*, 53 percent *obeying house rules*, 50 percent *taking care of equipment*, 47 percent *wearing safety equipment*, and 10 percent *others*. These totals do not total 100 percent, as many students indicated more than one rule. These findings are represented in Figure 4.6.



Legend

1. Coming to class on time
2. Assignment deadlines
3. Respecting others' belongings
4. Wearing safety equipment
5. Taking care of equipment
6. Handing in class work
7. 80% attendance
8. Acceptable behaviour
9. Obeying house rules
10. Others

Figure 4.6: Rules students adhere to

Importance of attending lectures regularly

Nearly three-quarters of the students indicated that they attended their lectures on a regular basis. Table 4.9 indicates the attendance of lectures by students.

Table 4.9: Lectures (N=137)

Lectures	Yes	No
Frequency	101	36
Percentage	74%	26%

Civil engineering rules of the profession

The civil engineering profession does not have a single uniform system or standard of ethical conduct across the entire profession. Ethical approaches vary somewhat by discipline and jurisdiction, but are most influenced by whether civil engineers independently provide professional services to clients or to the public if employed in government service, or if they are employees of an enterprise creating products for sale. Despite everything that goes with the profession, there are rules which govern the industry. The CE rules are referred to in the classroom but are not fully part of the classroom AS because these rules are executed on site and not in the classroom.

In reflecting on the civil engineering industry, students commented that it was important to have some concept of the rules and responded as follows:

"Civil engineers must be mindful of the safety, health and welfare of the public when performing their professional duties" (NCV 23).

"Due to safety issues the CE companies must only do work in their area of competence" (NCV24).

"The industry must act in a professional manner" (NCV25).

"Conflict of interest should be avoided by the industry" (JN58).

"The industry must build their professional reputation on the merit of their services" (JN59).

"The industry must have integrity and dignity and shall act with zero-tolerance approach" (JN60).

Assessment rules

Knowledge assessment plays an important role in developing students' ability to perform various theoretical tasks. Whether students like it or not, they all have to contend with different assessment tasks. In a classroom context, students either 'fail' or 'pass' when assessed by the lecturer in the classroom. The question was posed to the lecturers, "How do students deal with the assessment in the classroom?" The lecturers responded as follows:

"Many of the students don't like the idea of writing a test, but it must be done, otherwise they won't be able to sit for the final examination" (L02).

"Some students don't have any objection with classroom assessment" (L03).

"Many of the students are just lazy and don't want to study" (L04).

As can be derived from the students' and lecturers' comments, there are mixed feelings among them regarding assessment in class. Both the college classroom and the workshop/yard have assessment rules. The classroom assessment rules are based upon the knowledge taught in the classroom and the assessment rules in the workshop/yard are based upon the practice that was taught by the lecturer in the workshop/yard. What it means is that there are some forms of knowledge – practice relations that are exercised at the college. Whether these forms of knowledge and practice relations meet the requirements, remains to be seen.

4.3 CONCLUSION

This chapter summarises the perceptions of the learning taking place in the classroom by students and lecturers at FET colleges. The activity theory concept provides the opportunity to allow for the underpinning of subject, mediating artefacts, object, division of labour, community, and rules. The chapter also dealt with data, which was collected from the various data collection instruments, and describes the views of the students and lecturers with respect to their learning and how the gap between knowledge and practice can be bridged.

Findings or perceptions such as student knowledge, teaching and learning experiences, student perceptions, industry participation, institutional rules, and student descriptions are a few of the concepts which emerge and re-emerge throughout this study. From the information gathered, it was clear that students felt that there was a need for such a course – one which deals directly with skill specifics. The students felt restricted because of the lack of practical experience during their studies. There is far too little industry participation, which the students perceive as problematic.

In the next chapter, learning pertaining to knowledge and practice in the workshop/college yard is discussed, and the subject, object, mediating artefacts, division of labour, community of practice, and rules for civil engineering students and lecturers from FET colleges will be examined.

CHAPTER FIVE: STUDENTS AND LECTURERS' PERCEPTIONS OF THE WORKSHOP/COLLEGE YARD ENVIRONMENT

5.1 INTRODUCTION

The previous chapter gave an overall view of how data has been gathered from civil engineering students and lecturers in the classroom, and how various instruments were employed to gather data, which was later analysed. This chapter focuses on the data that was collected from lecturers and students in the workshop and college yard at FET college sites. The chapter refers to the workshop as a building with walls and a roof over it so that the tools and equipment are not exposed to the elements of the weather and where students can work in inclement weather. The college yard, on the other hand, is an open space with no protection from the weather and students work and operate in a more open space, as they would in the workplace.

Surveys and observation research methods were used in the establishment and collection of the perceptions of lecturers and students regarding knowledge (or what is called 'theory') and practice relations in the workshop/yard environment. Four college sites were visited and the surveys were discussed and handed out to lecturers and students for completion as discussed in the methods chapter. These survey questions were recorded and the results were summarised in order to draw conclusions from the responses. The findings from the data collection instruments are reported on below.

As indicated in Chapter 4, my argument is based on the relationship between knowledge and practice at FET colleges and the civil engineering workplace. In this chapter I was most interested in lecturer and student perceptions of the relationship between knowledge and practice in the workshop/yard environment. I used the workshop/yard AS to determine what form of learning was taking place in this environment that would give me an understanding of the bridging between knowledge and practice.

5.2 ACTIVITY SYSTEM OF STUDENT LEARNING IN THE WORKSHOP/ COLLEGE YARD

The findings of each of the six elements in the activity systems are reported on separately. This section deals with firstly, lecturers and students' views, as represented in the survey data, and secondly the interview data on the activities that take place in the workshop/yard. I begin with a profile of the lecturers.

Profile of the lecturers at FET colleges

The profile of the lecturers was to ascertain what their experience is at college and industry levels. Obtaining this information could give a sense of understanding of their knowledge and practice. The civil engineering lecturers who participated in this research project consisted of those from all four FET college sites. The lecturers had a range of knowledge, skills and expertise. There were both junior lecturers and senior lecturers among the target group. Senior lecturers are those with five or more years of experience and those who have been appointed as heads of department for civil engineering. The junior lecturers, on the other hand, are those with less than five years of lecturing experience at an FET site. The lecturers are referred to in this research data as (L01, L02, L03, etc.).

The profile of the civil engineering lecturers in the FET college was obtained from the quantitative and qualitative sections of the lecturers' questionnaires in which they were asked to identify their gender, language and age (refer to Appendix F, Questions 1, 2, & 3). This data constructed a profile of the civil engineering lecturers represented, as can be seen from the data breakdown below.

As can be seen in Table 5.1, nearly the entire lecturer sample is male:

Table 5.1: Gender (N=13)

Gender	Male	Female
Frequency	12	1
Percentage	92%	8%

Lecturers are predominately drawn from the three major language groups of the Western Cape: Afrikaans, English and isiXhosa. There were no isiZulu and other language speakers among the lecturers. Table 5.2 shows the different languages of the respondents.

Table 5.2: Language (N=13)

Language	Afrikaans	English	Xhosa	Zulu	Other
Frequency	4	7	2	0	0
Percentage	31%	54%	15%	0%	0%

Most of the respondents of the sample group were English speaking (54%), followed by an Afrikaans-speaking (31%), and a small isiXhosa-speaking group (15%).

The average age of the lecturers is 49 years. Table 5.3 below gives an idea of the diverse range of ages of lecturers represented on the civil engineering programme.

Table 5.3: Age (N=13)

Age	21 – 25	26 – 33	34 – 41	42 – 49	50 & over
Frequency	1	1	4	5	2
Percentage	8%	8%	31%	38%	15%

The fact that the average age of the lecturers is 49 years could mean that they have some length of experience in knowledge but more in practice, because they deal with practice on a daily basis in the workshop/yard. The workshop/yard lecturers are really at the centre of knowledge and practice relations. They should in the best position to ascertain whether students are properly prepared for the workplace or not.

The responses from the lecturers and students are presented in a form corresponding to the elements of the workshop/yard AS.

Mediating artefacts/Tools: These are the teaching and learning strategies, practical models and physical tools used in the workshop/college yard.

The workshop/college yard, as in the case of the classroom, should play an important role in preparing students for the workplace. These two environments are closer to each other than the workplace is. A greater emphasis on knowledge and practice relations can be exercised. The kind of artefacts that are used should be to build on the knowledge and practice relationship between the three ASs. The workshop/college yard activity in this study is seen as one of the activity systems investigated.

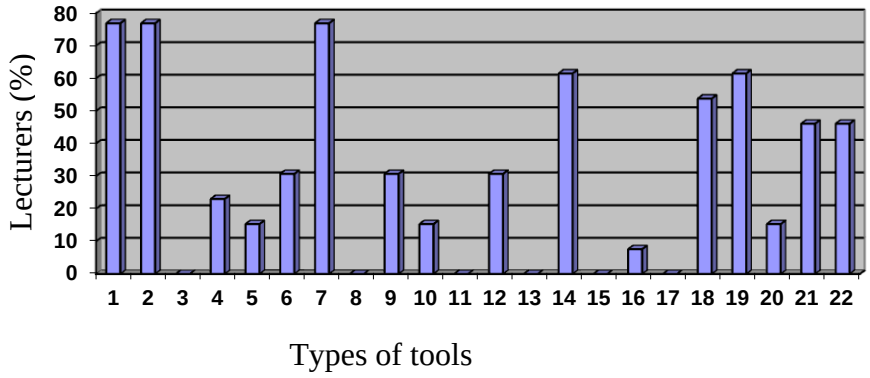
This environment is conducive to the learning of practical skills and students are often more relaxed because they work mostly on practical work. However, the tools such as teaching, learning and the physical tools that are used, differ substantially from those of the classroom. As I have previously explained, the tools used in the classroom are models and pictures of tools, but in the workshop/college yard, students use the actual physical tools.

This section describes and compares the lecturers and students' views of the tools used by them for teaching and learning in the workshop/yard. A variety of examples from lecturers and students are used in this section to illustrate the different tools used in the workshop/college yard. Lecturers have their own perceptions regarding teaching and learning aids as tools, the methods used for teaching and learning, the study and working methods used by the students which form part of their repertoire as developing civil engineering artisans and the curriculum as a tool which is used to prepare them for the workplace.

During my observations in the workshop/yard, the most relevant tools used are dumpy levels, spirit levels, hammers, tape measures, water levels and chisels. These tools are readily available for students to work with when they enter the workshop/yard. When students are exposed to these tools in this practical environment, they have already been taught the knowledge components of these tools in the classroom. The knowledge and practice relations can in some way become evident because of the exposure of the students in the workshop/yard.

Physical teaching and learning tools used in the workshop/college yard

Participants in this research were asked which of the following tools they used during exercises and activities in class and in the workshop. They had an opportunity to circle as many tools as possible. The data collected refers to Question 19 of the lecturer survey (Appendix F). An analysis of the responses indicates six of the tools as most used: spirit level, 76,9 percent; tape measure, 76,9 percent; dumpy level, 76,9 percent; hammers, 61,5 percent; water levels, 61,5 percent; and chisels, 53,8 percent. These totals do not add up to 100 percent, as many lecturers indicated more than one tool. These findings are represented in Figure 5.1.



Legend

1. Dumpy level
2. Spirit level
3. Abney level
4. Compactors
5. Graders
6. Theodolite
7. Tape measure
8. Plane table
9. Machines
10. Front loaders
11. Tilting level
12. Boning rod
13. Land chain
14. Hammers
15. EDM
16. Traveller
17. Planimeter
18. Chisels
19. Water level
20. Range rod
21. Setting-out rod
22. Drilling equipment

Figure 5.1: Tools used during activities

From the findings, it can be deduced that a larger variety of tools is used and learned about in the workshop/college yard environment than in the classroom. It can be seen that the students are dealing with more physical work, such as chasing into walls with a chisel, a tool added to the list of tools used in the workshop. As in the case of the classroom, many of the tools that students are expected to work with are not used in the workshop/college yard, for example, drilling equipment and graders. When the participants were questioned about their not using some of the other tools, their responses were as follows:

"Sometimes the tools are there but it is [*sic*] not working properly and therefore needs to be serviced or replaced with new ones" (LS13).

"The college just don't have the tools for us to work with" (LS15).

During the individual interviews I had with lecturers, they indicated that the colleges did not invest in the maintenance or purchase of equipment. One lecturer said that he had been affiliated with the college for 20 years, but management had bought only two second-hand dumpy levels during this time. The reason for this was that the colleges were not provided with sufficient funding to purchase and maintain equipment.

Lecturers and students' perceptions of teaching and learning aids as tools

In a workshop/college yard, students need to be exposed to a variety of teaching and learning tools. It is therefore in this context that lecturers are expected to use different teaching aids. This is a means of ensuring that students are active participants in this environment. Lecturers were asked to indicate the different teaching aids they use during their presentations. The data collected refers to Question 20 of Appendix F. An analysis of the responses indicates that 84,6 percent of the lecturers indicated the use of chalk boards; 76,9 percent, textbooks; 61,5 percent, models; and 53,8 percent, white boards. These findings are presented in Figure 5.2.

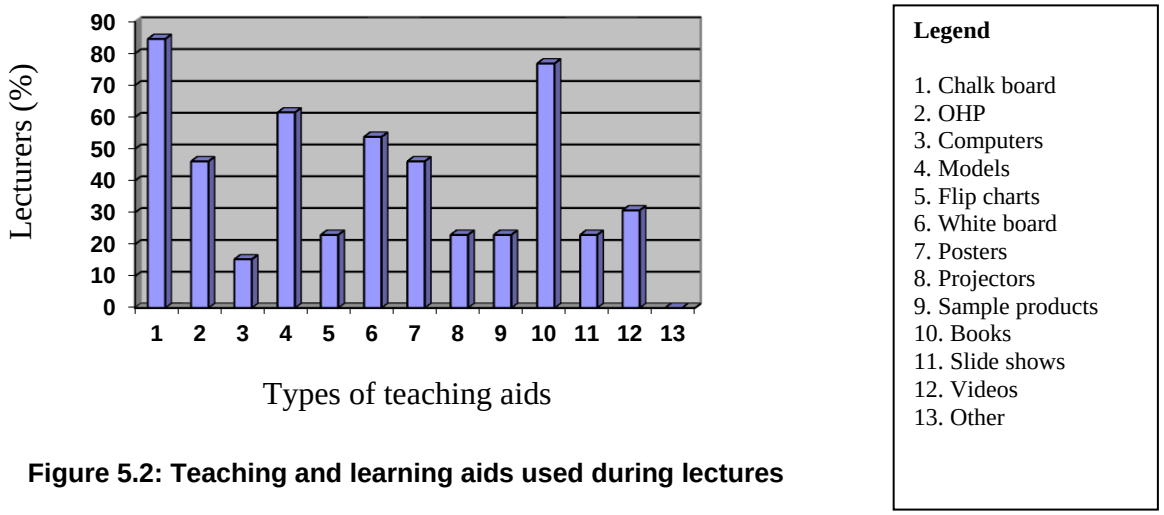


Figure 5.2: Teaching and learning aids used during lectures

As is the case within the classroom, textbooks and white/chalk boards were the most frequently used teaching aids. However, another prominent aid was models, which are more frequently used in the workshop/college yard. These models often give students an idea of what the actual product should look like. A model of a concrete column, with all its formwork, is highly valued by students. Surprisingly, according the responses, “not many sample products as models are being used, even though it is such an essential element” as teaching aids in the workshop/college yard. Some students, on the other hand, felt that it was not important to make use of all the teaching aids indicated in the graph:

> “I’m not interested in all those theoretical knowledge things, just teach me the practical stuff” (FG04).
>
> “If I’m in the workshop then I want to do real work practical” (FG08).

It is important to note that the teaching aids used involve the practical aspects of the teaching and learning in the workshop/yard.

In response to the question of why computers and other electronic equipment were not frequently used, one lecturer said, “It is impossible to use this kind of equipment in such a dusty and dirty environment” (L03). Another said: “I have the equipment but not in the workshop. It is locked up in a special room” (L06). There is a slight difference between the views of the students and lecturers; students feel that they come to the workshop/college yard to physically do practical work, whereas the lecturer takes the knowledge that was taught in the classroom and builds on that.

Teaching and facilitation methods used during teaching

The data presented in Figure 5.3 refers to Question 21 of the questionnaire, where lecturers were asked to indicate which teaching/facilitation and media methods they used on a regular basis. The method that stood out the most was tests, at 92,3 percent. Lectures, group work, practical work, projects and classroom activities constituted 53,8 percent. None of the lecturers used computer simulations.

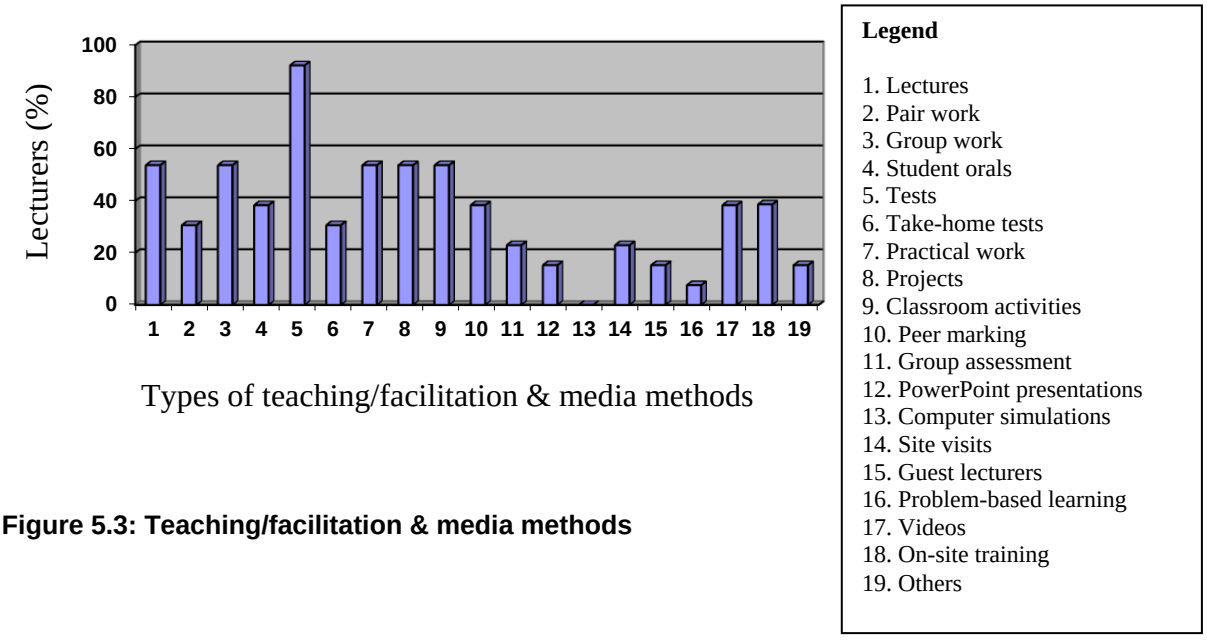


Figure 5.3: Teaching/facilitation & media methods

The findings indicate that lecturers used lectures in the workshop/college yard environment. They used this method simultaneously with demonstrations, which were not included in the list of teaching and facilitation methods. According to some of the lecturers, they taught a certain concept first, before they demonstrated to students what they actually meant. For example, they would make use of the chalk board to lecture students on the setting-out procedure, then, they would take the students out into an open space, such as the college yard, to demonstrate, with all the necessary equipment, how it should be done in a real work situation. From this information it can be deduced that there is interaction between knowledge and practice in the workshop/yard.

The testing method was referred to as the most frequently used, and is based on theoretical knowledge and practical skills. For example, the theoretical knowledge would comprise students writing down the procedure to set up a dumpy level, and the practical test would be to determine whether the student could actually set up the instrument on his/her own.

Teaching and learning methods students use when working or studying

Lecturers use different methods when they demonstrate practical skills to the students. This implies that students also use a variety of means when they work in the workshop/college yard or when they study theoretical knowledge pertaining to the practice. The reason for Question 23 (see Appendix F), that is, what methods the students used when working or studying, was to determine what influence methods have on the way students adapt to the workplace. The vast majority of the lecturers indicated team work, that is, 69,2 percent; while 61,5 percent of the lecturers reported practical work, and 53,8 percent indicated problem solving. These findings are represented in Figure 5.4.

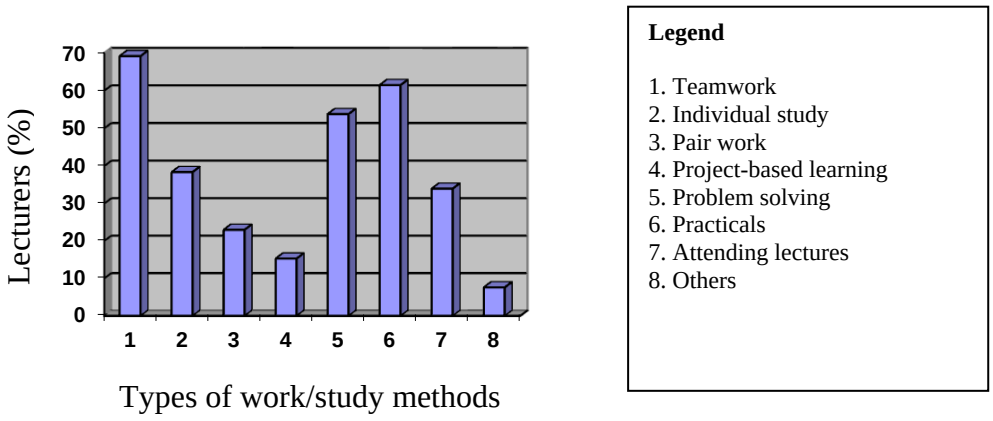


Figure 5.4: Methods used when students work or study

Students again felt that very little study at home was required from them during their time spent in workshop training. The reason for this was that the focus was much greater on practice than on theory. The three methods most prominent methods were team and practical work, and problem solving. All other methods are used in this environment, but not in the same way as in the classroom, where lectures and project-based learning predominate. Students and lecturers also indicated that they used other methods, but these were not specified.

Students were asked why they thought 'team work' featured so strongly in the working methods:

> "It's important to work in teams here in the workshop because that is how it is on site" (FG03).

"You can get hurt if you try to work alone and not with others" (FG05).
"CE sites are all about team work where we can learn from others" (FG06).

Lecturers' perceptions of the CE curriculum as a tool

In the previous chapter, students were asked to indicate whether they thought the CE curriculum prepared them for the workplace. Question 8 in the lecturers' survey focused on the lecturers indicating whether they thought the current CE curriculum fulfilled the needs of industry. The majority (46,3%) of the lecturers responded by saying the curriculum partly fulfilled the needs of the civil engineering industry; 30,7 percent were convinced that the curriculum did fulfil the needs of industry; whereas 23 percent were of the view that it did not meet industry's requirements, as indicated in Table 5.4. The reason for these responses is that lecturers visit students during their workplace training, and often see the discrepancies in respect of knowledge and practice used at the college, compared with conditions in the workplace.

Table 5.4: Curriculum (N=13)

Curriculum	Yes	No	Partly
Frequency	4	3	5
Percentage	30,7%	23%	46,3%

Workshop and college yards at FET colleges are where practice takes place. Skills training plays a central role in the development of human resources and therefore FET colleges have to continually upgrade their syllabus content and facilities to meet the demands of the industry.

From the students and lecturers' own experiences, 55 percent of the lecturers claimed the skills learned by the students in the workshop and college yard prepared them for the workplace, whereas 30 percent felt that they did not prepare students. 26 percent of the students noted that the skills did prepare them to some extent for the workplace, while 46 percent felt that they were not well prepared. Twenty-three percent of the students indicated that the skills did

prepare them for the workplace. Interestingly, most of the lecturers claimed that the skills taught did, in fact, prepare students for the workplace. There is also a knowledge component which students must be competent in when they proceed to the workplace. The reality cannot just be based upon the practice that is taught; the knowledge component has to be considered as well.

From Table 5.4, it is evident that there were mixed reactions from students and lecturers in respect of students' preparedness for the workplace based upon the CE curriculum. For example, one lecturer said, "I agree that the curriculum prepares the students because they can apply the skills by hanging a door" (L01). Whereas another disagreed, "When I visited students on site they executed the practical task very poorly due to incorrect methods that were taught on campus" (L07).

On the other hand, more students than lecturers indicated that the CE curriculum prepared them for the workplace:

> "The activities I did in the workshop allowed me to do everything on site" (FG03).
>
> "No tasks were out of reach for me, all was easy to handle due to the correct methods used by the lecturers" (FG05).

Nearly half (46%) of the students indicated that the CE course did not prepare them for the workplace.

The curriculum does not specify what practice needs to be covered with students in the workshop/yard. Over the years, colleges have taken the initiative to expose students to some form of practice, based on the knowledge taught in the classroom. The knowledge and practice interaction is therefore quite problematic, because the two do not 'speak' to each other.

Object

The object in this activity system focuses on the purpose of the activity in the workshop and college yard and represents that 'problem space' that students are

working in. Even in this problem space, the object allows the student to learn about the CE course and what kind of practical activities they are doing. Students are aware that they need to accomplish many practical tasks and, on completion, they undergo assessment to ascertain whether they have mastered the various tasks in the workshop/college yard before they move to the real work site for further practical exposure.

The questions explored were 13 and 17 in the lecturer survey (Appendix: B): why the activity is taking place and what the students are working on in the workshop/college yard. During students' training in the workshop/college yard they engage in many practical activities, such as putting the knowledge training from the classroom into practice. For example, in the classroom, students are taught what type of formwork to use for the construction of a concrete column. During their practical training in the workshop/college yard, they use the appropriate formwork to set up for the construction of a round, square, or octagonal column. A major part of their training is also to operate the tools and equipment in effective and efficient ways that will prepare them for the workplace.

Originally, when the students started with the course, there was only one object, and that was to obtain a CE qualification as an artisan. As they progressed with the course, they soon realised that they needed to accomplish different smaller tasks. The object is therefore different in each of the three environments. The classroom focuses on teaching knowledge/theory as the object and the workshop focuses on teaching practice, which has some form of connection with the knowledge gained in the classroom. As the course progressed, the perceptions of the students and lecturers revealed different themes which had an influence on the object. The following themes emerged:

- Assessing the challenges
- Understanding the course goals
- Students' prior knowledge
- Student interaction

In this study, the object becomes the focus of the activity, for example, “assessing the challenges for the subject to reach the outcome”. Contradictions have emerged in the object of each activity system as I later discuss in Chapter 8. These contradictions may have contributed to the knowledge and practice divide.

Assessing students’ practical skills challenges

Students’ practical skills are the most important activity leading to the outcome in the workshop/college yard, for this enables them to prepare for the workplace. To ascertain how lecturers deal with this challenge, they were asked how they attended to the skills challenges students had when they entered the workshop. Many of the lecturers felt that the course had many challenges which needed to be addressed for the sake of preparing the students properly for the workplace. Their responses were, among others:

> “Familiarise yourself with the problem first and then solve it” (L02).
>
> “Assess it first, bring a solution and then share with the group” (L03).
>
> “When the problem arises then I assist the students” (L11).

Some of the respondents indicated that they gave individual assistance to the students. For example, one respondent wrote,

> “I work individually with students” (L13). Several lecturers indicated that more practical sessions were needed.
>
> “The ratio between the practical and the knowledge should be looked at” (L07).
>
> “Spend more time on site doing practical work” (L13).

The responses were clustered into three main themes: content, skills, and students’ perceptions of general skills acquired. Some of the respondents indicated more than one aspect which the CE course addressed. An analysis of the responses indicates that 56 percent felt that the course addressed knowledge/content, 34 percent thought the course addressed practice/skills and 10 percent indicated that the course addressed general skills. These findings are represented in Figure 5.5.

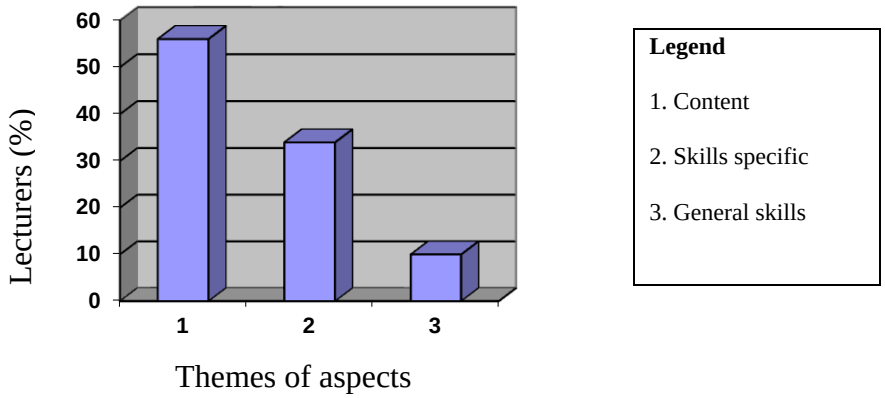


Figure 5.5: Aspects the civil engineering course addresses

The responses from the participants are a clear indication that there are many challenges, for example, the upgraded methods and material used in the industry can be rectified by upgrading the course content, thereby addressing the skills problems that students tend to encounter, such as not understanding the procedure for constructing the roof of a building. In general students and staff feel that more practical sessions in the workshop and college yard should be provided. This could promote closer links between knowledge and practice in the three ASs.

Understand the goals of the practical lesson

For lecturers, it is important that students understand the goals of the lessons because the goals will enable them to see the bigger picture of the course. For example, a brickwork lesson that advances students' understanding of constructing a corner in a building may also aim to develop students' knowledge of various means of brick bonding or cultivate their sense of wonder about block bonding at corners. Obtaining the most from the lesson entails getting students to stack the bricks in the manner in which they should be built in a real work setting. The only difference is that when students work on site, they use a bonding mixture such as mortar that will cement the bricks.

In this section I discuss the lecturers and students' perceptions of the goals and outcomes of the practical lesson. The lecturers were asked if the students

understood the goals of the course and if they could apply what they had been taught during lectures. The lecturers responded as follows:

> "Many of the students do have an idea of what is going on in the class and workshop" (L02).
>
> "Sometimes one can see the difference in the understanding of the students" (L04).
>
> "It's all about the students' attitude if they understand or not" (L07).

This revealed that the outcomes and goals are sometimes not reached. Was there any integration of knowledge and practice when the lesson was presented? These are indications that sometimes theory and practice do not connect with each other, even though they are 'on the same site' where teaching and learning is taking place.

The students, on the other hand, felt that sometimes the goals of the lessons were not clear and distinct and responded as follows:

> "I don't always know what the lecturer is trying to say during the lessons" (JN01).
>
> "Some of the lecturers come to class unprepared and therefore do not always know what the lesson was all about" (JN06).
>
> "Some of the lecturers are clear from the start to inform us what the lesson is about and it will assist us in the industry" (JN13).

As seen from the lecturers and students' responses, there are differences of opinion as to students' understanding of the goals of the lessons.

The major learning goal of a lesson is for students to understand the different concepts within civil engineering. Understanding implies students' ability to describe and explain different concepts. As a result of the lesson, students should be able to apply the CE concept appropriately in areal-life situation and to use the knowledge to integrate with the practice.

As can be seen in Table 5.5, nearly two-thirds of the lecturing staff who teach the CE course indicated that 62 percent of the students understood all the goals of

the lessons; in other words why they were learning about certain knowledge and practice relations. Fewer lecturers (38%) felt that only some of the students understood the goals of the lessons, and none indicated that students did not understand the goals of the lesson. Understanding the goals of the lesson does not imply that students are able to apply the knowledge within a practical context in the workshop/college yard. The goals of the lesson would, in most cases, be that whatever they had learned would have to be applied in a practical context; however this is not always the case.

Table 5.5: Students' understanding of the goals of lesson (N=13)

Curriculum	Yes	No	Some of them
Frequency	8	0	5
Percentage	62%	0%	38%

Lecturers' views of students' prior knowledge

Lecturers felt that a concerted effort should be made to introduce students to CE knowledge and practice before entering the civil engineering course, and that this could be done at school level.

> "The course is too compact; many should never have done this course, they do not have the knowledge" (L03).
>
> "Students should be taught the knowledge and practice that are on par with the latest developments in industry" (L11).

In the focus group interview, students alluded to the fact that they did not need any prior knowledge before they entered the course. It was a career that they wanted to pursue, and therefore they were paying for the course and needed to be taught:

> "It's for me to decide if I want to do the course or not with or without any CE knowledge" (FG05).
>
> "Why did the college accept me without any knowledge then?" (FG06).

From my own experience, I do not think students have to have any knowledge of the CE course before enrolling. The level of complexity is not that high for

students not to grasp what is going on in the classroom or workshop. FET colleges are institutions of learning, and therefore students need to be taught the knowledge and the practical components of the course.

Student and lecturer interaction

Interaction between students and lecturers, in respect of knowledge and practice, is vital for students to succeed in the course and be prepared for the workplace. Many students were of the opinion that regular feedback should be given to them after a practical assessment task had been completed. Opportunities should be allowed for students to gain clarity through questioning, and to express themselves freely if they were unsure of anything. Ascertaining diverse ways of performing various tasks in the workshop and college yard is also an excellent means of allowing students to interact with lecturers. Students often gain considerable confidence if they are exposed to CE professionals, such as quantity surveyors, land surveyors, general foremen, electrical engineers, and mechanical engineers.

The majority of the lecturers indicated that there should be more student interaction and noted:

> "Student interaction should make the industry more interesting" (L09).
>
> "The application of the knowledge should bring greater interaction" (L11).
>
> "Due to the lack of interaction between the college and industry, they do not provide the same practice/skills" (L04).

During my observations in the workshop, I noticed that some lecturers were often distant, for example, some of lecturers went about their own business instead of engaging with the students. This was more prevalent among the older lecturers. It could perhaps be that the lecturers' experience made them treat students more distantly. One of the younger lecturers was more spontaneous with the students. It could also mean that lecturers did not want to share their knowledge and experience with students, or they were not particularly knowledgeable about how to do certain tasks.

Practical examples

As for the students, they constantly need exposure to practical examples to improve their skills. Students were asked what suggestions they had for improving the civil engineering course. The students felt that the lecturers should demonstrate more practical examples pertaining to the knowledge, and that they should not just focus on the simulated exercises:

> "Lecturers need to improve on showing examples about the work we will do in industry" (FG04).
>
> "If the lecturer refers to a theoretical method of constructing the foundation of a building, they must show us the real thing as well; this will make it easier for us to relate" (FG05).
>
> "Have some practical artefacts in workshop as examples to show us how a bridge is constructed" (FG13).
>
> "There is no relationship between the knowledge we do in class and that of the practical in the workshop/college yard because nothing is shown to us by practical demonstrations" (FG15).

Division of labour

The roles of the student and lecturer in the workshop/college yard differ from each other. A workshop/college yard environment should be conducive to learning, owing to the interaction and the roles of the student, the lecturer in the classroom, and the lecturer in the workshop/yard.

The difference between the role of the student and lecturer lies in the nature of interaction between the knowledge and practice relations. There is a mediating role that requires the lecturer to evaluate the students' participation, providing them access to appropriate ways of knowing how to acquire practical skills in the workshop/college yard. On the other hand, the students have the opportunity to gather and obtain skills from the lecturer that will enable them to master various practical skills. In a workshop/college yard set up, the lecturer's task is to demonstrate skills to the students, while the students will complete various practical exercises and assessments tasks. The environment is crucial for theory

and practice relationships to be successful. One imparts knowledge or sets up a conducive environment for this.

In this section I describe lecturers' attitudes towards the D.O.L for teaching and learning in the workshop/college yard. The analysis allowed me to identify a few themes to indicate what students and lecturers say about their roles respectively: rating students' skills, rectifying skills problems among students, and student relations. Creating the right environment for learning, and engaging with the opportunities provided in the environment, are very important for student learning.

Rating students' skills

It is important that students obtain the necessary skills to take their meaningful place in the workplace. When they enter the workplace for workplace training, they are faced with many challenges if they do not have the appropriate skills.

In Question 12 of the lecturers' survey, lecturers were asked to rate their students' skills. During the rating of the students, lecturers have insight into how the students perform and what they are capable of in the workshop/college yard. This serves as a proxy for assessing readiness for the workplace. Rating students could give some indication to the lecturers in respect of which students should be ready for the workplace. Lecturers would therefore know which of the students should be given individual attention to improve their skills levels.

Table 5.6: Students' skills in the subject area (N=13)

Skills	Acceptable	Below standard	Above standard	Do not know
Frequency	7	5	1	0
Percentage	54%	38%	8%	0%

One respondent indicated that the students' skills were above standard, while 54 percent said that the skills were acceptable. It was alarming to note that 38 percent indicated that the skills were below standard as indicated in Table 5.6.

This could be an indication that these students are not prepared for the workplace.

Rectifying skills problems among students

The lecturers' role is to provide opportunities for learning, especially in developing knowledge and practice relationships; prior to that they serve as evaluators to determine where the shortcomings are. The data collected in Table 5.7 is in response to Question 11(a): "When you identify a skills problem with the students, do you rectify it immediately?" One out of the 13 lecturers responded by indicating 'not always', whereas all the others claimed to rectify the skills problem immediately.

Table 5.7: Lecturers rectifying the skill problem immediately (N=13)

Rectifying skills	Yes	No	Not always
Frequency	12	0	1
Percentage	92%	0%	8%

The fact that nearly all the lecturers said that they attempted to rectify the skills problems of the students, could be an indication that if they did not do so, students would be unprepared for the workplace; it could be a sign of committed lecturers or a combination of both. In the workshop/college environment, lecturers mostly focus on the practical skills of the students. There are multiple opportunities for learning, especially relating to knowledge and practice.

A second part of the question posed to the lecturers was how they rectified the skills problems that students encountered. One of the main roles of the lecturers is to give practical demonstrations to the students. The majority of the lecturers indicated that they rectified skills problems by using practical demonstrations as a tool.

Student relations

When positive relations exist among students in and outside the classroom, students are more motivated to learn, participate more actively in their own learning, and the learning is likely to be more effective (Hill & Hawk, 2000).

The vast majority (84,6%) of lecturers felt that students did get on well with one another, whereas 7,6 percent of the lecturers indicated that students only sometimes got on well. Most of the respondents (92,3%) indicated that they did have a good working relationship with their students, but 7,7 percent felt that they only sometimes had a good working relationship with the students because of students' bad attitudes in the workshop. It seems that the students are fairly mature in their approach to one another, as 76,9 percent of the respondents indicated that students normally resolved their differences appropriately.

For lecturers, it is important for students to exercise good human relations with their fellow students and with lecturers. Often the students will work with others in pairs or groups. This fosters good knowledge and practice relations when students go to the workplace to work on projects. It is important that this foundation is laid at college level, for students to take good human relations to the workplace.

Communities

The community refers to the people involved in the AS who carry out the activity, namely in the workshop/college yard. The main question is therefore, "What is the environment in which this activity is carried out?" The participants who shared the same *object* or class objective, *community* in this study, were the lecturers, college management, industry, and peers. In an attempt to determine to what extent the college forms part of the community in adequately preparing the students for the workplace, I posed a range of questions to all participants. The following were the themes that emerged: industry participation, links/partnerships between colleges and industry, and frequent civil engineering industry visits.

Industry participation

In this section it was important to clarify the interaction and links the lecturers have had with industry. The questions were posed in such a way to determine their participation and the usefulness of industry visits. Question 22 deals with industry participation as part of the community. Lecturers felt that industry should be more involved in developing the students, since they work in industry after they have qualified. The lecturers were of the view that industry could participate in a number of ways:

> "Industry involvement is very important in preparing the students" (L02).
>
> "If industry can put more money into the college sector, then we can upgrade our equipment and tools so that the students can work with the latest" (L03).
>
> "Students should be given access to building sites when the necessary arrangements are made; at the moment it is really a hassle to arrange for workplace training" (LO6).

Many of the lecturers felt that the college should become more involved by giving students more industry exposure:

> "Industry exposure will make the students more interested in their studies" (L08).
>
> "Students must be well prepared for the workplace" (L09).
>
> "The students need more exposure to site conditions; most of them do not know what is expected of them when entering the site" (L12).
>
> "Expose students to the industry" (L13).

Table 5.8: Industry visits (N=13)

Industry visits (how often)	Never	Seldom	Often	Very Often
Frequency	4	6	2	1
Percentage	30,7%	46,2%	15,4%	7,7%

The industry plays an important part in shaping the careers of students. When students see what is happening on site, they mentally prepare themselves for that which lies ahead of them. By just observing what the environment is like, for example, how the formwork of a column is constructed on site, gives them an opportunity to link knowledge with practice and the workshop/college yard with the workplace.

The need for students to be exposed to the industry could assist students with mental and physical preparation for the workplace. Students will be more confident and it could also build their self-esteem. It should also assist in making the connection between knowledge and practice.

Links/partnerships between colleges and industry

Links between education and the workplace are examples of a joint venture between two identifiably different but interdependent organisations, and hence subject to analysis in terms of the principles and theories of organisational behaviour (Wilson, 1984). In the present context, the significant principle is that two organisations will enter into joint ventures only if they have compatible needs that cannot be satisfactorily met independently, and the interactive venture is seen to have promise for fulfilling these needs (Tornatsky & Lounsbury, 1979).

Many of the lecturers also felt that:

> "The training provider and industry do not offer the same knowledge and practice and therefore they are not at the same level and use different methods of explaining CE concepts" (L03).
>
> "Whatever method is taught at the college, the same method must be used on site" (L07).
>
> "Partnerships must be set up with industry so that our students can familiarise themselves with proper procedures on what's happening on site" (L08).

The fact that respondents indicated that knowledge and practice were not on the same level could give the impression of a lack of preparedness by the student for

the workplace. Different methods are taught differently; this confuses students when they enter the site. They don't know which method is the correct one.

Rules

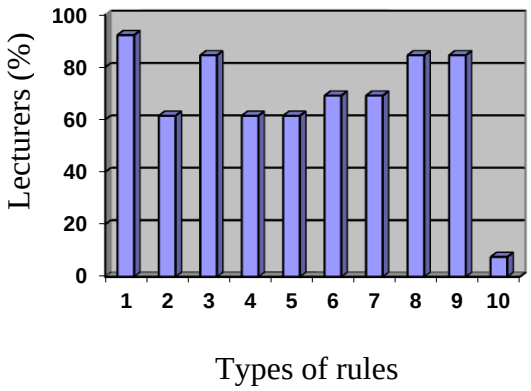
In this study, *rules*, including behaving properly in the workshop/college yard, following task direction (task rules), adhering to attending all practical demonstrations, completing assignments, mastering all practical tasks, and applying CE rules were highlighted in the data collected. The questions are therefore, "*What are rules or regulations governing the performance of activity?*" and "*How are they similar or different at the three sites?"*

The lecturers were requested to describe the rules in the workshop/college yard. Rules and regulations are formulated with a view to encouraging the running of educational institutions with available resources, safeguarding the legitimate rights and interests of staff, and students receiving adequate education.

In practice, many of us find that institutional rules are incomplete and problematic on their own and that rules offer a stronger basis for ethical practice. It is increasingly not a matter of choosing incomplete or stronger rules, but developing ways of practising both simultaneously in spite of their contradictions (Elwood, 2006)

Rules students must adhere to when in the workshop/college yard

Lecturers were required to indicate which rules the students should adhere to when in the workshop/college yard. An analysis of the responses indicate that 92,3 percent indicated coming to the workshop on time; 84,6 percent responded with respecting others' belongings, acceptable behaviour, and obeying house rules; 69,2 percent indicated handing in class work; 80 percent stressed attendance; 61,5 percent indicated meeting assignment deadlines, wearing safety equipment, and taking care of equipment. These totals do not add up to 100 percent, as many students indicated more than one rule. These findings are represented in Figure 5.6.



Legend

1. Coming to class on time
2. Assignment deadlines
3. Respecting others' belongings
4. Wearing safety equipment
5. Taking care of equipment
6. Handing in class work
7. 80% attendance
8. Acceptable behaviour
9. Obeying house rules
10. Others

Figure 5.6: Rules students adhere to

It is important to note how the rules of the workshop/yard compare with those in the real workplace.

Civil engineering rules of the profession

Lecturers at FET colleges have an influence on how students perceive the CE profession. Although the CE rules are not fully applied in the workshop/yard, they are applied to a certain extent. The workplace is actually where these rules are fully applied, hence the reason for teaching the students these rules in the classroom and workshop/yard. The civil engineering profession does not have a single uniform system or standard of ethical conduct across the entire profession. Ethical approaches vary by discipline and jurisdiction, but are most influenced by whether civil engineers independently provide professional services to clients or the public if employed in government service; or if they are employees of an enterprise creating products for sale. Despite everything that goes with the profession, there are rules that govern the industry.

When lecturers were asked about the rules of the profession, they responded as follows:

> "The CE rules should make all involved to act professionally" (L01).
>
> "The rules are put in place for people to act in a truthful manner" (L02).
>
> "Each employer or client must be treated with respect" (L03).
>
> "Conflicts of interest should be avoided" (L04).

> “These rules should make us to build a professional reputation on the merit of their services which the industry delivered” (L05).
>
> “The industry should uphold and enhance the honour, integrity, and dignity of those whom they work for” (L06).

Apart from the rules of the CE profession, there are also assessment rules which are extremely important for students to enable them to progress from one stage to the next. These rules should also assist in the knowledge – practice relations.

Assessment rules

Practical assessment plays an important role in developing students’ abilities to perform various tasks. Whether students like it or not, they all have to contend with different assessment tasks. In a practical context, students are either found to be ‘competent’ or ‘not yet competent’ when assessed by the lecturer in the workshop. The question was posed to the lecturers as to how students dealt with the assessment in the workshop/college yard. The lecturers responded in the following manner:

> “Many of the students do not like the idea of repeating an assessment; they feel that they can just move on to the next task” (L04).
>
> “Some students are quite comfortable with the assessment rules that are laid out to them” (L05).
>
> “I will never find a student competent in a specific assessment if they have not mastered the task; my name is at stake” (L06).

As can be discerned from some of the examples of the lecturers’ comments, they are very strict about the assessment of students as far the practical work is concerned. Practical work is correctly exercised in the workshop/yard, but the question remains whether the practical integrates with the knowledge from the classroom, and ultimately how it prepares students for the workplace. The data reveal a knowledge and practice divide.

5.3 CONCLUSION

This chapter summarises the perceptions of the learning that takes place in the workshop/yard by students and lecturers at FET colleges. The activity theory concept provided the opportunity to examine the subject, mediating artefacts, object, division of labour, community, and rules. The chapter also dealt with data collected by means of the different data collection instruments, and described the views of students and lecturers with respect to their learning, with special reference to the knowledge and practice relations in the workshop/yard.

Lecturers' knowledge and practice experience, teaching and learning experience, lecturer perceptions of industry participation, and institutional rules are a few of the concepts that emerge and re-emerge throughout this study. From the information gathered it was clear that both students and lecturers felt that there was a need for a CE course which deals with knowledge – practice integration. Lecturers offering the civil engineering course felt there was far too little industry participation, which they perceived as the reason for the problem. The use of proper and updated equipment would enhance practice, and students would be able to be better prepared for the workplace.

In the next chapter, the subject, object, mediating artefacts, division of labour, community, and rules pertaining to knowledge and practice relations with civil engineering workplace supervisors from various construction companies will be examined.

CHAPTER SIX: STUDENTS AND WORKPLACE SUPERVISORS' PERCEPTIONS OF THE WORKPLACE ENVIRONMENT

6.1 INTRODUCTION

In the previous two chapters, data from the civil engineering students and lecturers at FET college sites was presented. This chapter considers the knowledge and practice relations perceptions of the civil engineering site workplace supervisors and students. Because of the difficulty of obtaining permission from more workplaces, I received permission from eight CE sites only. Some companies indicated that owing to safety issues, they could not allow me on site. Therefore, eight civil engineering sites were visited and the surveys were discussed and completed. Of the eight civil engineering site supervisors, seven supervisors agreed to complete the survey; one was not interested. These survey questions were recorded and the results summarised in order to draw conclusions from the responses. The findings from the data collection instruments are reported below. This chapter presents the perceptions of workplace supervisors of students' learning at the workplace; the perceptions are presented within an activity framework and organised according to the AT elements.

6.2 ACTIVITY SYSTEM OF STUDENT LEARNING AT THE WORKPLACE

The findings of each of the six elements in the activity systems are reported separately. The activity is about the learning of students in the workplace. I tried to determine the knowledge and practice relations that should prepare students for the workplace. Firstly I deal with the survey data, and secondly, the interview data on the activities taking place in the workplace. I start with a profile of the workplace supervisor, and then present the findings according to the elements of AT.

Description of the workplace supervisor

A profile of the workplace supervisor at the civil engineering sites was obtained from the quantitative and qualitative sections of the supervisors' questionnaires, in which supervisors were asked to identify their gender, language, workplace experience, supervisory experience and their role as supervisors (refer to Appendix G, Questions 1, 2, 3, 4, & 5).

One of the major challenges I encountered was to get access to workplace supervisors on site. Initially I contacted many companies to allow me the opportunity to speak to their workplace supervisors to discuss the completion of the survey and to interview them. Employers were generally of the opinion they didn't have the time to see me. I managed to find eight companies that were agreeable, but finally only seven workplace supervisors agreed to complete the survey and were amenable to being interviewed. This is the reason for my small number of workplace supervisors. The responses detailed in Table 6.1, indicate that nearly the entire supervisor population working on Civil Engineering sites is male:

Table 6.1: Gender (N=07)

Gender	**Male**	**Female**
Frequency	6	1
Percentage	86%	14%

Supervisors are drawn from the three major language groups of the Western Cape, Afrikaans, English and isiXhosa. Table 6.2 shows the different languages of the respondents.

Table 6.2: Language (N=07)

Language	**Afrikaans**	**English**	**isiXhosa**	**isiZulu**	**Other**
Frequency	3	2	2	0	0
Percentage	42%	29%	29%	0%	0%

The average age of the supervisors is 42 years. Table 6.3 gives an idea of the range of ages represented by workplace supervisors. These supervisors are middle aged and have gained some form of practical experience of the industry. This could be the reason for their current positions as workplace supervisors.

Table 6.3: Age (N=07)

Age	**21 – 25**	**26 – 33**	**34 – 41**	**42 – 49**	**50 & over**
Frequency	0	1	1	4	1
Percentage	0%	14%	14%	58%	14%

The workplace supervisors reported on how they perceived the students on site and presented their views of the four different groups of civil engineering students who participated in this research project according to the questions set in the instrument. The four groups are stipulated in Chapter 4. The responses are plotted onto the elements of the AT model and later analysed.

Mediating artefacts/Tools: Teaching and learning strategies and physical tools used at the workplace

This study refers to the workplace as a building site where buildings are built, bridges are constructed, roads are laid, and dams are built. It is a process where a CE company takes over a piece of land from the owner and a few months later, the owner takes back the land with a building built on the land. The open land, which is referred to as the site, is where the students carry out the diverse activities that form part of their teaching and learning.

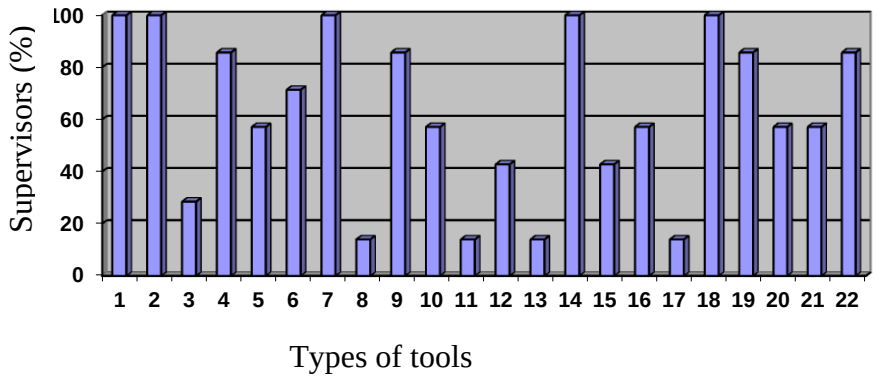
The workplace environment is conducive to learning, because of the interaction and activities that take place, and students are often more relaxed because they work mostly on practical projects. As outlined previously, the tools used in the classroom are models and pictures of tools, but in the workshop/college yard, the students use the actual tools.

This section describes the students and workplace supervisors' views on the tools used by them for teaching and learning at the workplace. Students

generally have their own perceptions regarding teaching and learning aids as tools, the methods used for teaching and learning, the working methods used by them which form part of their repertoire as developing civil engineering artisans, and the curriculum as a tool which is used to prepare them for the workplace. Workplace supervisors use a variety of tools, materials, methods and equipment in the workplace environment that should prepare students for the workplace.

Physical teaching and learning tools used at the workplace

Workplace supervisors were asked about the tools they used to train students on site. They had the opportunity to circle as many tools as they wished. The data collected refers to Question 13. An analysis of the responses indicated the five tools they used most: spirit level, tape measure, dumpy level, chisels and hammers were all rated 100 percent, while the second most used tools were the compactors, machines, water level, and drilling equipment at 85,7 percent. Tools which were used the least were the plane table, tilting level, land chain, and planimeter, rated at 14 percent. These findings are presented in Figure 6.1.



Legend

1. Dumpy level
2. Spirit level
3. Abney level
4. Compactors
5. Graders
6. Theodolite
7. Tape measure
8. Plane table
9. Machines
10. Front loaders
11. Tilting level
12. Boning rod
13. Land chain
14. Hammers
15. EDM
16. Traveller
17. Planimeter
18. Chisels
19. Water level
20. Range rod
21. Setting-out rod
22. Drilling equipment

Figure 6.1: Tools used on site to train students

During my observations on site, I noticed that students were mainly working with physical tools such as compactors, chisels, hammers, and drilling equipment.

The electronic tools, such as theodolites, planimeters, and tilting levels, were used either by the supervisor himself or by a qualified artisan. When I asked one of the supervisors why the students were not working with these tools, he responded: “These tools are very fragile and expensive. That’s the reason why they are used by the more senior people on site” (S04). This indicates that students are not given the opportunity to operate electronic tools, which indicates a clear gap between knowledge and practice in the college and in the workplace. Students are taught the theoretical knowledge of how these tools operate, but when they enter the site they are not given the opportunity to work with the tools.

Workplace supervisors’ perceptions of teaching and learning aids as tools

Workplace supervisors indicated that they used different teaching aids during their practical presentations to students. All the workplace supervisors indicated that they did not focus on the knowledge that was taught at the college, but only engaged in practical demonstrations. They explained procedures to students verbally, with an example at hand. The verbal explanation did not necessarily correspond with the knowledge gained at college, but was often the experience of the supervisor which was related to the students.

If there was no major project to be completed, students would be involved in the following:

> “Making models of various items such as building in a door frame or window frame” (S01).
>
> “The teaching method as a tool I use is practical demonstration simulated activities, for example, instructing them to make the formwork for a concrete pillar” (S02).
>
> “The teaching method as a tool that is used by me is just showing the students to use the tools and equipment correctly” (S03).
>
> “The major method as a tool I use is real work projects when the student is given the opportunity to work on real projects that give them an advantage over other students” (S06).

When I asked the students during my observations on site what the teaching aids workplace supervisors used most on site were, they responded:

> “Most of the time the supervisor will use practical examples to explain to us what they’re doing” (NCV06).
>
> “The latest tools and equipment are used and demonstrated to us so that we can use it correctly” (JN08).
>
> “We don’t use any textbooks or notes, just the tools as teaching and learning aids” (JN12).

This could be one form of knowledge and practice relations in the workplace. The workplace supervisor takes the students to where a carpenter is busy constructing a ceiling; the students then have the opportunity to see how a ceiling is constructed in practice. This is when students may make the connection between the knowledge gained in the classroom and real practice experienced on site. The workplace supervisor is not the one who makes the link between theory and practice; rather it is the student.

Team work, practical work, and practical demonstrations play an important role in the teaching of students on site. This is also a way of bridging the gap between knowledge and practice. What emerges from the perceptions is that most workplace supervisors use these three methods. They expanded when they were asked why they used these methods:

> “The student grasps better and quicker when I demonstrate verbally and practically to them how to execute various tasks, for example, setting the building profile” (S02).
>
> “I allow the students to do a lot of practical work because it makes them confident” (S03).
>
> “When students engage in team work exercises they learn more from their peers” (S07).

The observations on site confirmed that the students learned and benefitted from the practical demonstrations by the workplace supervisor and they responded by saying:

> “If I do not understand what to do I will just ask the supervisor to demonstrate what he wants” (LS02).
>
> “I could not build a corner joint with brickwork, but the supervisor demonstrated to me what I had to do and then I could do the activity” (LS07).

Students do learn the practical work when they are on site. Some of the students focus considerably more on the practice and are not too concerned about the theoretical knowledge. I have noticed how the students try to shift the knowledge that was taught in college to what the workplace supervisor wants them to do on site. Students often find it difficult to make the link between knowledge and practice. Workplace supervisors are not interested in long, theoretical explanations of how various tasks should be executed, as long as the job is done in the time allocated. Sometimes, the workplace supervisor forgets that the students are there to learn and that they need to try to make the connection between knowledge gained at college and practice in the workplace.

The data collected refers to the responses from the individual interviews with the workplace supervisors where they were asked which teaching methods they used most frequently to demonstrate to students. The workplace supervisors responded by indicating the following:

> “Mostly I allow the students to work in groups so that they can learn from each other” (S04).
>
> “What I have noticed, if students work in groups, many of the students hide behind the others and therefore do not do anything and they just do not learn; that is why they do a lot of pair work in my team” (S05).
>
> “It’s very vital for me that students work on real projects so that they can learn quicker and faster” (S06).
>
> “In my team students get to learn about problem-based learning; I often give them many problems to solve before I explain to them the correct thing to do” (S07).

According to the responses from the workplace supervisors, during these various activities which students are engaged in, they learn differently. What is really

important is that students should bridge the gap between knowledge and practice on their own. It is not easy for the student to do this, since the knowledge assimilated at college and the experience gained at the workplace are different in context. The workplace supervisor's knowledge is based on experience and the students' knowledge comes from the classroom and workshop/yard.

Workplace supervisors' perceptions of the CE curriculum as a tool

During my visits to the various CE sites, I interviewed workplace supervisors by asking them to complete the survey; while completing the survey, I raised the question about the CE curriculum's preparation of students for the workplace.

Supervisors were asked to indicate if the training at FET colleges fulfilled the needs of industry. The data collected refers to Question 7(a) of Appendix G. An analysis of the responses indicates that 28 percent of the supervisors agreed that it did fulfil the needs of industry, while 72 percent said that it partly fulfilled the needs. These findings are represented in Table 6.4.

Table 6.4: Training at FET colleges fulfil the needs of industry (N=07)

Training	Yes	No	Partly
Frequency	2	0	5
Percentage	28%	0%	72%

The workplace supervisors also had to explain why/why not the training at FET colleges met the needs of industry. Only two of the supervisors indicated that the training met the requirements of industry, and therefore their responses were different from those of the five supervisors who said that it partly met the needs of industry.

The questionnaire data revealed three main themes as to why/why not the training met the requirements of industry.

> "The training methods are a bit outdated. Some of the colleges are teaching students methods which my dad was taught when he started in the civil engineering industry" (S03).

> “Not in all cases. I studied at CPUT [Cape Peninsula University of Technology] and we did much more than what the FET college students are doing” (S04).
>
> “The students are used to working with old equipment and when they get to site we must train them on the new equipment again” (S05).

Additional comments were made by some of the workplace supervisors that the curriculum did not prepare students for the workplace:

> “The curriculum that I was taught a few years ago is still being used in the college without any adjustments” (S02).
>
> “If you just look at the way concrete columns are being constructed today, back then mostly timber formwork was used as the ‘boxing method’ but today steel formwork is mostly used” (S03).
>
> “When students come to site, I expect them to at least know the basics of methods such as determining the setting out procedure for a simple dwelling; most of them cannot even do that” (S05).
>
> “I would love to see the curriculum get a total overhaul, but whoever sets the curriculum must involve the industry for the latest techniques and methods used” (S06).
>
> “The curriculum should be more practically orientated, [and] allow the students to do more practical work with less theoretical knowledge” (S04).
>
> “Students should be given the opportunity to engage in more practical assessment tasks to enable them to become competent with the practical; the curriculum does not allow for that aspect” (S07).

As can be noted from the responses, workplace supervisors do not think the current curriculum as a tool prepares students fully for the workplace. They are of the view that the knowledge taught to the students is outdated. When students enter the site, they therefore find it difficult to come to terms with practice on site.

Object

The knowledge and skills which students require to enter the workplace are often enhanced by workplace supervisors or, in some cases, by senior students on

site, because of their previous experience. The object in the workplace is 'students doing real work practice'. Students enter the workplace with CE curriculum knowledge. The question posed is whether the curriculum knowledge which students bring with them to the world of work is effective in the workplace, taking into account the knowledge and skills students learn, particularly between the world of work and that of FET colleges.

In all three activity systems the outcome has always been '*students' preparedness for the workplace*'. However, the students who are the subjects are well aware of the fact that they need to accomplish many tasks, such as attending practical sessions regularly and completing a number of practical assessment tasks in the workplace and on site before they can qualify as CE artisans.

When the students are scheduled to proceed to site for workplace training, they know they are one step closer to reaching their goal of becoming qualified CE artisans. The object for the workplace is different in each of the three environments, as seen from the classroom and workshop perspectives in the earlier chapters. The analysis of the surveys, interviews and observation data revealed that new objects emerged as the course progressed. Thus, for the students, there are main reasons/motives that constitute the *objects* of this aspect of the course: students' understanding of instructions, project completion and quality assurance, application of various practical tasks, rating students' skills on site, and rectifying the skills challenges. The following were the themes from the workplace perspective that emerged from the workplace supervisors' responses.

Students' understanding of instructions

As can be seen in Table 6.5, 44 percent of supervisors responded that students did understand when instructions were given to them, while 28 percent indicated that students did not understand; some said they only understood some of the time.

Table 6.5: Students' understanding of instructions (N=07)

Instruction	Yes	No	Sometimes
Frequency	3	2	2
Percentage	44%	28%	28%

The instructions that are referred to are those given when students enter the workplace and they are asked to carry out and complete many activities as requested by the workplace supervisor. The students often engage with small- to-medium projects such as building in a door or window frame, setting out the foundations of a building, or erecting the formwork for concrete columns.

Understandably, students arrive at the site with some knowledge and skills. Their knowledge and skills need to be put into practice by following various instructions that come from the supervisor. The big question is therefore whether the students understand the instructions or not. Students' understanding of the workplace supervisor's instructions can reconcile knowledge and practice. One of the instructions from the supervisor could be: "Get a three-panel door from the store and hang the door at the main entrance of the building." The student may then go to the store and request a one-panel door from the storekeeper and then start hanging the door. The student will not have complied with the full instruction from the supervisor, because he/she hung the incorrect door. Those are the things that make supervisors contend that students do not understand instructions. This could also mean that the student does not have any knowledge of a three-panel door, and does not know where the main entrance of the building is.

Some supervisors indicated why they felt that students did not understand instructions:

> "I have requested that students meet at a certain time and bring their tape measures; only 30 percent of the students brought their tape measures along with them" (S03).
>
> "Students very seldom adhere to instructions. I have asked them to set up the three-meter profiles to build a corner of the building; they only build a one- meter profile" (S04).

This could mean there is either a lack of knowledge of what a tape measure is, or it could also be that they are forgetful. On the other hand, many of the supervisors were very positive and indicated that many students actually did understand instructions. Understanding instructions is one of the main reasons for bringing knowledge and practice together.

Project completion and quality assurance

The completion of projects is an essential aspect of being in the workplace. As penalties are imposed on the late completion of projects, it is paramount to complete projects on time, or ever better, ahead of time. Workplace supervisors responded in the following manner:

> "One of my main tasks is making sure that the project is completed on time" (S02).
>
> "If the project is completed before the time, we usually get a bonus for saving the company money" (S04).
>
> "We are often pushed by senior managers to complete the projects, so I see this as one of my 'big' roles" (S05).

Related to the above comments, many workplace supervisors described one of their roles as quality assurance of the work that workers carry out on site. Their responses were:

> "My responsibility is to make sure that the project is completed on time and with a high quality of workmanship" (S01).
>
> "Part of my responsibility is to make certain that the interns are being trained properly" (S02).
>
> "If the workers do not do a proper job, I remove them from the site, otherwise it becomes my problem" (S03).
>
> "I must make sure that the people do a proper job and not waste the company's money" (S04).

Workplace supervisors indicated that there is no time for teaching students. Their focus is mainly on completing the project on time. The concept of production is superseding learning.

Students applying different tasks

Supervisors were asked: “After showing a student the correct way of performing various tasks, can most students apply what you have taught them?” Table 6.6 indicates the responses by the supervisors.

Table 6.6: Students applying different tasks (N=07)

Tasks	Frequently	Seldom	Never
Frequency	4	3	0
Percentage	56%	44%	0%

Students are expected to carry out various tasks as instructed by the workplace supervisors on site. Many of them are able to perform various tasks at a very high level, which is a sign of implementing knowledge and practice. The theoretical knowledge, together with the practical done at college, allows them to perform certain tasks, for example, to read a drawing and from there, be able to apply their knowledge and skills.

Rating students’ skills on site

Table 6.7 shows how supervisors rate students’ skills when they are on site. Question 11 in the workplace supervisor’s survey refers to this.

Table 6.7: Rating students’ skills (N=07)

Student skills	Acceptable	Below standard	Above standard	Do not know
Frequency	4	3	0	0
Percentage	56%	44%	0%	0%

The fact that none of the students’ skills were above standard is a clear indication that they are still students and are working towards becoming qualified CE artisans. In other words, 44 percent of students are very poor in performing skills tasks when they are on site. The final-year students are normally better at doing certain tasks than first-year students, because of the experience they have

gained. Supervisors were generally very negative when they were asked to rate students' skills; they actually expected all students to be on par with qualified artisans, which was not always possible.

Rectifying a skills problem

A considerable majority, 86 percent of the supervisors, claimed that they rectified a student skills problem immediately. Table 6.8 refers to Question 10(a) of Appendix G.

Table 6.8: Rectifying a skills problem by the student (N=07)

Rectifying skills	Yes	No	Not always
Frequency	6	0	1
Percentage	86%	0%	14%

As can be seen from the responses of supervisors, skills are really at the heart of everything:

> "I would show the students what to do by calling all of them together so that the others can also learn from their mistakes. I do not wait for tomorrow but rather rectify it immediately" (S02).
>
> "Some supervisors call the group together and explain where they went wrong. I however rectify the problem with the student who has demonstrated a skills problem" (S03).
>
> "Immediately I show him/her how the tasks must be done, i.e. many of them don't use the dumpy level in the correct way. One can see the college taught them the incorrect way" (S04).
>
> "I call one of the more qualified supervisors to come and explain, that is, if I cannot explain to the students. But in most cases I teach them myself. The men do not like to be taught by a female supervisor" (S05).

Rectifying the skills problems of students could assist them to be better prepared for the workplace. The idea is really to make sure that they bridge the gap between the theoretical knowledge acquired at college and the skills required in

the workplace. The one way of doing that is to rectify the skills problems students have when they enter the workplace.

Division of labour

The question was posed, “Who is responsible for what, when carrying out tasks and how are the roles organised?” The tasks are real-time activities that are carried out by qualified personnel who are assisted by students and labourers. In this section supervisors considered their roles and their understanding of student activities on site.

In this section, I describe the workplace supervisors’ attitudes towards the D.O.L for teaching and learning at the workplace. The students’ main role at the workplace is to make sure that they learn as much about practice as possible, which they can link with the knowledge acquired at college. The analysis allowed me to formulate a few themes, to indicate what the workplace supervisors felt about their role. Three main themes in respect of the roles of supervisors emerged: completing projects with the latest specifications, kinds of projects the company takes on, and supervisor/student working relationships on site.

<u>Completing projects with the latest specifications</u>

Many of the workplace supervisors felt that all projects, such the tasks given by the employer, should be completed with the latest specifications and indicated the following:

> “The building materials which are delivered for the projects must be according to building specifications prescribed in the building regulations” (S07).
>
> “Making sure that the work is carried out according to the building regulations and current standards (S06).

Linking building regulations with current building practice is one way of bridging the gap between knowledge and practice at the workplace. The completion of the

tasks allocated is chiefly the role of the employer, but for the student it is secondary.

Kinds of projects the company takes on

Supervisors were asked to indicate the different projects they were responsible for. The data collected refers to Question 14. An analysis of the responses indicated that 85 percent of the companies were building dams and completing other projects, while 71 percent were building bridges, laying roads, and constructing houses and high-rise buildings; a further 42 percent were engaged in renovations, and 28 percent were building schools and multi-storey buildings. These totals do not add up to 100 percent, as many supervisors indicated their working on more than one project. These findings are represented in Figure 6.2.

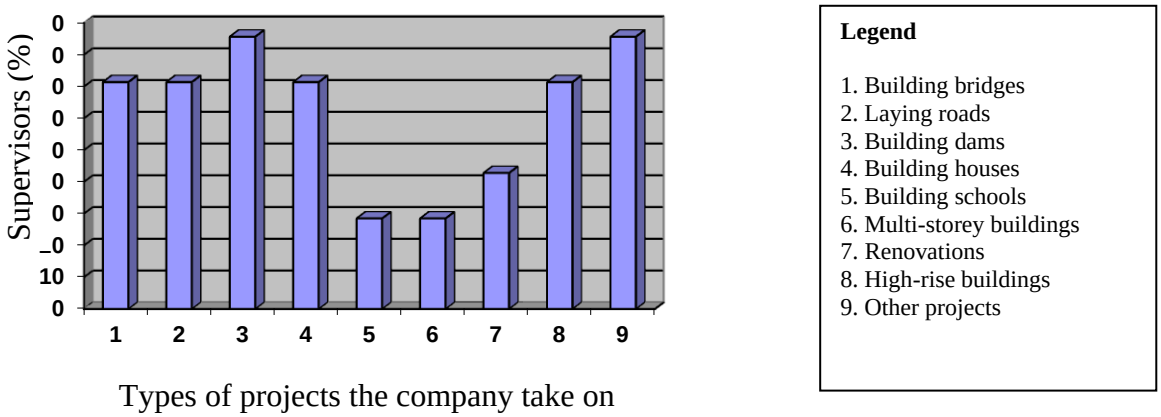


Figure 6.2: Different projects companies take on

The companies take on suitable projects to make money, and not for the purpose of student learning. It is not a question of whether the company takes on projects to build steel structures, but whether students can apply the CE knowledge from the college in the workplace. I am trying to ascertain the relationship between what students learn at college ('the knowledge') and the projects ('the practice') they are exposed to on site.

Supervisor/student working relationships on site

Supervisors were asked in Question 18 of the survey to describe their working relationships with students on site because this could indicate whether they were willing to assist students or not. Just over half (56 percent) of the supervisors claimed to have a good working relationship with students, 44 percent indicated they sometimes had a good working relationship with students; none claimed to have a poor relationship with students. The data illustrated in Table 6.9 refers to the relationships supervisors have with students on site.

Table 6.9: Working relationship with students (N=07)

Environment	Yes	No	Sometimes
Frequency	4	0	3
Percentage	56%	0%	44%

It is clear from the data that the supervisors get along well with students. None of them said that they did not want students to assist with the projects they were busy with. If there are good relationships between students and their workplace supervisors, this could mean that students could learn considerably better and would also be able to make the connection between knowledge and practice more easily.

Communities

This section deals with the environment in which the activity is carried out, namely the workplace. Those that constitute the community of the workplace are students, workplace supervisors, lecturers, artisans, consultants, engineering professionals, owners and employers. It was important to clarify the interaction and links the students had with industry as community settings. The research questions were posed in such a way to determine their participation in industry visits. The workplace supervisor plays major roles as an instructor, a facilitator and mediator, scaffolding students' practical skills. The following themes emerged in respect of the communities: site visits, workplace training, and student interaction.

Site visits

In Question 16, supervisors were asked if they took students to other building sites. All of the supervisors responded that they had never taken students to other sites. Supervisors did not feel the need to take students to other sites, because they contended that what they were doing on their sites was similar to what students would experience on other sites. Some workplace supervisors indicated that it was the responsibility of the college to allow students to visit other sites. As indicated in the previous chapters, it is very important for students to be exposed to site visits because such visits broaden their knowledge of civil engineering. Table 6.10 captures the responses.

Table 6.10: Sites visits (N=07)

Site visits (how often)	Never	Seldom	Often	Very often
Frequency	7	0	0	0
Percentage	100%	0%	0%	0%

Workplace training

An understanding of the supervisors' knowledge of the training at workplaces emerged from the responses requiring them to indicate if the training in industry prepared the students adequately to qualify as CE artisans. Supervisors felt that workplace training was adequately dealt with on site and responded:

> "The work we do with students on site will allow them to complete various tasks on site" (S03).
>
> "I think that students fit in well on site and that allows me to give them the best training" (S05).
>
> "The workplace training is really beneficial to the students" (S06).
>
> "Sometimes the students do not understand the instruction given to them but after explaining the tasks they correct their mistakes" (S07).

Workplace training is paramount to students because it allows them to make some form of connection between knowledge acquired in the classroom and

practice learned in the workshop/yard. A greater connection between knowledge and practice could be made if there were sufficient interaction between all stakeholders in the workplace community.

Students' interaction in the community

During observation, five of the workplace supervisors seldom interacted with the students. One of the workplace supervisors frequently interacted with the students and collaborated with them on the production and checking of inventory lists. During the instances when workplace supervisors interacted with the students, it was to inform them of where they had gone wrong and asking them when they would be done with the project they were working on. Workplace supervisors were observed interacting with other employees, for example, their colleagues.

Four of the students were frequently involved with alternative tasks, such as digging trenches, assisting other staff members to carry equipment, and taking inventory of stock. One student was occupied most of the time in answering the telephone and one student worked most of the time on issuing material to other staff members of the company.

Rules

In this study, *rules*, including safety rules, CE rules, general rules and regulations in the workplace, following task direction (task rules), daily reporting for work, listening to instructions, mastering all practical tasks, and applying CE rules were the order of the day. The question is therefore, "*What are the rules or regulations governing the performance of activity?"* These are the rules that try to connect knowledge with practice.

The workplace supervisors were requested to describe the rules at the workplace. Rules and regulations are formulated with a view to encouraging the efficient running of the site with available resources, safeguarding the legitimate

rights and interests of staff, students and those receiving workplace training, and promoting the health and safety of other workers.

Rules students must adhere to when on site

In an analysis of the responses to Question 17 in the supervisor survey, all supervisors indicated coming to work on time, completing the task on time, wearing safety equipment, taking care of equipment, and being at work every day, as important rules students must adhere to. The majority of supervisors (85%) indicated producing quality work and obeying house rules as important, while 71 percent indicated other aspects such as 'do not take longer lunch', 'do not waste material', and they 'are taught to clean behind themselves'. 28 percent felt respecting others' belongings and acceptable behaviour were important. These totals do not add up to 100 percent, as many supervisors indicated more than one rule. These findings are represented in Figure 6.3.

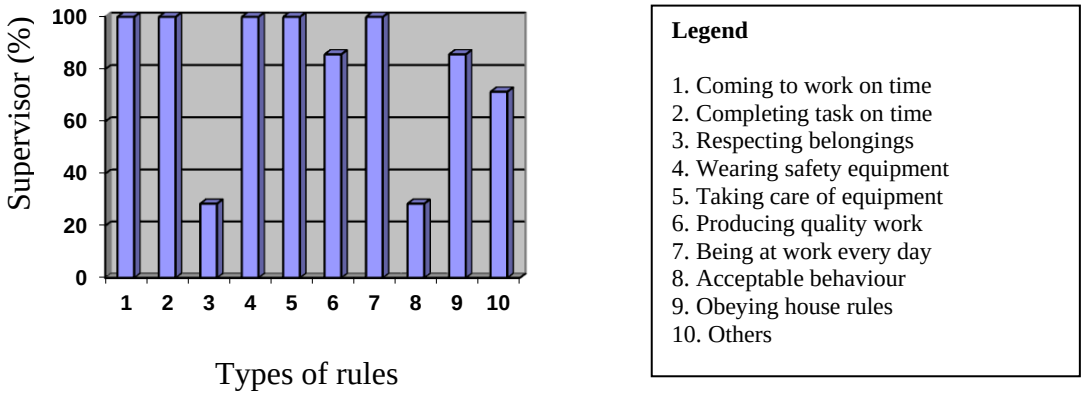


Figure 6.3: Rules students adhere to

Even though some of these rules form the basis of the connection between knowledge and practice, they are still very important in connecting with the real work and reality of the workplace. These rules build the character of the students.

Supervisors on site have a major influence on how students perceive the profession. When supervisors were asked about the rules of the profession, they responded as follows:

> "Maintain the safety of everybody in the workplace" (S01).

"Make sure that when students or any worker are busy with machinery and equipment, that it is safe and sure [sic]" (S02).

"All tasks that are carried out are done according to the necessary building and civil regulations" (S03).

"Must avoid conflicts of interest" (S04).

"Build their professional reputation on the merit of their services and shall not compete unfairly with others" (S05).

"Make sure that correct specifications and dimensions are used, avoid short-cuts (S06).

I have observed how the professional CE rules are exercised. If a plan or a drawing of a concrete column specifies that the strength of the concrete should be 25 Megapascals (MPa), the company cannot order 15 MPa. People's lives are at risk and therefore proper procedures should be followed. At one particular site, the specifications were that the students use six millimetre round bar as reinforcing steel; instead of using the six millimetre, they used ten millimetre, due to its strength.

Safety clothing and gear are essential for students. I have observed how students are escorted off the site if they are not properly attired with the necessary safety clothing. No students or any other workers are allowed to enter the site without the proper clothing. When students are late, they must report to the front office first to report their late coming. After the third instance of not being punctual, they are sent back to college and can no longer work on that site.

6.3 CONCLUSION

This chapter summarises the findings from workplace supervisors and students on site. Supervisor knowledge, teaching and learning experiences, supervisor perceptions, industry participation, workplace rules, and supervisor descriptions are a few of the concepts that emerge and re-emerge throughout this study. From the information gathered it was clear that supervisors felt that there was a need for such a course, which dealt directly with skill specifics. Supervisors dealing directly with students on site, felt that there was far too little industry

participation in assisting the college for integration of knowledge and practice to be effective. The use of proper equipment would enhance students' skills and enable them to understand the working environment better.

It was discouraging to note that the data indicated that neither FET colleges nor the civil engineering industry has a dedicated WIL programme in place that can bridge the gap between knowledge and practice. Chapters 4 – 6 presented the perceptions of students, lecturers and workplace supervisors. They also outlined what has been forthcoming in the three ATs of the research, with particular focus on knowledge and practice relations.

Chapter 7 will analyse the findings as indicated in the three ASs by focusing on two levels of analysis. These levels of analysis will try to assist in identifying contradictions pertaining to knowledge and practice in the different elements of AT. The chapter will have concluding observations, prior to the final chapter and summary.

CHAPTER SEVEN: KNOWLEDGE AND PRACTICE RELATIONS IN CIVIL ENGINEERING: CONTRADICTIONS AND ANALYSIS

7.1 INTRODUCTION TO THE CHAPTER

The learning in terms of knowledge and practice relations that is taking place by students at FET colleges and in the CE workplace has been at the forefront of this research. Learning does not only take place by placing a student in a classroom, workshop/college yard, or workplace, but through various activities that the students are exposed to within these environments, better known as activity systems in this study. The *What?* or *content*, and the *How?* or *methodology* of a curriculum also play a significant role in the teaching and learning of CE students.

For this study I have chosen to regard the CE student as the subject in my analysis. However, comments were not only gleaned from students, but also from lecturers and workplace supervisors of their impressions of how students learn in the different environments. The object is student learning in CE, and the desired outcome is for students to be adequately prepared for the workplace. The tools can be teaching and learning tools, course material, a pedagogic method, and physical tools. The students belong to a community of students, but here are also lecturers, workplace supervisors, professionals as engineers, experts in the CE field and the parents of the students. There are also CE procedural and general rules applicable to these environments.

Against this background, this chapter set out to investigate 1) what are the differences between the activity system elements across the three sites and 2) how do the elements at each site shape the students and staff's perceptions of the object? The focus has been on analysing the findings by making use of AT as an analytical tool and then determining the contradictions and similarities between the learning in the classroom, workshop/yard, and the workplace as separate ASs. The main research question thus constituted the initial focus of this research: *'Does the FET college adequately prepare the CE student for the workplace'?*

In order to answer the above question, the thesis took as its starting point 'activity theory' (AT) as a basis to work with by arranging the data according to the elements in an AS. The focus is on the learning in relation to knowledge and practice in the three activity systems, namely the classroom, workshop/college yard, and workplace. Initially two levels of analysis were undertaken in this chapter: first a basic comparison was made between the elements of an activity system to identify contradictions and similarities, for example, tools used in the classroom, tools in the workshop/college yard and tools at the workplace.

The second level of analysis was to highlight contradictions and to identify similarities between the four sub-systems of the three activity systems. This was done to determine how the subject is shaped to act on the object through the different elements of the community, rules, division of labour and tools, and mediating artefacts; in other words:

- The sub-system of subject-community-object (S-C-O) of the classroom
- The sub-system of subject-community-object of the workshop/college yard
- The sub-system of subject-community-object of the workplace

This was followed by the sub-systems:

- Subject-rules-object (S-R-O)
- Subject-division of labour-object (S-D-O)
- Subject-mediating artefacts-object (S-T-O)

I make use of Engeström's (2001) fourth principle, "*Contradictions as sources of change and development … are historically accumulating structural tensions within and between activity systems*", which is fundamental to the development of this study. I am of the view rather than to systematically eliminate misfits, it could be used to be identified challenges and to overcome them. Contradictions within the CE curriculum that cannot be resolved by participants should constitute the basis for future research. For example, the students, lecturers and workplace supervisors should be encouraged to identify emerging contradictions to establish good practice in adequately preparing the students for the workplace.

7.2 CONTRADICTIONS, MISFITS AND DISTURBANCES

The main reason for undertaking this study was to establish whether FET colleges adequately prepare CE students for the workplace by underpinning the relationship between knowledge and practice. As I have indicated in my theory chapter, I have used Engeström's (1987) AT model in trying to describe and explain how students, lecturers and workplace supervisors interact in each of the different environments. Because of many comments by CE students, lecturers, and workplace supervisors prior to this study, I have realised that there are tensions between the college sector and the CE industry pertaining to the preparation of students for the workplace. By identifying and acknowledging these tensions or contradictions in these environments, it is hoped that this will assist with positive changes.

Perceptions from participants in this study indicated that contradictions between activity systems emerged. One of the main reasons was that the lecturers in the workshop/yard tend to move away from the CE curriculum and teach the students what they think they should know for the workplace. In some cases, this leads to discussions between the college lecturers and the workplace supervisors in the hope of bringing about certain changes. In fact, contradictions can either enable learning to progress, or they can actually disable it, depending on whether or not they are sources for new developments (Nelson, 2002). However, contradictions may not lead readily to transformation because they may not be easily identifiable or acknowledged, visible, obvious, or even openly discussed by those experiencing them (Engeström, 2001; Capper & Williams, 2004).

7.3 INTRODUCTION TO CONTRADICTIONS BETWEEN ELEMENTS OF ACTIVITY SYSTEMS IN CIVIL ENGINEERING

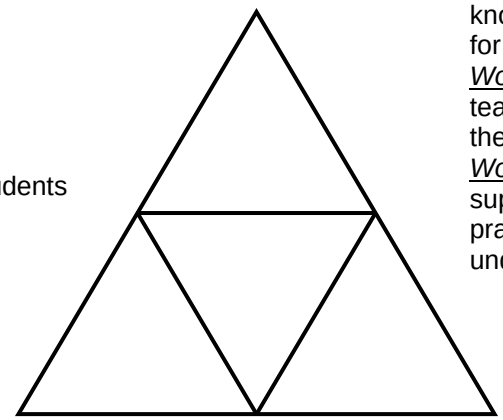
In this section I analyse the findings presented in Chapters 4 – 6, starting with the question, 'What are the differences between the activity system elements across the three sites?' I have described the elements of the three activity systems as reported on by the students, lecturers and workplace supervisors and noted that contradictions have emerged between the three activity systems with regard to knowledge and practice relations, hence the reason for focusing on the data that

relates to knowledge and practice divide. Figure 7.1 illustrates the differences in the elements of the three interacting activity systems, namely the classroom, the workshop/college yard and the workplace. Later in this section the actual differences in the elements are discussed. These differences in some cases create contradictions and could prevent students from being adequately prepared for the workplace.

Mediating artefacts/ Tools:
Classroom: Models of real artefacts, posters of equipment, methods used for teaching and learning, examinations/test and the content in the curriculum
Workshop/college yard: Outdated physical tools, methods used for teaching and learning and models of artefacts
Workplace: Up-to-date physical tools and real work

Object: The purpose of the activity
Classroom: Lecturers teaching knowledge in preparing students for the final examination
Workshop/college yard: Lecturers teaching practical skills relating to the knowledge from the classroom
Workplace: Workplace supervisors engage students in practice on site and students understanding instructions

Subject:
The Civil Engineering students



Rules:
Classroom: Rules of CE knowledge that appear in the curriculum, knowledge of the course and classroom content assessment rules, education policy, culture or norms and learning methods
Workshop/yard: Workshop knowledge and practice Assessment rules, old rules and obsolete rules of equipment and theory/ practice regulations
Workplace: Production culture in the workplace, safety rules on site, new rules and regulations on equipment in the workplace and workplace practice assessment rules

Community:
Classroom: Students, peers, lecturers, parents, college management structure and family
Workshop/yard: Students, peers, senior students, lecturers
Workplace: Industry, students, workplace supervisor, client, professionals such as engineers

Division of labour:
Classroom: Lecturer teaches knowledge, knowledge and practice divide and students learn the content of this knowledge.
Workshop/yard: Lecturers demonstrates practical skills to students, rectifying skills problems and students do practical work such simulating practical tasks.
Workplace: workplace supervisor focus on instructing the student how to work, role of students in the workplace are exposed to real work

Figure 7.1: Differences in the three integrated Activity Systems

This analysis is described as the first level, 'comparing the elements of the ASs', which forms the basis for the second level, 'comparing the sub-systems', by focussing on how the subject is shaped to act on the object in the various sub-systems. By comparing the different elements in the three ASs, I try to determine what is actually happening and what are the views of the community in each of the elements across the three ASs. I have selected a few different arrangements in each element that were most prominent for the first level of analysis, where different issues were foregrounded. Making use of AT has proved to be useful in identifying contradictions that influence CE students' learning engagement within the three activity systems. Most of the elements in the different ASs have a different focus and this makes it difficult for the integration of knowledge and practice to be recognised as a useful force in this study. I shall now discuss the differences illustrated in Figure 7.1 in the following order: community, rules, division of labour, object, and mediating artefacts.

7.3.1 Community contradictions: What groups of people work together on the object?

By focusing on the community 'as the people operating in this space', I refer to all those with an interest in the student working on the object. The community is different in the college and at work and is composed of the subject and other individuals that are brought together by a shared object. The community component in this instance puts the analysis of the activity investigated into the social and cultural context of the environment in which the subject operates. According to Figure 7.1, there are differences of what constitutes the community in the various elements.

Historically the family was involved in the decision-making of students; in other words, parents would mediate their children's direction in terms of which course they registered for at an FET college. The parents were involved in the teaching and learning of the students by attending parent evenings so that they were advised on the progress of their children. For most the students the family is part of this community. It is not only the family that constitutes the community. There are different individuals and groups of people that form part of this community, such as lecturers, workplace supervisors, experts in the CE field, professional

engineers, and business owners of CE companies. The people that form part of the community have different views and because of this they perceive the object to be different.

The different views of the community therefore display the contradictions between the community elements of the three activity systems. Students, for example, said that they would like to visit more CE sites to ascertain how the work activities were carried out. They also desired greater interaction between the college and the workplace so that they were able to apply the practical skills from the workshop/ college yard in the workplace. From the students' perspective they wished to be more involved in the workplace and draw on the knowledge from professionals in the community to perhaps help bridge the knowledge and practice divide.

This may allow a smooth transition between the ASs' community element, and could mean that students gain the relevant knowledge in the classroom and workshop that allows them to be confident when going on site and provides them with an opportunity to be part of the workplace community. Students suggested that becoming involved in the workplace community could assist them in developing links with the workplace community and could therefore allow for greater interaction between knowledge and practice.

7.3.2 Rules contradictions: What are the rules governing the performance of the activity?

In this section the focus is on what are the rules, norms, and conditions at each site of learning. Rules in any institution of learning are common practice. The rules that are prominent in this study are social rules that focus on the curriculum at the college. The curriculum is that one aspect around which everything revolves and the guide to determine whether what is taught in the classroom 'speaks' to what is taught in the workshop/yard and at the workplace. Linked to the social rules are the assessment rules put in place to determine whether students are competent to move onto the next level of study. In this case the assessment tasks are different between the classroom, workshop/yard and the workplace, and the possibility exists that the rules might also differ. Then there

are also the productivity rules from the workplace, which have no place in the classroom and workshop/yard.

Students, lecturers, and workplace supervisors are required to adhere to the rules, which simulate those of the institution and the workplace. These rules are important and have a direct influence on knowledge and practice relations in each AS. Different knowledge rules and regulations are imparted to students when they learn about the CE course, but when these rules and regulations are not applied in the workplace, it can be inferred that there is a knowledge and practice divide. Rules at the college are mostly assessment rules determined by the Department of Higher Education and Training, and the rules at the workplace are mostly linked to production, and are determined by the workplace. With production, the focus is on timelines and project completion. In other words, students and workers should work according to the allocated time. If these rules are not adhered to, companies pay penalties for not completing the project on time as per the contract.

There are also old and new rules in respect of machinery and equipment. In the classroom, students are taught the rules on the smaller equipment available in the classroom and in the workshop. However, in most cases, the equipment is out of date or obsolete, and therefore the rules pertaining to the equipment may be equally irrelevant. When students enter the workplace environment, they learn about the methods and rules of the latest equipment. It might even be that the methods used in the classroom to operate the new equipment are irrelevant.

The contradictions that exist are also in the rules of assessment as indicated in Chapters 4 - 6. Many of the rules regarding knowledge and practice relations appears in the policy documents and serve as regulations, for example, in terms of the knowledge component, the students need to write tests and pass with a minimum of 40%. For the practical assessment, they must be found competent before they can proceed to the next practical task. If they are found ‘not yet competent’, they must re-do the task until they master it. Assessment of students at the workplace site also happens, but to a much lesser degree, since the workplace supervisors focus on production. Lecturers have an opportunity to visit

workplace sites to assess students and record the assessment in the logbooks of the students.

7.3.3 Division of labour (D.O.L) contradictions: Who is responsible for what in the activity?

'Who is doing what', is the main purpose in this element and indicates the role of the student, lecturer and workplace supervisor. The division of labour (D.O.L) refers to the different roles undertaken by the members of the community in achieving the object: in other words, students, lecturers and the workplace supervisor. Engeström (1987) refers to the *division of labour* as a component that splits up human labour among members of the community. The structure of the CE curriculum allows for the diverse communities' participation in the activity systems, namely, the classroom, the workshop/college yard and the workplace. During the teaching and learning process in the different ASs, students should be exposed to all three communities and should actively participate in all three environments to permit them to qualify as CE artisans.

The responsibility of the students is to learn in the classroom and try to understand the knowledge first, so that the knowledge can be linked to the practical in the workshop/college yard. The students' role in the classroom is to gain knowledge and learn from the lecturers, complete assignments and write all the tests. In the workshop, they need to engage in practical activities, such as, "building of various items such as staircases, columns and setting out various projects" (NCV12).

The lecturers teach the CE content in the classroom, trying to ensure that there is a link between the knowledge and practice, and prepare the students for the final examination. In the workshop/college yard they have identified their responsibilities as ensuring that they rectify the practical skills problems students encountered in this environment.

The workplace supervisor's focus is on doing the job at the workplace and therefore most of them contended that "they build dams, bridges and roads". These activities occasionally bring the knowledge component into the practical training. They indicated that their responsibilities are to expose the students to

real work projects and ensure that the students complete these. The real work projects they refer to are the smaller projects, such as constructing concrete columns or hanging doors. The smaller projects form part of the completion of a bigger and final project.

Students perform different functions at work and in the classroom that may lead to a division between knowledge and practice. The structure of the workplace and classroom is such that this divide is accentuated, as the classroom is mostly about teaching the knowledge of the curriculum and work about doing/practice.

7.3.4 Object contradictions: The purpose of the activity

In examining the object, the focus is on 'what practice is being learned'? The object in the ASs is the subject's purpose in carrying out the activity. The nature of the object in this study has led to some confusion, because the object as seen by the students, lecturers and workplace supervisors differs. This means that the identified object is unpredictable, even though it remains the integral element of all three activity systems. This object difference may lead to knowledge and practice differences. For Leontiev (1981), the object of any activity is that 'thing' that drives the activity; what he refers to as the 'motive' for the activity. In this study it is seen as the central issue that represents the intention that motivates the activity. I have chosen what the '*purpose'* of the activity is because the data speaks mostly to the purpose of the activities, but as I have outlined earlier in Chapter 2, the object is also something which can be shaped by the system as a whole.

The 'object' in the classroom identified by the students, but highlighted by myself, was 'students learning to become civil engineering artisans'. Students viewed this as the focus or main reason for their studying the CE course. The majority of the students referred to the things they learned in the classroom and workshop, such as designing roads and bridges, and the construction of structures such as big buildings, which gave them an opportunity to learn about the CE industry (SN04, SN15, JN09), and would ultimately prepare them to become civil engineering artisans.

Lecturers constantly grapple with the question of the purpose of teaching the students: is it to prepare them for the final examination, or is it to prepare the students for the workplace? Most of the lecturers in the classroom are aware of what the purpose of teaching the students is: '*teaching the students for the final examinations'*.

The workplace supervisors identify the object as *'making sure that students understand instructions properly'.* For example, students will be given a task to perform according to specifications and then the workplace supervisor will determine whether the object has been reached or not. The focus of the workplace supervisors is ensuring that students understand the implications of not heeding instructions.

The contradictions in the objects of the three activities systems have been identified. The main object is students' learning to become CE artisans. However lecturers indicated that the object for them is teaching the correct knowledge for examination purposes, while that of the workplace supervisor is to determine whether students can follow instructions to do the job. The three objects that are presented are different and therefore the ASs will be different. Knowledge is mostly offered in the classroom, while practice occurs mostly on site.

7.3.5 Mediating artefacts/tool contradictions: Are these fulfilling the needs in preparing students for the workplace?

The focus is on 'how the student is learning' and what is being used for the learning to take place in the different environments. The mediating artefacts/tools in this study refer to the items used in the transformation process of the students from a college student to a qualified CE artisan. Students come into the course with very little or no CE knowledge. The mediating artefacts, such as the CE curriculum, allow them to gain knowledge through teaching and learning. Apart from the curriculum as a mediating artefact, there are also other artefacts as indicated in Figure 7.1. Figure 7.2 indicates how the physical tools are utilised in each of the environments and how there is a resemblance between the tools used in each of the environments. These are the same physical mediating artefacts that students learn about but the context is different. In the classroom

they learn about the knowledge aspect of the dumpy level instrument, while in the workshop they learn about the setting up and working operation of the instrument. In the workplace they do the real work by setting out a building.

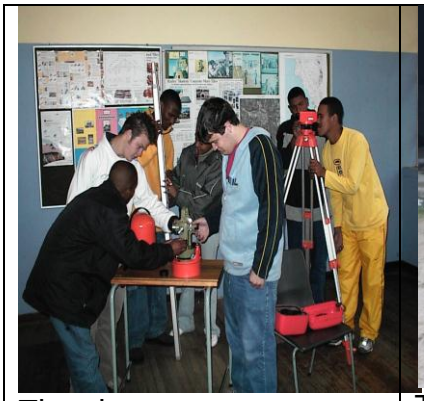
		
The classroom	The college yard	The workplace

Figure 7.2: Tools used in each of the ASs

Most of the students feel that the content knowledge in the CE curriculum does fulfil the needs of the industry, although, “there are some methods that are being taught in class which could be taught in a much quicker and easier way, for example, the construction of formwork for concrete columns is outdated and does not serve the needs of industry any longer” (FG03), and “the miniature tools and pictures used in the classroom do not speak fully to the real modern power tools that are used in industry” (JN12).

Most of the lecturers are of the view that the content knowledge in the CE curriculum does not fulfil the needs of industry owing to the knowledge and practice discrepancies. For example, the students learn obsolete methods and the time spent on knowledge outweighs that spent on practical in the workshop/college yard. This leads to a disjuncture between knowledge and practice. When the students come to the classroom, the lecturers teach them the knowledge prescribed by the curriculum because they will write an external examination at the end of the trimester or semester.

About half of the workplace supervisors’ responses indicated that the CE curriculum did not fulfil the needs of industry. They believe that many of the procedural instructional methods that are used by the college are out of date and

obsolete. For example, the current formwork for erecting concrete columns on site comprises steel structures, but at college, the timber method of constructing formwork is still being taught. There are differences between what students learn at college and the expected method in industry. For example, industry requires students to know about the latest developments, methods and techniques. There is also a difference between the taught curriculum as a tool and the knowledge as a tool that students at work need to draw on. This brings about the contradictions of what is taught and how the curriculum is taught.

Some students, lecturers and workplace supervisors questioned the context in which the CE curriculum is taught. It is senseless to teach a student a certain practical skill not required in the workplace, for example, the making of joints in woodwork. CE artisans do not manufacture furniture but rather erect buildings, and build dams and bridges, and should therefore be trained for such projects. Therefore, teaching the right content and skills is important to the students.

The study suggested there are significant contradictions between the classroom, workshop/college yard and the workplace. The contradictions in this study suggest future developments such as what the purpose of the CE curriculum is. There are indications that over the years, the CE curriculum has lost touch with what is happening in industry.

7.4 ANALYSIS OF CONTRADICTIONS BETWEEN SUB-SYSTEMS OF ACTIVITY SYSTEMS

In Section 7.3 I have shown the differences in the elements of the ASs. I shall now examine the implications of what students contend and what differences lead to contradictions between knowledge and practice. First, it is important to note that the object in the three ASs is not the same. Second, each system works on its own object instead of towards a common object that integrates knowledge and practice. Finally, the contradictions may lead to a knowledge and practice divide and widen the gap between the college and the workplace, thereby hindering students' progress in the workplace.

Employing a further level of analysis as indicated in the introduction to this chapter will determine how the community, rules, division of labour, and mediating artefacts mediate the subject to act on the object, and what contradictions/differences emerge by relying on Mwanza-Simwami's (2009) model of AT, which depicts the sub-systems of an Activity System (AS). This approach often involves preceding analysis as Section 7.3 indicates, with a description of the AS in terms of its elements such as the community, rules, division of labour, object, mediating artefacts and subject (Engeström, 1987). The previous analysis looked at the contradictions between individual elements of the three ASs. The description of this section of analytical data gathered from Chapters 4 – 6 could assist in identifying contradictions/differences between sub-systems of the three ASs.

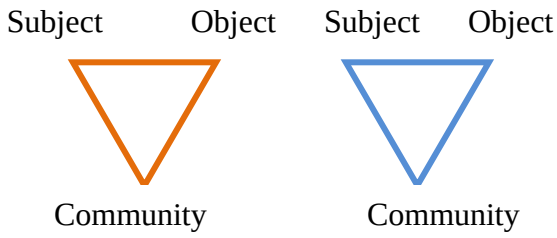
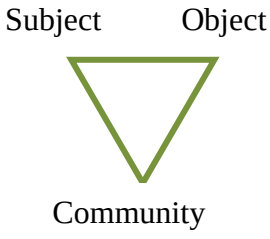
For the purpose of this study a *sub-system* is defined as one small triangle made up, for example, of the subject, community, and object (S-C-O) within the big triangle which is known as an AS. As pointed out in the level one analysis, contradictions have emerged between elements of ASs; so likewise have contradictions emerged between sub-systems of ASs. The question could thus be posed: 'How does the community mediate the way the subject acts on the object?' As indicated in Chapter 2 and clearly captured by Engeström (1999), the object of activity is regarded as a project under construction, moving from raw material to a meaningful shape and to a result or outcome. He furthers states that the object determines the horizon of possible goals and actions. The two columns indicate to what extent the community mediates the way the subject acts on the object. The small triangle represents a sub-system of an AS.

The 'object' or *purpose* of the activity should be common to allow for the outcome to be produced in all three the ASs. The findings suggest otherwise, because of what the mediation allows or disallows between the elements. The responses gleaned through student, lecturer and workplace supervisor data in the three environments allowed me to identify the differences and the interaction between the sub-systems of the various ASs.

7.4.1 Sub-system of the Subject, Community, and Object

Even though reference is made to three different sites, the college community cuts across the two sites, such as the classroom and the workshop/college yard. Then there is the workplace community which focuses on the workplace. The college community comprises the students, peers, lecturers, college management and parents who have an interest in the academic work of the students. The workplace community, on the other hand, comprises workplace supervisors, employers, CE professionals such as quantity surveyors and land surveyors, the client, and the owner of the projects. These communities contribute to how the subject may come to understand the object. In other words, the community of the college is not interested in the workplace community owing to the object difference, and the same can be said of the workplace community's lack of interest in the college community, because their focus is on a different object.

How does the community mediate the way the subject acts on the object?

The classroom and workshop/yard community	**The workplace community**
The college community cuts across the two sites, namely the classroom and the workshop/college yard.  	The workplace community focuses on the workplace. 
The college community allows for very little integration of knowledge and practice. The communities' mediation could lead to how the subjects act on the object through more knowledge than practice, although there is an element of practice that is taking place in the workshop/yard. The way in which the community operates is that of the college classroom, where the lecturers teach knowledge and set assessment tasks such as tests and assignments for the students. The workshop/college yard is one where the lecturers teach practical skills	In this community there is little integration of knowledge and practice but it is one of real work, where students have to try to combine and apply their knowledge and skills to do the work the company expects of them. The company mediates the way the subjects work on their object to be profit driven, with the result that very little time is set for learning. The idea that the object is under construction, the workplace learning by doing is the key, and often quicker methods of performing tasks are used,

which are in some form linked to the knowledge that was taught in the classroom. The community composition of students, lecturers and parents devoid of workplace people leads to a focus on knowledge and teaching, hence a disjuncture between knowledge and practice, as practice is largely absent. There are indications that work practice is absent in the mediation process between the community, subject and object.	which do not always coincide with what students have been taught at the college. The workplace community is of the opinion that the students should know what to do when they enter the workplace. There could be a gap between the knowledge and practice taught by the college and that implemented at the workplace. This causes a hiatus in the mediation process between the community, subject and object.

In this study I focused on this sub-system to determine to what extent the college and workplace communities mediate the subject to act on the object. Through the mediating process it is evident how a particular AS should be supported. This support could create a comfortable learning environment, together with the supportive roles of those involved. The college and workplace operate differently, which makes it difficult for a common object to emerge.

Although there might be urgency from the college community to shape students to be successful as CE artisans, the common object is not supported. The workplace community, on the other hand, has its focus on profit, production, and timeframes. This is problematic in that very little dedicated time is set aside for the proper training of students at the workplace. The workplace community has little or no interest in the college community, except in employing their students once they graduate. Workplace supervisors are not involved in the college and lecturers have very little involvement in the workplace. Student objectives could therefore be constrained.

The lack of work community involvement can be seen as a constraint in terms of students' learning to become CE artisans, since the workplace gives context and meaning to the curriculum. The links between the college and the workplace are not strong enough to facilitate better dialogue between them, ensuring that students are better prepared through knowledge and practice. The links between the communities could allow individuals to plan and prepare students better for the workplace by interacting with knowledge and practice from both communities.

7.4.2 Sub-system of the Subject, Rules, and Object

This section will interrogate how the rules mediate the student to work on the object. Rules are put in place for a community to follow various procedures within an activity system, as is the case with CE students. These rules may either be explicit or implicit. An example of an explicit rule is when students are assessed according to the rules laid down by the institution, such as writing two tests and submitting two assignments during the trimester. Implicit rules are inherent, for example, the culture of student learning. These rules have an impact on how the subject acts on the object: what the subject does with the knowledge received in the classroom, as it could determine the horizon of possible goals and actions.

The workshop is mandated to link knowledge and practice for students to be adequately prepared for the workplace. The reason is that practice is supposed to support the knowledge from the classroom. There are also policy rules that guide knowledge and practice relations between the college and the workplace. The rules define how the subject interacts with the object. Hardman (2007) refers to the notion of rules in AT as somewhat general. She refers to rules as social order and rules related to the instructional context. The rules included in each of the sub-systems refer to procedural, general, professional and policy rules. In other words, what rules students should adhere to, the CE professional rules, and the assessment rules when they are active in each of the three ASs.

How do the rules mediate the subject to act on the object?

The classroom rules	**The workshop/college yard rules**	**The workplace rules**
Subject Object  Rules	Subject Object  Rules	Subject Object  Rules
Rules in the classroom include those related to the knowledge contained in the curriculum of the course and assessment	Many of the rules that were only spoken and learned in the classroom must now be put into practice in the workshop/	Workplace rules among other involve production, safety rules on site, new rules and regulations on equipment in

procedures, the culture or norms of classroom behaviour and learning methods used In this sub-system, the focus is on how the rules mediate the subject to act on the object. In addition to shaping knowledge and learning, rules also have the effect of shaping learners' practice beyond the classroom. If incorrect or outdated knowledge is introduced in the classroom, practice beyond the classroom will also be affected. Knowledge / practice relationships are dependent on students' learning relevant knowledge and rules and being able to apply these beyond the classroom. It is important to note that the rules in classroom are impacted by policies from the Department of Higher Education and Training. Unless these policies take the broader context into account – in addition to the classroom context – rules may lead to a widening of the gap between knowledge and practice, or at least students' perceptions of this.	college yard. In the workshop/ yard, are rules among others, assessment rules, old rules and obsolete rules of equipment and knowledge/ practice regulations. The workshop/ yard rules encompass attempting to turn the knowledge concepts from the classroom into practice. However, perceptions of the students and lecturers in this environment that it is not always possible and is often difficult to create a balance between knowledge and practice. The rules do not always mediate how the knowledge and practice can be connected within this sub-system. Students and lecturers imagine the workshop to be the bridge in closing the gap between knowledge and practice but when students physically attend the workshop/yard they experience the gap between knowledge and practice that exists. As a rule, all students must complete all practical modules in the course; if not, they will not graduate, which could mean that they have not acted on the object of the workshop /yard or allowed the subject to be mediated to act on the object.	the workplace and workplace practice assessment rules. Perceptions of the workplace supervisor and the students are that the object is trying to inculcate the culture of production, whereas knowledge and practice integration are distant in the workplace. Students need to apply and focus mostly on safety rules and rules of the CE profession which may enable them to at least be safe in the workplace. However, some of these rules are very flexible and occasionally annoy the workplace supervisors. Workplace supervisors often think that students should know every practical rule when they enter the site. This is rather difficult as the study suggests, there is not always a link between the three ASs. In this environment the focus is on how the rules are applied in the workplace to assist students to do workplace skills. The combination of being knowledgeable about the rules and the application of the rules could put students in a position to cope with practice at the workplace and may become fully operational in the workplace.

The CE programme at FET colleges and CE workplaces has always been divided into two sections, namely the knowledge and practice components. Certain rules and regulations were implemented previously for students to complete the knowledge and practice at the college, and the practical on-site training at the workplace. Since the inception of CE programmes, the

workshop/college yard has tried to serve as a bridge between the college and the workplace, especially so that knowledge and practice could be integrated.

The assessment rule for the lecturers is to set knowledge and practice assessment tasks, for the workplace supervisor to assess the student against the requirements in the logbook, and for the student to execute the assessment tasks either at college or at the workplace. The assessment performed for the students allows them to keep track of their performance, while for the lecturers it allows them maintain student records, as required by the institution. The knowledge required for assessment in the classroom, workshop/college yard and the workplace is different. The rules pertaining to knowledge and practice in respect of what students are taught and assessed on in the classroom and workshop/college yard are different from what the students learn and are assessed on in the workplace.

7.4.3 Sub-system of the Subject, Division of Labour (D.O.L), and Object

The D.O.L in this sub-system refers to the negotiation of responsibilities, tasks and power relations within a classroom, workshop/college yard as well the workplace. The focus is on ‘how the D.O.L shapes how the student perceives the object of becoming a CE artisan’. The D.O.L plays an important role in shaping the students’ thoughts on how to act on the object. The different responsibilities could also lead to D.O.L between knowledge and practice. This could also assist students in the way they think, because the responsibility is on them to act on the object. It is really a question of how the activity can be carried out and what negotiation is taking place around knowledge and practice relations; in other words, ‘who’ is responsible for ‘what’ in the teaching and learning process. Hence the focus in this research is specifically on the division of labour in the classroom between lecturer and student, in the workshop/yard between lecturer and student, and in the workplace between student and workplace supervisor. The question therefore is, ‘How does the D.O.L allow the subject to act on the object?’ The D.O.L plays out in the roles that participants occupy in the teaching and learning. The roles that the different participants play serve as shaping the subject to act the object. In general, lecturers’ roles are to teach and assess,

students' roles are to learn and complete assessments, and workplace supervisors' roles are to engage the students in workplace work as well as to give instructions on how the real work projects should be carried out. This section depicts the different roles undertaken by the members of the community and how the D.O.L shapes the subject to act on the object.

How does the D.O.L mediate the subject to act on the object?

The classroom D.O.L	**The workshop/college yard D.O.L**	**The workplace D.O.L**
Subject Object  D.O.L	Subject Object  D.O.L	Subject Object  D.O.L
"How do these roles shape the students to act on the object?" In the classroom the students are learning about the curriculum in a classroom environment, according to students, there are not enough opportunities to experience practice due to no practical being carried out in the classroom. The classroom is an environment where there is separation of knowledge and practice and this may influence students' perceptions of the purpose of CE education. Where the DOL separates knowledge and practice by cutting back on site visits and teaching students alternate ways of practical methods etc. there is a possibility that students themselves view the object as learning the curriculum rather than a more integrated knowledge and	The D.O.L in the workshop/ yard is different from that of the classroom. The classroom and workshop are two different worlds, even though they to prepare the subjects for the same purpose: 'workplace preparedness'. In this environment the lecturer and student work together so that their roles may mediate the subject to act on the object in a different way to that of the classroom. For example, students must comply with certain roles in the workshop/college yard to prepare them for the workplace. The role that students are among others would be for students to work on practical projects that enable them to be found competent in the workplace. The D.O.L for the lecturers in the workshop/college yard is to make sure that they teach	The workplace is one of action, activities and real work projects. The roles of the participants are so different and therefore do not assist the subject to fully act on the object. The D.O.L mediates the interaction between the subject and the object, but not what is expected to take place in the workplace AS, for example, there is hardly any learning taking place. The workplace is an important environment for the student to apply the knowledge taught by the lecturer in the classroom and workshop/ college yard. However, the roles of the responsible for making sure that students are knowledgeable about both knowledge and practice are different. The major focus in the D.O.L at the workplace are for the workplace supervisor to make sure that he/she *completes the projects* with the latest specifications, makes a profit for the company

practice approach, thus strengthening the knowledge practice divide.	practical skills to the students and constantly rate the students' skills and correct it where needed to prepare them for the workplace. What should be happening is reference to what was taught in the classroom and linking knowledge to practice. If the D.O.L element is properly worked upon, one may see a better relationship between the subjects reaching the object.	and completes the projects on time. The perceptions of the workplace supervisors are that the subjects are shaped in this environment to act on the object in this manner. However, this particular object may not be the ideal object for the students to act upon. The fact that roles of the workplace supervisor is different to that of the lecturer in the classroom and workshop/ yard, very little or no time is spent by the workplace supervisor on the workplace training of the students.

The main differences in the D.O.L are that in the classroom students are given more knowledge than practice, with which they are uncomfortable. When the students go to the workshop/college yard, they are exposed to minimal practical opportunities, and the lecturers will always refer to what they have been taught in the classroom. The workplace supervisors at the workplace do not focus on theoretical knowledge at all, but rather on whether the students have the correct practical skills, and whether the correct methods are used when constructing various projects, such as columns and walls, etc. The college focuses on minimal integration of knowledge and practice, despite whether the content is correct or not, or whether the methods used by the lecturers are correct or not. The workplace, on the other hand, trains students in the latest developments that will boost production and ultimately result in profit.

In summary there are two main points which can be made about divisions of labour at the three sites. Firstly, the roles and relative positions of power between students and lecturers or supervisors are similar. Students are always in relatively subservient positions but these are different as students occupy a learner role at the college whereas at work they are expected to work/produce under instructions from the supervisor. The second observation relates to Daniels (2001) observation that the D.O.L in education can also be used to highlight divisions between theory (or knowledge) and practice. In the college

classroom knowledge is highlighted often at the expense of practical application, whereas in the workplace practice takes on the most dominant position rather than classroom knowledge. The effect of these different D.O.L may then be that the classroom object is perceived by students and staff as being mainly concerned with knowledge whereas in the workplace it may be understood by supervisors and students as mostly about 'doing the job', or practice. The D.O.L. in the workshop could link knowledge and practice, but as is discussed in Chapter 8, the workshops close links to the classroom may prevent this integration.

7.4.4 Sub-system of the Subject, Mediating artefacts, and Object

Since the establishment of technical colleges, later promulgated as further education and training (FET) colleges, it has been important that students do well in the classroom by passing the examinations. Previously, when students passed the external examination, the knowledge component or classroom content, it would be an indication that the lecturers were doing their jobs properly. If students are unsuccessful in the examinations, lecturers are perceived as not doing their work. This could be one of the reasons why the lecturers in the classroom teach what is in the CE curriculum, immaterial to its being correct or incorrect, relevant or irrelevant. The reason for this is that they are evaluated on the number of students passing the subject.

This section depicts the three triangles symbolising the three sub-systems in each of the activity systems of the classroom, workshop/college yard, and workplace. The subject uses various mediating artefacts or physical tools to act on the object. The focus will therefore be on the mediating artefacts' influence on or shaping of the subject on how to perceive the object. These mediating artefacts also mediate the activity of the CE student within the context of the environment in which the subject operates, which either enables/helps or constrains/restricts the subject to act on the object.

How do the mediating artefacts mediate the subject to act on the object?

The classroom object	The workshop/college yard object	The workplace object
Mediating artefacts  Subject Object	Mediating artefacts  Subject Object	Mediating artefacts  Subject Object
In a classroom, various mediating artefacts are used such as small physical tools, teaching and learning tools, the CE curriculum as a tool, and assessment as a tool. Smaller tools are mostly used in the classroom because it can be brought inside the classroom. The physical tools used in the classroom are based upon miniature tools, models and posters. The perceptions of students and lecturers are that many of these tools are used in preparing the students for a final examination which is the main object in the classroom environment. The CE curriculum and the content knowledge of the different subjects are the main tools used in the classroom. Various methods and concepts are taught according to what is prescribed in the curriculum. Even though the curriculum is one of the main mediating artefacts, the lecturer in the classroom does not have full control over the curriculum as a tool because the curriculum has been compiled by the Department of Higher Education.	The workshop/yard is one where the students mostly work with physical tools to carry out various activities. The practical activities done in the workshop/yard are in some way linked with the knowledge taught in the classroom. However, by using the mediating artefacts it is not always possible to make a complete link in the learning between knowledge and practice. The CE curriculum as a tool in the workshop/yard does not play as major a role as is the case with the classroom, because it does not prescribe practice but the lecturers focus mainly on what was taught in the classroom to link it to practice. This could therefore make it difficult for the subject to be shaped to work on the object in this environment. The physical tools that are used in the classroom are different to those of the workshop/yard. In the workshop/yard the students learn about the real workplace tools even though in some instances there is no knowledge and practice relationship, but the students try to make that link between the workshop/yard and the	The mediation of the subject through the mediating artefacts in the workplace in many instances is different from that of the classroom and the workshop. In the classroom and workshop/ yard, learning as a tool plays a very important part, whereas the use of physical tools in the workplace takes preference. Most of these tools are different in the three environments. Not much physical learning takes place, but rather learning by watching others doing the work on site. Perceptions from students are when they are given the opportunity to be shaped through physical learning it could be with the integration of knowledge and practice on site. The CE curriculum in the classroom does not have much influence on what the students learn at the workplace. The workplace supervisors are of the view that the curriculum should prepare them for the workplace. There are some concepts and principles students learn in the classroom and workshop/college yard that have a direct influence on how students perform on site. There is also some content that is out of date or obsolete, and does not benefit the students when entering to site.

However, the methods that are used in teaching the curriculum depend on the lecturer. Teaching and facilitation methods as tools in the classroom are intended to expose students to different kinds of methods of how activities in the classroom can be executed. Students have a choice to work as individuals or to work in groups. Through the use of these mediating artefacts the subject may be shaped to interact with the object.	classroom. The learning tools used in this environment, unlike in the classroom environment where students have a choice to work individually or in groups, in the workshop/ yard students must work in groups to solve practical problems among themselves first before seeking assistance from the lecturer. In the workshop/yard the tools elicit the little knowledge and practice relations than the classroom and the workplace tries to implement knowledge and practice relations.	Physical tools at the workplace comprise the actual, heavy equipment that allows students to work on different projects. The equipment is modern and very advanced. These tools serve as a learning tool for the students doing workplace training on site. The teaching method as tool on the part of the workplace supervisor is one of demonstration, instruction, and rectification. Ultimately there is no integration of knowledge and practice relations at the workplace. The perceptions from students and workplace supervisors are that practice is the only component that is focused upon and this shapes how the subject acts on the object.

As indicated in the analysis section, the CE student is referred to as the subject. The focus of the sub-system was to determine how the elements in the sub-systems mediate the subject to act on the object in the classroom, workshop/college yard and workplace. The contexts in which these three operate are very different in their own way.

The knowledge and practice content in the CE curriculum was developed externally by the Department of Higher Education. The college sector really had little input into what is taught to the students who enrol for the course. Previously the college only offered the Apprenticeship course, but later various programmes such as the NATED programme, Learnership programme, and the National Certificate Vocational in CE were developed. The CE industry was not consulted in the development of these programmes.

This study tries to demonstrate the complexity of the interaction between activity systems, shaped by the contradictions among the elements of the various activity systems. It could mean that the result of the contradictions stems from the learning that is taking place in three different environments, but the ‘outcome’,

student preparedness for the workplace, remains the same. Basharina (2007) highlights the need to guide students and to consider their expectations relating to the workplace. For students to be prepared, they need to be guided in the right direction in all three activity systems. The contradictions identified indicate how these influence what is taught in the classroom, workshop/college yard, and the workplace respectively.

The difference between the sub-systems is that in the classroom the emphasis is on knowledge; students and lecturers choose what to learn (or teach), either as individuals or in groups; in the workshop/college yard, knowledge and practice become the focal point and students are encouraged to work in groups; while at the workplace, the practical component and the teaching methods such as demonstrations, instructions, and rectification are the main mediating artefacts.

The difference between the physical tools is that the classroom does not lend itself to actual large tools and therefore miniature tools and posters are used to demonstrate to students what the tools look like for examination purposes; in the workshop/college yard real tools, even though out of date in some instances, are given to the student to work with, and in the workplace students are exposed to advanced modern tools. Overtime, the physical tools used by the colleges have also deteriorated and many of the colleges do not have the funds to purchase new equipment or even upgrade their existing equipment.

A major gap between the college sector and industry has been exposed, owing to the knowledge/practice lacunae. Not exposing students to both knowledge and practice in the classroom and workshop/yard could be a contributing factor to their being ill prepared for the workplace.

7.5 CONCLUDING REMARKS

Differences between the elements in the various activity systems can be shown to support the divisions between knowledge and practice in the different sites. Differences between the sub-systems of the activity systems at the different sites can be shown to support the development of different objects. These different

objects can again be shown to strengthen the divisions between knowledge and practice at the different sites.

The next chapter provides the conclusion to and recommendations of the research.

CHAPTER EIGHT: STRENGTHENING KNOWLEDGE AND PRACTICE RELATIONSHIPS IN CIVIL ENGINEERING

8.1 INTRODUCTION

In this research, I have explored the use of Activity Theory (AT) to theorise the knowledge and practice relations in the FET college and workplace. AT is a theory of practice and has allowed me the opportunity to unfold the disconnection between the elements and sub-systems in three ASs. According to Kaptelinin and Nardi (2012), AT is generally optimistic, and therefore there are opportunities for change. These opportunities can make a difference to the way in which lecturers and workplace supervisors teach, and also to how students learn, pertaining to the preparation for the CE workplace. This concluding chapter provides a summary of the findings of the study, the historical roots of the college, workplace and workshop/yard as a bridge between the college and the workplace, recommendations for future implementation, and concluding remarks.

When I started this research, my initial enquiry was whether FET colleges prepared CE students adequately for the workplace. I used the theoretical argument of the division of knowledge and practice between the college and workplace. As Eraut (2004) explains, workplace knowledge is context bound, for example, its focus is real workplace practice, while college knowledge is college bound. According to Eraut, if this is what is taking place, there is often difficulty in relating knowledge to practice.

Gamble (2003) states that any curriculum that leads to a qualification requires proper knowledge that leads to practice. She argues that the two cannot stand on their own as separate entities. In similar fashion Barnett (2006) refers to the curriculum that only faces one way, when its purpose is to induct students into a disciplinary field of knowledge. The same difficulty exists within the CE curriculum for FET students in the classroom, namely, the one-way approach where students are prepared only for the final examinations, instead of linking knowledge and practice between the classroom, workshop/yard and the workplace.

She also describes how knowledge should underpin practice. According to her the demise of many college graduates has been the absence of practice/on-the-job training. The correct knowledge in both these environments is essential to enhance knowledge and practice relations. As I have indicated, correct and updated knowledge in the CE curriculum should be taught to CE students. At present some of the knowledge in the curriculum is out of date and obsolete, which makes it difficult for students to connect with the practice in the workplace. The knowledge that is taught to students is not integrated, and it is also the incorrect knowledge. The incorrect knowledge taught also underpins practice. In other words, incorrect practice is then also taught at the college.

This gap between the type of underpinning knowledge and the general distance between knowledge taught at the college and that required in practice may have led to students not being adequately prepared for the workplace. I have therefore argued for more effective knowledge and practice integration between the college and the workplace. Gamble (2003) has shown in her study that integration of knowledge and practice may provide more skilled artisans to meet the demands of industry.

8.1.1 Summary of findings

The theoretical knowledge programmes offered at FET colleges are frequently criticised by CE workplace supervisors for their perceived lack of practical application and incorrect methods inculcated by college lecturers. The workplace supervisors are not implying that there should *not* be theoretical knowledge imparted to students at college, but that a practical component should be incorporated into the knowledge component. Theoretical knowledge is not taught at the workplace, and therefore the workplace supervisors feel that it is the responsibility of the college to engage in both knowledge and practice. Workplace supervisors believe that there is a disconnection between knowledge and practice. As stated above, the disconnection is further exacerbated as the knowledge taught in the classroom and workshop/college yard is very different from the practical work that students are exposed to when arriving on site for experiential training. From the evidence it is clear that the knowledge component

does not measure up to the practical element that students are exposed to when they enter the workplace. There are glaring divisions between knowledge and practice.

It seems that the divisions originate with the 'object' or *purpose* of the activity. The reason for focusing on the 'object' is because in AT all the other elements in the ASs give shape to the object. There may be a general view among lecturers that the object is common to all three ASs, "*learning to become CE artisans*". However the research findings have shown that the focus of the three ASs is different in the elements and therefore changes the object. The 'object', which leads to the outcome in all three ASs, has an overall purpose, 'knowledge and practice integration'.

I focused on three different objects from an AT perspective. For example, the lecturers in the classroom are of the opinion they prepare students for the workplace from a knowledge perspective. This knowledge, however, is focused on preparing students for the final examination. The lecturers in the workshop/yard perceive their task to be teaching the students practical skills for the workplace. The workplace supervisor, on the other hand, maintains his/her focus is to make profit for the company, instead of making the workplace a learning environment for the students. They believe students should be fully prepared when entering the workplace.

My view is if those responsible for the preparation of students can work together, they can open up spaces for the proper development of the classroom and workplace through transfer of learning. Moore (2004) refers to the meaningful transfer of learning that can take place between the college and the workplace through interaction between activity systems, for example, students learning about specific mediating artefacts, but at the same time given the opportunity on site to work with the artefacts as well. AT makes available opportunities for challenges, so that changes can be effected (Argote, 1999). This could mean a better-prepared student for the workplace through knowledge and practice integration.

In Figure 8.1, I describe the continuum which gives rise to the disconnection between knowledge and practice in the three ASs. Students move from the classroom, where knowledge predominates and is taught in isolation, and very little practical work is done. From there they move to the workshop/college yard where reference is made to the knowledge that was taught in the classroom – a slight combination of both knowledge and practice. It would seem that the workshop/yard could be the AS that solves the knowledge and practice divide, but this does not occur. Ideally, if the curriculum were to specify the correct content relating to the practice requirements for industry, the workshop/yard could well have a huge impact on knowledge and practice integration. When students complete their training at the college, they move to the workplace with some knowledge and practical skills that might not be entirely pertinent to the workplace.

This continuum illustrates the current situation and gives reason for the disconnection between knowledge and practice that exists. All three ASs should have one common object, "*students learning to become CE artisans*", but the focus should ideally be on knowledge and practice integration in all ASs to reach this common object. For this purpose a closer relationship between the classroom and the workshop/yard should exist at the college than between the college and workplace, for the object to reach its full potential. The tensions that exist in this continuum retard the development of a proper CE curriculum with integration of knowledge and practice.

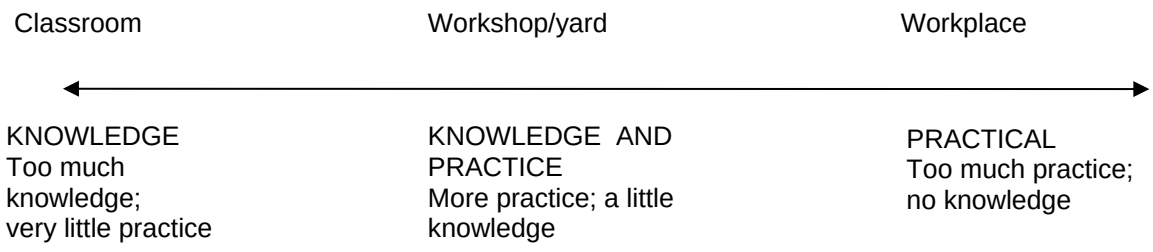


Figure 8.1: The continuum which gives rise to the disconnection

In the light of what was said, the FET colleges and CE workplaces should work to produce a more advanced and improved object in the light of poorly articulating systems. The object for this study should be more advanced, or new in the sense that the object should have been ‘knowledge and practice relations’. Engeström (1999) suggests that expansive cycles could be a way of dealing with a new object that may lead to the emergence of new structures such as a curriculum that links knowledge and practice. This process could open up learning spaces.

The components of knowledge and practice are rolled out at the college and the workplace respectively. At present both those components are isolated and do not fully assist in the preparation of students for the workplace. The failure of the workshop/yard to bridge the gap between college/knowledge and workplace/practice is a particular concern. The failure of the workshop/yard to produce what it should be producing could mean that it has not been given the opportunity to do so owing to discrepancies in the CE curriculum.

I have tried to articulate the gap between knowledge and practice through an AT lens. Given the fact that the subject moves between the three ASs as indicated in Figure 8.2, the one AS may always be influenced by the other. They are influenced by the various objects each AS focuses upon. For this reason, Le Maistre and Paré (2004) state that students should be able to carry the knowledge gained in the classroom environment into the workplace. In other words, the textbook/knowledge descriptions now become the actions of daily practice when students enter the CE workplace. When there is little cooperation, interaction, integration and a lack of ownership between those responsible for teaching, students could find it difficult to make a fluent transition from one AS to another.

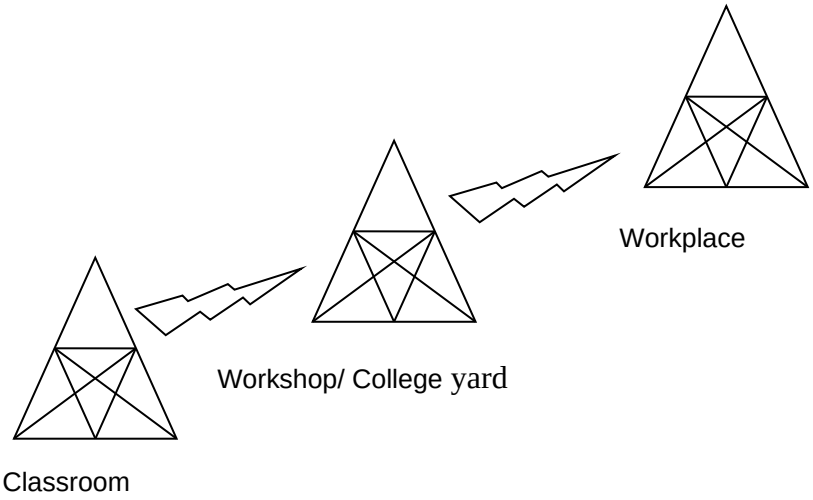


Figure 8.2: Activity Systems comparing sub-systems

The three ASs are radically different in the various elements of the mediating artefacts, rules, community and division of labour, and the different foci on the object. For students to be adequately prepared and to qualify as CE artisans, they need to move through all three systems and at the same time they need to be found competent in the respective CE practical skills and theoretical knowledge components. This has become difficult for students and has therefore led to knowledge and practice tensions.

The gap between knowledge and practice is evident, particularly between the classroom and workplace, which has been my argument throughout this study. There are differences in the elements of the various ASs, which brings about the difference in the objects. The object is changed as the elements shape the subject to act on the object. Blackler (2005) suggests these differences serve to shape the object in different ways. The shaping of the object that illustrates the differences did not occur overnight, but is historically imbedded in the elements.

8.1.2 Historical roots of differences between college and workplace

In the historical roots, I refer to the principles of ‘historicity’ and ‘contradictions’ in AT (Engeström, 2001). According to Engeström (2001), the existence of mutual relationships between elements of an activity system of activities means that activity systems are not static but constantly evolve over periods of time. He

further states that activity systems' problems and potential can only be understood against their own history. The history of an activity system is not only imbedded in its internal structure and organisation, but also in the global history of the tools, procedures, concepts and principles which have become mediators of the activity. Keeping with the example of learning in the classroom activity system discussed thus far, the knowledge and practice relations have changed to '*a more knowledge approach'* over a long period of time, as a result of the historical evolution from technical colleges to FET colleges; however the curriculum has remained static.

This historical evolution through AT has allowed me to look at how difficulties have arisen historically. Prior to the introduction of FET colleges, there was a strong symbiotic relationship between technical colleges and industry. A student would not automatically be eligible to attend a college if signed as an apprentice with a company. In other words, the student was in the employ of the company and therefore the company had a say in when student would attend the college for theoretical knowledge. The practice was taught at the workplace. Students would attend college for three months of the year and the rest of the year they would work on site and be fully exposed to practical training. The technical college era was characterised by a strong relationship between knowledge and practice.

Since the introduction of FET colleges, anyone is allowed to attend the college as a private student and to complete the knowledge component of the CE course. The difficulty that arose was the separation of knowledge and practice. Private students were not given the opportunity to go to a workplace for practice, but could only study at the college. In some instances these students would occasionally be exposed in the workshop/yard to some form of practical. There were indications that the classroom and workshop/yard was isolated from the workplace. The workplace would take no responsibility for the private students' practical learning. This, over the years, created a disconnection between knowledge and practice, which gave rise to students not being adequately prepared for the workplace.

Historically, the curriculum has been devised outside the jurisdiction of the college, which has no input into what or what not to teach. However, at the end of a trimester or semester, students are assessed on the content of the curriculum. The Department of Higher Education (DHET), which is responsible for the curriculum, does not elicit industry's experience and knowledge to assist in compiling a well-structured curriculum that can serve the needs of both students and the economy. The CE industry believes it could have made a significant contribution to a well-constructed curriculum, but was not invited to be part of the process when the curriculum was devised. An obsolete curriculum, therefore, cannot serve the needs of the industry. Students are taught specific methods of how to set out a building at college, but when they enter the real workplace, they are told that this method is incorrect.

Another principle of Engeström's (2001) AT entails contradictions, and stems from historicity. This is most important in the context of this thesis because it concerns the role of contradictions or tensions as sources of change and development (Engeström, 2001). The term *contradiction* is not to be understood as a problem, obstacle, conflict, or communication breakdown, but rather as opportunities for new developments. Contradictions are historically accumulating structural tensions within and between activity systems (Engeström, 2001), as is the case in this study. With the contradictions that have emerged, opportunities for closing the gap between knowledge and practice can be strengthened. The AS that may be instrumental in closing the gap is the workshop/yard.

8.1.3 Workshop/yard to serve as a bridge between the college and the workplace

As previously alluded to each AS operates on its own. However, the workshop/yard should be able to support both the classroom and the workshop. There should be more involvement from the workshop/yard in better interconnecting these two environments. The workshop/yard should serve as a bridge between the college and workplace, but it does not, because the workshop/yard is too close to the college curriculum, which often contains

incorrect information. This bridge may serve to correct the knowledge and practice which may be interwoven between the ASs.

8.2 RECOMMENDATIONS AS DEVELOPMENTS

Recommendations for this thesis are like the AT fifth principle of opportunities for expansive learning, flowing out from the analysis of contradictions. There is a strong sense that knowledge and practice cannot be applied separately; they need to be integrated at all stages of the curriculum. A good knowledge and practice relationship between the college and the workplace is where knowledge and practice are integrated with the same emphasis in the two ASs, as indicated in Figure 8.3. An ideal situation would be that the classroom is treated as AS one that feeds into the workshop/yard and this in turn feeds back into the classroom as the arrow indicates. The workplace should also feed into the workshop/yard and this in turn feeds back into the workplace. The workshop/yard therefore becomes more involved with the linking of the classroom knowledge and the workplace practice. This is really where the knowledge and practice come together. Bringing knowledge and practice together could assist in alleviating much of the disconnection that currently exists. In the workshop/yard, knowledge and practice need to be implemented equally in terms of the elements of AT to strengthen knowledge and practice relations. Students should be able to move freely, yet on an organised basis, between the ASs.

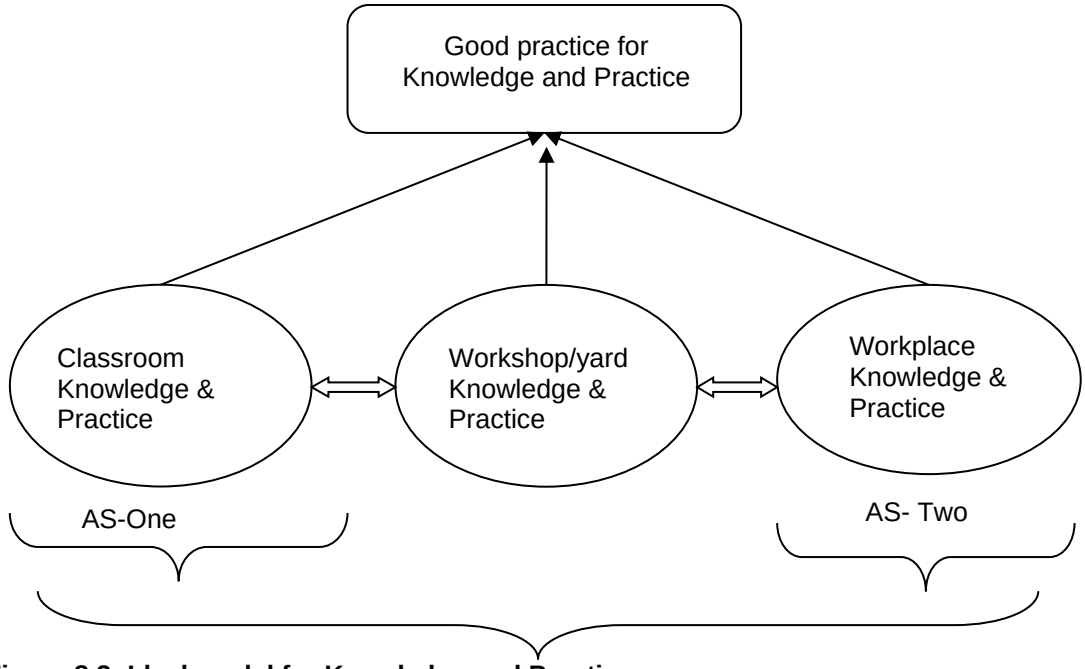


Figure 8.3: Ideal model for Knowledge and Practice

This model does not offer a 'quick fix' solution but the challenge lies in how well knowledge and practice can be implemented in both ASs. If it does not happen, the CE industry will always grapple with a lack of competitiveness and the transformation of knowledge and practice relations. This is where an advisory committee can be instrumental in forging the link between the workshop/yard and the classroom, and the workshop/yard and the workplace.

Knowledge and practice integration can play a major role with regard to the readiness of CE graduates to enter the workplace and contribute effectively to the economy. Should knowledge and practice integration be properly implemented, it could offer opportunities for students to prepare for, and learn from, the workplace, to transfer the classroom knowledge and a wide variety of skills learned in the workshop/college yard, back to the workplace.

The disconnection between the ASs confirms that the services provided by the FET colleges and the workplace for the intended purpose are not up to standard and not enough effort is made to prepare students adequately for the workplace. The research further confirmed that the CE industry was not actively involved in

assisting FET colleges to train students. Based on the lessons learnt, two recommendations are made that could assist with the integration of knowledge and practice that may allow FET colleges and workplaces to prepare students adequately for the workplace.

8.2.1 Links between knowledge *'the college'* and practice *'the workplace'*

The surfacing of the disconnection between knowledge and practice between the FET college sector and CE workplaces supports the idea of establishing links between these two sectors. This collaboration between them could be the turning point in preparing students better for the workplace. The Engineering Council of South Africa (ECSA) plays a pivotal role in advising universities on engineering education in South Africa. For FET colleges, there is no professional body such as ECSA to advise on engineering education and how students can be prepared for industry. As new developments and ideas in CE are constantly forth coming, it would therefore be advisable for FET colleges to establish an advisory committee of CE professionals linked with professional associations such as ECSA to assist with closing the gap between knowledge and practice at the college and the workplace. These advisory committees can be in the form of hybrid forums, as proposed by Rip et al. (2004), as a trade-off between differences and to negotiate something productive. There will always be differences between the college and the workplace. Where differences are obvious but not vast, this does not impede people from meeting and discussing possible solutions.

The workability of such a forum may give the student a better opportunity to make a link between knowledge and practice as well as a clearer understanding of the workplace setting. The knowledge and practice should be integrated, but not in its current form where the main focus is on the knowledge in the classroom and the practical at the workplace. The workplace supervisors should also play a teaching role when students enter the workplace for workplace training, and not only focus on production and profit.

I also sourced expert opinion by informal interviews with experts, for example, deputy chief executive officers and programme managers in the CE fields at FET

colleges, who indicated some concerns pertaining to the knowledge/practice divide. The experts suggested that FET colleges and industry should be encouraged to work together in developing training strategies to meet the needs of the college and the workplace in the province. They also indicated that Further Education and Training (FET) colleges should convene a task team to secure practical training at workplaces for students, while collaborative ventures would assist in setting clear goals, attaining benefits for all partners and maintaining on-going communication. ECSA may be tasks to establish a board to deal with these various issues. There are indications that expert opinion supports my argument for knowledge and practice integration.

8.2.2 Policy formulation and implementation

The need for policy review, for example, to have the workplace involved at college level to enhance the integration of knowledge and practice relations in the sector has become apparent. Colleges are expected to radically transform and make difficult contributions to major policy challenges. However, these institutions are new and fragile, and are based on historically weak predecessors. Much of the reform process is oblivious to the connection between the college and workplace.

It is probable that those responsible in the different ASs are protecting their turf and therefore would not want to be part of a policy review if it is going to negatively affect them in any way. However, policy should inform good practice and how this practice should be rolled out. Policy should speak to business and how it should contribute more effectively to communities in this system. This should allow for a top-down as well as bottom-up approach. This means that everybody in the various communities in each AS should communicate and become involved in the execution of new policy (Tsolo, 2001).

The DHET should not deny FET colleges and workplaces an opportunity to be involved in the formulation of policy. Should this opportunity not be granted, the DHET will deny FET college graduates workplace training, and this will lead to an unskilled and inexperienced workforce. It is therefore recommended that FET

colleges and industry should be encouraged to work together in developing knowledge and practice relations strategies that meet the needs of people in the province. Furthermore, the two sectors should share a common goal with regard to recruitment and placement of students from FET colleges in industry for effective workplace training; moreover, the focus should not be on production.

The Minister of the DHET, Mr Blade Nzimande (2012) called for every workplace site to become a learning site. This therefore requires greater integration of the suggested two ASs in Figure 8.3. This is very different from what FET colleges and CE workplaces are offering students at present. The Minister encourages workplaces to become learning places where college and work links are strengthened. This could assist the sector in becoming more responsive to the needs of society and the economy. Collaborative ventures would assist in setting up clear goals, attaining benefits for all partners, and maintaining on-going communication.

The underlying challenges for FET colleges and their CE departments are to keep abreast with the latest developments in the industry and to constantly reposition themselves in response to emerging industry trends. This should be based upon the CE curriculum, for example, colleges should look at the needs of industry and align the curriculum with these needs. I believe that all students are entitled to a curriculum that gives them a general education, with CE specialist skills which will prepare them for the workplace.

Again, expert sources made some suggestions to policy formulations. One of the experts said that FET colleges should seriously consider transforming from their traditional operation, “training for the sake of training”, and that they should conform to the demands of new skills legislation. Some of them said that through innovative policy, fresh activities at FET colleges would make them more responsive to industry, business and their students. Expert opinion from the colleges supports my argument to a certain extent.

8.3 CONCLUDING REMARKS

The key argument for the disconnection between knowledge and practice is the perceived differences in the object/purpose in the ASs. A common object is therefore proposed that should make FET colleges more responsive to the needs of industry.

The research has established that both CE industries and FET colleges should ensure that they increase their involvement with and participation in the provision of adequately prepared students for the workplace in the Western Cape Province of South Africa. In this research, I have attempted to construct a convincing argument through analysis, that a knowledge and practice divide is evident between the college and the workplace.

My proposed intervention is that the DHET should take the lead in embracing knowledge and practice in the FET colleges and in the workplace. With the assistance of the DHET, an advisory committee should be established to examine how best practices might be implemented to adequately prepare students for the workplace. The efficacy of such a specific intervention could allow colleges and industry to form closer links in future.

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APPENDICES

Work integrated learning in Civil Engineering

Department of Research
Faculty of Education
Mowbray Campus

Cape Peninsula University of Technology
P.O. Box: 652
Cape Town 8000
021 467 2000

Appendix A: Permission letter from the WCED

Western Cape Government
Education

Audrey.wyngaard2@pgwc.gov.za
tel: +27 021 467 9272
Fax: 0865902282
Private Bag x9114, Cape Town, 8000
wced.wcape.gov.za

REFERENCE: 20050120-0006
ENQUIRIES: Dr A T Wyngaard

Mr Joseph Bronkhorst
12 Linnet Way
Pinelands
7405

Dear Mr Joseph Bronkhorst

RESEARCH PROPOSAL: WORK INTEGRATED LEARNING IN CIVIL ENGINEERING: AN ACTIVITY THEORETICAL STUDY

Your application to conduct the above-mentioned research in FET Colleges in the Western Cape has been approved subject to the following conditions:

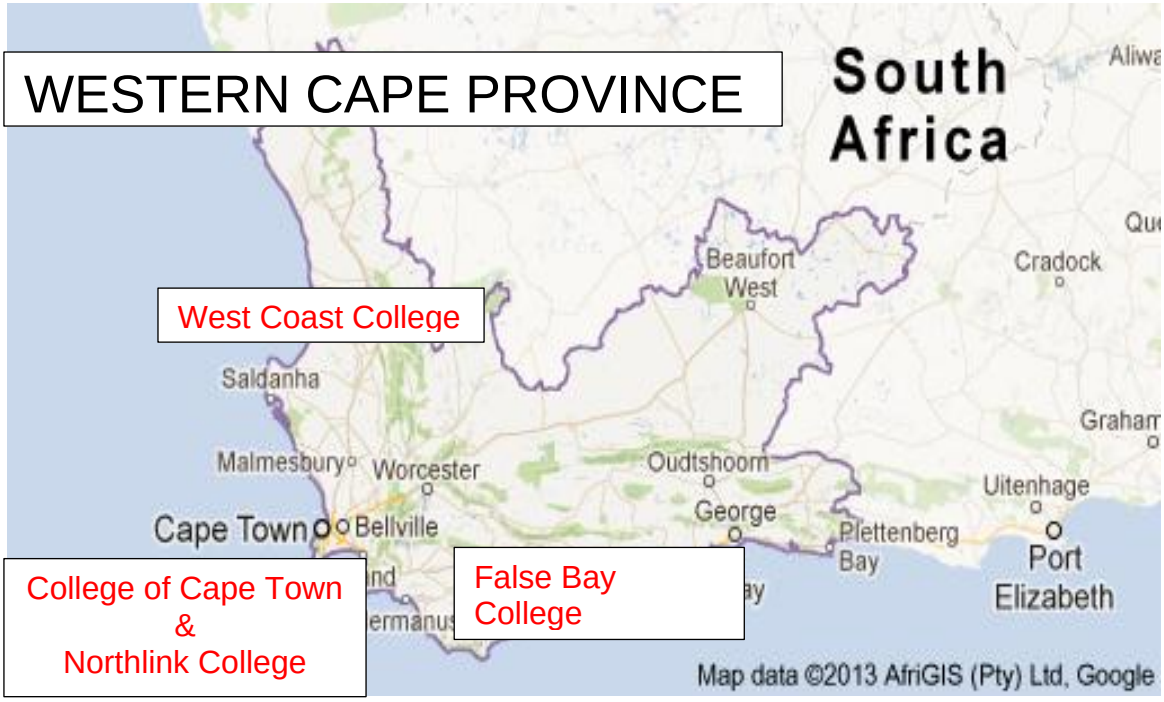
1. Principals, educators and learners are under no obligation to assist you in your investigation.
2. Principals, educators, learners and schools should not be identifiable in any way from the results of the investigation.
3. You make all the arrangements concerning your investigation.
4. Approval for projects should be conveyed to the District Director of the schools where the project will be conducted.
5. Educators' programmes are not to be interrupted.
6. The Study is to be conducted from **01 February 2007 till 21 June 2007**
7. No research can be conducted during the fourth term as schools are preparing and finalizing syllabi for examinations (October to December).
8. Should you wish to extend the period of your survey, please contact Dr A.T Wyngaard at the contact numbers above quoting the reference number?
9. A photocopy of this letter is submitted to the principal where the intended research is to be conducted.
10. Your research will be limited to the list of schools as forwarded to the Western Cape Education Department.
11. A brief summary of the content, findings and recommendations is provided to the Director: Research Services.
12. The Department receives a copy of the completed report/dissertation/thesis addressed to:

The Director: Research Services
Western Cape Education Department
Private Bag X9114
CAPE TOWN
8000

We wish you success in your research.

Kind regards.
Signed: Dr Audrey T Wyngaard
for: **HEAD: EDUCATION**
DATE: 18 April 2005

Appendix B: Map of the Western Cape Province



Appendix C: Clearance from FET Colleges

28 ANDREWS ROAD
THORNTON
7460
May 13, 2006

MR. ISAACS
CEO **********

Dear Sir

I am writing to ask your permission to conduct research at your institution **********. My research is based on Work Integrated Learning in the Civil Engineering department at FET Colleges. The names of the institution will publish but the names of the participating will however not be published for ethical reasons.

Please indicate your approval of this permission by signing the letter where indicated below and returning it to me as soon as possible.

Thank you very much.

Sincerely,

……..
Mr. JV. Bronkhorst

PERMISSION GRANTED FOR THE ABOVE REQUEST

……
Mr. Isaacs (CEO **********)
DATE:

Appendix D: Clearance from Civil Engineering companies

28 ANDREWS ROAD
THORNTON
7460
May 13, 2006

Maxload Building and Civils
Observatory
Cape Town
7455

MR.Harmse
CEO **********

Dear Sir

I am writing to ask your permission to conduct research at your company **********. My research is based on Work Integrated Learning in the Civil Engineering. The names of the institution will publish but the names of the participating (workplace supervisors) will however not be published for ethical reasons.

Please indicate your approval of this permission by signing the letter where indicated below and returning it to me as soon as possible.

Thank you very much.

Sincerely,

……..
Mr. JV. Bronkhorst

PERMISSION GRANTED FOR THE ABOVE REQUEST

……
Mr.Harmse (CEO **********)
DATE:

Appendix E

Covering letter to students

Dear Student

In order to improve work-integrated learning (WIL) within the civil engineering departments at Further Education and Training institutions (FETI), it is necessary to obtain input from students. Attached, find a questionnaire for completion by you as the student. I am certain by completing this questionnaire you're input will make a significant difference to WIL. You do not have to fill in your name on this questionnaire but is assured of complete confidentiality.

Thanking you in anticipation of your co-operation in this research project.

Yours sincerely

Joe Bronkhorst

Questionnaire for students.

Please indicate with an X in the appropriate box.

1. Gender

Male	
Female	

2. Home language

Afrikaans		English		Xhosa		Zulu		Other	

3. Age group

18-20		21- 22		23-24		25-26		27 and over	

4. How long have you been working in the civil engineering industry?

None	
1 year	
2 year	
3 years	
More than 3 years	

5. What kinds of experience have you gained in the civil engineering industry?

……
……
……
……

6. What programme are you registered for?

Skills	
Apprenticeship	
Learnership	
Supervisors	
Multi-skill	
N-course	
Other	

7. What grade did you previously passed at college?

N2	
N3	
N4	
N5	
N6	
None	

8. How long do you study civil engineering at the college?

1 year	
2 years	
3 years	
4 years	
More than 4 years	

9. Circle those aspects, which you think your subject/course addresses:

Work ready graduates	Mathematics literacy	Technical report writing	Basic civil engineering procedures	Civil engineering plant
English communication	Afrikaans communication	Problem-solving	Trouble shooting	Time management
Respect for others	Self-respect	Co-operativeness	Team work	Public speaking
Engineering design	Safety procedures	Hand skills	Site plan reading	Interpreting drawings
Supervisory management	Tape reading	Site supervision	Setting-out of buildings	Proper use of C/E equipment
Proper house keeping	Punctuality	Correct use of leveling equipment	Load bearing structures	Others

10. In your opinion, does the current curriculum fulfill the needs of the civil engineering industry?

Yes	
No	
Partly	

11. In your opinion, do most students understand the goals of the lesson?

Yes	
No	
Some of them	

12. Are you required as students to do exercises/activities in class and in the workshop?

Yes	
No	
Quite often	
Rarely	

13. Circle which of the following tools do you use during the exercises/activities in class and in the workshop?

Dumpy level	Spirit level	Abney level	Compactors	Graders
Theodolite	Tape measure	Plane table	Machines	Front loaders
Tilting level	Boning rod	Land chain	Hammers	Any other equipment
EDM	Traveler	Planimeter	Chisels	
Water level	Range rod	Setting out rod	Drilling equipment	

14. Circle which of the following teaching aids the lecturer uses during his/her lectures in the class and in the workshops.

Chalk board	HOP	Computers	Models	Flip-charts
White board	Posters	Projectors	Sample products	Books
Slide shows	Video's	Other		

15. Circle which of the following teaching/facilitation methods/media the lecturer use on a regular basis.

Lecturing method	Pair work	Group work	Student orals	Tests
Take-home test	Practical work	Projects	Classroom activities	Site visit
Peer-marking	Group assessment	Power-point presentations	Computer simulation	Other
Guest lecturer (from industry)	Problem-based learning	Video's	On site training	

16. Do you enjoy study civil engineering?

Yes	
No	

17. How often do you participate in industry visits?

Never	
Seldom	
Often	
Very often	

18. Circle which of the following methods does students most times uses when work/study?

Teams	Individually	Pair work	Projects
Problem solving	Practical models	Lecturers	Other

19. Circle which of the following rules must students adhere to when at the college.

Punctuality	Handing in of assignments	Respecting each other belongings	Wearing safety equipment	Taking care of equipment
Handing in class work	80% attendance	Good behavior	Good house keeping	Other

20. Did you attend your lecturers on a regular basis?

Yes	
No	

21. Circle the following how you would describe your lecturer.

Approachable	Caring	Helpful	Friendly	Like to assist
Answer questions	Abrasive	Control freak	Scary	Abrupt
Unfriendly	Distant	Hardworking	Punctual	Other

22. What made you study civil engineering?

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23. What knowledge could you apply in the workplace after completing a course in civil engineering at the college?

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24. What was your best experience during your studies at the college?

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25. How can the college improve the civil engineering course?

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26. Please evaluate the following by ticking (√) the appropriate block.

Excellent=exceed your expectations **Good**=met your expectations
Not good=disappointed **Poor**=totally unacceptable

Description	Excellent	Good	Not good	Poor
Lecturers knowledge of the course				
Quality of class explanations				
Student and lecturer interaction				
The use of practical models				
Visits to building sites				

27. Do you have any further suggestions you would like to make regarding the civil engineering course?

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THANK YOU FOR COMPLETING THIS QUESTIONNAIRE

Appendix F

Covering letter to lecturers

Dear Colleagues

In order to improve work-integrated learning (WIL) within the civil engineering departments at Further Education and Training institutions (FETI), it is necessary to obtain input from lecturers. Attached, find a questionnaire for completion by you as the lecturers. I am certain by completing this questionnaire you're input will make a significant difference to WIL. You do not have to fill in your name on this questionnaire but is assured of complete confidentiality.

Thanking you in anticipation of your co-operation in this research project.

Yours sincerely

Joe Bronkhorst

Questionnaire for lecturers.

Please indicate with an X in the appropriate box.

1. Gender

Male	
Female	

2. Home language

Afrikaans		English		Xhosa		Zulu		Other	

3. Age group

21-28		26-33		34-41		42-49		50plus	

4. Which of the following subjects do you lecture at the college? Please circle the subjects you lecture.

Mathematics	Mathematics literacy	Construction plant and equipment	Construction materials	Carpentry skills
Building science	Building and structural surveying	Drawings and settings	Concreting	Plumbing skills
Building drawing	Building construction	Computer literacy	Carpentry	Bricklaying skills
Building and civil technology	Quantity surveying	Life skills	Masonry	Plumbing skills
Building administration	Supervisory management	Communication	Plumbing	Other

5. How many years of teaching/lecturing experience do you have in the civil engineering department?

1-5 years	
6-10 years	
11-15 years	
16-20 years	
More than 20 years	

6. How many years of workplace/site experience do you have in the civil engineering industry?

None	
1-5 years	
6-10 years	
11-15 years	
16-20 years	
More than 20 years	

7. Circle those aspects which you think your subject/course addresses:

Work ready graduates	Mathematics literacy	Technical report writing	Basic civil engineering procedures	Civil engineering plant
English communication	Afrikaans communication	Problem-solving	Trouble shooting	Time management
Respect for others	Self-respect	Co-operativeness	Team work	Public speaking
Engineering design	Safety procedures	Hand skills	Site plan reading	Interpreting drawings
Supervisory management	Tape reading	Site supervision	Setting-out of buildings	Proper use of C/E equipment
Proper house keeping	Punctuality	Correct use of leveling equipment	Load bearing structures	Others

8. In your opinion, does the current curriculum fulfill the needs of the civil engineering industry?

Yes	
No	
Partly	

9. In your opinion, do most students understand the goals of the lesson?

Yes	
No	
Some of them	

10. After a lesson/lecture can most students apply what they have learned (e.g. in a problem-solving task)?

Frequently	
Seldom	
Never	

11(a). When you identify a skills problem with the student, do you rectify it immediately?

Yes	
No	
Not always	

11(b) If you answered "Yes" in 11(a), how and when do you rectify the problem?

……..
……..
……..
……..
……..
……..

12. How do you rate your students' skills in your subject area:

Acceptable	
Below standard	
Above standard	
Don't know	

13. Do you require students to do exercises/activities in class?

Yes	
No	
Quite often	
Rarely	

14. Are the activities you require from students to do sufficiently challenging?

Yes	
No	
Not always	

15. Do you require group work activities in class/for homework?

Yes	
No	
Quite often	
Rarely	

16. If you answered 'Yes' to question 15, is there generally good participation in group work/classroom based activities:

Yes	
No	
Sometimes	

17. Do you try to model classroom activities on workplace activities?

Yes	
No	
Sometimes	

18. Do you try to model homework activities on workplace activities?

Yes	
No	
Sometimes	

19. Circle which of the following tools you use during your lectures and in the workshops.

Dumpy level	Spirit level	Abney level	Compactors	Graders
Theodolite	Tape measure	Plane table	Machines	Front loaders
Tilting level	Boning rod	Land chain	Hammers	Any other equipment
EDM	Traveler	Planimeter	Chisels	
Water level	Range rod	Setting out rod	Drilling equipment	

20. Circle which of the following teaching aids you use during your lectures and in the workshops.

Chalk board	HOP	Computers	Models	Flip-charts
White board	Posters	Projectors	Sample products	Books
Slide shows	Video's	Other		

21. Circle which of the following teaching/facilitation methods/media you use on a regular basis.

Lecturing method	Pair work	Group work	Student orals	Tests
Take-home test	Practical work	Projects	Classroom activities	Site visit
Peer-marking	Group assessment	Power-point presentations	Computer simulation	Other
Guest lecturer (from industry)	Problem-based learning	Video's	On site training	

22. How often do you participate in industry visits?

Never	
Seldom	
Often	
Very often	

23. Circle which of the following does students most times use to work/study?

Teams	Individually	Pair work	Projects
Problem solving	Practical models	Lecturers	Other

24. Circle which of the following rules must students adhere to?

Late coming	Handing in of assignments	Respecting each other belongings	Wearing safety equipment	Taking care of equipment
Handing in class work	80% attendance	Unruly behavior	Good house rules	Other

25. Do students get on well with their classmates?

Yes	
No	
Seldom	
Some times	

26. Do you have a good working relationship with your students?

Yes	
No	
Some times	

27. When there are differences among students do they normally resolve their differences?

Yes	
No	
Some times	

28. Please evaluate yourself by ticking (√) the appropriate block.

Excellent=exceed my expectations **Good**=meet my expectations
Not good=disappointed **Poor**=totally unacceptable

Description	Excellent	Good	Not good	Poor
Your knowledge of the course				
Your class explanations				
Student and lecturer interaction				
The use of practical models				
Visits to building sites				

29. Do you have any further suggestions you would like to make regarding the civil engineering course?

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THANK YOU FOR COMPLETING THIS QUESTIONNAIRE

Appendix G

Covering letter to Supervisors

Dear Supervisor

In order to improve work-integrated learning (WIL) within the civil engineering industry and Further Education and Training institutions (FETI), it is necessary to obtain input from supervisors. Attached, find a questionnaire for completion by you as the supervisor. I am certain by completing this questionnaire you're input will make a significant difference to WIL. You do not have to fill in your name on this questionnaire but is assured of complete confidentiality.

Thanking you in anticipation of your co-operation in this research project.

Yours sincerely

Joe Bronkhorst

Questionnaire for Supervisors.

Please indicate with an X in the appropriate box.

1. Gender

Male	
Female	

2. Home language

Afrikaans		English		Xhosa		Zulu		Other	

3. Age group

21-28		26-33		34-41		42-49		50plus	

4. How many years of workplace/site experience do you have in the civil engineering industry?

None	
1-5 years	
6-10 years	
11-15 years	
16-20 years	
More than 20 years	

5. How many years of supervisory experience do you have in the civil engineering industry?

None	
1-5 years	
6-10 years	
11-15 years	
16-20 years	
More than 20 years	

6. What is your role as a civil engineering supervisor?

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7 (a). In your opinion, does the training at FET colleges for the students fulfill the needs of your company?

Yes	
No	
Partly	

7 (b). Explain why/why not the training meets/does not meet company's needs.

……
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……
……

8. In your opinion, do most students understand the instructions you give them on site?

Yes	
No	
Some of them	

9. After showing a student the correct way of performing various tasks' can most students apply what you have taught them (e.g. in different task)?

Frequently	
Seldom	
Never	

10(a). When you identify a skills problem with the student, do you rectify it immediately?

Yes	
No	
Not always	

10(b). If you answered "Yes" in 12(a), how and when do you rectify the problem?

……..
……..
……..
……..
……..

11. How do you rate the students' skills on site?

Acceptable	
Below standard	
Above standard	
Don't know	

12. Describe your average student on site.

……
……
……
……
……

13. Circle which of the following tools you use on site to train the students. Please include any additional equipment not in the table below:

Dumpy level	Spirit level	Abney level	Compactors	Graders
Theodolite	Tape measure	Plane table	Machines	Front loaders
Tilting level	Boning rod	Land chain	Hammers	Any other equipment
EDM	Traveler	Planimeter	Chisels	
Water level	Range rod	Setting out rod	Drilling equipment	

14. Circle what projects does your company take on?

Building of bridges	Building of houses	Renovations
Laying of roads	Building of schools	High rise buildings
Building of dams	Building of multi story buildings	Other projects

15. Do you think your company provides a good environment for the student to learn?

Yes	
No	
Some times	

16. How often do you take the students to other building sites to show them various projects?

Never	
Seldom	
Often	
Very often	

17. Circle which of the following rules students are required to adhere to?

Coming to work on time	Completing tasks on time	Respecting each other belongings	Wearing safety equipment	Taking care of equipment
Producing quality work	Be at work everyday	Acceptable behavior	Obeying house rules	Other

If you circled "Other" please list these rules:……...
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18. Do you have a good working relationship with the students?

Yes	
No	
Some times	

19. Do you have any further suggestions you would like to make regarding the students which you supervise on site.

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THANK YOU FOR COMPLETING THIS QUESTIONNAIRE

Appendix H: Student focus group interview questions

1. What type of school did you previously attend?
   a) Was it an Academic, Technical, Business or any other school?
   b) Did you do any civil engineering subjects at that school and what were the subjects?
   c) If yes, did you enjoy engaging in civil engineering subjects and why?

2. Before you started your studies with the college, have you been working in the civil engineering industry before? If yes
   a) For how long have you been working in the industry?
   b) What kind of experience have you gained in the industry
   c) Can you make a link between the industry experience and training provided at the college? If yes
   d) What is that link?

3. What is the course/program for which you are registered?
   a) Nated, skills, NCV, learnerships
   b) Why have you registered for the specific course?

4. Do you enjoy studying civil engineering? If yes..no
   a) What makes you enjoying your studies?
   b) What makes you not enjoying your studies?
   c) The lectures that are presented are they exciting or boring? If yes..
   d) Why do you say they are boring?.

5. What made you studying civil engineering?
   a) Did you attend an open day at college?
   b) Have any of your relatives study here at this college before?
   c) Were you perhaps told by your parents to study civil engineering
   d) Did friends encourage you perhaps?
   e) Did you obtain a bursary from a company?

6. Do you attend your lectures on a regular basis? ….if no
    a) What's the reason for not attending your lectures regularly?
    b) If you do not attend your lectures when you are supposed to attend, what and where do you find yourself?
    c) Does your employer know when you not attending your lectures?..if yes, what is their reaction?

7. Did you learn anything here at the college? If yes…
    a) What have you learnt?

8. If you go back to your workplace, would you be able to apply what you have been taught here? If yes..
    a) What are the things you would be able to apply in the workplace?
    b) If no. Why would you not be able to apply your knowledge?

9. Are there differences in the methods used by the college to that of your workplace? If yes..
    a) What are the differences?
    b) Are there differences in the equipment and plant as well?

10. What were your best experiences during your studies at the college?
    a) Why do you say that was your best experiences?
    b) Have you shared those experiences with others?
    c) If it's work related, do you practice those experiences in the workplace?

11. If there is anything the college can improve in the civil engineering department:
    a) What would it be? If there are..
    b) Why do you think it must improve?

12. How would you evaluate the following:

Excellent=exceed your expectations **Good**=met your expectations

Not good=disappointed **Poor**=totally unacceptable

Description	Excellent	Good	Not good	Poor
Lecturers knowledge of the course				
Quality of class explanations				
Student and lecturer interaction				
The use of practical models				
Visits to building sites				

Appendix I: Lecturer individual interview

1. Before you started your started working at the college, have you been working in the civil engineering industry before? If yes
   e) For how long have you been working in the industry?
   f) What kind of experience have you gained in the industry
   g) Can you make a link between the industry experience and training provided at the college? If yes

2. Do you prepare students adequately for the workplace?
   a) If yes, what is the reason for your answer?
   b) Do you focus a lot on workplace training?

3. What course/program do you lecture?
   c) Nated, skills, NCV, learnerships
   d) Why do you lecture a specific course?

4. Do you enjoy lecturing civil engineering? If yes..no
   e) What makes you enjoying your work?
   f) What makes you not enjoying your work?
   g) Your colleagues are they exciting or boring? If yes..
   h) Why do you say they are boring?.

5. Did you learn anything here at the college? If yes…
   b) What have you learnt?

6. Are there differences in the methods used by the college to that of your workplace? If yes..
   c) What are the differences?
   d) Are there differences in the equipment and plant as well?

7. What were your best experiences during lecturers at the college?
   d) Why do you say that was your best experiences?
   e) Have you shared those experiences with others?
   f) If it's work related, do you practice those experiences in the workplace?

8. If there is anything the college can improve in the civil engineering department:
   c) What would it be? If there are..
   d) Why do you think it must improve?

Appendix J: Supervisor interview

1. What is your role as a civil engineering supervisor?

2. Do students have the necessary skills and knowledge when they enter the site?

3. In your opinion, does the training at FET colleges for the students fulfill the needs of your company?

4. Explain why/why not the training meets/does not meet company's needs.

5. In your opinion, do most students understand the instructions you give them on site?

6. After showing a student the correct way of performing various tasks' can most students apply what you have taught them (e.g. in different task)?

7. When you identify a skills problem with the student, do you rectify it immediately?

8. How do you rate the students' skills on site?

9. Describe your average student on site.

Appendix K: Observation schedule: Workshop activities

Date:…… Description of task:……

Number of students on site:…….. Level:……

Venue:……

Length of observation:……hrs……mins

1. Most often 2. Often 3.Seldom 4. Not at all

		Student 1	Student 2	Student 3	Student 4	Student 5	Student 6
1	What are the learning that is taking place by the students in the workshops?						
2	Are the students eager learners and do they want to apply their knowledge?						
3	Do the students use the correct tools for the task?						
4	Are there a relationship between						

	resources of that of the institution and that of the workplace?						
5	Do students maintain high quality standards?						
6	Do students evaluate their products on completion?						
7	Do students draw on knowledge of the supervisors?						

Appendix L: Student data summary (sample)

STUDENT QUESTIONNAIRES- SENIOR NATED			
QUALITATIVE DATA			
Q 27: How can the college improve the civil engineering course?			
Students	Responses	Keywords	Codes
SN01	By introducing site visits and showing us the tools that are used to construct a house	Introducing site visits, showing us tools used to construct houses	Site visits-provide equipment
SN02	By mixing the practical and theory, because it's better to see do the stuff you learn	Mixing practical with theory, better to see stuff you learn	Integrate practical and theory
SN03	They can improve the civil engineering course by getting students to be more active in workshops and by getting enough lecturers and classes	Students more active in workshops, getting enough lecturers	Improve practical work-get more lecturers
SN04	By starting at the exact date and not two weeks later into the trimester. By being well organised interms of who is teaching what subjects and also the administration of procedures, registration get the best possible lecturers to teach on the subjects.	Starting date, not two weeks later, well organised, administration procedures, get best lecturers to assist	Punctuality-administration procedures-lecturer dedication
SN05	by offering degrees at colleges	Offering degrees	Offering degree courses
SN06	Improve lectures by being punctual. Lecturers should be more caring, helpful, assist more	Lecturers punctual, lecturers be more caring, assist, improve	Punctuality-improve lecturing

	and improve lecturing methods	lecture methods	methods
SN07	75% of my lecturers attend class and the times the lecturers that barely attend the class do attend, then they are not prepared and cannot explain the subject well enough for the class to understand	Lecturers not prepare, cannot explain well, class understand	Lecturer dedication
SN08	More practical, show how the instruments are being used and let us work with the instruments	More practical, show instruments work,	Improve practical work-use of instruments
SN09	They can give us more projects to work on about civil engineering. Example task	More projects, example task	More projects
SN10	Market it in the workplace. It must be job focus	Market in the workplace, job focus	Market workplace
SN11	By adding the math's, physical science, computers lessons and communication	Adding math's, physical science, computers, communication	Add more subjects
SN12	To employ lecturers who really love their job	Employ lecturers who love their job	Lecturer dedication
SN13	I think here at school we still need more equipment so that the student can know exactly what is this for, like practical tools	Need more equipment, students must know what it's used for, like practical tools	Provide equipment

Appendix M: Lecturer data summary (sample)

LECTURERS QUESTIONNAIRES			
Q 30: Further suggestions regarding the civil engineering course.			
Lecturer	Responses	Keywords	Codes
L01	Students must at least have a grade 12 or N3 when they start with N4-N6. Many of them don't have the right grades.	At least have grade 12 or N3, many do not have the right grades	Student qualification
L02	Many of my own colleagues need better qualifications. Educate our own staff first	Own colleagues need better qualifications. Educate the staff first	Staff qualification
L03	The course is far too compact for the students. Many of the students should never have done this course they don't just have the knowledge.	Course is too compact, many should never have done this course, don't have the knowledge	Student knowledge
L04	To improvement to our ways we think its okay for students. To bring more challenges that will make students to be more keen in skill development	Improve our ways towards students, set more challenges for students, keen on skill development	Challenges, Skills development

L05	I think that many of our colleagues at our institution should move away from the norm of "that we are training artisans". They should promote them to obtain a professional qualification so that we can equip the student on a more professional manner.	Move away from the norm that we are training artisans, promote them to obtain professional qualification, equip students in a more professional manner.	Student qualification, equipment
L06	Ensure that the correct infrastructure is in place. Screen prospective students thoroughly. An ongoing transparent support system and communication is essential	Ensure correct infrastructure, screen prospective students, ongoing transparent support systems, communicate	Infrastructure, ongoing support
L07	New text books need to be looked at and brought into line with the students' prior knowledge. The grade 9 qualification for NCV students at present is not good enough. Students are out of their depth. They are illiterate and innumerate.	New text books, course in line with students prior knowledge, grade 9 qualification for NCV not enough, they are illiterate and innumerate	Learning material, student qualification
L08	To expose the students more to the industry. Get the students more interested in their studies.	Industry exposure, students more interested in their studies	Industry exposure

Appendix N: Supervisor data summary (sample)

SUPERVISORS QUESTIONNAIRES			
Q 6: What is your role as a civil engineering supervisor?			
Supervisor	Responses	Keywords	Codes
S01	Represent the company at meetings and promote the correct company image. Ensure that operatives are working to the latest methods statements and check if it's done accordingly. Make sure the job is done according to the National Building regulations.	Represent company, promote company image, working to latest specifications, build to National Building regulations	Company image, latest specifications, building regulations
S02	Make sure that the project is completed on time and a high quality of workmanship exist and at the same time making sure the students gets the correct training	Project completion, quality assurance, student training	Project completion, quality assurance, training
S03	Make sure the job is finish on time. Also see that the workers do a proper job.	Project completion, quality assurance	Project completion, quality assurance,
S04	To see that the people do their jobs properly and not wasting the companies money and time.	Quality assurance, no time wasting	Quality assurance, productive
S05	I'm a trainee supervisor. I check that the students are treated well and not being	Students are treated well, logbooks are signed	Student treatment, record keeping

	abused by the senior people. Making sure that their log books are kept up to date and are signed by the supervisors.		
S06	Make sure the work is carried out according to the building regulations, current standard and the companies quality assurance procedures. Monitor the work of the workers/students and sub-contractors. Plan the projects and order material.	Building regulations and specifications, quality assurance, monitor work, plan project	Latest specifications, building regulations, progress
S07	Received and inspect the material that are delivered on site. Build according to specifications. Ensure good communication on site. See that the project is completed on site.	Receive and inspect material, build according to specifications, good communication, project completion	Inspection, latest specifications, project completion, communication