INVESTIGATING THE EFFECTIVENESS OF USING AN INTEGRATED PROJECT TO IMPROVE TRANSFERABILITY OF IT SKILLS TO THE WORKPLACE

By

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DECLARATION

The contents of this dissertation represent my own work, and the opinions contained therein are my own and not necessarily those of the Technikons. All references have been accurately reported.

Name: Faiza Allie

Signature: 

Date: January 2004

DEDICATION

This dissertation is dedicated to my parents Mohamed and Amina Alli; my sister Zaida Abrahams; my family and friends; my confidante Shafiek Hassan; and the many others who touched my life positively.

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in Partial Fulfillment of the Requirements for the
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INVESTIGATING THE EFFECTIVENESS OF USING AN INTEGRATED PROJECT TO IMPROVE TRANSFERABILITY OF I.T. SKILLS TO THE WORKPLACE

By

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This study was initiated following an investigation into using an Integrated Project (IP) as a learning experience to improve the skills of students at Peninsula Technikon. The literature reviewed indicated a variety of skills required for IT staff in general, but no importance was indicated for the various skills.

The objectives of the study were:

1 To identify the critical skills from literature and industry for entry-level software developers;

2 To determine from the lecturing staff's perspective, which skills they regard as the critical skills for entry-level software developers;

3 To determine from the students' perspective, whether the IP had equipped them with skills needed to be effective in the workplace; and

4 From the findings of the study to identify the components of a potentially effective IP.

To fulfill the objectives, data was gathered by means of various questionnaires completed by industry representatives, lecturers and students. The results of the study revealed that a mismatch existed between the skill importance rating of companies and the skill ratings of students, especially with regard to their Programming and Database skills.

The study further revealed that the IP did not contribute more to the skills competence of students than the other forms of learning experiences. The IP should provide the vehicle to increase students' skill competency levels and deeper understanding. by including the critical skills required by industry. The key skills identified from this study for an entry level software developer to be productive in industry namely, Debugging/Error Trapping, Teamwork/ Group work, General Programming, Database Relationships, Data-Access and Written Communications should be included in the IP. It is possible that a well designed IP can narrow the gap between industry expectations and student performance.

INTRODUCTION

Background to the Study

The transfer to the workplace of knowledge gained by students attending Higher Education and Training (H.E.T.) institutions is an important aspect to consider when dealing with curriculum development. According to Gibbons (1994) 'real world' needs of the workplace have to impact more on education. Within the process of student training the stakeholders who influence the transfer of knowledge into the workplace are:

- Students who are the future employees after graduation;
- Employers (industry) who have expectations of the skills that students should possess to perform the jobs that they are employed to do; and
- Academic staff (educational institution) whose role is to create the environment for, and facilitate, the process of effective learning.

The New Academic Policy for Programmes and Qualifications in Higher Education (NAP) in South Africa highlights the relationship between assessment and student learning (Council on Higher Education, 2002). In particular, this policy requires the type and conditions of assessment used, to have a direct effect on the quality of student learning and the skills they acquire. For example, non-written training tests as a form of assessment are most effective when job or role situations are simulated in a training environment. In such cases students would need to apply cognitive, psychomotor, and affective material in simulating actual job or role performance (Van de Kerkhove, 1988).

Performance in such a scenario is based on a predetermined set of performance criteria that includes demonstrating and applying skills that resemble the real-life situation. In Information Technology (IT), for example, students are required to write or maintain programs for changing business needs, after careful planning and analysis.

The South African Qualification Authority (SAQA) has taken heed of the global trend of using integrated tasks and assessments to simulate work experience, and promote life-long learning, by stipulating that integrated tasks should be used to demonstrate outcomes. The NAP document stipulates as follows:

> *In the outcomes-based approach intrinsic to the National Qualification* Framework (NQF), a qualification signifies and formally certifies the demonstrated achievement by a learner of a planned and purposeful combination of learning outcomes, at a specified level of performance. SAQA has stipulated that the learning outcomes of all South African qualifications should include critical cross-field or generic skills as well as discipline, domain-specific or specialized knowledge, skills and reflexivity. SAQA's format for qualification specification minimally includes the title and purpose of the qualification, its NQF level, credits, rules of combination for its learning components (modules and unit standards), forms of integrated assessment (to ensure that learners synthesize the learning from the various modules) and recognition of prior learning and moderation arrangements (Council on Higher Education, 2002: 40)

Perkins (1991) uses an interesting term, namely 'deep understanding' which he defines as the understanding which allows students to apply knowledge and make connections between the known and the unknown to transfer the learning. This type of learning goes beyond memorization of the given and encourages students to apply knowledge to unknown circumstances. In this approach content across subjects can be connected within a course level, which in turn can simulate real-life work experiences. Skills that are acquired and learnt across subject areas are important parts of this perspective of deep understanding. Students achieve deeper

understanding when they are challenged to perform tasks that allow them to combine knowledge gained in separate modules within a course and succeed in integrating it. Warburton (2003) perceives deep learning as a key strategy by which students extract meaning and understanding from course materials and experiences, and deem it particularly relevant in the context of education for sustainability where holistic insight is essential.

Discipline-based content design focuses on strict interpretation of the disciplines with separate modules in separate time blocks (Walker et al., 1998). Generally, no attempt at integration is made. This approach makes a slight attempt to show relationships between individual modules within a discipline. Knowledge presented in discrete packets has boundaries that are well defined that may lead to students having a disconnected view of discipline areas once applied in the work place. Despite being provided with a rich knowledge base, students may be unable to integrate and apply that knowledge in complex work situations (Walker et al., 1998).

In a study of marketing education done in Australia and New Zealand, typical course curricula included units of various topics in a prescribed hierarchy (Walker et al., 1998). This model is very similar to the South African scenario. The approach has profound consequences as students regard subject areas as mutually exclusive. The report further suggests that the segregated nature of course structuring and subject delivery potentially inculcated a blinkered rather than holistic view of disciplines. Similar conclusions and recommendations are found in related work by others (Warburton, 2003; Chapman and Sorge, 1999; Arredondo and Rucinski, 1998; Freeman, 1994). These authors highlight the importance of integration in course curricula in order to produce workers with integrated disciplinary skills and expertise.

Interdisciplinary research has common themes that connect traditional content areas (Glickman, Gordon and Ross-Gordon, 1995). Alternately, common concepts or skills might connect different subject areas (Drake, 1988). Since the interdisciplinary approach encourages students to discover relationships and make applications across existing content areas, it is most appropriate for a curriculum aimed at transactional learning. Current Technikon programmes apply a form of transactional learning through the practice of experiential training. Transactional learning promotes skills such as problem solving and development of cognitive skills within academic disciplines (Drake, 1988). Within the IT industry, managers require staff to work with little supervision, troubleshoot, manage resources and solve technical and business problems (Feldman, 1998). This emphasizes the need to move from subject specifics towards a more holistic integrated approach.

A survey done by the Illinois State Board of Education (Arrendondo and Rucinski, 1998) reported that 51% of Illinois schools implemented and acknowledged some form of integration in their curricula. Principals of schools interviewed in this study endorsed the use of integrated curricula, and have strong beliefs about its efficacy as a strategy for improving learning of students. This survey indicated an increase in the use of integrated curriculum material with a positive impact. Taking into consideration the emphasis of integration of modules, skills and assessments in various literature, as well as the nature of the Technikon structure in promoting experiential training in exit level courses, further consideration is required to inculcate this type of learning at all levels.

Recommendations were made that all courses contain a compulsory capstone unit, which is purposefully designed to integrate all course material (Walker et al.,

1998). A method of incorporating the integration of skills and modules into a course is to utilize an Integrated Project (IP) in order to add value to student learning and help transfer IT skills into the workplace.

Anecdotal feedback from companies where Technikon students have previously undergone experiential training suggest that students' performance is poor in the areas of teamwork, communication skills, time management and problems analysis. It is possible that by simulating industry projects by means of an IP, these skills might be improved.

This research aims to explore the use of an IP to bring together disciplinary and generic skills, while at the same time giving the students the chance to produce and consolidate their knowledge. It further aims to enrich the curricula by giving students regular opportunities to simulate industry projects.

Statement of the Problem

The benefits of preparing students for the workplace by means of an Integrated Project are not being realized in current Technikon IT programmes.

Hypotheses

The hypotheses to be tested in this study are:

1 Employers are satisfied with students' Software Development skills;

2 Lecturers are not aware of the industry skill requirements of an Entry-level Software Developer;

3 Students who have completed the IP view it as effective preparation for the workplace.

Objectives

The study is directed at achieving the following objectives:

1 To identify the critical skills from literature and industry for entry-level software developers;

2 To determine from the lecturing staff's perspective, which skills they regard as the critical skills for entry-level software developers;

3 To determine from the students' perspective, whether the IP had equipped them with skills needed to be effective in the workplace; and

4 From the findings of the study to identify the components of a potentially effective IP.

Research methodology

In order to achieve the objective of the research the following methodological approach will be followed:

Relevant literature will be reviewed to establish the critical skills required for entry-level programmers to be immediately productive in industry. In particular the literature search will include the examination of SAQA documents, existing international standards and industry standards.

Self administered questionnaires will be used to obtain opinions, expectations and attitudes from industry, institutions and students with respect to skills displayed by students.

Responses will be statistically analyzed. These findings will be used to determine whether there are any gaps between industry skills benchmarks and the outcomes of the IP.

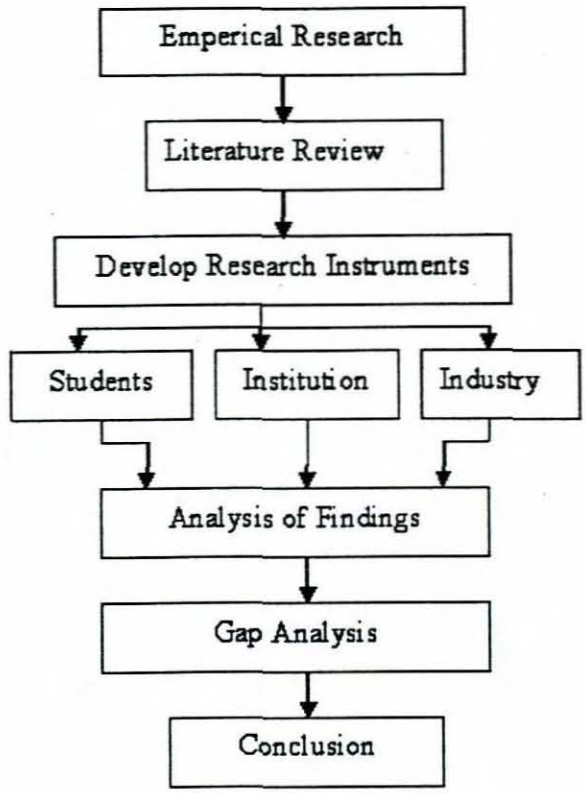

Figure 1.1 Flowchart of Methodology

Limitations of the Research

This research project is subject to the following limitations. These are as follows:

- The student sample will be taken from full-time students, specializing in Software Development, within the department of IT at Peninsula Technikon. These students should have completed a 3 months Experiential Training period.
- The industry survey would be limited to companies that employ these final year students, and in particular their immediate supervisors.
- The survey would be limited to academic staff in the IT Departments of Technikons where projects have been used previously.

Assumptions

It is assumed that all participants in this study will give accurate feedback on their experiences.

Ethical Statement

To comply with internationally accepted ethical standards, no names of individuals will be recorded on questionnaires. In this way, no individual will be linked to a particular completed questionnaire, thus assuring anonymity. No compensation will be paid to any of the respondents for participation in the study. As with other studies, quality assurance will be done with respect to the following aspects:

1 General conduct and competence of interviewers;

2 Correctness and completeness of questionnaires, especially where open ended questions are concerned;

3 Quality of data capturing done by encoders; and

4 Frequency distributions run to check that all variables contain only values in the accepted range and variable labels.

Terms Used

Core skills

Disciplinary or technical skills associated with a function or task (NWCET, 1999).

Employability skills

Transferability skills or generic skills to support a discipline such as communication skills, teamwork (NWCET, 1999).

Experiential Learning / Co-operative education

Working together of industry and the Technikon, in a process in which academic study is integrated with work experience in order to benefit both the students and industry. This term is used by the Technikon sector to describe the integration of 'productive work' into the career-focused curriculum (Council on Higher Education, 2002).

Information Technology (IT)

Any computer-based tool (includes design, development, installation, and implementation of information systems and applications) that people use to work with information and support the information and information-processing needs of an organization (Haag et al., 2002).

Integrated Project

A systems development project that requires students to fully integrate and implement all the conceptual ideas and technological aspects of systems development. The aim is to provide students with in-depth experience and insight on the actual progression of the development of a real system giving them the opportunity to apply the skills obtained in prior or parallel courses (Becker et al., 1994).

Interdisciplinary

Interdisciplinary curriculum has many variations. The subjects are interconnected in some way beyond the common theme or issue. These connections are made explicit to the students. The curriculum may be tied together by guiding questions, a common conceptual focus, or cross-disciplinary standards (Drake, 1988).

Multidisciplinary

The disciplines are connected through a theme or issue that is studied during the same time frame, but in separate classrooms. Generally students are expected to

make the connections among subject areas rather than having them taught explicitly (Drake, 1988).

NQF

National Qualification Framework: A quality assurance system in which the development and registration of standards and qualifications is carried out by Standards Generating Bodies (SGBs) reporting to National Standards Bodies (NSBs), while the quality assurance is looked after by Education and Training Quality Assurance Bodies (ETQAs) that carry out their function in co-operation with providers and moderating bodies. (Council on Higher Education, 2002)

SAQA

South African Qualification Authority: A body established by the South African Qualifications Act of 1995 to oversee the development of implementation of the NQF (Council on Higher Education, 2002).

Software Development

A set of activities that results in software products. Software development may include new development, modification, reuse, re-engineering, maintenance, or any other activities that result in software products. A specialization area within the National Diploma in Information Technology, where the focus is on designing and producing software products and systems to meet specific needs, so that they work reliably and their production and maintenance is cost effective (CTP, 2003).

Technikon

A H.E.T. Institution, which concentrates on the application of scientific principles to practical problems and to technology, thus preparing learners for the practice, promotion and transfer of technology within a particular vocation or industry (Council on Higher Education, 2002).

Structure of Study

This dissertation will be structured as follows:

Chapter 1: Introduction

This chapter gives a general synopsis of the research problem. In addition it briefly describes the background, objectives and methodology.

Chapter 2: Literature Review

The literature of concepts related to the research problem are discussed. Theories and previous research done in the field are discussed in detail. Policy documents, international and local industry standards related to the critical skills needed in industry will be investigated and analysed.

Chapter 3: Methodology

This chapter describes the methodology followed to achieve the objectives of the study.

Chapter 4: Data Analysis

This chapter discusses descriptively the collected data and their statistical analyses.

Chapter 5: Summary, Conclusions and Recommendations

In this chapter the results of the research are discussed and compared against the findings of the literature. The key findings are summarized and the study is concluded.

LITERATURE REVIEW

Introduction

This chapter offers a review of relevant literature, standards and curricula created within the local and international Information Technology (IT) area. The relevant literature relating to the "perceived" IT skills gap will be surveyed.

Background

The rapid evolution of the IT sector strongly influences and impacts on IT education, affecting both the content and pedagogy (Amaral et al., 2001). Empirical research has shown that early work experience of young technological workers is important in determining their long-term work job performance (Lee, 1999; Lee et al., 1995). Research about how young IT workers acquire their knowledge base and the skills they need to perform their tasks within a work environment provide an important insight into the development of an effective workforce (Lee, 1999).

IT Skills Standards

To successfully align curricula at higher education institutions (HEIs) to industry requirements it is necessary to develop industry skill standards. The United States of America (USA) has largely been instrumental in developing skill standards for the IT industry. These skill standards benefit industry, students, academics and government and therefore occupy an indispensable position in any dialog concerning education or training

in the technical fields of IT (NWCET, 1999). South African IT industry Strategy (SAITIS) conducted a study in 1999 and concluded as follows:

> Understanding the dynamics of the supply and demand for labour in South Africa is critical for strategic planning, both at the national and the organizational level. This has been, and still is, made very difficult given the lack of reliability and depth of labour market data in South Africa. The IT skills base and the changes in this skills base over time have not been systematically investigated to date. There has also not, to date, been an attempt to provide a consistent and standardised approach to classifying IT skills (SAITIS Baseline Studies, 1999, pp. 127).

IT Skills Gap

Several authors confirm and emphasize that there is a need for graduates of an undergraduate IT programme to be equipped to function in an entry-level position, and have a basis for continued career growth (Sergeant, 1998; van Slyke et al.; 1998; Trauth et al., 1993). The demand for knowledgeable and competent IT graduates equipped with sufficient real world skills is on the increase (Davis et al., 2002; Scott et al., 2002; Lightfoot 1999). The IT skills gap, represented by

$$I_s - P_s = IT_s$$

where I_s = skills required by industry

P_s= Skills of the programmer

IT_s = Skills gap,

can be defined as the discrepancy between the entry-level graduate's skills and the skills that industry requires from them to be productive within industry.

Milton (2000) identifies discordance between industry and academic universities, and the lack of consensus concerning industry skill requirements, as the main causes of the IT skill gap. Several studies have examined the critical IT skills required by industry and perceived by students (Scott et al., 2002; Lee, 1999; Trauth

et al., 1993). Scott et al., (2002) investigated the skills gap within IS at the University of Cape Town. Findings of this research indicated that a correlation existed between the specific skills and technologies that industry requires and those which students possess. The study further indicated that knowledge of certain technologies is lacking from the formal IS curriculum.

The consequence of this gap is that IT companies are forced to increase and improve their own training programmes in order to maintain a set level of quality (Nuthall, 2001). Retraining of employees is a very expensive solution to the IT skill gap scenario (Trauth et al., 1993).

Information Technology Curricula

Industry, students, educators, government, and professional bodies each have a major stake in the education of students and in the efficient development of a productive workforce. Student perceptions of curriculum design are essential as they have the least power to influence the curriculum, but stand to lose the most (Lightfoot, 1999). Lightfoot (1999) emphasizes that the education system, particularly at the college undergraduate level, has the responsibility to prepare future IT professionals for an entry-level position in the IT industry. Several authors confirm that curricula must provide students with the fundamental background and abilities to learn new skills throughout their career (Davis et al., 1997; Couger et al., 1995; Lee et al., 1995).

IS 2002 Model Curricula

The first IT curriculum was developed in 1972 (ACM '72) and revised in 1982 (ACM '82) by the Association for Computing Machinery (ACM). Other organizations including the Association for Information Systems (AIS) and the

Association of Information Technology Professionals and Information Federation for Information (IFIP) also published separate model curricula for IT in 1998.

IS '97 was the first collaborative effort of worldwide organizations such as the ACM, AIS, Association for Information Technology Professionals (AITP) and the Computer Society of the Institute of Electrical and Electronic Engineers (IEEE-CS) to develop curricula guidelines for IT (Gorgone et al., 2002). IS 2002, which is the second collaborative effort, is also part of the Computing Curricula 2001 project (CC2001), commissioned to develop curricula guidelines for undergraduates in computing. The need for such an intervention was driven by the rapid, continued change in the IT industry in recent years. A curriculum model was developed to serve as a guide and reference to curriculum designers and developers, developing future IT programmes (Gorgone et al., 2002). The availability of a curriculum model enabled local academic units to maintain a rate of academic progress consistent with both employment needs across the USA., and with the common body of knowledge in the IS field (Gorgone et al., 2002). The IS 2002 core courses were developed after research into the characteristics of IT professionals and surveys on appropriate mastery levels of key skill areas in IT. Observations of this research have been published by Landry et al. (2002). The model curriculum guidelines state that several characteristics of the IT profession have been relatively constant over time and have been integrated into IS 2002 (Gorgone et al., 2002). Figure 2.1 presents a high-level categorization of the exit characteristics that guide the IS 2002 curriculum.

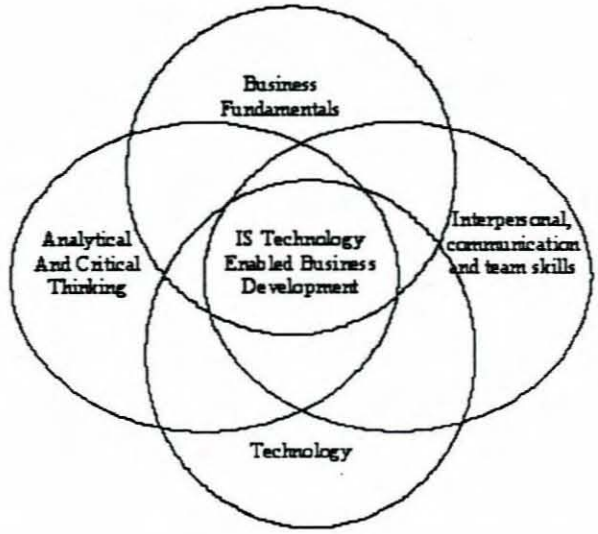

Figure 2.1 Exit characteristics guiding the IS 2002 curriculum

The scope of the IS field covers the intersections between organizations, people and IT (Couger et al., 1995). In this model there is an intersection of technology, people, tasks, data and organizations, such that the combinations of these factors create unique management influences, issues and problems for organizations to solve. The best IS solutions will be those which consider all of these areas that are depicted.

An explanation of capabilities and knowledge expected for IT Programme Graduates (Gorgone et al., 2002), as specified by the IS 2002 curricula follows in the next section.

Prerequisite Skills

The IS 2002 curriculum assumes prerequisite knowledge of elementary desktop computing, as is understood from Table 2.1.

Table 2.1. Prerequisite Skills

Word processing	Spreadsheets	Email & Web browsing

Adapted from Gorgone et al. (2002)

Analytical and Critical Thinking

Analytical and critical thinking skills form an integral part of the IS 2002 curriculum as indicated in Table 2.2 below. With the latest trend of hackers and viruses, ethical violations in companies are on the increase. An important issue is the proper education of IT students to deal with on the job ethical issues (Couger, 1989). Wong (1996) identifies IT professionals with business acumen, leadership and critical thinking as the key element to the success of most IT projects.

Table 2.2. Analytical and Critical Thinking

Organisational Problem Solving	Ethics and Professionalism	Creativity
Problem solving models, techniques and approaches	Codes of conduct	Creativity concepts
Personal Decision making	Ethical theory	Creativity techniques
Critical Thinking	Leadership	The systems approach
Methods to collect, summarise and interpret data	Legal and regulatory standards	
Statistical and mathematical methods	Professionalism - self directed leadership, time management	
	Professionalism – commitment to and completion of work	

Adapted from Gorgone et al. (2002)

Business Fundamentals

The trend of applying information technologies to service industry requirements is growing. The need of businesses to computerize and reengineer business processes requires IT professionals to have an in-depth business functional knowledge (Lee, 1999; Davenport and Short, 1990; Trauth et al., 1993; Wong, 1996). Couger (1988) believes that IT professionals, who are responsible for Design and Implementation, must be competent not only in technology but also have an in-depth understanding of business functions and business needs in their organizations. A list of business fundamental skills as prescribed by the IS 2002 curriculum is listed in Table 2.3.

Table 2.3. Business Fundamentals

Business Models	Functional Business Areas	Evaluation of Business Performance
Contemporary and emerging business models	Accounting	Benchmarking
Organisational theory, structure and functions	Finance	Value chain and value network analysis
System concepts and theories	Marketing	Quality, effectiveness, and efficiency
	Human Resources	Valuation of organizations
	Logistics and Manufacturing	Evaluation of investment performance

Adapted from Gorgone et al. (2002)

Interpersonal, Communication, and Team skills

Teamwork is one of the most familiar concepts of IT. In order to draw on the various technical and behavioral skills needed for a project, almost all system development activities are performed through teamwork (Dos Santos and Hawk, 1988). Teamwork is an essential skill according to literature (NWCET, 1999). By working in teams, students develop their communication skills that are essential in dealing with IT clients. A survey of past graduates and employers evaluated IS programmes at the University of South Australia. Research has shown that behavioral knowledge and skills are essential for IT professionals due to the shift in the demand for staff and IT job trends (Gupta and Wachter, 1998; Young, 1988; Cheney et al., 1980; Couger and Zawacki, 1978). Research done on critical skills of IS professionals supported by the Boston Chapter of the Society for Information Management has shown an increase in IS personnel growth outside the traditional centralized IS department towards the functional business areas of organizations (Lee et al., 1995), emphasizing the importance of multi-skilling.

A complete list of interpersonal, communication and team skills identified as being essential characteristics of IS graduates is listed in Table 2.4.

Table 2.4. Interpersonal, Communication, and Team skills

Interpersonal	Team Work and leadership	Communication
Listening	Building a team	Listening, observing, interviewing and documenting
Encouraging	Trusting and empowering	Abstraction and precise writing
Motivating	Encouraging	Developing multimedia content
Operating in a global, culturally diverse environment	Developing and communicating a vision / mission	Writing memos, reports, and documentation
	Setting and tracking team goals	Giving effective presentations
	Negotiating and facilitating	Application Development, requirements
	Team decision making	
	Operating in a virtual team environment	
	Being an effective leader	

Adapted from Gorgone et al. (2002)

Technology

Technology rate of change in the IT field implies that a multiplicity of technical skills is needed (Wong, 1996; Lee et al. 1995). According to Lee (1999), after aligning business needs, the next ranked IT skill critical for future employment are integrating networks, integrating existing and new applications and developing databases. Lightfoot (1999) maintains that deep understanding of IT necessitates fundamental principles of programming logic, algorithms and data structures to form the basis for long-term learning that will take place after graduation. The above skills together with those specified in Table 2.5 summarizes essential technology skills required by graduates.

Table 2.5. Technology

Application Development	Internet Systems Architecture and Development	Database Design and Administration	Systems Infrastructure and Integration
Programming – principles, objects, algorithms, modules, testing	Web page development	Modeling and design, construction, schema tools, and DB systems	Computer systems hardware
Application Development-Requirements, spec's, development	Web architecture design and development	Triggers, stored procedures, design and development of audit controls	Networking (LAN/WAN) and telecommunications
Algorithmic design, data, object and file structures	Design and development of multi-tiered architectures	Administrations: security, safety, backup, repairs, and replicating	LAN / WAN design and management
Client-server software development			Systems software
			Operating systems management
			Systems configuration, operation, and administration

Adapted from Gorgone et al. (2002)

Information Systems - Technology-enabled Business Development

Technology Management Knowledge is a contrast to specific technical specialties. It is concerned with where and how to deploy information technology effectively and profitably for meeting strategic objectives (Cash and Konsynski, 1985; Lee et al., 1995) as can be seen in Table 2.6. The trend is to analyze business problems and provide IT solutions (Lee et al., 1995). IT has played key roles in the development of the global marketplace and will continue to be of strategic importance for companies. The use of IT for competitive advantage, to change and streamline organization structures and bring efficiency to organizations is increasing (Phukan, 2001).

Table 2.6. Information systems Technology-enabled business development

Business Process Design	System Analysis and Design	Systems Implementation	IS Project Management
Strategic utilization of information technology and systems	Systems analysis	Deployment	IS Planning
IT and organisational systems	Logical and physical design	Maintenance	Use of IT
	Design execution		Customer Service
	Testing		

Adapted from Gorgone et al. (2002)

Skill Standards of North West Center for Emerging Technologies (NWCET)

The skill standards developed by the NWCET identify the skill standards for IT in the USA. NWCET's Curriculum Research and Development Group have developed an IT core curriculum consisting of learning components, learner programme outcomes and key competencies. The curriculum was developed using quantitative and qualitative information collected using expert panels of IT workers, managers and other stakeholders within the USA. Figure 2.2 depicts the pyramid of competencies identified by the NWCET. The skill standards are categorized into three broad skill categories.

All curricula would contain a combination of outcomes from each tier. The first tier is representative of employability or foundation skills such as problem solving and teamwork which was researched by the Secretary's Commission on Achieving

Necessary Skill (SCANS) and implemented by the U.S. Department of Labor. These employability skills are necessary for the effective utilization of technical knowledge and tools (NWCET, 1999).

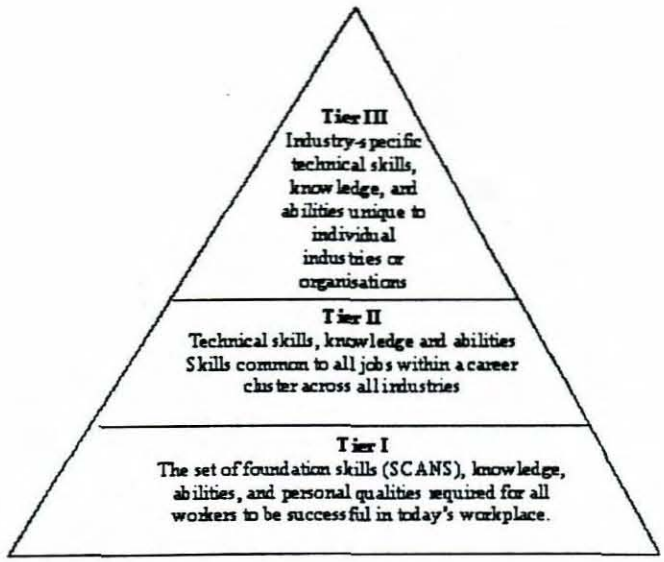

Figure 2.2 Pyramid of competencies (NWCET, 1999)

The second tier comprises technical skills, knowledge and competencies that are necessary in all professions of the field regardless of the workplace such as basic programming skills, basic networking skills and basic database management skills.

Finally, the third tier contains the technical skills, knowledge and competencies that are completely identified within the environment of a company or organization, for example, the required knowledge of data communications and network protocols may differ per company or industry. The learning components are tabulated in Table 2.7.

Table 2.7. NWCET Core Skills

CURRICULUM RESEARCH AND DEVELOPMENT GROUP	
Analytical Skills and problem solving	
Analytical and Logical Thinking	Pattern recognition and modeling
Conceptualization	Problem solving
Data Gathering, analysis and organization	Statistical Analysis
Estimation and Cost/Benefit analysis	Business Environment Skills
Hypothesis Development and design	
Business Organization and environment	
Computer trends in Business and society	Professional Development
Principles of Accounting	Professionalism
Coordination and Communication skills	
Customer relations	Task Management
Oral Communication	Teamwork
Project Management	Written Communication
Core Computer Software and hardware skills	
Database Applications	Principles of Programming
Email	Software Installation and configuration
Hardware installation and configuration	Spreadsheet Applications
Internet	Windows environment
Network Technologies	Word Processing
Presentation Software	
Project and Process flow	
Analysis and synthesis	Quality Assurance
Design and development	Research
Planning and Organization	Technical Documentation
Project Documentation	User Testing and validation
Proposal Writing	

Technikons in South Africa

Technikons (soon to become universities of technology) in South Africa use the career-focused, hand-on approach to education and training (CTP, 2003). Their interface with industry has enabled them to structure courses with practical applications and endeavor to deliver graduates with knowledge that is immediately relevant in the workplace (NRF, 2003). Technikons are the equivalent of universities of technology, technological universities, technical universities or institutes of technology found in countries such as the USA, United Kingdom (UK), New Zealand and Germany (Haupt, 2003; CTP, 2003).

Technikons and universities are administered by the Higher Education Branch of the National Department of Education (CTP, 2003). According to the ICT sector scan of the Western Cape in 2002, on average 48% of employees in the companies surveyed had an ICT related university degree or Technikon Diploma (SAITIS, 2002). This is high by international standards.

Peninsula Technikon

The Department of IT at Peninsula Technikon currently offers programmes in Software Development, Communication Networks and Multimedia as previously stated. This research however, deals only with the Software Development specialization area.

IT – Software Development course structure at Peninsula Technikon

The design of the 3-year Diploma programme is based on the national standards and requirements of South African Qualifications Authorities (SAQA) and the National Qualification Framework (NQF). The curriculum is based on the IS 2002 curriculum model and corresponds to SAQA / NQF levels 5 and 6. Local and national industry requirements are heeded via an advisory committee consisting of local industry representatives and academics.

Deep Understanding and Integration of Skills within Curricula

Developing a deep understanding of IT requires that the curriculum covers the fundamental principles of programming. Teaching for deep understanding goes beyond memorization of the given and encourages students to apply knowledge to unknown circumstances. Students with a deep understanding of IT are actually prepared for the long-term learning that will take place after graduation (Lightfoot,

1999). Educators in IT need to play an important role in responding to changes in the industry. It is essential for IT courses to provide a platform for consolidating knowledge (Mathieu, 1993). Gupta and Wachter (1998) states that IT courses should include lectures, assignments, case studies, situation analyses reports and a major team project in order to consolidate knowledge. These skills will allow students to learn new technologies and tools, practice the skills learned, develop analytical skills, learn the underlying problem and finally integrate skills to build a system (Scott et al., 2002).

Given the broad spectrum of topics that should be covered within an IT curriculum, and the diverse preparation required for it, IT and IS courses are usually taught independently of each other. Consequently students fail to identify the practical concepts, which spans over more than one course (Becker et al., 1994).

Projects

Walker et al., (1998) suggests that all courses contain a compulsory capstone unit, which is purposefully designed to integrate all course material. Capstone experiences are needed so that knowledge can be acquired via active, experiential learning opportunities (Becker et al., 1994). Industry comments from previous research indicated that students should be encouraged to do more project work and develop practical skills, as students project management skills and human dynamics expertise were minimal (Hodgett, 2002). A method of incorporating the integration of skills and modules into a course is to utilize an Integrated Project (IP) in order to add value to student learning and help transfer IT skills into the workplace. At the exit level the use of real-life projects are ideal as students are mature and should have the

ability to deal with business problems and clients. An added challenge is that real world projects are difficult to evaluate (Scott et al., 2002). The difficulty in remaining unbiased when assessing the projects with the lack of industry standards as in South Africa remains a challenge.

The fact that capstone projects are used widely emphasizes the importance of integration of skills. Technikon programmes apply a form of transactional learning through the practice of experiential training. Transactional learning promotes skills such as problem solving and development of cognitive skills within academic disciplines (Drake, 1988). Especially at a vocational institution this sort of activity is vital and should encourage and develop skills such as business acumen, problem analyses, written and oral communication, technical skills, problem solving and project management amongst others. The main aim of such a project is to give students the real-world work experience and integrate topics covered within the course. Anecdotal feedback from companies where Technikon students have previously undergone experiential training suggest that students' performance is poor in the areas of teamwork, communication skills, time management and problems analysis. It is possible that by simulating industry projects by means of an IP, these skills might be improved.

Chapter Summary

Some of the key literature on IT model curricula, key skills for software developers, and curriculum integration has been reviewed. The literature suggest that the IT industry requires competent staff with well-balanced business acumen, problem analyses skills, written and oral communication skills, technical skills, problem

solving and project management. From the academic perspective, learning experiences are needed so that knowledge can be acquired via active, experiential learning opportunities.

In the next chapter the methodology is described to achieve the stated objectives of the study.

METHODOLOGY

This chapter describes the methodology followed to achieve the objectives of the study.

Previous Research

According to the literature reviewed, not much research has been done in relation to skill levels of IT students at technikons, universities of technology, technological universities, technical universities, polytechnics or institutes of technology both locally and internationally, and the skills gap that exists between these students and industry. Similar research has however been done relative to skills of IT students at universities (Scott et al., 2002; Hodgett, 2002).

Previous research relied on Delphi studies (Brancheau and Wetherbe, 1987; Dickson, et al., 1984; Hartog and Herbert 1986; Niederman, et al., 1991) as cited in Lee (1995). Delphi is a method of combining the judgments of knowledgeable individuals when there is no determinate answer based on hard data or well-established theory available (Dalkey, 2003). From discussions with industry participants, the need for concrete data on specific activities was identified. The recommendation was that surveys should be used and formulated in terms of specific activities (Lee, 1999). Most research methods could be used to investigate teaching and learning. However, the purpose of the research determines the method used. The two distinct research paradigms are qualitative or quantitative (Sarantakos, 2000; Strauss and Corbin, 1990).

Qualitative Research

Qualitative research concentrates on investigating subjective data, in particular the perceptions of people involved, with the intention to gain greater insight and knowledge. This method uses detailed descriptions of events, situations or people. Common techniques within qualitative research include interviewing, document analyses and field observations of people (Patton, 1990; Straus and Corbin, 1990).

Quantitative Research

The quantitative paradigm concentrates on what must be measured, and involves collecting and analyzing objective (often numerical) data that can be organized into statistics. Quantitative research methodology emphasizes numbers, measurements, experimental design and statistical analysis (Patton, 1990). Common techniques include questionnaires, structured interviews, and tests (Sarantakos, 2000). Findings from quantitative methods may often be reported using descriptive statistics such as mean, standard deviation, correlation (Sarantakos, 2000).

Bearing in mind that an objective of the study is to identify the critical skills for entry-level software developers from the staff, student and industry perspective, it is essential to measure and compare the students' expertise in the various skill categories.

To effectively measure the skill levels of students, questionnaires were used based on quantitative responses. The respondents would reply to the questions on the questionnaire with a numeric response between 1 and 5, based on the rating scale provided.

Measurement

> Measurement relates to limiting the data of any phenomenon - substantial and insubstantial - so that the data may be examined mathematically and, ultimately, according to an acceptable qualitative or quantitative standard (Leedy, *1997:26*).

Measurement can be seen as a tool by which data can be inspected, analysed and interpreted so that the researcher can find meaning to data gathered. Qualitative measurement produces mostly non-numerical data and is generally subjective, whereas quantitative measurement is usually numeric and processed by statistical techniques.

Validity and reliability are two considerations essential to measurement. Valid measurement is achieved when scores (including the results of qualitative classification) meaningfully capture the ideas contained and measure what they are supposed to measure (Adcock and Collier, 2001). The validity relates to the acquisition of data and the skillfulness with which the research structure and instruments are designed. It is concerned with the effectiveness of the measuring instrument in reaching the objective of the research (Leedy, 1997). Validity refers to the question "What does the question measure, and does it measure what it is supposed to". Reliability concerns the consistency or accuracy with which the measuring instrument performs or measures. It refers to how well the instrument consistently yields similar results (Leedy, 1997).

Scales of Measurement

In order for the measurement to be valid and reliable, the nature of the data dictates the appropriate scales to be used. Two categories of scales, their

characteristics and the statistical possibilities of the scale are found. Table 3.1 summarises the non- interval scales.

Table 3.1. Non-interval scales

Measurement scale	Characteristics of the scale	Statistical possibilities of the scale
Nominal scales	Measures in terms of names or designations of discrete units.	Statistically it can be used to determine the mode, the percentage values, or the chi square
Ordinal scales	Measures in terms of values such as "more" or "less", "larger" or "smaller", without specifying the size of the intervals.	Statistically it can be used for determining the mode, percentage, chi square, median, percentile, rank, or rank correlation.

As adapted from Leedy (1997)

The interval scales which are categorized into (i) interval and (ii) ratio scales are summarized in Table 3.2.

Table 3.2. Interval scales

Measurement scale	Characteristics of the scale	Statistical possibilities of the scale
Interval scales	Measures in terms of equal intervals or degrees if difference but whose zero point is arbitrarily established.	Statistically it can be used to determine the mean, the standard deviation, the t-test, the F-test, and the product moment correlation.
Ratio scales	Measures in terms of equal intervals and an absolute zero point of origin	Statistically it can used for determining the geometric mean, the harmonic mean, the percent variation, and all other statistical determinations

As adapted from Leedy (1997)

The research instrument used was a Likert-format questionnaire with five response options, based on the scale provided for the various sections of the questionnaires. The respondent would reply to the questions by selecting a numeric response between 1 and 5, based on the rating scale provided for the specific section

of the questionnaire. The Likert scale was an appropriate approach in that the respondents are limited to the number of responses to choose from, while still offering enough choices to make a suitable decision, based on their experience. This approach also allows a large amount of data to be captured whilst simplifying the capturing and analyses process.

The advantages of using scales as identified by Sarantakos(2000) include:

- High coverage of significant aspects of the concept;
- High precision and reliability;
- High comparability between sets of data; and
- Simplicity with regards to collection and analysis of data.

Analysis

Factor analysis is a mathematical tool, which can be used to examine a range of data sets. It has been developed primarily for analyzing relationships among a number of measurable entities, such as survey items. The underlying assumption of factor analysis is that a number of unobserved latent variables (or factors) exists that account for the correlations among observed variables. The primary purpose of factor analysis is data reduction and summarization (Leedy, 1997). The factor analysis method therefore groups variables with similar characteristics together. When factor analysis is used the variables should be quantitative at the interval or ratio level. Categorical data (such as religion, country) are not suitable for factor analysis.

Sample selection

The descriptive survey method will be used in this study. A critical aspect to consider in using the descriptive survey is the population and sample of the study.

> The sample should be carefully chosen that, through it, the researcher is able to see all the characteristics of the total population in the same relationship that they would be seen were the researcher, in fact, to inspect the total population (Leedy, 1997: 204).

This study focuses on three specific samples to be considered with regard to sampling design namely, final year Software Development students at Peninsula Technikon, industry representatives where these students experienced their industry exposure, and lecturers who previously completed a questionnaire during a pilot study at the Technikon Computer Lecturers Association (TECLA) conference and indicated that their students engaged in an integrated project during their years of study.

The data for the study were collected using questionnaires.

Questionnaires were used since:

- They were easy for students and industry to understand;
- They ensured a good and reliable response level; and
- They were quick to complete (Leedy, 1997).

Since the questionnaire is an impersonal probe, it is the ideal instrument to use in this research. Due to the impersonality associated with the questionnaire two important guidelines are suggested by Leedy (1997), namely:

- Language must be unmistakably clear; and
- Questionnaires should be designed to fulfill a specific research objective.

When constructing a questionnaire, consideration should be given to the various forms of questions that will be posed. As is evident from Table 3.3 each type of question is designed to achieve a specific goal or objective.

Table 3.3. Question types and Descriptions

No.	Type of questions	Description
1	Open-ended	Allow respondents to answer in their own words
2	Closed ended	questions to which people respond in fixed categories of answers
3	Paired comparison questions	questions that ask respondents to make a judgment between alternatives taken two at a time
4	Contingency questions	questions asked only of some respondents, determined by their respondents, determined by their responses to other questions
5	Ranking questions	closed ended questions that ask respondents to rank order a set of options
6	Inventory questions	closed ended questions that ask respondents to list all reactions that apply to them
7	Matrix questions	closed ended questions that ask respondents to use the same categories to supply information
8	Multiple choice questions	closed ended questions that ask respondents to select a category response from a range of possible responses

Question Design

After completing a literature search on skill requirements, the questionnaire was adapted from a survey conducted by Scott et al., (2002). The skill categories used coincided with the skills identified in literature. The following eight skills categories were identified to be essential to software developers:

- General Business Skills;
- Analysis skills;
- Design skills;
- Programming skills;
- Database skills;
- Data communications skills;
- Interpersonal skills; and
- Project management skills.

In order to determine the above skill levels, respondents were requested to complete questionnaires using the five point Likert scale provided. The Likert scale is a set of items of equal value and a set of response categories constructed around a continuum of agreement / disagreement, to which subjects are asked to respond. The Likert scale used ensured that the capturing and analyses of the results would be uncomplicated. Rating scales enabled the respondents to rate their perceived

development at the various interventions. Since there were three questionnaires used in this study as previously discussed, each of these will be dealt with individually in the next section.

Software Development students Questionnaires

Sample Selection

The student sample was taken from full time students at Peninsula Technikon specializing in Software Development and who were eligible to graduate at the end of 2003. The questionnaire was designed to compare the skills of final year Peninsula Technikon IT students specializing in Software Development against industry requirements. The following criteria were used to select the sample of the students. They had to:

1 Be eligible to graduate at the end of 2003;
2 Specialize in Software Development; and
3 Have performed their experiential training in June 2003.

Of the 54 final year students within the Information Technology course, there were 28 students who satisfied all these criteria.

Questionnaire Design

To effectively measure the skill level of the student, the questionnaire was designed to return quantitative responses. The survey was intended to collect data from students relating to the acquisition of students' skill levels developed:

- In the taught component of the course;
- As a result of participating in an integrated project;
- As a result of their industry exposure; and
- To determine whether there was a difference in the methodologies, tools and techniques taught at the Technikon and those used in industry.

A numeric response rate between 1 and 5 was used, based on the rating scale provided for the category of questions. The questionnaire was tested for bias by making sure that the skills selected were not specific to Peninsula Technikon only. A national survey of staff at IT departments at Technikons was conducted to establish the categories of skills that were addressed in their programmes. Only those that were common to all the programmes were used in the development of the final questionnaire.

In order for students to respond without the fear of being penalized based on their responses, it was made clear to them that their response would not affect their project mark.

The student questionnaire was divided into four sections. Section A, B and C which used the same rating scale dealt with the eight systems development skill areas identified in the literature. Students were asked to select the most applicable user response in the grid based on the skill category and rating scale provided as shown in Table 3.4.

- Section A aimed to determine the extent that the student gained or developed the skill as a result of their attendance in the IT course;
- Section B aimed to determine the extent that the student gained or developed the skill as a result of engaging in an integrated project; and
- Section C aimed to determine the extent that the student gained or developed the skill as a result their industry exposure;

Table 3.4. Rating scale 1

Level	Explanation
5	I have developed excellent skills in this area
4	I have developed very good skills in this area
3	I have developed average skills in this area
2	I have developed some basic skills in this area
1	I have not developed any skill in this area

Section D consisted of a list of more specific methodologies and techniques, all of which were to be rated as shown in Table 3.5.

Table 3.5. Rating scale 2

Level	Explanation
5	Expert user in all areas and competent to use skill in professional environment
4	Expert user in some areas with good overall knowledge
3	Good knowledge in all areas but lack understanding of complex areas
2	Average knowledge in some areas with basic background
1	Basic background knowledge only

Administration of the Questionnaire

The questionnaire was personally administered by the researcher. To receive the highest return of the questionnaires the students were requested to complete the questionnaire during scheduled class time.

Confidentiality

The respondents' anonymity was guaranteed by not including any details on the questionnaire that might be directly linked to any respondent. A copy of the questionnaire is included in Appendix A.

Response Rate

Since all 28 students qualifying for industry exposure in Software development completed the questionnaire, the response rate was 100%.

Industry Questionnaire

Sample Selection

The industry sample was made up of those companies who employed third year Software Development students during 2003 for experiential training. A total of 17 companies met the criteria. This particular questionnaire was used to gain data

relative to students' skill levels and the latest trends, relative to methodologies and tools used within the IT industry. The questionnaire was completed by the direct supervisor of the student since they would have had the most contact with them during their period of industry exposure.

Industry Questionnaire Design

This questionnaire was divided into four sections. Section A and B dealt with the eight systems development skill areas identified in the literature, Section C with specific technologies and Section D with data relative to the company that students were employed in. Supervisors were asked to select the most applicable response in the grid based on the skill category and five point rating scale provided such as shown in Tables 3.6 and 3.7.

Section A was designed to rate the skills of the student during their period of experiential training. Section B aimed to determine from the supervisor's perspective, the importance of each of the skills for an entry-level software developer to be productive at that company.

Table 3.6. Industry rating for Sections A and B

Level	Explanation
5	The student has excellent skills in this area
4	The student has very good skills in this area
3	The student has average skills in this area
2	The student has some basic skills in this area
1	The student has no skill in this area

Section C rated the importance of the methodologies / tools as used in the company.

Table 3.7. Industry rating scale for Section C

Level	Explanation
5	Skill in this area is vitally important /could not cope without it
4	Skill in this area is important
3	Skill in this area is of average importance
2	Skill in this area is not very important
1	Skill in this area is not important

Section D covered data relative to the type of company students were employed in as well as a description of the work they did while they were there.

Administration of the Questionnaire

Each of the companies were contacted telephonically by the researcher, to set up appointments in order to survey the supervisor of the students using the questionnaire. The supervisors who were not available for an appointment had the questionnaire emailed to them. Completed questionnaires were then returned via email or fax. Follow up calls had to be made and emails sent to ensure the optimal response rate was achieved.

A covering letter was included stating the purpose of the research, and the questionnaire was included in the envelope which was sent to the supervisor at the company. A copy of the covering letter and questionnaire are included as Appendix B and C.

Confidentiality

The respondents' anonymity was guaranteed by not including any details on the questionnaire that might be directly linked to any respondent. A copy of the questionnaire is included in Appendix C.

Response Rate

Of the 17 companies targeted, all had completed the questionnaire, giving a response rate of 100%.

Staff Questionnaire

Sample Selection

The staff sample was drawn from the participants in a pilot study to determine if their students engaged in a project during their academic programme. They were IT lecturers from all the Technikons nationally who attended the TECLA conference in 2003.

Of the Technikons respresented at the conference, eight technikons indicated that their students undertook projects. These made up the staff sample.

Questionnaire Design

To effectively measure responses of staff, the questionnaire was designed to return a quantitative response. The survey was intended to collect data from staff in order to determine:

- Whether lecturers regarded a project as adequate preparation for the workplace; and
- From the lecturing staff's perspective which are the critical skills for entry-level software developers.

The questionnaire is attached in appendix F.

Administration of the Questionnaire

The questionnaire was administered telephonically. An initial email, as can be seen in Appendix E was sent to the respondents explaining the reason for the research. The questionnaire was attached so that respondents could be familiar with the questions when contacted.

Confidentiality

The respondents' anonymity was guaranteed by not including any details on the questionnaire that might be directly linked to any respondent.

Response Rate

Since all three respondents from each of the 8 technikons were contacted, the response rate was 100%.

Analysis of Data

The collected data was captured, encoded and statistically analyzed using the statistical package "Statistical Program for Social Sciences" (SPSS).

Chapter Summary

In this chapter the methods were outlined that were used to gather data from all staff, industry and students. The questionnaire design and sample selection were discussed.

In the next chapter the findings, after the analyses of the data are presented and analyzed.

DATA ANALYSIS

To draw conclusions from the empirical data collected, statistical evidence is necessary to establish the existence and strength of relationships between the variables represented by the data. The SPSS (Statistical Program for Social Sciences) computer software was used to analyze the data from the various survey instruments. The findings of each of the questionnaires and the analysis of these findings are presented in this chapter, namely the staff pilot study, staff, student and industry questionnaires.

Pilot study

The pilot survey of academic staff served to determine at which Technikons students in IT were required to do projects as part of their academic programme. Of the staff that responded, 73% confirmed the use of projects in their subjects. Responses to the pilot questionnaire were used to identify from which technikons academic staff could be included in the staff questionnaire used later in this study.

All academic staff (100%) agreed that technical abilities, logic and interpretation of data were important aspects of the IT course. Similarly, 97% of respondents reported that teamwork was an essential skill that students had to master. Respondents furthermore reported that General Business (29%), Personal Development (24%), Creativity (24%) and understanding Business Procedures (18%) were important skills to consider in order for students to become productive in industry.

To ensure that students met the needs of industry, academic staff indicated that projects (26%), quality assurance (21%), regular industry visits (16%), course portfolios, student presentations (5%) and practical simulations of the business environment were used.

Staff Questionnaire Analysis

This particular questionnaire was designed to determine which skills academic staff perceived as important for an Entry Level Software Developer to be productive upon completion of their academic programmes. It was also designed to determine staff's perception of integrated projects. Most academic staff at Technikons surveyed during the pilot study reported that they expected students to complete a project during their academic programme. Academic staff opined that second and third level students were expected to complete a project. Staff reported that subjects that included projects were mostly those which included a programming language as can be seen in Table 4.1. For example, Development Software II, Development Software III, Technical Programming III, Technical Programming II, Technical Programming III and Internet Programming III include programming languages.

Table 4.1 Subjects currently including a project

Subject	Response		
Development Software III	58.8%	Information Systems I	11.8%
Development Software II	35.3%	Application and Design III	5.90%
Technical Programming I	23.5%	Communications Networks II	5.90%
Technical Programming III	23.5%	Communications Networks III	5.90%
Internet Programming III	23.5%	Application and Design III	5.90%
Technical Programming II	17.6%	Systems Software II	5.90%
Information Systems II	17.6%	Systems Software III	5.90%
Information Systems II	17.6%	Projects III	5.90%
Development Software I	11.8%	IT Skills II	5.90%

Academics were presented with six statements referring to the nature of the subjects that they taught and projects they assigned. They were required to indicate to what extent they either agreed or disagreed with each statement. Their responses are ranked in Table 4.2, with the scale indicating that when the mean is smaller, the level of agreement is stronger. Evidently, most staff reported that subjects should be taught on an integrated basis (mean = 1.38) and that projects could be used to better equip students for the workplace (mean = 1.38). While their responses to whether subjects should be self-contained indicated disagreement (mean = 4.71) with that statement, it confirmed the earlier sentiment of agreement with subject integration.

Table 4.2 Perceptions of Subject Integration and Projects

	1 %	2 %	3 %	4 %	5 %	6 %	Mean[1]	Std. Dev.
Projects better equip students for the workplace	76.20	9.50	14.30	0.00	0.00	0.00	1.38	0.74
Subjects should be taught on an integrated basis	76.20	9.50	14.30	0.00	0.00	0.00	1.38	0.74
Topics that are not part of the subject outcomes, should be included in projects	23.80	33.30	33.30	9.50	0.00	0.00	2.29	0.96
Theoretical subjects are able to expose students to workplace experiences	14.30	4.80	19.00	38.10	19.00	4.80	3.57	1.40
Projects cannot adequately simulate the work environment	0.00	9.50	9.50	38.10	33.30	9.50	4.24	1.09
Subjects should be self contained	9.50	4.80	9.50	9.50	14.30	52.40	4.71	1.74

[1] The scale used to indicate the level of agreement is a 6-point Likert scale where 1 = Totally agree, 2 = Strongly agree, 3 = Agree, 4= Disagree, 5 = Strongly Disagree and 6 = Totally Disagree.

Staff were asked to indicate how important eight attributes were for students to be productive in industry. Their responses were ranked by the means to indicate which attributes were regarded as most important. Design (mean = 4.45), Analysis (mean = 4.43) and Database (mean = 4.38) skills were reported to be the most important skills for students to be productive in industry. On the other hand General Business skills (3.95) were regarded as the least important skill for students to have. These findings are shown in Table 4.3.

Table 4.3 Importance of Attributes of Students to be Productive in Industry

Rank	Attribute	1 %	2 %	3 %	4 %	5 %	Mean[2]	Std. Dev.
1	Design	0.00	0.00	10.00	35.00	55.00	4.45	0.69
2	Analysis	0.00	0.00	9.50	38.10	52.40	4.43	0.68
3	Database	0.00	0.00	4.80	52.40	42.90	4.38	0.60
4	Interpersonal	0.00	0.00	14.30	33.30	52.40	4.38	0.74
5	Project Management	0.00	0.00	14.30	57.10	28.60	4.14	0.65
6	Programming	0.00	4.80	19.00	42.90	33.30	4.05	0.86
7	Data Communication	0.00	0.00	28.60	42.90	28.60	4.00	0.77
8.	General Business	0.00	0.00	33.30	38.10	28.60	3.95	0.81

Academic staff were asked to identify which of the eight skills were regarded as exit level outcomes of their courses. Their responses are shown in Table 4.4. It is evident that Analysis (86%) and Design (86%) were regarded equally important by most staff as exit level outcomes. Similarly, Database skills were regarded as exit level skills by 76% of the staff. Staff had mixed opinions regarding whether project management (57%), Programming (57%), Data Communication (47%) were exit level outcomes. Similarly, 76% of staff did not regard General Business skills as an exit level outcome.

[2] The greater the means, the stronger the level of importance. Responses were ranked using a 5-point Likert scale with 1 representing not important at all, 2 representing unimportant, 3 representing average importance, 4 representing important, and 5 representing very important.

Table 4.4 Exit Level Outcomes

Skill	Yes
Analysis	85.7%
Design	85.7%
Databases	76.2%
Project Management	57.1%
Programming	57.1%
Data Communication	47.6%
Interpersonal	47.6%
General Business	23.8%

Table 4.5 shows the grading allocation on average per skill category, per subject taught in the course. Programming (24%), Design (23%) and Analysis (17%) skills were the skill categories that made up the major proportion of the grade (63%). Interestingly while Programming skills were not regarded as important to be productive (ranked 6th) in industry, nor as a critical exit level outcome (57%), it carried the most weight in the overall grade for each subject. General Business (9%) and Interpersonal skills (5%) were the skills that contributed the least to the overall grade.

For the grade allocated to each skill category in the assigned projects, Programming (22%), Design (18%), Database (14%) and Analysis (12%) skills constituted the bulk of the grade (66%).

Table 4.5 Subject Grading Allocation per Skill Category

Rank	Skill	Subject Mark Allocation	Rank	Project Mark Allocation
1	Programming	24%	1	22.00%
2	Design	23%	2	18.00%
3	Analysis	17%	4	11.75%
4	Database	13%	3	13.50%
5	Data Communication	8%	7	05.25%
6	Project Management	6%	5	08.25%
7	General Business	4%	8	04.75%
8	Interpersonal	5%	6	07.00%

The findings in Table 4.6 are similar to those of Table 4.3 in that Design (95%) and Analysis (86%) were regarded by most staff as skills to be mastered on completion of their subjects.

Table 4.6 Mastery of skills after Subject completion

Skill	Yes
Design Skills	95.20%
Analysis	85.70%
Database Skills	66.70%
Project Management Skills	66.70%
Programming Skills	66.70%
Data Communication Skills	61.90%
Interpersonal Skills	52.40%
General Business Skills	28.60%

Discussion

By comparing the means of the various responses, it was possible to rank the eight skill categories in relation to the different questions asked. A number of trends emerged from the analysis of the data. Academic staff rated Design, Analysis and Database skills as the top three skills in all questions, except those relating to mark allocations. For the subject and project mark allocations, Programming was rated as the top skill. This is most likely due to the fact that the programming language is the vehicle to develop the software. Though academic staff rated Interpersonal skills as the fourth most important skill for students to be productive in industry, they were given the lowest rating in the evaluation of the subject and regarded as the second least significant skill to be mastered after subject completion. General Business was generally regarded as the least significant skill. All the skills were rated as above average importance, with seven being rated as important.

The result suggest that staff place equal emphasis on all skill categories, while it is possible that industry may require more emphasis on some skills and less on others.

Industry Questionnaire Analysis

In this particular questionnaire industry participants were asked to rate the skills of the students they had employed during their mandatory Experiential Training (ET) period in industry, the importance of each of those skills for an entry-level programmer, and the importance of various methodologies and tools relative to their use in their organizations. The Likert scale used in this questionnaire identifies skills of average importance as 3.00 and skills which are important as 4.00. For the purpose of the study, scores greater than 3.50 would therefore be regarded as indicating the skills to important. Using a 5-point Likert scale[3], industry respondents were asked to rate the skills demonstrated by students during their Experiential Training period in their company. The proportion of skills that were not required during the Experiential Training period varied from 6% to 53% in some cases. These responses were not included in the calculation of the means. The responses are discussed below.

From Table 4.7 it is evident students' Business Understanding Skills (mean = 2.31) were reported as being basic to average.

[3] All Students skill levels were ranked using a 5-point Likert scale where 1 = No skill, 2 = Some basic skill, 3 = Average skill, 4 = Very good skills and 5 = Excellent skills.

Table 4.7 Student General Business Skills

Rank	Skill	1 %	2 %	3 %	4 %	5 %	Mean[4]	Std. Dev.
1	Business Understanding	23.10	23.10	53.80	0.00	0.00	2.31	0.85
2	Specific Business Knowledge	25.00	33.3	41.70	0.00	0.00	2.17	0.83
3	Feasibility Analysis	40.00	40.00	20.00	0.00	0.00	1.80	0.79

Of the Analysis skills identified in Table 4.8 most students were reported to have above average System Analysis (mean = 3.09) and average Modeling / Diagramming (mean = 3.00) skills.

Table 4.8 Student Analysis Skills

Rank	Skill	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Std Dev.
1	Systems Analysis	0.00	27.30	45.50	18.20	9.10	3.09	0.94
2	Modeling / Diagramming	0.00	30.00	50.00	10.00	10.00	3.00	0.94
3	Business Analysis	18.20	27.30	54.50	0.00	0.00	2.36	0.80

As shown in Table 4.9, all Design skills were rated as above average (means > 3.00)

Table 4.9 Student Design Skills

Rank	Skill	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Std. Dev.
	Systems design	0.00	25.00	25.00	37.50	12.50	3.37	1.06
	Prototyping	0.00	12.50	50.00	25.00	12.50	3.37	0.91
	Graphical User Interface	0.00	10.00	60.00	30.00	0.00	3.20	0.63

Respondents reported in Table 4.10 that the skills of students in General Programming (mean = 3.21) skills were above average (means >3.00). Data-Access (mean = 3.00) and Client-server (mean = 3.00) skills were rated as average (mean = 3.00). However, industry reported that students displayed basic competency in

[4] All Students skill levels were ranked using a 5-point Likert scale where 1 = No skill, 2 = Some basic skill, 3 = Average skill, 4 = Very good skills and 5 = Excellent skills.

Object-Oriented programming (mean = 2.58) and Debugging / Error Trapping (mean = 2.85) skills.

Table 4.10 Student Programming Skills

Rank	Skill	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Std. Dev.
1	General Programming	0.00	14.30	50.00	35.70	0.00	3.21	0.69
2	Client-Server	0.00	25.00	50.00	2525	0.00	3.00	0.75
3	Data-Access	11.10	11.10	55.60	11.10	11.10	3.00	1.11
4	Object Oriented	0.00	28.60	57.10	14.3	0.00	2.85	0.69
5	Debugging / Error Trapping	0.00	50.00	41.70	8.30	0.00	2.58	0.66

From Table 4.11 it is evident that industry reported the Developing Database structure skill of students as average (mean = 3.00).

Table 4.11 Student Database Skills

Rank	Skill	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean[5]	Std Dev.
1	Developing Database Structures	9.10	27.30	36.40	9.10	18.20	3.00	1.26
2	Database Relationships/ Normalisation	12.50	25.00	37.50	25.00	0.00	2.75	1.03

From Table 4.12 it is evident that students displayed basic proficiency in the Network Communications (mean = 2.25) skills category.

[5] All Students skill levels were ranked using a 5-point Likert scale where 1 = No skill, 2 = Some basic skill, 3 = Average skill, 4 = Very good skills and 5 = Excellent skills.

Table 4.12 Student Data Communication Skills

Rank	Skill	0 (%)	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Std. Dev.
1	Network Communications	29.40	11.07	23.50	23.50	5.90	0.00	2.25	1.33
2	Developing systems security	47.10	17.60	11.80	23.50	0.00	0.00	2.11	1.27

Table 4.13 indicates that most students were reported to demonstrate above average Teamwork / Group work skills (mean = 3.29), while their Written Communication (mean = 2.93) skills were rated as below average.

Table 4.13 Student Interpersonal Skills

Rank	Skill	1 %	2 %	3 %	4 %	5 %	Mean	Std Dev.
1	Teamwork / Group work	0.00	23.50	35.30	29.40	11.80	3.29	0.99
2	Verbal Communication	0.00	25.00	50.00	25.00	0.00	3.00	0.73
3	Written Communications	6.30	18.80	56.3	12.50	6.30	2.93	0.92

As seen in Table 4.14 the Project Management (mean = 2.12) skills of students were rated below average (means < 3).

Table 4.14 Student Project Management Skills

Rank	Skill	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Std. Dev.
1	Project Management	25.00	50.00	12.50	12.50	0.00	2.12	0.95

Importance Rating of Skills as Indicated by Industry

In this particular question, industry respondents were asked to rate the importance level (if any) of each of the skills pertaining to an Entry-level Software

Developer. A 5-point Likert scale[6] was used to determine the importance level of the skill.

It is evident from Table 4.15 that all General Business skills were reported to be of below average importance (mean < 3.00).

Table 4.15 Importance Rating of Industry for General Business Skills

Rank	Skill	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Std. Dev.
1	Business Understanding	23.50	17.60	41.20	5.90	11.80	2.65	1.27
2	Feasibility Analysis	23.50	35.30	29.40	5.90	5.90	2.35	1.12
3	Specific Business Knowledge	40.00	13.30	26.70	20.00	0.00	2.27	1.22

The findings in Table 4.16 indicate that most of the respondents regarded Modeling / Diagramming (mean = 3.79) and Systems Analysis (mean = 3.65) as skills that were of above average importance.

Table 4.16 Importance Rating of Industry for Analysis Skills

Rank	Skill	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Std. Dev.
1	Modeling / Diagramming	0.0	14.30	14.30	50.00	21.40	3.79	0.97
2	Systems Analysis	0.0	11.80	23.5	52.90	11.80	3.65	0.86
3	Business Analysis	5.90	41.2	11.80	35.30	5.90	2.94	1.14

From Table 4.17 it is evident that all Design skills were rated as of above average importance (mean > 3.00).

Table 4.17 Importance Rating of Industry for Design Skills

Rank	Skill	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Std. Dev.
1	Systems design	0.00	7.10	14.30	71.40	7.10	3.79	0.70
2	Graphical User Interface	0.00	14.30	14.30	57.10	14.30	3.71	0.91
3	Prototyping	0.00	0.00	71.40	21.40	7.10	3.36	0.63

[6] The scale used to indicate the level of importance is a 5-point Likert scale with 1 = not important, 2 = not very important, 3 = average importance, 4 = important and 5 = vitally important / could not cope without it. The greater the means the greater the importance level.

It is evident from Table 4.18 that within the Programming skills category, Debugging / Error trapping (mean = 4.46), Data-Access (mean = 4.36) and General Programming (mean = 4.29) are rated as important skills (means > 4.00) required for Entry-level Software Developers. Object Oriented Programming (mean = 3.77) was reported as being of average importance.

Table 4.18 Importance Rating of Industry for Programming Skills

Rank	Skill	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Std. Dev.
1	Debugging / Error Trapping	0.00	0.00	15.40	23.10	61.50	4.46	0.78
2	Data-Access	0.00	0.00	7.10	50.00	42.90	4.36	0.63
3	General Programming	0.00	7.10	0.00	50.00	42.90	4.29	0.83
4	Client-Server	0.00	7.70	38.50	15.40	38.50	3.85	1.07
5	Object Oriented	0.00	7.70	30.80	38.50	23.10	3.77	0.93

From Table 4.19 it is evident that Database Relationships / Normalization (mean = 4.00) is regarded as an important skill.

Table 4.19 Importance Rating of Industry for Database Skills

Rank	Skill	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Std. Dev.
1	Database relationships / Normalisation	0.00	0.00	14.30	71.40	14.30	4.00	0.55
2	Developing Database Structures	0.00	0.00	28.60	64.30	7.10	3.79	0.58

The findings in Table 4.20 suggests that industry rates Data Communication skills as not very important (means < 3.00).

Table 4.20 Importance Rating of Industry for Communication Skills

Rank	Skill	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Std. Dev.
1	Developing systems security	18.80	18.80	43.80	18.80	0.00	2.63	1.03
2	Network Communications	17.60	23.50	41.20	17.60	0.00	2.59	1.00

From the responses in Table 4.21 industry reported that Teamwork (mean = 4.29) and Written Communication (mean = 4.06) were important skills for an Entry-level Software Developer.

Table 4.21 Importance Rating of Industry for Interpersonal Skills

Rank	Skill	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Std. Dev.
1	Teamwork / Group work	0.0	0.0	17.60	35.30	47.10	4.29	0.77
2	Written Communication	0.0	5.90	11.80	52.90	29.40	4.06	0.83
3	Verbal Communication	0.0	5.90	23.50	58.80	11.80	3.76	0.75

From Table 4.22 Project Management skills (mean = 3.00) are reported to be of average importance to Entry-level Software Developers.

Table 4.22 Importance Rating of Industry Project Management Skills

Rank	Skill	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Std. Dev.
1	Project Management	11.80	11.80	47.10	23.50	5.90	3.00	1.06

Discussion on Skill Categories

In order to rank the responses of the various items within each of the eight skill categories, a composite score was developed for each skill category. The score was computed by adding together the means of the responses to the various items within each category and dividing the sum total by the number of items within that category. For example, in Table 4.13 the composite score of 3.07 for Interpersonal skills was computed as follows:

$$(3.29 + 3.00 + 2.93) / 3 = 3.07$$

In Table 4.23 the composite scores from each skill category for the skill ratings of students and the skills importance rating of industry for an Entry-level Software Developer are compared.

Industry reported that Programming (mean = 4.15) and Interpersonal (mean = 4.04) skills were ranked as the most important skills that students should have acquired while studying. There is a mismatch between Programming skills, with students being less skilled than required by industry. Programming skills as indicated in Table 4.23 were regarded as the most important skills required by industry in students. However, the highest student ratings reported was 3.31 indicating average competency only. Students' Interpersonal skills (mean = 3.07) are generally aligned with that of industry requirements. However, of the three Interpersonal skills evaluated in this study, Written Communication was reported to be the weakest skill possessed by students. Industry reported this skill, as the most important Interpersonal skill needed by students. Database, Design, and Analysis skills (importance ratings of 3.90, 3.62 and 3.46 respectively) are regarded as of average importance relative to skills students must have. The rating of the skills of students during their Experiential Training reflected average competency in Design (mean = 3.31) skills although the ranking suggested this to be their strongest skills. Industry expectations and actual student skills relative to General Business Skills were the least significant of the eight skills. This finding is consistent with academic staff perceptions of General Business skills as the least important exit level outcome.

Table 4.23 Ranking of Industry Skills-Importance Rating and Skill Rating of Students

Skill	Rank	Skills Importance Rating	Rank	Skill Rating of Students
Programming	1	4.15	3	2.93
Interpersonal	2	4.04	2	3.07
Database	3	3.90	4	2.88
Design	4	3.62	1	3.31
Analysis	5	3.46	5	2.82
Project Management	6	3.00	7	2.12
Data Communication	7	2.61	6	2.18
General Business	8	2.43	8	2.09

Discussion on skill importance

In order to identify differences between those skill requirements regarded as important by industry in students and those actually demonstrated by them during their period of Experiential Training, industry's responses were ranked as shown in Table 4.24. The comparison of the means made it possible to rank the 22 skills with regards to the importance industry respondents assigned to them, and their importance for entry-level graduates to be productive in industry. The ideal would be for all students to have maximum competency (5.00) in the skill areas which industry regarded as the most important.

When one looks at the ratings and rankings of the various skill categories as shown in Table 4.23 it is noticeable that Programming skills were rated as the most important skill category by industry. Debugging / Error-Trapping and Data-Access are skills within the Programming skills category. On the other hand, the ratings of the skills demonstrated by the students in these areas during their period in industry were below average. From Table 4.24 it is evident that while industry rated these skills as the most important of all the 22 skills listed, the competence of the students was rated basic to average for Debugging/Error Trapping and average for Data-Access. This finding suggests that there is a mismatch between the competence levels of the students in the skills which industry regards as most important.

For the Database category, industry regarded these skills as average to important. The ratings of the skills of students in these areas were below average. Database Relationships / Normalization and Developing Database structures are skills within the Database skill category. Database relationships / Normalization skills are important from the industry perspective. The competence of the students were rated as basic to average by industry respondents.

For the Design category which industry regarded as average to important, the students' competence level was average.

The literature regarding Technical skills such as Programming, Databases and System Design supports the view of industry that they are the most important skill for entry level Software Developers (Scott, 2002; Lee et al., 1995).

Teamwork / Groupwork which is an Interpersonal skill was rated as important by industry. The competence level of the students were rated as above average. Several authors suggest that Interpersonal and Communication skills are the most important requirements for software developers (Lee, 1999; Trauth et al., 1993; Cheney et al., 1990). They contend that they are even more important than the Technical skills.

Generally, the competence of students across all the skill categories is average at best. However, the levels of importance attached to the various skills varies.

Table 4.24 Comparison of Skill Importance Rating and Skill Rating of Students

Skill Importance Rating			Skill	Skill Rating of Students		Rank Diff.
Ranking	Mean	Cat[7]		Ranking	Mean	
1	4.46	Pgm	Debugging / Error Trapping	15	2.58	-14
2	4.36	Pgm	Data-Access	9	3.00	-7
3	4.29	IntP	Teamwork / Group work	3	3.29	0
4	4.29	Pgm	General Programming	4	3.21	0
5	4.06	IntP	Written Communications	12	2.93	-7
6	4.00	DB	Database Relationships/ Normalisation	14	2.75	-8
7	3.85	Pgm	Client-Server	8	3.00	-1
8	3.79	Des	Systems design	1	3.37	7
9	3.79	DB	Developing Database Structures	10	3.00	-1
10	3.79	Ana	Modeling / Diagramming	13	2.85	-3
11	3.77	Pgm	Object Oriented	7	3.00	4
12	3.76	IntP	Verbal Communication	11	3.00	1
13	3.71	Des	Graphical User Interface	5	3.20	8
14	3.65	Ana	Systems Analysis	6	3.09	8
15	3.36	Des	Prototyping	2	3.37	13
16	3.00	PM	Project Management	20	2.12	-4
17	2.94	Ana	Business Analysis	16	2.36	1
18	2.65	GBS	Business Understanding	17	2.31	1
19	2.63	DC	Developing systems security	21	2.11	-2
20	2.59	DC	Network Communications	18	2.25	2
21	2.35	GBS	Feasibility Analysis	22	1.80	-1
22	2.27	GBS	Specific Business Knowledge	19	2.17	3

Systems Development Methodologies

Section C of the questionnaire required respondents to rate the importance of certain methodologies and tools in relation to their use within their respective companies. By comparing the means of the responses where the methodologies, tools and techniques were used within their companies it was possible to rank the usage of

[7] For the Skill category Pgm = Programming, IntP = Interpersonal, DB = Database, Des = Design, Ana = Analysis, PM = Project Management, GBS = General Business, DC = Data Communication

specific methodologies, tools and techniques. The 5-point Likert scale suggests that the larger the mean, the greater the usage within companies.

From Table 4.25 it is evident that where the methodologies were used, the Systems Development Lifecycle (mean = 4.50) was important (means > 4 < 5). The structured approach (mean = 4.43), Object Oriented Approach (mean = 4.13) and Joint Application Development (mean = 4.00) were all ranked as important methodologies used in the companies surveyed. The Whirlpool method is not used by any of these companies.

Table 4.25 Systems Development Methodologies (Industry)

Rank	Skill	0 (%)	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean [8]	Std. Dev.
1	Systems Development Lifecycle	41.20	0.00	0.00	0.00	29.40	29.40	4.50	0.53
2	Structured Approach	58.80	0.00	0.00	5.90	11.80	23.05	4.43	0.77
3	Object Oriented Methodology	52.90	0.00	0.00	11.80	17.60	17.60	4.13	0.83
4	Joint Application Development (JAD)	82.40	0.00	0.00	5.90	5.90	5.90	4.00	1.00
5	Iterative Systems Development	58.80	0.00	0.00	11.80	23.50	5.90	3.86	0.69
6	Prototyping	64.70	0.00	23.5	5.90	5.90	0.00	2.50	0.84
7	Rapid Applications Development (RAD)	64.70	17.60	0.00	11.80	5.90	0.00	2.17	1.33
8	Whirlpool Method	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

With respect to Analysis and Design Techniques, Table 4.26 indicates that Process modeling (mean = 4.00) with the highest mean was important for use in companies.

[8] The scale used to indicate the level of importance is a 6-point Likert scale with 0= not used, 1 = not important, 2 = not very important, 3 = average importance, 4 = important and 5 = vitally important / could not cope without it.

Table 4.26 Analysis and Design Techniques (Industry)

Rank	Skill	0 (%)	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Std Dev
1	Process Modeling Techniques	35.30	0.00	0.00	11.8	41.20	11.80	4.00	0.63
2	Object-Oriented Techniques	52.90	0.00	5.90	17.60	5.90	17.60	3.75	1.16
3	Technology Modeling Techniques	52.90	0.00	5.90	5.90	35.30	0.00	3.63	0.74
4	Data Modeling Techniques	41.20	0.00	11.80	23.50	17.60	5.90	3.30	0.95
5	Business Modeling Techniques	2.90	0.00	29.40	11.80	5.90	0.00	2.50	0.76

Table 4.27 indicates that Microsoft Visio (mean = 3.33) was the most important Design Tool with an average importance in the companies surveyed.

Table 4.27 Design Tools (Industry)

Rank	Skill	0 (%)	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Std. Dev.
1	Microsoft Visio	29.40	5.90	17.60	11.80	17.60	17.60	3.33	1.37
2	Magic Draw	76.50	5.90	0.00	17.60	0.00	0.00	2.50	1.00
3	ER Studio	88.20	5.90	0.00	5.90	0.00	0.00	2.00	1.41

As indicated in Table 4.28, MS Frontpage (mean = 2.75) and Visual Interdev (mean = 2.75) had ratings of not very important to average importance in the companies surveyed.

Table 4.28 Web Design Tools (Industry)

Rank	Skill	0 (%)	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Std. Dev.
1	MS Frontpage	52.90	5.90	11.8	17.6	11.8	0.00	2.75	1.04
1	Visual Interdev	76.50	5.90	5.90	5.90	0.00	5.90	2.75	1.71
2	Dreamweaver	88.20	5.90	0.00	5.90	0.00	0.00	2.00	1.14

In Table 4.29 it appears that the most important Programming languages were PL/SQL (mean = 4.33), HTML (mean = 4.20), C++ (mean = 4.14), Java (mean = 4.00) and Clarion (mean = 4.00).

Table 4.29 Programming Languages (Industry)

Rank	Skill	0 (%)	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Std. Dev.
1	PL/SQL	82.40	0.00	0.00	5.90	0.00	11.80	4.33	1.54
2	HTML	70.60	0.00	0.00	11.80	0.00	17.6	4.20	1.10
3	C++	58.80	0.00	5.90	5.90	5.90	23.50	4.14	1.21
4	Java	52.90	0.00	11.8	5.90	0.00	29.40	4.00	1.41
5	XML	52.90	0.00	0.00	17.60	23.5	5.90	3.75	0.71
6	Cobol	82.40	0.00	0.00	5.90	11.8	0.00	3.67	0.58
7	ASP	70.60	0.00	5.90	5.90	11.80	5.90	3.60	1.14
8	Visual Basic.net	76.50	0.00	0.00	17.60	0.00	5.90	3.50	1.00
8	C#	88.20	0.00	0.00	5.90	5.90	0.00	3.50	0.71
8	Perl	88.20	0.00	5.90	0.00	0.00	5.90	3.50	2.12
8	PHP	88.20	0.00	5.90	0.00	0.00	5.90	3.50	2.12
12	Visual Basic 6	35.30	17.6	0.00	5.90	29.4	11.80	3.27	1.55
13	Delphi	76.50	17.6	0.00	0.00	0.00	5.90	2.00	2.00

Table 4.30 shows that companies reported Microsoft SQL Server (mean = 4.09), MySql (mean = 4.33) and Oracle (4.00) as the most important Database Platforms within their companies.

Table 4.30 Database Platforms (Industry)

Rank	Skill	0 (%)	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Std. Dev.
1	Microsoft SQL Server	35.30	0.00	5.90	17.60	5.90	35.30	4.09	1.14
2	MySQL	82.40	0.00	0.00	0.00	11.80	5.90	4.33	0.58
3	Oracle	70.60	0.00	0.00	11.80	5.90	11.80	4.00	1.00
4	DB2	82.40	0.00	0.00	5.90	11.80	0.00	3.67	0.58
5	Microsoft Access	29.40	0.00	0.00	41.20	17.6	11.80	3.31	1.25

From Table 4.31 it is evident that Project Scheduling and Budgeting (mean = 3.42) and Gantt chart (mean = 3.36) Techniques, although considered the most important Project Management techniques were of average importance in companies.

Table 4.31 Project Management Techniques (Industry)

Rank	Skill	0 (%)	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Std. Dev.
1	Project Scheduling and Budgeting	29.40	11.80	11.80	11.80	5.90	29.40	3.42	1.62
2	Gantt Chart	35.30	0.00	17.60	11.80	29.40	5.90	3.36	1.03
3	Project Metrics and Measurement	64.70	5.90	5.90	0.00	17.60	5.90	3.33	1.51
4	Work Breakdown Structure	52.90	11.80	0.00	11.80	23.50	0.00	3.00	1.31
5	PERT Diagrams	64.70	5.90	5.90	11.80	11.80	0.00	2.83	1.70
6	Critical Path method	47.10	5.90	17.60	11.80	17.60	0.00	2.78	1.09
7	Networks Diagram	70.60	5.90	17.60	0.00	0.00	5.90	2.40	1.52
8	Function Point Measurement	88.20	5.90	0.00	5.90	0.00	0.00	2.00	1.41

Discussion of Tools and Methodologies

By calculating the composite score for each category of tools and methodologies it is evident that Database Platforms (mean = 3.88) and Programming Languages (mean = 3.61) were regarded as most important. Design Tools, Web Design Tools and Project Management Tools were regarded as the least important. This result is shown in Table 4.32.

Table 4.32 Composite Scores Tools and Methodologies

Rank	Industry	Skill
1	3.88	Database Platforms
2	3.61	Programming languages
3	3.44	Analysis and design techniques
4	3.20	Systems Development Methodologies
5	2.61	Design tools
6	2.50	Web Design Tools
7	2.26	Project Management Techniques

The analysis suggest that where the Tools and Methodologies were used in industry, they were not regarded as important.

Student Questionnaire

In this particular questionnaire students were asked to rate the extent to which they had developed each of the listed skills as a result of attending class, doing projects or undergoing Experiential Training. The questionnaire further enquired about their particular skill levels in the various methodologies and tools that they used. The means of the responses were ranked in descending order. The 5-point Likert scale[9] used suggests that the greater the mean, the greater the level of the students' competency in a skill.

Class Attendance

The results in Table 4.33 indicate that students had developed average skills to very good competence in all the Interpersonal skills in that category.

Table 4.33 Interpersonal Skills Competence (Class attendance)

Rank	Skill	1 %	2 %	3 %	4 %	5 %	Mean	Std. Dev.
1	Teamwork / Group work	7.10	3.60	10.70	42.90	35.70	3.96	1.13
2	Written Communications	7.40	3.70	25.90	37.00	25.90	3.70	1.13
3	Verbal Communication	11.10	3.70	25.90	29.60	29.60	3.62	1.27

In the Data Communication Category the results in Table 4.34 indicate that students had developed some basic to average skills in Developing Systems Security (mean = 2.53) and Networks Communication (mean = 2.00) as a result of their class attendance.

[9] The scale used to indicate the skill level attained is a 5-point Likert scale with 1 representing that the student had not developed an skill, 2 representing some basic skills, 3 representing average skill, 4 representing good skills and representing excellent skills in the area.

Table 4.34 Data Communication Skills Competence (Class attendance)

Rank	Skill	1 %	2 %	3 %	4 %	5 %	Mean	Std Dev
1	Developing systems security	23.10	19.20	42.30	11.50	3.80	2.53	1.10
2	Network Communications	39.30	32.10	17.90	10.70	0.00	2.00	1.01

For Analysis skills from Table 4.35 it can be seen that students rated their skills in Modeling (mean = 3.85) and Systems Analysis (mean = 3.77) as average to very good due to class attendance (means > 3 < 4).

Table 4.35 Analysis Skills Competence (Class attendance)

Rank	Skill	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Std. Dev.
1	Modeling / Diagramming	0.00	7.40	18.50	55.60	18.50	3.85	0.81
2	Systems Analysis	3.70	0.00	29.60	48.10	18.50	3.77	0.89
3	Business Analysis	11.10	11.10	51.90	22.20	3.70	2.96	0.97

According to Table 4.36, students rated their skills in Developing Database structures (mean = 3.75) as average to very good due to class attendance.

Table 4.36 Database Skills Competence (Class attendance)

Rank	Skill	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Std. Dev.
1	Developing Database Structures	0.00	3.60	35.70	42.9	17.90	3.75	0.79
2	Database relationships / Normalisation	0.00	10.70	32.10	42.90	14.30	3.60	0.87

Table 4.37 indicates that Feasibility Analysis (mean = 3.17) skills acquired during class attendance were rated by students as average.

Table 4.37 General Business Skills Competence (Class attendance)

Rank	Skill	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Std. Dev.
1	Feasibility Analysis	10.70	17.90	28.60	28.60	14.30	3.17	1.21
2	Business Understanding	7.10	21.40	46.40	17.90	7.10	2.96	0.99
3	Specific Business Knowledge	14.8	37.00	37.00	11.10	0.00	2.44	0.89

Table 4.38 indicates that in the Programming Skills category, students rated their General Programming skills (mean = 3.92) as average to very good as a result of their class attendance.

Table 4.38 Programming Skills Competence (Class attendance)

Rank	Skill	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Std. Dev.
1	General Programming	0.00	0.00	32.10	42.90	25.00	3.92	0.76
2	Debugging / Error Trapping	3.60	3.60	39.30	39.30	14.30	3.57	0.92
2	Data-Access	3.60	10.7	35.70	25.00	25.00	3.57	1.10
4	Object Oriented	7.40	18.50	29.60	37.00	7.40	3.18	1.07
5	Client-Server	15.40	38.50	15.40	23.10	7.70	2.69	1.22

Table 4.39 indicates that Graphical User Interface (mean = 4.48) skills were rated by students as very good to excellent as a result of class attendance. However, Systems Design (mean = 3.75) and Prototyping (mean = 3.32) were rated average to very good.

Table 4.39 Design Skills Competence (Class attendance)

Rank	Skill	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Std. Dev.
1	Graphical User Interface	0.00	7.10	7.10	35.70	50.00	4.28	0.89
2	Systems Design	0.00	7.10	28.6	46.40	17.90	3.75	0.84
3	Prototyping	7.10	14.30	21.40	53.60	3.60	3.32	1.02

Table 4.40 indicates that as a result of class attendance, some basic skills were developed for Project Management (2.77).

Table 4.40 Project Management Skills competence (Class attendance)

Rank	Skill	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Std. Dev.
1	Project Management	22.20	18.50	29.60	18.50	11.10	2.77	1.31

Integrated Project

The result in Table 4.41 indicates that students had rated themselves as having very good skills in Teamwork (mean = 4.17) as a result of the IP. Similarly, they rated their Written Communication (mean = 3.96) and Verbal Communications (mean = 3.92) as average to very good.

Table 4.41 Interpersonal Skills Competence (Integrated Project)

Rank	Skill	1 %	2 %	3 %	4 %	5 %	Mean	Std. Dev.
1	Teamwork / Group work	0.00	0.00	21.40	39.30	39.30	4.17	0.77
2	Written Communication	0.00	0.00	28.60	46.40	25.00	3.96	0.74
3	Verbal Communication	0.00	0.00	39.30	28.60	32.10	3.92	0.85

In the Data Communication Category the results in Table 4.42 indicate that students had developed some basic to average skills in Developing Systems Security (mean = 2.73) and Networks Communication (mean = 2.15) as a result of the IP.

Table 4.42 Data Communication Skills Competence (Integrated Project)

Rank	Skill	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Std. Dev.
1	Developing systems security	15.40	19.20	42.30	23.10	0.00	2.73	1.00
2	Network Communication	30.80	34.60	23.10	11.50	0.00	2.15	1.00

For Analysis skills from Table 4.43 it can be seen that students rated their Modeling / Diagramming (mean = 3.51) and Systems Analysis (mean = 3.50) as average to very good the IP (means > 3 < 4).

Table 4.43 Analysis Skills Competence (Integrated Project)

Rank	Skill	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Std Dev
1	Modeling / Diagramming	3.70	3.70	40.70	40.70	11.10	3.51	0.89
2	Systems Analysis	7.10	7.10	25.00	50.00	10.70	3.50	1.03
3	Business Analysis	7.10	14.30	42.90	28.60	7.10	3.14	1.00

Table 4.44 indicates that Feasibility Analysis (mean = 3.28) skills acquired while doing the IP were rated by students as average.

Table 4.44 General Business Skills Competence (Integrated Project)

Rank	Skill	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Std. Dev.
1	Feasibility Analysis	7.10	14.30	35.70	28.60	14.30	3.28	1.11
2	Business Understanding	7.10	14.30	35.70	28.60	14.30	3.10	1.06
3	Specific Business Knowledge	15.40	23.10	30.80	19.20	11.50	2.88	1.24

Table 4.45 indicates that in the Programming Skills category, students rated their General Programming skills (mean = 3.78) as average to very good as a result of their participation in the IP.

Table 4.45 Programming Skills Competence (Integrated Project)

Rank	Skill	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Std Dev
1	General Programming	0.00	0.00	39.30	42.90	17.90	3.78	0.73
2	Debugging / Error Trapping	11.10	0.00	33.30	37.00	18.50	3.28	0.85
2	Data-Access	3.60	7.10	53.60	28.60	7.10	3.28	0.85
3	Object Oriented	14.30	7.10	42.90	28.60	7.10	3.07	1.11
5	Client-Server	23.10	15.40	38.50	15.40	7.70	2.69	1.22

According to Table 4.46, students rated their skills in Developing Database structures (mean = 3.74) as average to very good due to doing the IP.

Table 4.46 Database Skills Competence (Integrated Project)

Rank	Skill	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Std. Dev.
1	Developing Database Structures	3.7	3.7	18.5	63.0	11.1	3.74	0.85
2	Database relationships / Normalisation	3.7	7.4	33.3	48.41	7.4	3.48	0.89

Table 4.47 indicates that all skills in the Design skill category were rated as average to very good as a result of the IP (means >3.00).

Table 4.47 Design Skills Competence (Integrated Project)

Rank	Skill	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Std. Dev.
1	Graphical User Interface	3.60	3.60	17.90	42.90	32.10	3.96	0.99
2	Systems design	3.60	0.00	35.70	46.40	14.30	3.67	0.86
3	Prototyping	7.10	3.60	42.90	39.30	7.10	3.35	0.95

Table 4.48 indicates that average skills were developed in the Project Management (mean = 3.25) was category as a result of the IP.

Table 4.48 Project Management Skills Competence (Integrated Project)

Rank	Skill	1 %	2 %	3 %	4 %	5 %	Mean	Std. Dev.
1	Project Management	3.60	14.3	39.30	39.30	3.60	3.25	0.88

Experiential Training

The result in Table 4.49 indicates students rated themselves as having very good Teamwork / Group Work (mean = 4.14) and Verbal Communication (mean = 4.07) skills (means > 4.00). This was attributed to their Experiential Training experience.

Table 4.49 Interpersonal Skills Competence (Experiential Training)

Rank	Skill	1 %	2 %	3 %	4 %	5 %	Mean	Std. Dev.
1	Teamwork / Group work	3.60	3.60	10.70	39.30	42.90	4.14	1.00
2	Verbal Communication	7.40	3.70	11.10	29.60	48.10	4.07	1.20
3	Written Communications	11.50	3.80	15.40	26.90	42.30	3.84	1.34

The result in Table 4.50 indicates that students had developed some basic to very good skills in Systems Security (mean = 2.76) and Network Communications (mean = 2.25) as a result of the Experiential Training.

Table 4.50 Data Communication Skills Competence (Experiential Training)

Rank	Skill	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Std. Dev.
1	Developing Systems Security	23.10	19.20	26.90	19.20	11.5	2.76	1.33
2	Network Communications	44.40	7.40	29.60	14.80	3.70	2.25	1.28

From the table in 4.51 it can be seen that students rated their Systems Analysis (mean = 3.35) and Business Analysis (mean = 3.35) as average a result of Industry Exposure.

Table 4.51 Analysis Skills Competence (Experiential Training)

	Skill	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Std. Dev.
1	Systems Analysis	14.30	7.10	21.40	42.90	14.30	3.35	1.25
2	Business Analysis	14.80	11.10	14.80	51.90	7.40	3.25	1.22
3	Modeling / Diagramming	8.00	12.00	48.00	24.00	8.00	3.12	1.01

Table 4.52 indicates that Business Understanding (mean = 3.28) skills acquired as a result of Experiential Training were rated by students as average.

Table 4.52 General Business Skills Competence (Experiential Training)

Rank	Skill	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Std. Dev.
1	Business Understanding	14.30	7.10	25.00	42.90	10.70	3.28	1.21
3	Feasibility Analysis	14.80	11.10	22.20	40.70	11.10	3.22	1.25
2	Specific Business Knowledge	18.50	11.10	18.50	40.70	11.10	3.14	1.32

Table 4.53 indicates that in the Programming Skills category, students rated their General Programming skills (mean = 3.21) as average as a result of Experiential Training.

Table 4.53 Programming Skills Competence (Experiential Training)

	Skill	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Std. Dev.
1	Data-Access	17.90	3.60	28.60	39.30	10.70	3.21	1.25
2	General Programming	18.50	3.70	29.60	37.00	11.10	3.18	1.27
3	Debugging / Error Trapping	21.4	7.10	17.90	42.90	10.70	3.14	1.35
4	Object Oriented	30.80	26.90	11.50	23.10	7.70	2.50	1.36
5	Client-Server	37.00	7.40	33.30	18.50	3.70	2.44	1.28

Table 4.54 indicates that in the Database Skills category, students indicated that they had developed average Database Relationships / Normalisation (mean =3.18) skills as a result of their Experiential Training.

Table 4.54 Database Skills Competence (Experiential Training)

Rank	Skill	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Std. Dev.
1	Database relationships / Normalisation	18.50	11.10	18.50	37.00	14.80	3.18	1.35
2	Developing Database Structures	17.90	10.70	21.40	35.70	14.30	3.17	1.33

Table 4.55 indicates that all skills in the Design skill category were rated as average to very good as a result of the Experiential Training (means >3.00 <4).

Table 4.55 Design Skills Competence (Experiential Training)

Rank	Skill	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Std. Dev.
1	Graphical User Interface	18.50	7.40	7.40	37.00	29.6	3.51	1.47
2	Systems Design	14.80	11.10	18.50	33.30	22.20	3.37	1.36
3	Prototyping	0.00	0.00	0.00	0.00	0.00	3.00	1.21

Table 4.56 indicates that average skills were developed in the Project Management (mean =3.00) skill as a result of Experiential Training,

Table 4.56 Project Management Skills Competence (Experiential Training)

	Skill	1 %	2 %	3 %	4 %	5 %	Mean	Std. Dev.
1	Project Management	15.40	26.90	19.20	19.20	19.20	3.00	1.38

Discussion

Table 4.57 contains a list of composite scores for each skill category relative to the extent to which students had gained the skills in each category through each of class attendance, integrated projects and industry exposure.

Design and Interpersonal skills were the two skill categories in which students gained the most competence across all the learning experiences. Programming skills which was ranked as the most important industry skill, ranked 6th for IP and 7th of ET. Data Communication skills were gained least across all learning experiences.

Table 4.57 Composite Scores of Skill Requirements across all Learning Experiences

	Class		IP		ET		Composite Score	
Skill	Rank	Mean	Rank	Mean	Rank	Mean	Mean	Rank
Interpersonal	2	3.76	1	4.02	1	4.02	3.93	1
Design	1	3.78	2	3.66	2	3.29	3.58	2
Database	4	3.68	3	3.61	5	3.18	3.49	3
Analysis	5	3.53	4	3.38	3	3.24	3.38	4
Programming	3	3.39	6	3.22	7	2.89	3.17	5
General Business	6	2.86	7	3.09	4	3.21	3.05	6
Project Management	7	2.77	5	3.25	6	3.00	3.01	7
Data Communication	8	2.27	8	2.44	8	2.51	2.41	8

Comparison of Learning Experiences

While it is debatable whether students' perceptions can be regarded as valid, they are one of the three cooperative partners who influence the transfer of knowledge. Haupt (2003) argues that as such their views should be noted.

This study compares the learning experiences from the students' perception. In trying to put together an intervention to address the skills gap, one must be careful to address not only the students' perceptions but also which skills were in fact regarded as critically important by industry for Entry-level software developers. On the 5-point Likert scale where the optimum score of 5 indicated excellence, students were asked to rate their skills competence after each of the learning experiences they were exposed to during their academic programme namely, in the classroom, through integrated projects and industry exposure. The ranking in Table 4.58 shows perceived skill acquisition of students across the three learning experiences.

From the individual composite scores of the 22 skills identified, students rated the skills they had gained to be very good in only one area, namely Teamwork (mean = 4.09).

They rated 16 other skills as average to very good, for example Written Communications (mean = 3.84), General Programming (mean = 3.64) and Database Relationships/ Nomalisation (mean = 3.42). The remaining five skills were rated basic to average, for example Client-Server (mean = 2.61).

Since this study is concerned with the value of an IP to improve the competency of students in all the skills needed to be productive in industry, it is important to consider the contribution of the IP.

Students rated the skills as a result of their IP experience to be very good in only one area, namely Teamwork (mean =4.18). They rated 17 other skills as average to very good, for example General Programming (mean = 3.79). The remaining four skills were rated basic to average, for example Specific Business Knowledge (mean = 2.88).

Prima facie it is evident that the contribution of the IP to the level of skills gained does not differ much from the ET and Classroom experience. This finding suggests that the IP by itself cannot improve the overall skill competence of the student. However, it is possible that it can make a greater contribution than evidenced from this study.

The shortcomings within the present IP needs to be addressed, recognizing the level of importance that industry attaches to the various skills.

Table 4.58 Comparison of Students Responses

	Class		IP		ET		Composite
Skill	Rank	Mean	Rank	Mean	Rank	Mean	Mean
Graphical User Interface	1	4.29	3	3.96	4	3.52	3.92
Teamwork / Group work	2	3.96	1	4.18	1	4.14	4.09
General Programming	3	3.93	5	3.79	11	3.19	3.64
Modeling / Diagramming	4	3.85	9	3.52	16	3.12	3.50
Systems Analysis	5	3.78	10	3.50	6	3.36	3.55
Developing Database structure	6	3.75	6	3.74	13	3.18	3.56
Systems design	7	3.75	7	3.68	5	3.37	3.60
Written Communications	8	3.70	2	3.96	3	3.85	3.84
Verbal Communication	9	3.63	4	3.93	2	4.07	3.88
Database Relationships / Normalisation	10	3.60	11	3.48	12	3.19	3.42
Debugging / Error Trap	11	3.57	8	3.52	15	3.14	3.41
Data-Access	12	3.57	14	3.29	10	3.21	3.36
Prototyping	13	3.32	12	3.36	17	3.00	3.23
Object Oriented	14	3.19	18	3.07	20	2.50	2.92
Feasibility Analysis	15	3.18	13	3.29	9	3.22	3.23
Business Analysis	16	2.96	16	3.14	8	3.26	3.12
Business Understanding	17	2.96	17	3.11	7	3.29	3.12
Project Management	18	2.78	15	3.25	18	3.00	3.01
Client-Server	19	2.69	21	2.69	21	2.44	2.61
Developing systems security	30	2.54	20	2.73	19	2.77	2.68
Specific Bus. Knowledge	21	2.44	19	2.88	14	3.15	2.82
Network Communications	22	2.00	22	2.15	22	2.26	2.14

Students' rating on Specific Methodologies and Tools

Table 4.59 indicates that Students' Systems Development Methodologies skills were at a good to expert level for the Systems Development lifecycle (3.71) and structured Approach (3.52). These findings indicate that students were familiar with

all the methodologies and viewed their skill levels as above average skill for all the Systems Development Methodologies.

Table 4.59 Systems Development Methodology (Students)

Rank	Skill	0 (%)	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Std Dev
1	Systems Development Lifecycle	14.30	3.60	7.10	17.90	39.30	17.9	3.71	1.04
2	Structured Approach	3.60	0.00	10.70	32.10	46.40	7.10	3.52	0.80
3	Iterative Systems Development	28.60	0.00	0.00	14.30	32.10	25.00	3.15	0.75
4	Rapid Applications Development (RAD)	21.40	3.60	25.00	28.60	7.10	14.30	3.05	1.17
5	Object Oriented Methodology	3.60	3.60	28.60	42.90	17.90	3.60	2.89	0.89
6	Prototyping	21.40	7.10	25.00	21.40	21.40	3.60	2.86	1.08
7	Joint Application Development (JAD)	21.40	7.10	21.40	39.30	7.10	3.60	2.73	0.94
8	Whirlpool Method	60.70	7.10	17.90	0.00	14.30	0.00	2.55	1.22

Table 4.60 indicates that students had good to expert skills in most of the Analysis and Design techniques (mean > 3.00 < 4.00). The higher levels of skills were in Data Modeling (mean = 3.82) and Process modeling (mean = 3.68), Data Modeling Techniques (mean = 3.82). Technology Modeling Techniques (mean = 1.96) were rated as basic to average.

Table 4.60 Analysis and Design Techniques (Students)

Rank	Skill	0 (%)	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Std. Dev.
1	Data Modeling Techniques	0.00	3.60	0.00	25.00	53.60	17.90	3.82	0.86
2	Process Modeling Techniques	0.00	3.60	3.60	28.60	50.00	14.30	3.68	0.90
3	Business Modeling Techniques	10.70	3.60	14.30	25.00	39.30	7.10	3.36	0.99
3	Object-Oriented Techniques	10.70	3.60	7.10	42.90	25.00	10.70	3.36	0.95
5	Technology Modeling Techniques	39.30	3.60	14.3	17.90	14.30	10.70	3.24	1.20

Table 4.61 indicates that that they had developed good to expert levels of skills in the ER Studio (mean = 3.82) and Systems Architect (mean = 3.40).

Table 4.61 Design Tools (Students)

Rank	Skill	0 (%)	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Std. Dev.
1	ER Studio	60.70	0.00	3.60	10.70	14.30	10.70	3.82	0.98
2	System Architect	82.10	0.00	3.60	7.10	3.60	3.60	3.40	1.14
3	With Class	67.90	3.60	7.10	10.70	7.10	3.60	3.00	1.22
3	RFFLow	78.60	3.60	3.60	7.10	3.60	3.60	3.00	1.41
5	Magic Draw	82.10	7.10	0.00	0.00	10.70	0.00	2.80	1.26
6	Rational Rose	85.70	7.10	0.00	0.00	3.60	3.60	2.75	2.06
7	Microsoft Visio	53.60	14.30	3.60	17.90	3.60	7.10	2.69	1.44
8	Visual UML	64.30	7.10	10.70	10.70	3.60	3.60	2.60	1.26
9	Enterprise Architect	85.70	10.70	0.00	0.00	3.60	0.00	1.75	1.50

From Table 4.62 students reported that they lacked skills in Web Design Tools with their ratings being average to good. Their skills for Microsoft Frontpage (mean = 2.67) were average to good.

Table 4.62 Web Design Tools (Students)

Rank	Skill	0 (%)	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Std. Dev.
1	Microsoft Frontpage	50.00	14.30	0.00	17.9	14.30	3.60	2.67	1.50
2	Dreamweaver	60.70	17.90	7.10	0.00	7.10	7.10	2.45	1.69
3	Netscape Composer	60.70	14.30	7.10	7.1	7.10	3.60	2.45	1.44
4	Visual Interdev	60.70	00	7.10	7.10	7.10	0.00	2.09	1.22

Table 4.63 shows that students skills were expert users in Visual Basic (mean = 4.18) and students had good to expert knowledge in Cobol (mean = 3.80), HTML (mean = 3.78) and PL/SQL (mean = 3.48). The analysis indicates that student were familiar with all programming languages.

Table 4.63 Programming Languages (Students)

Rank	Skill	0 (%)	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Std. Dev.
1	Visual Basic 6	3.60	0.00	0.00	10.70	50.00	35.70	4.18	0.77
2	Cobol	10.70	3.60	3.60	25.00	32.10	25.00	3.80	1.04
3	HTML	3.60	0.00	0.00	39.30	39.30	17.90	3.78	0.75
4	PL/SQL	10.70	0.00	3.60	39.30	46.40	0.00	3.48	0.59
5	Java	10.70	3.60	10.70	35.70	35.70	3.60	3.28	0.89
6	C++	42.90	7.10	10.7	17.90	21.40	0.00	2.94	1.06
7	Delphi	75.00	10.70	0.00	0.00	10.70	3.60	2.86	1.77
8	XML	53.60	3.60	14.30	21.40	3.60	3.60	2.77	1.01
9	Smalltalk	82.10	7.10	3.60	0.00	3.60	3.60	2.60	1.82
10	Visual Basic.net	67.90	10.70	3.60	7.10	10.70	0.00	2.56	1.33
11	Powerbuilder	85.70	7.10	0.00	0.00	7.10	0.00	2.50	1.73
12	Clarion	71.40	10.70	0.00	10.7	7.10	0.00	2.50	1.31
13	C#	75.00	10.70	3.60	0.00	10.70	0.00	2.43	1.51
14	ASP	50.00	17.90	14.30	10.70	7.10	0.00	2.14	1.10
15	Perl	89.30	7.10	0.00	0.00	3.60	0.00	2.00	1.73
16	PHP	85.70	7.10	0.00	0.00	7.10	0.00	2.50	1.73

Table 4.64 shows that students had Expert knowledge Microsoft Access (mean = 4.00). For Oracle (mean = 3.67) students reported to have good to expert knowledge of this platform, but lacked understanding of complex areas.

Table 4.64 Database Platforms (Students)

Rank	Skill	0 (%)	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Std. Dev.
1	Microsoft Access	3.60	0.00	0.00	32.10	32.10	32.10	4.00	0.83
2	Oracle	3.60	0.00	0.00	35.70	57.10	3.60	3.67	0.55
3	Microsoft SQL Server	57.10	7.10	7.10	25.00	3.60	0.00	2.58	0.90
4	MySQL	67.90	10.70	7.10	3.60	7.10	3.60	2.55	1.51
5	Ingres	85.70	7.10	0.00	3.60	3.60	0.00	2.50	1.91
6	Cache	7.10	10.70	39.3	39.3	3.6	0.00	2.38	0.75
7	DB2	75.00	14.30	7.10	0.00	3.60	0.00	1.71	1.12
8	InterBase	89.30	7.10	0.00	3.60	0.00	0.00	1.67	0.75
9	Paradox	89.30	10.70	0.00	0.00	0.00	0.00	1.00	1.00
9	Informix	89.30	10.70	0.00	0.00	0.00	0.00	1.00	0.00
9	Sybase	89.30	10.70	0.00	0.00	0.00	0.00	1.00	0.00

Table 4.65 shows that students reported their Gantt chart (mean = 3.00) skills as good, but lacking complex understanding. Students reported their Critical Path method (mean = 1.94), Gozinto Chart (mean = 1.80), Function Point Management (mean = 1.80), Boehm (mean = 1.75) and Product structure models (mean = 1.50) as basic to average knowledge only.

Table 4.65 Project Management Techniques (Students)

Rank	Skill	0 (%)	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	Std. Dev.
1	Gantt Chart	10.70	7.10	25.00	28.6	17.9	10.7	3.00	1.54
2	PERT Diagrams	35.70	3.60	17.90	32.1	10.7	0.00	2.78	0.81
3	Project Metrics and Measurement	71.40	3.60	14.30	0.00	10.70	0.00	2.63	1.19
4	Project Scheduling and Budgeting	35.70	10.70	14.30	25.00	7.10	7.10	2.63	1.34
5	Networks Diagram	57.10	17.90	14.30	7.10	0.00	3.60	2.00	1.21
6	Work Breakdown Structure	64.30	14.30	10.70	7.10	3.6	0.00	2.00	1.05
7	BANG	89.30	7.10	0.00	0.00	3.60	0.00	2.00	1.73
8	Critical Path	39.30	21.4	25.00	10.7	3.6	0.00	1.94	0.90
9	Gozinto Chart	82.10	14.30	0.00	0.00	0.00	3.60	1.80	1.79
10	Function Point Measurement	82.10	10.70	3.60	0.00	3.60	0.00	1.80	1.30
11	Boehm	85.70	10.70	0.00	0.00	3.60	0.00	1.75	1.50
12	Product Structure Model	67.90	14.30	7.10	7.10	3.6	0.00	1.50	1.31

Methodology Comparison

Table 4.66 ranks the various methodologies and tools used by students and industry. Amongst Analysis and Design Techniques (ADT), the rankings were similar. Students indicated that they had good to expert knowledge (means > 3 and < 4) in all Analysis and Design Techniques.

Table 4.66 Analysis and Design Techniques

	Industry			Student		
Techniques	Rank	Mean	Std. Dev.	Rank	Mean	Std. Dev.
Process Modeling Techniques	1	4.00	0.63	2	3.68	0.90
Object-Oriented Techniques	2	3.75	1.16	3	3.36	0.95
Technology Modeling Techniques	3	3.63	0.74	5	3.24	1.20
Data Modeling Techniques	4	3.30	0.95	1	3.82	0.86
Business Modeling Techniques	5	2.50	0.76	4	3.36	0.99

Amongst Web Design Tools, Industry ranked Visual Interdev higher than what students did. There was consensus in the ranking of Microsoft Frontpage as shown in Table 4.67. Students indicated that their Web Design Tools skills were average to good.

Table 4.67 Web Design Tools

	Industry			Student		
	Rank	Mean	Std. Dev.	Rank	Mean	Std. Dev.
MS Frontpage	1	2.75	1.04	1	2.67	1.50
Visual Interdev	1	2.75	1.71	3	2.09	1.22
Dreamweaver	3	2.00	1.14	2	2.45	1.69

From Table 4.68 there appears to be a difference in the database platforms with regards to use in industry and the skill levels of students. Students are mostly skilled in Microsoft Access (mean = 4.00) and Oracle (mean = 3.67). Both Access and Oracle are frequently used in industry and many students indicated that they were skilled in these technologies. The students' MySql (mean = 2.55) and Microsoft SQL server (mean = 2.58) knowledge were above average.

Table 4.68 Database Platforms

	Industry			Student		
Tool	Rank	Mean	Std. Dev.	Rank	Mean	Std. Dev.
MySQL	1	4.33	0.58	4	2.55	1.51
Microsoft SQL Server	2	4.09	1.14	3	2.58	0.90
Oracle	3	4.00	1.00	2	3.67	0.55
DB2	4	3.67	0.58	7	1.71	1.12
Microsoft Access	5	3.31	1.25	1	4.00	0.83

Table 4.69 indicates that Microsoft Visio was mostly used by industry. For this tool the students perceived their skill to be above average competency (mean = 2.69). Students were more skilled in ER studio (mean = 3.82), however it is not used widely in industry (mean = 2.00). Students had above average competency in the three Design Tools rated as most commonly used in industry.

Table 4.69 Design Tools

	Industry			Student		
Tool	Rank	Mean	Std. Dev.	Rank	Mean	Std. Dev.
Microsoft Visio	1	3.33	1.37	8	2.69	1.44
Magic Draw	2	2.50	1.00	6	2.80	1.26
ER Studio	3	2.00	1.41	1	3.82	0.98

The most widely used language used in industry were PL/SQL (mean = 4.33). The students' knowledge in this language (mean = 3.48) was rated as good. Students perceived their competence in most programming languages as being at an above average to expert level.

Table 4.70 Programming Languages

	Industry			Student		
Tool	Rank	Mean	Std. Dev.	Rank	Mean	Std. Dev.
PL/SQL	1	4.33	1.54	4	3.48	0.59
HTML	2	4.20	1.10	3	3.78	0.75
Java	3	4.00	1.41	5	3.28	0.89
C++	4	4.14	1.21	6	2.94	1.06
XML	5	3.75	0.71	8	2.77	1.01
Cobol	6	3.67	0.58	2	3.80	1.04
ASP	7	3.60	1.14	14	2.14	1.10
Visual Basic 6	8	3.27	1.55	1	4.18	0.77
Visual Basic.net	9	3.50	1.00	10	2.56	1.33
Perl	9	3.50	2.12	15	2.00	1.73
PHP	9	3.50	2.12	15	2.00	1.73
C#	9	3.50	2.12	13	2.43	1.51
Delphi	13	2.00	2.00	7	2.86	1.77

From Table 4.71 it appears that the students skill levels for the Systems Development Lifecycle (mean = 3.71), Structured (mean = 3.52), Object Oriented (mean = 2.89) and Joint Application Development (mean = 2.73) methodologies were all at good to expert levels.

Table 4.71 Systems Development Methodologies

	Industry			Students		
Technique	Rank	Mean	Std.Dev.	Rank	Mean	Std. Dev.
Systems Development Lifecycle	1	4.50	0.53	1	3.71	1.04
Structured Approach	2	4.43	0.77	2	3.52	0.80
Object Oriented Methodology	3	4.13	0.83	5	2.89	0.89
Joint Application Development (JAD)	4	4.00	1.00	7	2.73	0.94
Iterative Systems Development	5	3.86	0.69	3	3.15	0.75
Prototyping	6	2.50	0.84	6	2.86	1.08
Rapid Applications Development (RAD)	7	2.17	1.33	4	3.05	1.17
Whirlpool Method	8	0.00	0.00	8	2.55	1.22

For Project Management Techniques, industry and students rankings were similar Table 4.71 indicates that students rated their expertise as above average to good for Project Scheduling and Budgeting (mean = 2.63), Gantt Charts (mean =

3.00) and Project Metrics and Measurement (mean = 2.63). There was consensus in the ranking of the Product Structure model.

Table 4.72 Project Management Techniques

	Industry			Students		
Tool / Methodology	Rank	Mean	Std. Dev.	Rank	Mean	Std. Dev.
Project Scheduling and Budgeting	1	3.42	1.62	3	2.63	1.34
Gantt Chart	2	3.36	1.03	1	3.00	1.15
Project Metrics and Measurement	3	3.33	1.51	3	2.63	1.19
Work Breakdown Structure	4	3.00	1.31	5	2.00	1.05
PERT Diagrams	4	2.83	1.70	2	2.78	0.81
Critical Path method	6	2.78	1.09	8	1.94	0.90
Networks Diagram	7	2.40	1.52	5	2.00	1.21
Function Point Measurement	8	2.00	1.41	9	1.80	1.30

Summary of Tools and Methodologies

Students were skilled in most Software Methodologies and Tools used in companies. For the Analysis and Design Techniques which industry reported as important, students reported good to expert knowledge. While industry did not place much importance to the specific Web Design Tools they used, students reported average to good knowledge. Students were familiar with all the Database Platforms industry regarded as important. While industry had placed above average importance to Microsoft Access, students reported their knowledge to be at an expert level. Students reported above average competency in all three Design Tools most commonly used by companies. Students reported skills that were above average to slightly below expert level in all Programming Languages. For the Systems Development Methodologies where companies indicated that the Systems Development Lifecycle and the Structured Approach were vitally important, the students indicated their skills to be at a good to expert level. Students were familiar with all Project Management Techniques.

Chapter Summary

The responses to the Pilot, Student, Academic Staff and Industry questionnaires were analyzed. The findings suggest that staff do not fully comprehend the importance rating of specific skill categories for entry-level software developers. The gap between what staff regards as important and what industry requires of students was indicated by academic staff rating most skill categories as important. This mismatch could possibly cause an incorrect subject or skill development emphasis in courses offered.

The student questionnaire aimed to compare the students' perceptions of skills gained in each of the three learning experiences they were exposed to during their academic programme namely, in the classroom, through integrated projects and industry exposure. From the analysis it was evident that the contribution of the IP does not differ much from the Experiential Training and Classroom experience, suggesting that it is possible that they all contribute equally.

The industry questionnaire analysis indicates discrepancies between some of the skill categories that industry believe are important for entry-level software developers and the skill rating of students. In the Programming skill category there is mismatch with the students being less skilled than required by industry.

For Interpersonal skills which industry regarded as important, and Design skills which industry rated as average, the importance rating of industry and the skill rating of students are similar. However, the students' written communication skills were reported to be one of the weakest skills the students possess. Generally the students' competence across the skill categories were average.

Analyses on the importance of certain methodologies used with industry, and the skill level of students for the various methodologies indicates that many of the students were skilled in the technologies that are used by most companies.

In the next chapter the study is concluded and includes suggestions for further research.

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The purpose of this study, as stated in chapter entitled, Introduction, was to investigate the effectiveness of using an IP to improve transferability of IT skills to the workplace. The study was directed at achieving a number of objectives, and testing several hypotheses namely:

1 Identify the critical skills from literature and industry for entry-level software developers;

2 Determine from the lecturing staff's perspective, which skills they regard as the critical skills for entry-level software developers;

3 Determine from the students' perspective, whether the IP had equipped them with skills needed to be effective in the workplace; and

4 From the findings of the study to identify the components of a potentially effective IP.

The study reviewed the available literature to support the objectives. Questionnaires were designed to return a quantitative response. The data were analyzed using the SPSS software, and the findings were recorded. This chapter reviews and summarizes the findings relative to each of the objectives listed. Additionally conclusions drawn from the study are stated that include recommendations for an effective IP.

Identification of critical skills for Entry-Level Software Developers

There are differences between the skill importance rating of companies and the skill ratings of students by these companies. From the literature it appears that

employers regard Programming, Database, Design and Interpersonal skills as important when evaluating entry-level software developers (Van Slyke, 1998; Leitheiser, 1993; Lee et al., 1995). According to Couger (1995) these results correspond with the IS '95 curriculum. The findings of the study is supported by the literature that Programming and Interpersonal skills are the most important skills. Database and Design were regarded as average to important by industry for entry-level software developers to be productive in industry. Industry reported the students' competence in Design and Interpersonal skills as above average. They rated their Programming and Databases skills as basic to average. Evidently, employers are not satisfied with the level of skills competence of Technikon students. These findings suggest that the academic institution needs to do more so that students are adequately equipped with the skills that industry expects.

The hypothesis that employers are satisfied with students' Software Development skills is therefore rejected.

Lecturers' perspective on critical skills for Entry-level Software Developers

The study revealed that lecturing staff had identified Design, Analysis, Database, Interpersonal, Project Management, Programming and Data Communication as important for students to be productive in industry. The mark allocation for projects and subjects correspond with staff's views of skill importance. However, the grading allocation for Programming was the highest for both subject (24%) and project mark (22%) allocations. Industry had only rated Programming and Interpersonal skills as important. For Database, Design and Analysis they had attached average importance.

This suggests that while staff are placing equal emphasis on all skill categories, it is possible that industry may require more emphasis on some skills and less on others.

The hypothesis that lecturers are not aware of the industry skill requirements of an entry-level Software Developer cannot be rejected.

Students' Perception of the IP as a Learning Experience

The study revealed that from the students' point of view, they had developed mostly average to very good competency in most (17 of the 22) skills identified, as a result of the IP. The ratings of the skills derived from the various learning experiences are similar, suggesting that it is possible that they all contribute equally in the opinion of the students. Therefore, the IP as a separate learning experience is not as prominent as anticipated. While the IP is an effective learning experience, it cannot be relied upon in isolation from other learning strategies. There is a close relationship between the ratings of the various skills from the various learning experiences. However, the IP as a separate learning experience cannot improve the overall competency of the student.

The hypothesis that students who have completed the IP view it as effective preparation for the workplace cannot be rejected.

Discussion

It is not surprising that where IT courses are being offered independently of each other, students fail to identify the practical application of concepts that span across more than one subject (Becker et al., 1994). Deeper understanding requires an

integrative approach to tie together the skill categories identified as essential for students to successfully enter the workplace as productive entry-level software developers. The theory, practices, and tools learned in the courses should become the building blocks for an effective IP.

Although students are required to apply theoretical knowledge learnt in the classroom to practical tasks, they are not applying much of this knowledge to 'real world' situations. The result of this is that the knowledge acquired may be inert, resulting in students' being incapable of applying it to different situations.

The findings of this research which compared the three learning experiences from the students' perception, suggest that there is a close relationship between the ratings of the various skills from the various learning experiences. This implies that the IP has to be integrated into the course curriculum to obtain the maximum benefit of such a learning experience. The IP should provide the vehicle to increase the students' skill competency levels and deep understanding of skills necessary to become a productive workforce.

Recommendations for an effective IP

The research findings suggest that there is a difference between the skill importance rating of industry and the skill rating of students. For example, Debugging/Error-Trapping, Data-Access, Teamwork, / Group work, General Programming, Written Communications and Database Relationships were the skills which industry regarded as most important for an entry-level software developer. Contrary to this, the rating of the skills demonstrated by the students during their period in industry was basic to average.

From the academic staff perspective, all the skill categories were rated as above average importance, with seven being rated as important. This result suggest that staff place equal emphasis on all skill categories, while it is possible that industry may require more emphasis on some skills and less on others. Students were skilled in most methodologies and tools used by industry.

While training students as entry-level programmers, an important consideration is that they are being trained for life-long learning. The IP should be designed to focus on those skills which industry regards as essential for entry-level software developers. This could aid the application and transferability of skills to the workplace and encourage deeper understanding of concepts which may otherwise be dormant. It is possible that a well designed IP can narrow the gap between industry expectations and student performance.

Rather than giving equal attention to all skills, the IP should target those which are considered most important by industry; namely:

- Debugging / Error Trapping, Data-Access and General Programming in the Programming skill category;
- Database Relationship / Normalisation in the Database skill category; and
- Teamwork / Groupwork and Written Communications in the Interpersonal skill category.

Conclusion

Based on the results of the study, there is consensus regarding the categories of skills essential for entry-level software developers. These results are also aligned with the IS 2002 curricula specifications.

The IP as an independent learning experience cannot address all shortcoming of an academic programme. All three learning experiences have to be improved in order to achieve the students' optimum skill levels. This reinforces the concept of deep understanding where students extract meaning and understanding from all learning experiences (Warburton, 2003; Chapman and Sorge, 1999; Arredondo and Rucinski, 1998; Freeman, 1994). An IP designed and implemented correctly, could provide the platform for integrating course curricula, in order to produce workers with integrated disciplinary skills and expertise.

Further Research

The focus of this research has been directed at Peninsula Technikon's IT students. The findings of this study can be utilized as a guideline for curriculum design at other institutions. Comparative studies could be conducted at other education institutions to facilitate the development of skills. Further research on project assessment is necessary, as real world projects are difficult to assess and incorrect strategies could result in mark inconsistencies when evaluating these projects.

APPENDIX A - STUDENT SOFTWARE DEVELOPMENT SKILLS SURVEY

STUDENT QUESTIONNAIRE

This research aims to compare the skills of third year Information Technology students specializing in Software Development at Peninsula Technikon, against industry requirements for entry-level programmers.

An integrated project implies the culmination of all modules or subjects within a level, into a single deliverable. The modules of the level are connected through the use of a project. Students are expected to make the connections among subject areas to complete the project. The project simulates real-world scenarios.

Please complete the questionnaire as accurately as possible.

The questionnaire comprises of **FOUR** sections, **ALL** of which are required to be answered.

Section A, B and C – SKILL DEVELOPMENT

These sections consist of a list of skill categories, each of which must be rated according to the rating scale explained below:

Rating Scale 1

Level	Explanation
5	I have developed excellent skills in this area
4	I have developed very good skills in this area
3	I have developed average skills in this area
2	I have developed some basic skills in this area
1	I have not developed any skill in this area

Section D – METHODOLOGIES / TOOLS

This section consists of a list of more specific methodologies and techniques, each of which musts be rated according to the rating scale as explained below.

If a methodology of skill or techniques was not used, **please leave that answer blank.**

Rating Scale 2

Level	Explanation
5	Expert user in all areas and competent to use skill in professional environment
4	Expert user in some areas with good overall knowledge
3	Good knowledge in all areas but lack understanding of complex areas
2	Average knowledge in some areas with basic background
1	Basic background knowledge only

SECTION A

According to **rating scale 1**, rate the extent that you gained or developed the skill as a result **of your attendance in the Information Technology course at Peninsula Technikon.**

GENERAL BUSINESS SKILLS	**Skill Rating**				
	1	**2**	**3**	**4**	**5**
Specific business knowledge Knowledge of specific areas of business (e.g. Accounting, Finance, Law, HR)					
Business Understanding Strategic thinking, decision-making, understanding of business principles					
***Feasibility* Analysis** Determining the feasibility or viability of a proposed system (e.g. SWOT or Cost Benefit Analysis)					
ANALYSIS SKILLS	**Skill Rating**				
	1	**2**	**3**	**4**	**5**
Business Analysis Analysing business problems (e.g. context, business areas)					
Systems Analysis Technical analyses of problems (e.g. Process modeling, data flow modeling)					
Modelling / Diagramming Modelling of diagramming of a proposed system's scope, processes and data flows					
DESIGN SKILLS	**Skill Rating**				
	1	**2**	**3**	**4**	**5**
Graphical User Interface (GUI) design Designing a graphical user interface / layer with which the user interacts					
System design Design of components or modules that make up a system or program (e.g. systems architecture)					
Prototyping Using prototypes or example programs to design a system					
PROGRAMMING SKILLS	**Skill Rating**				
	1	**2**	**3**	**4**	**5**
General Programming General programming skill					
Object Oriented Programming with components, objects and classes (e.g. properties and methods)					
Client-Server Programming client-server applications					
Data-Access Connecting to / manipulating databases from programming platform (e.g. SQL, ADO,DAO,RDO)					
Debugging / Error Trapping Finding and eliminating bugs and errors in the program					
DATABASE SKILLS	**Skill Rating**				
	1	**2**	**3**	**4**	**5**
***Developing* Database Structures** Developing database tables, queries etc					
Database Relationships / Normalization Developing relationships between tables and reducing data redundancy					
DATA COMMUNICATION SKILLS	**Skill Rating**				
	1	**2**	**3**	**4**	**5**
Network Communications Setting up and configuring physical networks					
Developing System Security Programming and managing system security (e.g. user access, integrity, virus protection etc.)					
INTERPERSONAL SKILLS	**Skill Rating**				
	1	**2**	**3**	**4**	**5**
Team / Group work The ability to work in a team and communicate with team members					
Verbal Communication Skills Interviewing, negotiation and presentation skills					
Written Communication Skills System documentation, incl. reporting on user requirements, system design, user manuals, help doc.					
PROJECT MANAGEMENT SKILLS	**Skill Rating**				
	1	**2**	**3**	**4**	**5**
Project Management Co-ordinating & scheduling work, managing and budgeting resources, measuring system size / risk					

SECTION B

According to **rating scale 1**, rate the extent that you gained or developed the skill **as a result of engaging in an Integrated Project.**

GENERAL BUSINESS SKILLS	**Skill Rating**				
	1	**2**	**3**	**4**	**5**
Specific business knowledge Knowledge of specific areas of business (e.g. Accounting, Finance, Law, HR)					
Business Understanding Strategic thinking, decision-making, understanding of business principles					
Feasibility Analysis Determining the feasibility or viability of a proposed system (e.g. SWOT or Cost Benefit Analysis)					
ANALYSIS SKILLS	**Skill Rating**				
	1	**2**	**3**	**4**	**5**
Business Analysis Analysing business problems (e.g. context, business areas)					
Systems Analysis Technical analyses of problems (e.g. Process modeling, data flow modeling)					
Modelling / Diagramming Modelling of diagramming of a proposed system's scope, processes and data flows					
DESIGN SKILLS	**Skill Rating**				
	1	**2**	**3**	**4**	**5**
Graphical User Interface (GUI) design Designing a graphical user interface / layer with which the user interacts					
System design Design of components or modules that make up a system or program (e.g. systems architecture)					
Prototyping Using prototypes or example programs to design a system					
PROGRAMMING SKILLS	**Skill Rating**				
	1	**2**	**3**	**4**	**5**
General Programming General programming skill					
Object Oriented Programming with components, objects and classes (e.g. properties and methods)					
Client-Server Programming client-server applications					
Data-Access Connecting to / manipulating databases from programming platform (e.g. SQL, ADO,DAO,RDO)					
Debugging / Error Trapping Finding and eliminating bugs and errors in the program					
DATABASE SKILLS	**Skill Rating**				
	1	**2**	**3**	**4**	**5**
Developing Database Structures Developing database tables, queries etc					
Database Relationships / Normalization Developing relationships between tables and reducing data redundancy					
DATA COMMUNICATION SKILLS	**Skill Rating**				
	1	**2**	**3**	**4**	**5**
Network Communications Setting up and configuring physical networks					
Developing System Security Programming and managing system security (e.g. user access, integrity, virus protection etc.)					
INTERPERSONAL SKILLS	**Skill Rating**				
	1	**2**	**3**	**4**	**5**
Team / Group work The ability to work in a team and communicate with team members					
Verbal Communication Skills Interviewing, negotiation and presentation skills					
Written Communication Skills System documentation, incl. reporting on user requirements, system design, user manuals, help doc.					
PROJECT MANAGEMENT SKILLS	**Skill Rating**				
	1	**2**	**3**	**4**	**5**
Project Management *Co-ordinating & scheduling work, managing and budgeting resources, measuring system size / risk*					

SECTION C

According to **rating scale 1**, rate the extent that you gained or developed the skill **as a result of the industry exposure**

GENERAL BUSINESS SKILLS	**Skill Rating**				
	1	**2**	**3**	**4**	**5**
Specific business knowledge Knowledge of specific areas of business (e.g. Accounting, Finance, Law, HR)					
Business Understanding Strategic thinking, decision-making, understanding of business principles					
Feasibility Analysis Determining the feasibility or viability of a proposed system (e.g. SWOT or Cost Benefit Analysis)					
ANALYSIS SKILLS	**Skill Rating**				
	1	**2**	**3**	**4**	**5**
Business Analysis Analysing business problems (e.g. context, business areas)					
Systems Analysis Technical analyses of problems (e.g. Process modeling, data flow modeling)					
Modelling / Diagramming Modelling of diagramming of a proposed system's scope, processes and data flows					
DESIGN SKILLS	**Skill Rating**				
	1	**2**	**3**	**4**	**5**
Graphical User Interface (GUI) design Designing a graphical user interface / layer with which the user interacts					
System design Design of components or modules that make up a system or program (e.g. systems architecture)					
Prototyping Using prototypes or example programs to design a system					
PROGRAMMING SKILLS	**Skill Rating**				
	1	**2**	**3**	**4**	**5**
General Programming General programming skill					
Object Oriented Programming with components, objects and classes (e.g. properties and methods)					
Client-Server Programming client-server applications					
Data-Access Connecting to / manipulating databases from programming platform (e.g. SQL, ADO,DAO,RDO)					
Debugging / Error Trapping Finding and eliminating bugs and errors in the program					
DATABASE SKILLS	**Skill Rating**				
	1	**2**	**3**	**4**	**5**
Developing Database Structures Developing database tables, queries etc					
Database Relationships / Normalization Developing relationships between tables and reducing data redundancy					
DATA COMMUNICATION SKILLS	**Skill Rating**				
	1	**2**	**3**	**4**	**5**
Network Communications Setting up and configuring physical networks					
Developing System Security Programming and managing system security (e.g. user access, integrity, virus protection etc.)					
INTERPERSONAL SKILLS	**Skill Rating**				
	1	**2**	**3**	**4**	**5**
Team / Group work The ability to work in a team and communicate with team members					
Verbal Communication Skills Interviewing, negotiation and presentation skills					
Written Communication Skills System documentation, incl. reporting on user requirements, system design, user manuals, help doc.					
PROJECT MANAGEMENT SKILLS	**Skill Rating**				
	1	**2**	**3**	**4**	**5**
Project Management Co-ordinating & scheduling work, managing and budgeting resources, measuring system size / risk					

SECTION D

According to **rating scale 2**, specify your skill level for the methodologies / tools used in your course or projects. **(Do not include industry exposure)**. If a methodology or techniques was not used, **please leave that answer blank.**

SYSTEMS DEVELOPMENT METHODOLOGIES	Rating				
	1	2	3	4	5
Iterative Systems Development					
Joint Application Development (JAD)					
Prototyping					
Object Oriented Methodology					
Rapid Applications development (RAD)					
Structured Approach					
Systems Development Lifecycle					
Whirlpool Method					
ANALYSIS AND DESIGN TECHNIQUES	**Rating**				
	1	2	3	4	5
Process Modelling Techniques e.g. Process Diagram, Data Flow Diagram (DFD), Activity Diagram , Other					
Data Modelling Techniques e.g. Entity Relationship Diagram (ERD), etc.					
Business Modelling Techniques e.g. Context Diagram, Other					
Technology Modeling Techniques e.g. Component Diagram, Technical Environment Diagram, etc.					
Object-Oriented techniques e.g. Use Case Diagram, Class Diagram, Sequence Diagram, etc.					
DESIGN TOOLS	**Rating**				
	1	2	3	4	5
Enterprise Architect					
ERStudio					
Magic Draw					
Microsoft Visio					
Rational Rose					
RFFlow					
System Architect					
Visual UML					
With Class					
WEB DESIGN TOOLS	**Rating**				
	1	2	3	4	5
Dreamweaver					
Microsoft Frontpage					
Netscape Composer					
Visual InterDev					
PROGRAMMING LANGUAGES	**Rating**				
	1	2	3	4	5
Active server Pages (ASP)					
C++					
C#					
Clarion					
Cobol					
Delphi					
Extensible Markup Language (XML)					
HTML					
Java					
PL/SQL					
Perl					
PHP					
Powerbuilder					
Smalltalk					
Visual Basic 6					
Visual Basic.net					
DATABASE PLATFORMS	**Rating**				
	1	2	3	4	5
DB2					
Cache					
Informix					
Ingres					
InterBase					
Microsoft Access					
Microsoft SQL Server					
MySQL					
Oracle					

Paradox					
Sybase					
PROJECT MANAGEMENT TECHNIQUES	**Rating**				
	1	**2**	**3**	**4**	**5**
Project Scheduling and Budgeting					
Critical Path Method					
Gantt Chart					
Gozinto Chart					
Networks Diagram					
PERT Diagrams					
Product Structure Model					
Work Breakdown Structure					
Project Metrics and Measurement					
BANG					
Boehm					
Function Point Measurement					

Designed by Faiza Allie, and Dr. Theo C. Haupt, Peninsula Technikon, September 2003
Adapted with Permission by Elsje Scott, University of Cape Town, August 2002

APPENDIX B - INDUSTRY LETTER

Peninsula Technikon

Faculty Research Office – Engineering Faculty

P.O. Box 1906, Bellville, Cape Town, South Africa, 7535
Tel: (021) 959-6637/6666, Fax: (021) 959-6743

29 January, 2004

Dear Sir / Madam

M.TECH (INFORMATION TECHNOLOGY): FAIZA ALLIE

The Department of Information Technology at Peninsula Technikon is presently conducting research into issues relative to information systems in various contexts. In fulfillment of the requirements for her M. Tech (Information Technology) program, Miss Faiza Allie who is a full time lecturer at Peninsula Technikon is currently conducting empirical research to establish possible differences in systems development skills gained by students at Peninsula Technikon and industry.

Miss Allie would like to gather information from industry about the skills of the students who performed experiential training at your company.

The results of this study are part of a major research effort. Should you have any further questions please feel free to call the project leader, Dr Theo C Haupt on any of the above numbers. Responses provided will be kept strictly confidential. Research data will be summarized so that the identity of individual respondents will be concealed. You have our sincere thanks for participating in this valuable study.

Yours faithfully

Dr. Theo C Haupt
Research Coordinator

APPENDIX C - INDUSTRY SOFTWARE DEVELOPMENT SKILLS SURVEY

INDUSTRY QUESTIONNAIRE

This research aims to compare the skill of the third year Information Technology students who are specializing in Software Development at Peninsula Technikon, against industry requirements.

Please complete the questionnaire as accurately as possible.

The questionnaire comprises of four sections, all of which are required to be answered.

Section A and B – SKILL DEVELOPMENT
These sections consist of a list of skill categories, each of which should be rated according to the rating scale explained below:

Rating Scale 1

Level	Explanation
5	The student has excellent skills in this area
4	The student has very good skills in this area
3	The student has average skills in this area
2	The student has some basic skills in this area
1	The student has no skill in this area

Rating Scale 2

Level	Explanation
5	Skill in this area is vitally important /could not cope without it
4	Skill in this area is important
3	Skill in this area is of average importance
2	Skill in this area is not very important
1	Skill in this area is not important

Section C – METHODOLOGIES / TOOLS
This section consists of a list of more specific methodologies and techniques, each of which should be rated according to the rating scale as explained below.

If a methodology of skill or techniques is not used, **please leave that answer blank.**

Rating Scale 3

Importance Level	Explanation
5	Skill in this area is vitally important /could not cope without it
4	Skill in this area is important
3	Skill in this area is of average importance
2	Skill in this area is not very important
1	Skill in this area is not important

SECTION A

According to **rating scale 1**, rate the skill of the student who was employed for experiential training.

GENERAL BUSINESS SKILLS	**Skill Rating**				
	1	**2**	**3**	**4**	**5**
Specific business knowledge Knowledge of specific areas of business (e.g. Accounting, Finance, Law, HR)					
Business Understanding Strategic thinking, decision-making, understanding of business principles					
Feasibility Analysis Determining the feasibility or viability of a proposed system (e.g. SWOT or Cost Benefit Analysis)					
ANALYSIS SKILLS	**Skill Rating**				
	1	**2**	**3**	**4**	**5**
Business Analysis Analysing business problems (e.g. context, business areas)					
Systems Analysis Technical analyses of problems (e.g. Process modeling, data flow modeling)					
Modelling / Diagramming Modelling of diagramming of a proposed system's scope, processes and data flows					
DESIGN SKILLS	**Skill Rating**				
	1	**2**	**3**	**4**	**5**
Graphical User Interface (GUI) design Designing a graphical user interface / layer with which the user interacts					
System design Design of components or modules that make up a system or program (e.g. systems architecture)					
Prototyping Using prototypes or example programs to design a system					
PROGRAMMING SKILLS	**Skill Rating**				
	1	**2**	**3**	**4**	**5**
General Programming General programming skill					
Object Oriented Programming with components, objects and classes (e.g. properties and methods)					
Client-Server Programming client-server applications					
Data-Access Connecting to / manipulating databases from programming platform (e.g. SQL, ADO,DAO,RDO)					
Debugging / Error Trapping Finding and eliminating bugs and errors in the program					
DATABASE SKILLS	**Skill Rating**				
	1	**2**	**3**	**4**	**5**
Developing Database Structures Developing database tables, queries etc					
Database Relationships / Normalization Developing relationships between tables and reducing data redundancy					
DATA COMMUNICATION SKILLS	**Skill Rating**				
	1	**2**	**3**	**4**	**5**
Network Communications Setting up and configuring physical networks					
Developing System Security Programming and managing system security (e.g. user access, integrity, virus protection etc.)					
INTERPERSONAL SKILLS	**Skill Rating**				
	1	**2**	**3**	**4**	**5**
Team / Group work The ability to work in a team and communicate with team members					
Verbal Communication Skills Interviewing, negotiation and presentation skills					
Written Communication Skills System documentation, incl. reporting on user requirements, system design, user manuals, help doc.					
PROJECT MANAGEMENT SKILLS	**Skill Rating**				
	1	**2**	**3**	**4**	**5**
Project Management Co-ordinating & scheduling work, managing and budgeting resources, measuring system size / risk					

SECTION B

According to **rating scale 2**, rate the importance of each of the skills for an entry level software developer at your company.

GENERAL BUSINESS SKILLS	**Skill Rating**				
	1	**2**	**3**	**4**	**5**
Specific business knowledge Knowledge of specific areas of business (e.g. Accounting, Finance, Law, HR)					
Business Understanding Strategic thinking, decision-making, understanding of business principles					
Feasibility Analysis Determining the feasibility or viability of a proposed system (e.g. SWOT or Cost Benefit Analysis)					
ANALYSIS SKILLS	**Skill Rating**				
	1	**2**	**3**	**4**	**5**
Business Analysis Analysing business problems (e.g. context, business areas)					
Systems Analysis Technical analyses of problems (e.g. Process modeling, data flow modeling)					
Modelling / Diagramming Modelling of diagramming of a proposed system's scope, processes and data flows					
DESIGN SKILLS	**Skill Rating**				
	1	**2**	**3**	**4**	**5**
Graphical User Interface (GUI) design Designing a graphical user interface / layer with which the user interacts					
System design Design of components or modules that make up a system or program (e.g. systems architecture)					
Prototyping Using prototypes or example programs to design a system					
PROGRAMMING SKILLS	**Skill Rating**				
	1	**2**	**3**	**4**	**5**
General Programming General programming skill					
Object Oriented Programming with components, objects and classes (e.g. properties and methods)					
Client-Server Programming client-server applications					
Data-Access Connecting to / manipulating databases from programming platform (e.g. SQL, ADO,DAO,RDO)					
Debugging / Error Trapping Finding and eliminating bugs and errors in the program					
DATABASE SKILLS	**Skill Rating**				
	1	**2**	**3**	**4**	**5**
Developing Database Structures Developing database tables, queries etc					
Database Relationships / Normalization Developing relationships between tables and reducing data redundancy					
DATA COMMUNICATION SKILLS	**Skill Rating**				
	1	**2**	**3**	**4**	**5**
Network Communications Setting up and configuring physical networks					
Developing System Security Programming and managing system security (e.g. user access, integrity, virus protection etc.)					
INTERPERSONAL SKILLS	**Skill Rating**				
	1	**2**	**3**	**4**	**5**
Team / Group work The ability to work in a team and communicate with team members					
Verbal Communication Skills Interviewing, negotiation and presentation skills					
Written Communication Skills System documentation, incl. reporting on user requirements, system design, user manuals, help doc.					
PROJECT MANAGEMENT SKILLS	**Skill Rating**				
	1	**2**	**3**	**4**	**5**
Project Management Co-ordinating & scheduling work, managing and budgeting resources, measuring system size / risk					

SECTION C

According to **rating scale 3**, rate the importance of the methodologies / tools in comparison to use in your company. If a methodology of skill or techniques is not used, **please leave that answer blank.**

SYSTEMS DEVELOPMENT METHODOLOGIES	Rating				
	1	2	3	4	5
Iterative Systems Development					
Joint Application Development (JAD)					
Prototyping					
Object Oriented Methodology					
Rapid Applications development (RAD)					
Structured Approach					
Systems Development Lifecycle					
Whirlpool Method					
ANALYSIS AND DESIGN TECHNIQUES	**Rating**				
	1	2	3	4	5
Process Modelling Techniques e.g. Process Diagram, Data Flow Diagram (DFD), Activity Diagram , Other					
Data Modelling Techniques e.g. Entity Relationship Diagram (ERD), etc.					
Business Modelling Techniques e.g. Context Diagram, Other					
Technology Modeling Techniques e.g. Component Diagram, Technical Environment Diagram, etc.					
Object-Oriented techniques e.g. Use Case Diagram, Class Diagram, Sequence Diagram, etc.					
DESIGN TOOLS	**Rating**				
	1	2	3	4	5
Enterprise Architect					
ERStudio					
Magic Draw					
Microsoft Visio					
Rational Rose					
RFFlow					
System Architect					
Visual UML					
With Class					
WEB DESIGN TOOLS	**Rating**				
	1	2	3	4	5
Dreamweaver					
Microsoft Frontpage					
Netscape Composer					
Visual InterDev					
PROGRAMMING LANGUAGES	**Rating**				
	1	2	3	4	5
Active server Pages (ASP)					
C					
C#					
Clarion					
Cobol					
Delphi					
Extensible Markup Language (XML)					
HTML					
Java					
PL/SQL					
Perl					
PHP					
Powerbuilder					
Smalltalk					
Visual Basic 6					
Visual Basic.net					

DATABASE PLATFORMS	Rating				
	1	2	3	4	5
DB2					
Cache					
Informix					
Ingres					
InterBase					
Microsoft Access					
Microsoft SQL Server					
MySQL					
Oracle					
Paradox					
Sybase					
PROJECT MANAGEMENT TECHNIQUES	**Rating**				
	1	2	3	4	5
Project Scheduling and Budgeting					
Critical Path Method					
Gantt Chart					
Gozinto Chart					
Networks Diagram					
PERT Diagrams					
Product Structure Model					
Work Breakdown Strucutre					
Project Metrics and Measurement					
BANG					
Boehm					
Function Point Measurement					

SECTION D

Please complete the appropriate box by writing your response or marking with X.

Type of Company

Software House		Retail Company	
Educational Institution		E-Commerce company	
Financial Institution		Other:	

Description of work performed by student

System Development		System Testing	
System Analysis		PC Support	
Database Management		Data Communication or Networking	
System Maintenance		Documentation	
Help Desk		Other:	

Designed by Faiza Allie, and Dr. Theo C. Haupt, Peninsula Technikon, September 2003
Adapted with Permission by Elsje Scott, University of Cape Town, August 2002

APPENDIX D - STAFF PILOT QUESTIONNAIRE

INFORMATION TECHNOLOGY INTEGRATED PROJECT QUESTIONNAIRE

Please study the definition of an integrated project carefully before answering **all** the questions by marking your selection with an **X** as applicable

An integrated project is one that requires a student to work on different aspects of a single project involving more than one course or subject offering across a single level of study

1. Indicate which of the following streams are offered by your institution:

Stream	1st year	2nd year	3rd year	4th year
Business Analysis				
Communication Networks				
Multimedia				
Support Services				
Technical Application				
Programming				
Other				

2. Does your institution have a separate Department of Information Technology or similar department?

Yes		No	

3. Is a first year exit level certificate offered?

Yes		No	

4. Are your students expected to undergo a period of in-service training or experiential learning during their academic program?

Yes		No	

5. If so, indicate when this occurs in their academic program and for how long

Level	1st yeare	2nd year	3rd year
Period months)			

6. Who is largely responsible for placing the student with an employer for this period?

Student	
Institution	
Employer	

7. Indicate in the table below in which subjects students are required to complete a project

	Subject 1	Subject 2	Subject 3	Subject 4	Subject 5	Subject 6
Level 1						
Level 2						
Level 3						
Level 4						

8. Are your students expected to complete an integrated project during their academic program?

Yes		No	

9. If so, indicate in the table below which subjects are involved and at what level of study

	Subject 1	Subject 2	Subject 3	Subject 4	Subject 5	Subject 6
Level 1						
Level 2						
Level 3						
Level 4						

Before responding to the following statements that relate to your experience as a lecturer in the National Diploma of Information Technology (or similar), read them carefully and mark your response in the relevant box with an **X**

(SA=Strongly Agree, A=Agree, N = neither agree nor disagree, D=Disagree, SD=Strongly Disagree)

		SA	A	N	D	SD
1.	I believe that our final year students are adequately prepared for industry					
2.	I believe that Industry is satisfied with the quality of our final year students					
3.	I believe we have a good working relationship between our department and industry					
4.	I believe we are adequately preparing our students for industry					
5.	I believe that our students would be productive in industry after their first year of study					
6.	We have an active advisory board in the department					
7.	Our advisory board consists of more than 4 companies					
8.	Our advisory board meets regularly					

10. How important on a scale of 1 to 5 (1=not important at all; 5 = very important), do you regard the following attributes for a student to be productive in industry?

	1	2	3	4	5
Technical abilities such as programming, database knowledge, networking etc.					
Logic					
Teamwork					
Communication skills					
Project planning					
Interpretation of data					

11. Specify any other skills you consider important for students to become productive in industry

12. Specify any method employed by your department in order to ensure students are able to meet the needs of industry

Name		**Technikon**	
Contact No		**Email address**	

Thank you for your participation and contributing to the improvement of cooperative IT education in South Africa

APPENDIX E - STAFF LETTER

Dear Colleagues

The Department of Information Technology at Peninsula Technikon is presently conducting research into issues relative to Information Technology in various contexts. In partial fulfillment of the requirements for my M. Tech (Information Technology) program, I need to collect data relative to the course that you currently offer.

I have attached a questionnaire that I will use for this purpose when I call you by telephone in the next few days.

Your responses to the questions will be treated with the strictest confidence. All data will be summarized so that your identity will remain concealed.

Your participation is important for the success of this project.
Should you for any reason wish not to participate, please inform me.

Thanks
Faiza Allie

APPENDIX F - STAFF QUESTIONNAIRE

Please answer **ALL** the questions

1. Are your students expected to complete a project during their academic program?

Yes		No	

2. If **YES**, indicate the subjects at each level where students are expected to perform projects.

Level	Subject (s)
1	
2	
3	

3. Read the following statements that relate to your experience as a lecturer in the National Diploma of Information Technology (or similar), and mark your response with an **X** in the relevant box.

TA = Totally Agree, SA = Slightly Agree, A = Agree, D = Disagree, SD = Slightly Disagree, TD = Totally Disagree.

		TA	SA	A	D	SD	TD
1	Subjects should be self contained						
2	Projects better equip students for the workplace						
3	Subjects should be taught on an integrated basis						
4	Theoretical subjects are able to expose students to workplace experiences						
5	Topics that are not part of the outcomes of a subject, should be included in projects						
6	Projects cannot adequately simulate the work environment						

4. How important, on a scale of 1 to 5, do you regard the following attributes for a student to be productive in industry?

1 = not important at all; 2 = unimportant; 3 = average importance; 4 = important; 5 = very important

Skill Category	1	2	3	4	5
General Business skills					
Analysis skills					
Design skills					
Programming skills					
Database skills					
Data communication skills					
Interpersonal skills					
Project management skills					

5. Which of the following skills is an exit level outcome in the course you are teaching?

Skill Category	X
General Business skills	
Analysis skills	
Design skills	
Programming skills	
Database skills	
Data communication skills	
Interpersonal skills	
Project management skills	

6. What percentage of the total marks (100%) for a subject is allocated to each of the categories? If not evaluated, indicate by means of a zero (0).

Skill Category	%
General Business skills	
Analysis skills	
Design skills	
Programming skills	
Database skills	
Data communication skills	
Interpersonal skills	
Project management skills	

7. Which of the following do you expect your students to master when you have completed offering your subject?

Skill Category	X
General Business skills	
Analysis skills	
Design skills	
Programming skills	
Database skills	
Data communication skills	
Interpersonal skills	
Project management skills	

Thank you for your participation and contributing to the improvement of IT education in South Africa.

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BIOGRAPHICAL SKETCH

Faiza Allie was born in Cape Town, South Africa on March 13, 1969. She completed the National Higher Diploma in Computer Data Processing at Peninsula Technikon, Cape Town (NHD CDP PenTech). In 1993, after having worked in industry, Faiza entered the Educational Stream as a Lecturer in Peninsula Technikon's Engineering Faculty. In the Department of Information Technology she has lectured in subjects ranging from Networking and Programming to Analysis and Design and Project Management.

She has kept abreast of industry trends through her membership of the Computer Society of South Africa (CSSA), her membership of the Technikon Computer Lecturers Association (TECLA) and her involvement in organizing students' experiential training. Having worked as a valuable member in the Department of Information Technology for 10 years, Faiza has initiated various projects and been instrumental in building rapport between students, staff and industry.

In an attempt to keep subject matter relevant and students interested, Faiza has been incorporating integrated projects and real life scenarios / case studies into her subject matter. During 2002 she was responsible for organizing the Technikon Computer Lecturers Association (TECLA) conference.

Faiza's research interests include system and skills development, project assessment and developing and promoting mutual understanding and cohesion between industry, students and academia.