

**A theoretical framework of workplace
learning for entry-level software
engineering graduates**

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Dedication

To my beloved father, who fought the brave battle and lost.

To my cherished sister, who fought the brave battle and won.

*To my treasured son, who is fighting the brave battle;
may you always, always win.*

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Abstract

Title: A theoretical framework of workplace learning for entry-level software engineering graduates

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This purpose of this study was to investigate the organisation of the workplace to support the workplace learning (WPL) of entry-level software engineering (SE) graduates. To profile the SE WPL environment, the prevalence and perceived effectiveness of five specific areas were studied – WPL strategies, experienced guides, the SE graduates as learners, organisational supports, and learning opportunities – and a theoretical framework emerged from the literature review, representing the rhetoric of the SE WPL environment. Such profiling necessitated a mainly quantitative approach using a series of three web-based survey instruments – graduate survey, on-the-job learning guide survey, and organisation survey. A non-probability, convenience sampling approach was used for all three surveys.

The key findings indicate that direct guidance and dynamic resources (e.g. Internet, Knowledge Bases, etc.), along with the Instructional Model of Learning were the most effective strategies for SE graduate WPL. Indirect guidance strategies were not used frequently. The most effective strategies were using the Internet, scaffolding, diagrams, feedback, and using knowledge bases of previous problem solutions. Graduates and guides were very willing participants in WPL. Guides emerged as an effective support for WPL, particularly when they were selected for the graduate by the organisation. Graduates that selected their own guide were not adequately prepared for WPL which was considered ineffective. Organisations were an effective support for WPL and their workplaces invited WPL to take place. Learning opportunities were available and structured. They were also sequenced along pathways of learning designed to take the graduate from peripheral to full participation in the task.

The theoretical framework was revised based on the findings, resulting in a revised theoretical framework that represented the reality of the current SE WPL environment. This revised framework was reflected into the SE industry and recommendations were provided for supporting, evaluating, and improving WPL. The framework was also reflected into higher education practices so that recommendations could be made to better prepare SE graduates for the expectations of WPL. To facilitate this reflection, a fourth survey was conducted – the undergraduate survey – which provided a baseline of the WPL supports and strategies used in the higher education classroom. Again, a non-probability, convenience sampling approach was used for this survey.

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List of Abbreviations and Acronyms

APLS	Adult Participation in Learning Survey (UK)
CBT	Computer-based Training
CIPD	Chartered Institute of Personnel and Development
CPD	Continuing Professional Development
CSO	Central Statistics Office
DIT	Dublin Institute of Technology
HR	Human Resource
HRM	Human Resource Management
IS	Information Systems
IT	Information Technology
LAWS	Learning at Work Survey
LC1	Learning Condition 1: A high degree of exposure to change
LC2	Learning Condition 2: A high degree of exposure to demands
LC3	Learning Condition 3: Managerial responsibilities
LC4	Learning Condition 4: Extensive professional contacts
LC5	Learning Condition 5: Superior feedback
LC6	Learning Condition 6: Management support for learning
LC7	Learning Condition 7: Rewarding of proficiency
LISP	LISt Processing
NALL	New Approaches to Lifelong Learning
OECD	Organisation for Economic Co-operation and Development
PBL	Problem-based Learning
SE	Software Engineering
SMEs	Small and Medium-sized Enterprises
SPSS	Statistical Package for the Social Sciences
WCM	Workplace Curriculum Model
WIT	Waterford Institute of Technology
WPL	Workplace Learning
XP	eXtreme Programming

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CHAPTER 1

INTRODUCTION

1.1 Importance of WPL

Learning obtained in educational institutions has too often been accused of failing to meet the knowledge and skill requirements of the workplace (Billett 2001; Tynjala 2008; Virtanen *et al* 2014). The software engineering (SE) literature is replete with concerns relating to the inadequate skill set of their graduates (Nikula *et al* 2005; Sancho-Thomas 2009; Lee and Cheng 2011; Moreno *et al* 2012). These concerns are manifested through the notable increase of academic, industry, and government sponsored studies commissioned or undertaken to tackle the problem (Reed and Kelly 2002). These research studies show that Irish SE practitioners believe graduates emerging from third-level programmes do not possess the skills required by the SE industry (Reed and Kelly 2002; Devereux 2004; Drohan 2005). In particular, these skills gaps were evident across varying levels of education, from higher certificate to post-graduate qualifications (Reed and Kelly 2002).

The potential of the workplace as a learning environment is receiving increasing attention in recent literature (Harris *et al* 2001; Evans and Kersh 2004; Lee *et al* 2004; Noe *et al* 2010). Particular consideration is afforded to the development of workers' competencies and the process through which these skills are developed in the WPL environment (Colley *et al* 2003; Nordman and Hayward 2006). In Tikkanen's (2002) study, the respondents believed that approximately half of their competence could be attributed to experience on-the-job, a third to personal characteristics, and only one fifth of their current competence could be attributed to formal training. However, Skule (2004) cautions that WPL is not an adequate substitute for school-based education programmes.

Nabi and Bagley (1998) maintain that industry does not expect higher education to provide graduates with a complete universal set of skills applicable to all organisations. Billett (2001) maintains that leading authors in the field describe WPL

as the primary method of applying and refining the learning acquired in educational establishments. Cheetham and Chivers (2001) believe that the bulk of a professional's skills and competencies are learned in the workplace after graduation. Stange (2002) concurs, suggesting that workers acquire the majority of their job-related skills and competencies through learning provided by employers in the workplace. Indeed, a large portion of an adult's learning occurs in the workplace (Boud and Middleton 2003). Generally, larger companies are more likely to provide training (Dostie and Montmarquette 2007), particularly those geographically dispersed (Loewenstein and Spletzer 1999). In addition, employees possessing third-level qualifications working in high-skilled professions are more likely to receive employer-provided training (Gobbi 1998; Frazis *et al* 1998; Loewenstein and Spletzer 1999; Stange 2002; Bélanger and Larivière 2005; Ahlgren and Engel 2011). Typically, half of tertiary educated workers receive training in their workplace (Stange 2002).

In a study undertaken by Collin and Tynjala (2003), SE employees praised the merits of WPL stating that they learned much of their job-related competencies in this manner. Similar results were evident in a study conducted by Drohan (2005) where SE practitioners were asked to articulate the manner in which they learned their problem solving skills. Table 1-1 lists the frequency that SE practitioners identified each contributory factor as central to their problem solving skill acquisition. Each SE practitioner surveyed in this study identified one, or a combination, of the factors as contributory to the development of their problem solving skills.

An overwhelming 91% of respondents identified on-the-job training, while working actively in their role, as the most popular technique for acquiring problem solving skills. Close to half (45%) identified mentoring and observing experienced colleagues as contributory to their problem solving skills (Drohan 2005). These findings emphasise the critical importance that WPL has in relation to developing the skill set of SE practitioners. As the SE industry consistently reports inadequate skills in their SE graduates (section 1.1), WPL is particularly crucial.

Table 1-1 Contributors to problem solving skills of SE practitioners

Source: Drohan (2005)

Contributors to problem solving skills	Percentage of practitioners
On-the-job training / experience	91%
Mentoring / observing others in industry	45%
Training (HEIs)	32%
Training (in-house training in industry)	18%
Experimenting in industry / trial and error	14%
Continuous learning / reading	9%

1.2 WPL and graduates

Training as a discipline is a relatively new field, only gaining recognition after World War II (O' Connor 2004; Rowden 2007). The SE discipline is also in its infancy, only emerging in the 1960s. However, the field of SE has experienced unprecedented growth. According to Myers and Avison (2002), the majority of early research concentrated on technical concerns, with the emphasis moving towards the management of Information Systems (IS) in the 1980s. The 1990s witnessed considerable expansion to include issues such as inter-organisational and IS relationships, communication, interpersonal relationships, and social issues. As both training and SE are new disciplines, the amalgamated discipline of SE training could be viewed as an emerging field.

Industry's view of training as a supporting role often results in its perception as an outlay rather than an investment (O' Connor 2004; Freyens 2006). Callahan and Pedigo (2002) consider that these costs are often viewed by industry as being the 'least likely' to contribute to their overall profit margin and as a result, are prudent when deciding to fulfil employees' training requests. Callahan and Pedigo (2002) believe organisations may be concerned that the training they provide will be used by their employees to secure employment elsewhere. For these reasons, Stellin (2002) states industry's preference is to recruit employees already experienced in the role. Mayo (2004) maintains that some organisations refuse to hire graduates and instead

opt for recruits with a minimum of two years' experience. A recent suite of annual studies, from 2009-2012, consistently reported that approximately three quarters of organisations prefer to recruit personnel with relevant work experience (National Association of College and Employers 2010, 2012). These findings are in line with Mourshed *et al* (2012) who report that seventy percent of organisations opt for more qualified recruits, due to the perceived lack of skills in recent graduates. Nikula *et al* (2005) ascertain that skill gap concerns are often left to the SE industry to resolve as they are familiar with the skills required of graduate employees. This non-ideal situation can adversely affect the hiring of new graduates (Nikula *et al* 2005).

These industrial perspectives and concerns have serious implications for newly qualified graduates. Callahan and Pedigo (2002) argue that such perspectives place pressures on recent graduates to gain experience whilst in higher education through internship, work experience initiatives, part-time or full-time employment. However, these options to gain experience are not always feasible for undergraduates. Indeed, Hegarty and Johnston (2008) report that the overall research trend indicates that working during term-time whilst in higher education can damage the degree classification. An alternative solution is to provide SE undergraduates with exposure to typical work environments in the classroom in an effort to acclimatise them to the expectations of the workplace prior to graduation; according to Nikula *et al* (2005) this solution has received little attention in the literature. In an effort to address these concerns, organisations often operate graduate training schemes specifically designed to ease the transition between higher education and the world of work (Collins 2005).

1.2.1 Graduate training schemes

Numerous large organisations recruit graduates directly into formally organised graduate training schemes. Collins (2005) ascertains that these programmes were traditionally associated with financial institutions but they have become very popular in SE organisations. These intensive programmes are structured in a variety of ways, ranging from classroom-based training to on-the-job learning during placement in chosen business functions. Harvey *et al* (1997) maintains that, depending on the organisation, the job role and the structure of the training course, a graduate can

participate in these training programmes for any length of time from six months to three years.

Harvey *et al* (1997) state that typical graduate training schemes are designed to introduce the graduate to the organisation, their business practices and on-the-job work experience, thereby fostering experiential learning from the outset. Continuing in this vein, Collins (2005) maintains that schemes support the novice employee in terms of mentor programmes and finding the role or function that best suits the graduate. However, care must be taken to ensure that the graduate training schemes provide adequate hands-on experience (Harvey *et al* 1997).

Ultimately, companies need to recoup the investment they make when hiring graduates (Hegarty and Johnston 2008). However, when graduates are involved in these training schemes, they are usually not gainfully earning for the organisation. Drohan (2005) maintains that this lack of turnover in conjunction with the training costs makes graduate training schemes an expensive practice. As these schemes are expensive to develop and deploy, they are a costly outlay - one in which the return-on-investment is not always realised. Some organisations are not willing, or cannot justify investment in schemes of this nature; rather, they rely on commercial training courses to fulfil current needs (Harvey *et al* 1997). Others, who cannot afford to run such schemes or hire inexperienced graduates, find themselves paying higher salaries to employ experienced staff (Newman *et al* 2004).

1.2.2 Informal versus formal learning

As an alternative to graduate training schemes, another approach would be to transfer the responsibility for narrowing the skills gap onto graduates by requiring them to learn on-the-job. The literature recognises the importance of informal learning (Noe *et al* 2010) and consistently reports that more informal learning occurs than formal in the workplace (Day 1998; Rendall 2001; Millar 2005; Stevens *et al* 2002; Livingstone and Eichler 2005). Many studies investigated employer-provided training paying particular attention to measuring the incidence of informal and formal learning. Mincer 1989 (cited in Sicherman 1990) found that approximately 80% of the US private sector's WPL is informal. Marsick and Watkins (1990), reporting on

Carnevale's (1984) statistics, state that 83% of time is spent engaging in informal and incidental learning, whereas a meagre 17% of time is allocated to formal learning. Barron *et al* (1997), analysing the results of the 1982 *Employment Opportunity Pilot Project* and the 1992 *Small Business Administration* datasets, estimate that informal learning comprises 85% of all training. Frazis *et al* (1998) analysing the results of the 1995 *Survey of Employer-Provided Training*, report that employees, over a 6 month period in 1995, engaged in 70% informal and 30% formal learning. Livingstone (2001), reporting on the *New Approaches to Lifelong Learning* (NALL) 1998 survey, states that Canadian adults engage in five times more informal learning than formal (i.e., the ratio of 5:1 converts to approximately 83%). Figure 1-1 displays these percentages in graphical format. The high level of correlation between the studies covering more than a decade of research further highlights the importance of informal learning in workers' skill acquisition. More recent research conducted by Eraut (2011) across multiple disciplines, reported similar statistics where informal learning incidences accounted for between 70% and 90% of all learning in the workplace.

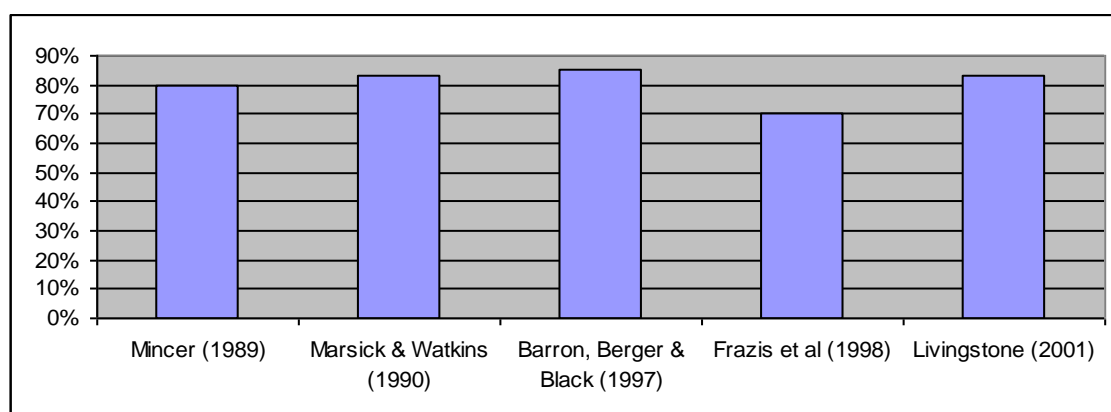


Figure 1-1 Incidence of informal learning as a percentage of overall learning

Source: Author

Therrien and Léonard (2003) measured the incidence of formal and informal learning within the context of company innovativeness. Those companies classified as innovative provided more informal training (79%) than those that did not innovate (65%). The high incidence of informal learning is consistent with the studies presented in Figure 1-1 and Eraut's (2011) recent findings. Therrien and Léonard (2003) figures are of particular relevance to the SE industry which, by its very nature, is highly innovative.

1.2.3 Graduate informal and formal learning

Entry-level employees (graduates) receive copious amounts of guidance from their experienced colleagues (Chivers 2006). When new recruits join an organisation, the majority of workers report that their initial training was predominantly informal where they learned from colleagues (Loewenstein and Spletzer 1999). Typically, informal learning in the workplace provides more learning opportunities than traditional classroom-based approaches as it is more adaptive to the changing nature of the workplace (Rowden 2007). According to Cowling (2003), entry-level SE graduates should possess the ability to improve their own learning and performance through such learning.

Harris *et al* (2001) report that both informal and formal learning contribute to newcomers learning in different ways and argue that both are needed; they contend that informal learning contributed to learning ‘how’ to do tasks, whereas, formal learning focused on the ‘why’. Boud and Middleton (2003) suggest that the impact formal learning has on work practices is often considered inferior to that of informal learning from experienced colleagues. Other authors echo this sentiment, suggesting that informal learning is superior and more effective than formal learning (Lee *et al* 2004; Hager 2004a; Van Rijn *et al* 2013). However, some contend that the costs associated with informal training far outweigh formal training costs (Frazis *et al* 1998; Freyens 2006). Conversely, Eraut (2011) argues that informal learning is merely considered a side-effect of working.

Rowden (2007) states that more work related learning occurs when engaged in tasks in the workplace than in the formal classroom setting. Informal learning practices structured using goal-directed activities in the workplace appear to contribute more to learning than formal practices (Bjorke 2005). This sentiment is echoed in Tikkanen’s (2002) study where it emerged that workers preferred to learn through self-directed and expert-directed learning as opposed to formal training situations.

1.3 Current informal learning research trends

It is widely accepted that a considerable amount of informal learning occurs in the workplace (section 1.2.2). Research in the area of informal learning is novel (Millar

2005), limited, and largely anecdotal (Noe *et al* 2013), however, interest in the topic is on the increase (Skule 2004; Marsick 2009). Metso and Kianto (2014) maintain that few studies have investigated the WPL of entry-level professionals commencing their career. Many authors draw attention to a paucity of discipline specific informal learning research, for example, in Information Technology (IT) (Lohman 2005a), accountancy (Hicks *et al* 2007), pharmacy (Noble and Hassell 2008), and human resource management (HRM) (Crouse *et al* 2011).

Bélanger and Larivière (2005) suggest that rather than ascertaining the existence of informal learning in the workplace, that a more pertinent and valuable research question would be to determine the acknowledgement and support that organisations afford to informal learning in the workplace. Garrick (1998) concurs by stating that it is pertinent to determine the impact that the reformed workplace has on the structure of informal learning and how employee participation is both recognised and rewarded by the organisation. Ashton (2004) highlights concerns regarding the dearth of attention afforded to the organisational structure in the WPL literature. Lohman (2005a) suggests that future research should study the degree to which an “organisation’s culture, design, policies and procedures, and people support engagement in informal learning” (p.52). Noe *et al* (2010) call for more research “to gain a better understanding of how individual and organizational factors influence its [informal learning in organisations] effectiveness” (pp. 305-306). Research is being conducted to ascertain how the workplace can be organised to support learning, the steps employees can take to promote their own learning, and the role co-workers can adopt to cultivate WPL (Billett 2001). However, this research is in its infancy and, at present, does not significantly influence WPL practices (Billett 2001).

Vaughan (2008) suggests that the challenge is to investigate and formalise the nature of informal learning while concentrating on learning processes amongst other criteria. Billett (2002a), a veteran WPL researcher, suggests that a richer understanding of contemporary WPL can be achieved if its procedural and conceptual facets can be studied. Procedural aspects include the provision of learning experiences to teach vocational competency that will in turn, ensure the continuity of the workplace. ‘Conceptual’ refers to individual agency and advancing understanding in WPL (Billett 2002b).

Having identified the importance of informal WPL, particularly for graduate employees in the SE discipline, and examining the current informal learning research trends, the research study is introduced in the following section.

1.4 Identification of research issues

Cheetham and Chivers (2001) state that entry-level professionals should recognise that they still have a lot to learn and should be willing to engage in continuing professional development (CPD) practices. They suggest that these professionals should prepare themselves for the expectations of WPL and develop a range of study skills to enable such learning. A workplace that understands, supports, and encourages WPL (Allen *et al* 1997; Billett 2003) while also tailoring it for their specific requirements (Billett 2001) facilitates WPL.

1.4.1 Aim of the study

Taking the foregoing sentiments and the above research trends into consideration, the aim of this study is:

to investigate the organisation of the workplace to support the WPL that entry-level SE graduates encounter whilst engaged in everyday work practices and activities.

In particular, the procedural facets of SE graduate learning in the workplace will be examined with the ultimate goal of measuring the perceived reality of the current WPL practices in the SE discipline. This study will strive to understand the key elements of WPL that a graduate encounters in order to provide insight into the organisation of the environment supporting WPL and its perceived ability to develop SE graduate competency.

Findings emerging from this study could lead to an improved theoretical and practical framework of WPL. This in turn could better prepare entry-level SE professionals for their active role in WPL and inform both WPL and higher education teaching practices.

The higher costs, frequency, and preference for informal learning, coupled with the importance that SE practitioners place on informal learning strategies for skills

development, and the lack of research in the area justify the importance of this study. In addition, SE entry-level workers receive a high concentration of informal training in their initial period of employment following graduation; this renders the SE discipline highly suitable for a study on WPL practices and structures.

1.4.2 Objectives of the study

Five objectives contribute to the overall aim:

1. To review the relevant literature relating to WPL strategies and supports to obtain a comprehensive understanding of the research topic.
2. To investigate the WPL strategies and supports that a SE graduate encounters while participating in everyday work practice and activities in an entry-level SE position.
3. To investigate the perceived effectiveness of these WPL strategies and supports for enabling SE entry-level graduates to become competent in their SE role.
4. To illustrate how the WPL strategies and supports identified above interconnect, thereby gaining insights into the perceived structure of WPL environments for entry-level SE graduates.
5. To explore the application of the structured WPL environment in:
 - a. industry for improving WPL practices and SE graduates' competency.
 - b. higher education for improving the readiness of SE graduates for the expectations of WPL practices.

The researcher is uniquely placed to conduct this study as she spent close to a decade working as a SE professional in industry and an equal amount of time in academia as a SE lecturer. Whilst the researcher was working as a SE, issues with the readiness of SE graduates' to engage effectively in WPL were prevalent across the five companies she worked in. These issues often impacted organisations' ability to bill new graduates to their clients while also incurring loss of opportunity costs for those guides supporting the graduates. Now that the researcher is working as a SE lecturer, the readiness of SE graduates for WPL has always fascinated her and this study evolved from this interest. The researcher's experience from both points of view – experience of WPL in the field, both as a graduate and a guide, and heavy

involvement with learning – place her in a prime position to research the topic in terms of insider knowledge, experience, industry contacts, access to a sample group, and so on.

Having identified the aim and objectives of the study, the following section defines the key terms used in the research. The research questions are presented at the end of the literature review.

1.5 Defining key terms

Fenwick (2006) draws attention to a worrying trend occurring in WPL research; the loose or non-definition of the key terms, namely learning, work, and the workplace. Other authors concur, maintaining that these terms are used as if there is a common understanding of their meaning and context (Boud and Solomon 2003; Colley *et al* 2003). According to Fenwick (2006), this problem was particularly evident at the 2004 *Working Life Learning* conference where numerous papers failed to define learning; when each of the presenters was asked to provide a definition for learning, varied definitions were furnished.

WPL studies have referred to learning as a product (e.g., knowledge creation) and/or a process (e.g., communication of knowledge). Work has been classified as paid, unpaid, structured, informal, tasks, social, and so on. Workplaces ranged from public (e.g. Richter *et al* 2011) to private (e.g. Chivers 2011), small companies (e.g. Ahlgren and Engel 2011) to very large organisations (e.g. Noe *et al* 2013), producing products varying from software packages (e.g. Lohman 2005a) to medicines (e.g. Bélanger and Larivière 2005). Fenwick (2006) cautions that diverse or omitted definitions of key WPL terms disguise fundamental conceptual and contextual differences across studies; danger surfaces when studies relating to different phenomena are viewed as universal theory, compared, and inferences drawn from their results.

Fenwick (2006) urges each WPL study to carefully define learning, work and the workplace. Adopting this approach would facilitate the comparison and synthesis of existing research thereby enabling researchers to build on previous studies and

develop knowledge in the area. Consequently, this research will define its key terms at the outset, namely WPL, expertise, work, and the workplace.

1.5.1 Defining WPL

Matthews (1999) considers WPL to be a difficult concept to define. Lee *et al* (2004) state that no one definition of WPL exists in the literature and believes the plethora of definitions exists for two reasons. Firstly, WPL has been defined from the perspectives of both the organisation and the employee. Secondly, WPL has been defined across many disciplines. Fenwick (2006) calls for the broadness of this term to be curtailed and its scope delineated specifically for each distinct study.

Fenwick (2006) also draws attention to the extent the discipline is fraught with learning definitions. She believes this is due to the existence of two learning philosophical approaches, product and process, which impact how researchers define learning. This study will explore the literature on learning as a product and a process with a view to selecting a pertinent learning philosophy. With the philosophy selected, informal and formal aspects of WPL will be examined. Finally, learning will be defined within the context of this study.

1.5.1.1 Learning as a product

Learning as a product refers to achieving tangible outcomes such as acquiring new knowledge or certification (Felstead *et al* 2004a). From this perspective of learning, knowledge is treated as a product that can be created, stored, utilised, and exchanged (Fenwick 2006). According to Rowden (2007), learning as a product involves two basic assumptions, namely stability and replicability. The stability of product-oriented learning assumes that knowledge is reasonably static, experiencing little change over time. Whereas, replicability, ignores different learning styles and assumes a one-size-fits-all approach to learning. Rowden (2007) contends that viewing learning as a product is representative of the training discipline where information is provided to the learner and only converted to knowledge when workers have the opportunity to apply it to their role. In addition, these training episodes are generally concise and designed specifically to teach one or few related tasks. Learning as a product is also termed learning as acquisition (Felstead *et al* 2004b).

1.5.1.2 Learning as a process

Learning as a process involves individuals improving their work performance by engaging in work tasks and activities (Felstead *et al* 2004a). Learning as a process involves the learner engaging with individuals, tools, and artefacts in the workplace (Felstead *et al* 2004b). Viewing learning as a process facilitates the individual development of the learners by encouraging them to construct their own understanding of the knowledge or subject area (Fenwick 2006; Rowden 2007). This internalisation of knowledge facilitates transfer from one situation to another (Rowden 2007) rendering the worker more valuable to the organisation. Learning as a process is also termed 'learning as participation' (Felstead *et al* 2004b). Communities of practice subscribe to learning as a process of social participation (Wenger 1998).

1.5.1.3 Selecting the learning philosophy

In a constantly evolving workplace, predicting future knowledge, skill, and attitude requirements is an arduous task. It is important that workers can adapt and apply their learning to novel situations and changing work requirements (Rowden 2007). Viewing learning as a process encourages this (Fenwick 2006; Rowden 2007).

Hager (2004b) argues that learning in the workplace has too often been viewed erroneously by many as product. He advocates it is emerging as process-oriented and researchers in the discipline should be cognisant of this. Rowden (2007) concurs, suggesting that the process view of learning is more suited to the changing nature of contemporary workplaces. Bryson *et al* (2006) also contest the product philosophy of WPL in favour of the process-oriented perspective. In addition, the results from the *Adult Participation in Learning Survey* (APLS) study showed that learning as a process was better at raising performance than learning as a product (Felstead 2006).

Hager (2004b) argues that there are numerous advantages for embracing the process perspective of learning rather than the product. As work is fundamentally a process, it is logical to view WPL as a process. Adopting such a stance situates learning in the work environment, thereby embracing changes in work practices while also providing learning with social and cultural perspective. The learner is considered an integral part of the learning environment rather than being viewed as an external entity. In

addition, WPL theory can be better understood when researchers consistently view learning as a process rather than a product. Consequently, the definition of WPL in this study will embrace learning as a process in the main. However, a very small minority of WPL strategies chosen for inclusion in the survey instruments are inherently learning as a product - for example, access to learning materials and resources.

1.5.1.4 Examining formal and informal learning

Prior to defining learning for this study, the terms formal, incidental, and informal learning need to be examined. The WPL literature is replete with numerous classifications of these terms, with little agreement on a standard definition or delimitation of boundaries (Garrick 1998; Malcolm *et al* 2003; Vaughan 2008). For example, Marsick and Watkins (1990) define:

<i>Formal learning</i>	as structured, classroom-based activities that take place off-the-job (p.12).
<i>Informal learning</i>	as planned, experiential, and non-classroom based learning (pp. 6-7). Informal learning can be intentionally encouraged by organisations (p.12).
<i>Incidental learning</i>	as a subset of informal learning that is unplanned, unintentional and a by-product of another activity (pp.6-7).

According to Rendall (2001), formal learning is any form of learning that has time allocated for it whereas informal learning can be viewed as any learning that is carried out while performing work duties.

Malcolm *et al* (2003) studied over 250 texts in an effort to clarify and define these terms. Following their extensive analysis, they suggest that it can be difficult to separate and define informal and formal learning as independent terms. Other authors concur that, in learning experiences, there are elements of both formal and informal learning which results in an unclear boundary between the terms (Colley *et al* 2003; Marsick 2009; Armson and Whiteley 2010). Instead, Malcolm *et al* (2003) state that the degree of formality/informality of learning situations should be defined using

specific attributes – namely: process, purpose, content, location, and setting. The nature of learning situations, when analysed using these attributes, can contain varying degrees of formality and informality and exhibit interrelationships.

However, Livingstone (2001) recommends that all future research on WPL should clearly differentiate between the informal learning that occurs outside established curricula and the non-formal learning occurring in structured courses and workshops. Taking Malcolm *et als* (2003) suggestion of defining the degree of formality/informality in the context of process, purpose, content, location, and setting and applying it to the Marsick and Watkins (1990) definitions, this study will refer to formal and informal learning as depicted in Figure 1-2 below.

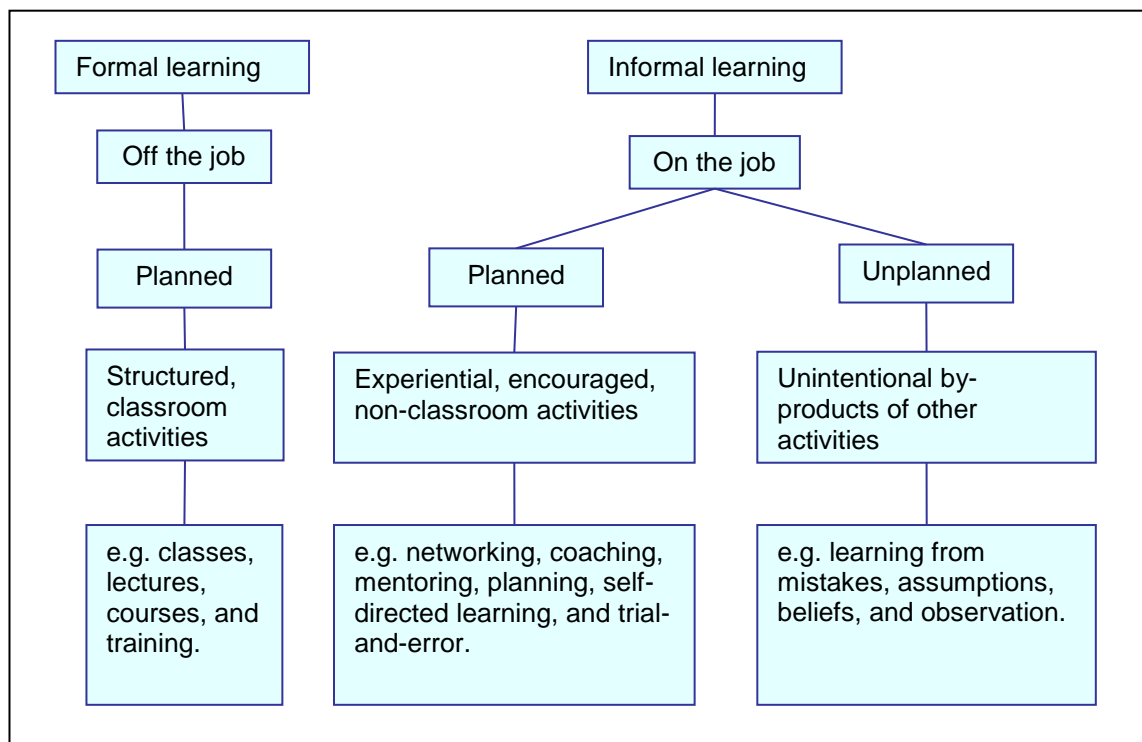


Figure 1-2 Definitions of formal and informal learning

Source: Adapted from Marsick and Watkins (1990)

Kock and Ellström (2011) suggest that similarities between formal learning and the learning as acquisition theory can be seen. Likewise, parallels exist between informal learning and the learning as participation theory. Having identified WPL as a process (i.e., learning as participation) earlier, this study will focus solely on informal learning due to its WPL context. This, in turn, will impact how learning will be defined.

1.5.1.5 Arriving at a definition for learning and WPL

Definitions, which view learning as a process, will be examined before arriving at a working definition for the purpose of this study.

Stevens *et al* (2002) define WPL to cover “all the learning that goes on within or is linked directly to performance in the workplace” (p.13). Rowden (2007) classifies WPL as that which:

occurs during the activities and experiences of work...the way in which workers, or groups of workers acquire, interpret, assimilate, or reorganise related clusters of facts, skills, and feelings, and how they construct meaning from their personal and shared organisational life (p.8).

This definition clearly identifies learning as a process where novices construct their own meaning through engagement in work activities. Livingstone (2005) offers a more concise definition by identifying learning strategies through which people learn such as formal schooling and informal learning:

Learning involves the gaining of knowledge and skill or achieving understanding anytime and anywhere through individual and group processes. It includes formal schooling, and further or continuing adult education, as well as informal education or training and non-taught self-directed or collective informal learning (p.1).

This study will adopt a similar approach of considering learning strategies when defining WPL. However, the scope of this study does not include classroom-based training activities; it centres on the informal learning that novice workers obtain whilst actively performing their daily work tasks (section 1.5.1.4). Sicherman (1990) defines learning on-the-job as:

The amount of time devoted to increasing the worker’s market productivity...Informal training could also take the form of assigning senior workers to monitor and assist new workers (pp.221-2).

Livingstone and Eichler (2005) concur with this definition, stating that informal learning occurs when mentors guide others to obtain relevant job skills.

Matthews (1999) identifies five key issues that should be included in definitions of WPL. These are the learning context, the reason for learning, the process for learning, the learning outcomes, and finally, sustained development. Taking the informal learning perspective, Matthews (1999) key issues, and the above definitions into consideration, this study will define WPL to encompass:

The on-going development of novice workers’ expertise arising from the indirect guidance from the physical and social environment and direct guidance from experts and others that a

novice worker experiences whilst participating in everyday work tasks and activities in the SE discipline.

In order to situate this research in the WPL literature, further clarification of terms utilised in the above definition will be required. Direct and indirect guidance are covered at length in section 2.8.3.2 (n.b. principles 3 and 4). Expertise, work tasks and activities, and workplace environment are defined in the following sections.

1.5.2 Defining expertise

The term expertise, used in the above definition of WPL, needs to be defined. As Billett's (2001) definition of expertise reaches far beyond technical competence and covers full participation in the workplace, it will be utilised in this study when referring to experienced workers:

The capacity to think and act in ways that permit individuals to resolve non-routine problems, to understand what constitutes an appropriate action and to become a full participant whose contributions are such that they themselves shape work practice in particular ways (p.99).

1.5.3 Defining work

Livingstone and Eichler (2005) define work in general to include "any activity directed toward making or doing something" (p.1). Fenwick (2006) identifies a clear distinction between paid and unpaid work. Work tasks and activities, in the context of this study, are defined as:

Any paid activity that an entry-level SE graduate engages in that is directed towards the development of IS.

1.5.4 Defining workplace

When defining WPL environments, Fenwick (2006) provides several keywords that could be used such as flexible work, geographically dispersed sites, time, space, place, size, sector, and market. Lee *et al* (2004) also caution that definitions of the WPL environment should encompass flexible working arrangements such as tele-working and virtual offices. Taking these suggestions and keywords into account, this study defines the WPL environment as:

A large department, function, or company actively developing IS, hiring recently graduated SE novices and providing the graduates with access to learning opportunities through everyday SE work activities, either remotely or in a traditional office.

1.5.5 Identifying other key terms in the research

This section introduces the terminology for other key terms in the study and the reasoning behind selecting them.

The term ‘guide’ and ‘mentor’ are interchangeable and refer to the same entity. The role of a ‘mentor’ in the workplace is to facilitate the learning of less experienced employees. Billett (2001) refers to mentors as ‘learning guides’ and uses the term ‘expert guidance’ in his WPL models. The term ‘guide’ as opposed to ‘mentor’ will be used in this study and the reasoning is two-fold. Firstly, Billett’s 2001 book is a seminal work in this study and ‘guide’ is the standard term used widely in it. For consistency purposes, the term ‘guide’ is preferable to the term ‘mentor’. Secondly, the ‘mentoring’ strategy is identified as one of many WPL strategies in Chapter 2 and the term ‘mentor’ could imply engagement in one singular WPL strategy. In order to avoid confusion with the mentoring strategy, the term ‘guide’ is more favourable to ‘mentor’.

The terms ‘learner’ and ‘graduate’ will be used interchangeably, depending on the situation, to imply a novice, recently graduated, entry-level SE employee. The term ‘organisation’ will be used to represent the department, function, or company that took part in the study.

Having determined that this study will view learning as a process, and having defined necessary key terms, the next section defines the contextual background of the study.

1.6 Contextual background of the study

Vaughan (2008) argues that there is little theory relating directly to WPL when compared to other learning related fields such as adult education and early childhood education. Of the available WPL literature, the definition of WPL (section 1.5.1.5) was typically used as a selection tool, where practicable.

When searching for literature, books, journal articles, conference papers, reports, and limited newspaper articles published in the English language from the Western body of work were examined. Multiple databases and Google Scholar were searched for

articles, reports and conference papers typically published in the past twenty or so years (from 1992 onwards) however some articles and reports referenced in this study were pre-1992. No date restriction was imposed when searching for books in libraries and on Google Books. Reference lists in the retrieved, relevant literature were examined to identify additional, pertinent publications.

In keeping with the above definition of WPL (section 1.5.1.5), works relating to the WPL of entry-level workers was fundamental to the entire literature review. The seminal text for this study was Billett (2001) which unlocked the gateway to the relevant literature. Lohman's (2005a; 2005b) work which studied the informal learning of IT professionals (strategy use, barriers to learning, and personal learner characteristics) also had a significant influence on the approach taken in this study.

The literature review broadly outlined the evolving, contemporary workplace while focusing on the WPL supports and learning strategies from the guide, learner, and organisational perspective. Participation was discussed from the learner-guide relationship aspect and the levels of expert guidance available in the workplace. The literature review identified the indirect and direct strategies available in the workplace while also addressing workplace pedagogy, associated workplace curriculum models (WCM), and conditions for ideal WPL environments, all of which can be used to measure the quality of WPL environments. Throughout, the limitations of WPL environments were discussed.

In essence, the literature review conceptualised the above topics and identified the current state of the research in the area so that this study could be positioned within the existing literature. A theoretical framework continually evolved throughout the literature review which proposed to measure the prevalence and perceived effectiveness of the informal WPL environment with a particular focus on both direct and indirect guidance for entry-level workers. Billett's earlier publications were central to the development of this framework.

The operationalisation of SE was the focus of this study in order to compare the reality with the theoretical perspective presented in the literature review. Consequently, this research was meta-level, thereby rendering individual

heterogeneity, emotions, politics, and so on outside the scope of this study. Also, as the emphasis of the theoretical framework was more on the WPL supports and strategies rather than the individual as a learning entity, literature relating to learning cycles (including works by Kolb and Marsick & Watkins), learning styles, active and passive learners, learner agency (which is a prevalent theme in Billett's more recent publications), and so on were considered outside the scope of the study. Continuing in this vein, it was not necessary to review theories such as andragogy, learning theories (including Eraut's (2004) typology of informal learning), schema theory, action learning, activity theory, activity systems (including Yrjö Engeström's work), and so on.

The theoretical framework does not measure learning at the team level (section 4.2.2) so literature relating to collective learning, distributed mentoring (where multiple mentors support one learner), communities of practice, group dynamics, and on-boarding (organisational socialisation techniques) was not reviewed. As communities of practice include the relations of mutual engagement, negotiation of a joint enterprise, and the development of a shared repertoire (Wenger 1998), this literature was not considered relevant as a unit however, insight was drawn from its underlying tenets such as enabling engagement and the resources identified in the shared repertoire. This sentiment is in line with Boud and Middleton's (2003) perspective where they caution against an exclusive focus on communities of practice as it can limit the understanding of nuances and complexities of actual WPL practices. However, this study recognises that WPL is situated within a community of practice. Learning organisations and knowledge societies are also outside the scope of the framework. Due to the linkages with formalised training and education institutions, the literature relating to Work-based Learning (WBL) has not been widely used in this study; however, insight has been drawn from its informal learning features.

1.7 Structure of the dissertation

This chapter, Chapter 1, establishes the background and rationale for the study. The current WPL research trends are discussed in order to position this study in the literature, prior to identifying the aims and objectives of the study. The key terms -

WPL, expertise, work, and the workplace – are defined. Finally, this chapter selects and delineates the literature included in this study.

Chapter 2 (Literature Review) explores the contemporary workplace facing today's graduates, discusses multiple influences on worker participation in WPL, and identifies and categorises multiple strategies used in WPL. The workplace pedagogy is then explored and conditions for ideal WPL environments are identified along with metrics for measuring them. As this chapter progresses, a theoretical framework continually evolves. The chapter concludes with a statement of the research questions and a final theoretical framework. This framework organises and illustrates the topics discussed in the literature review within the context of these research questions.

Chapter 3 (Methodological Considerations) identifies the use of mixed methods as the most appropriate philosophical approach based on the research objectives and questions. Cross-sectional web-based surveys were then selected as the most applicable method within this philosophical approach. The chapter concludes with a discussion of survey use in existing WPL learning research and issues arising from it.

Chapter 4 (Data Gathering and Analysis) discusses the chosen method for the study. In particular, it discusses data collection from many perspectives - the target population, unit of analysis, sampling, access, survey design, validity, reliability, and reflexivity. This chapter also covers the data analysis techniques applied to the gathered data, such as cleaning and analysing the quantitative data followed by analysing the qualitative data. Finally method limitations are presented.

Chapter 5 (Findings) initially profiles each of the four respondent groups in the study. The remaining sections in the chapter are structured according to the three research questions. The first section, WPL supports for SE graduates, presents and structures the data required to answer research question one. The second section, Perceived effectiveness of WPL supports and strategies, presents and structures the data associated with research question two. The final section, Undergraduate use and perceived effectiveness of WPL strategies, presents and structures the data associated with research question three. This chapter concludes with numerous summary tables of the findings.

Chapter 6 (Analysis) uses the findings from the previous chapter to answer the first two research questions under five main headings - Guide factors, Learner factors, Organisational supports, Learning opportunities, and Strategy. These headings are sections on the theoretical framework (Figure 2-9) presented in Chapter 2.

Chapter 7 (Revised Theoretical Framework) revises the theoretical framework (Figure 2-9) based on the findings and the answers to the research questions in Chapter 6. Recommendations for the use of the revised framework in industry and higher education are posited. Research question 3 is answered in this chapter.

Chapter 8 (Conclusion) revisits the aims and objectives of the study outlining how each was achieved. The key findings and recommendations are detailed along with the contribution to WPL and higher education. Finally the limitations of the research and future research directions are discussed prior to providing an overall summary for the study.

1.8 Conclusion

This introductory chapter discussed the background and rationale for conducting this study while also firmly situating the identified research issues in the current WPL literature and research trends. The key terms used in this study were also defined within the context of the research study being undertaken.

The next chapter, the literature review, examines the theory relating to the key elements of WPL and their contribution to structuring WPL environments in contemporary organisations.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In a study conducted by Bauer *et al* (2004), both workers and management believe that numerous learning opportunities exist in the workplace. Harvey *et al* (1997) stated that WPL occurs in the workplace while workers are conducting their daily tasks. Billett (2001) believes this form of learning is practically unavoidable and Gerber *et al* (1995) consider it more relevant and job-specific than formal learning. Darwin (2000) maintains most governments and organisations deem WPL as crucial for all workers. Harvey *et al* (1997) feel this form of learning can be used to educate both novice and established employees.

Billett (2001) maintains that the implementation of WPL is known to increase the productivity of novice workers and the quality of their learning experiences in conjunction with improving their working life. Billett (2001) believes that direct instruction from experienced colleagues provides opportunities for learning in the workplace that would otherwise remain inaccessible. WPL is a legitimate, effective, and suitable approach for learning in the workplace that benefits learners by teaching them pertinent vocational knowledge (Billett 2003).

Sheridan and Linehan (2011) maintain that the interaction between the novice worker and the experienced employee is pivotal for WPL. WPL encourages interdependent learning as both novice and experienced employees generally participate in such initiatives. Harvey *et al* (1997) found that the benefits include being able to learn from an expert practitioner while also learning pertinent information relating to the particular task. The instructional approach involves the experienced worker guiding and encouraging the novice worker to reason and behave like an expert whilst engaging in a particular work activity. Billett (2001) maintains that throughout the process, novice workers are encouraged to monitor their progress. Harvey *et al*

(1997) ascertain that this form of learning increases knowledge retention as the novice can apply their newly acquired expertise to their role immediately.

Billett (2001; 2002b; 2004) indicates that learning in the workplace can be a controlled phenomenon where learning episodes are structured through the goals, activities and culture of the workplace. In particular, Billett (2004) stated that there is evidence of the existence of a learning curriculum and predefined WPL strategies. Continuing in this vein, Billett (2004) maintains that guided learning is at the core of any workplace curriculum; the better the quality of the guided learning, the more successful the learning curriculum. Fuller *et al* (2003) found that quality WPL aims to develop rounded experts that participate fully in the workplace while also fostering career progression. Noe *et al* (2013) also found that WPL facilitates employability.

WPL is valuable for employer and employee alike (Lee *et al* 2004; Svensson *et al* 2009). However, Lee *et al* (2004) caution that the potential benefits achievable from WPL are not an incidental by-product of its recognition; rather the benefits are achieved when WPL is studied and developed. WPL needs to be led by the organisation (Dale and Bell 1999) and management needs to possess the requisite skills' set to do so (Svensson *et al* 2009). Boswell (1995) and Howell (1995) (cited in Matthews 1999) argue that the organisation should plan and integrate WPL into it and that it should never be an afterthought. Millar (2005) concurs, suggesting that to remain competitive, organisations should focus on developing a productive workforce through the supporting, structuring and continued appraisal of their WPL practices. In particular, Appelbaum and Gallagher (2000) believe those organisations wishing to capitalise on WPL should intentionally incorporate tailored learning for individuals into daily practice, develop workplace educators, evaluate existing training programmes and cultivate knowledge transfer. Matthews (1999) state they should also determine the extent to which their policies, systems, structures and activities either support or inhibit learning in their organisation.

Given the perception that WPL is more important than formal learning (section 1.2.3), it is alarming that WPL remains the least recognised of the two and receives the least planning and organisation (Stevens *et al* 2002). This chapter examines literature pertaining to both the planning and organising of WPL, with particular reference to

identifying the key elements of WPL and the organisation of these key elements, for entry-level workers in contemporary organisations.

The literature is arranged thematically as follows:

- The factors influencing the emergence of the contemporary organisation and the impact this evolution has on WPL are presented in section 2.2.
- In relation to expert WPL guidance, literature relating to the selection, preparation, and participation levels of guides is presented in section 2.3 along with the numerous influences contributing to and inhibiting guide participation.
- The literature pertaining to WPL learner preparation, participation, and experiences is presented in section 2.4.
- The supports an organisation provides for WPL are covered in section 2.5.
- The opportunities available in the workplace and the access provided to these opportunities are reviewed in section 2.6.
- A wide range of WPL strategies emerging from studies in the area is discussed in section 2.7.
- Workplace pedagogy and designing ideal WPL environments based on existing WCMs is discussed in section 2.8.
- Measuring these WPL environments is covered in section 2.9.

As this chapter progresses through the above themes, a theoretical framework evolves directly from the key sentiments in order to conceptualise the organisation of the workplace to support WPL. At the end of the chapter, the completed theoretical framework is cross referenced with the research questions emerging from the literature review.

2.2 Contemporary workplaces

Organisations have increased in complexity over the past few decades (Darwin 2000). Prior to investigating WPL, contemporary organisations need to be understood. This section identifies the factors influencing the evolution of the contemporary, complex organisation and the impact these factors have on WPL from the type of work undertaken and the pressures facing employees working in these organisations.

WPL is highly pertinent for contemporary organisations. It is highly sought-after (Garrick 1998), is quickly becoming a strategic tool for survival (Bélanger and Larivière 2005) and can result in an improved competitive advantage (Döös *et al* 2005; Noe *et al* 2010). Organisational success and survival is fostered when WPL is a core strategic element (O' Connor 2004; Rowden 2007; Noe *et al* 2010). Reed and Kelly (2002) believe that, in today's knowledge economy, these sentiments are particularly pertinent as the success of the SE industry depends on the competency of its professionals.

Contemporary organisations are continually evolving with internal and external driving forces altering their WPL landscape. Globalisation, competition, profit margins, and technological advances are among the driving forces behind the constantly changing workplace of contemporary organisations (McBrier and Wilson 2004; Livingstone and Eichler 2005; Dostie and Montmarquette 2007). Mayo (2004) identifies political, economic, social, technological, legal, and environmental changes as drivers that influence staff development. Such forces can result in increased incidences of WPL (Watkins and Marsick 1992; Matthews 1999).

Professions and roles are experiencing change in contemporary organisations. Lohman (2005a) states that such changes are particularly relevant in the IT discipline. Vaughan (2008) ascertains that it is now harder to predict future roles and the skills required. Jarvis *et al* (2006) maintain that WPL has become more prominent as contemporary organisations' flexibility relies on their workers' willingness and ability to learn, change, and evolve. Darwin (2000) maintains that these changes are typically driven by technology, which either changed certain professions or made them obsolete. Chin *et al* (2002) state the increased prevalence of technology in the contemporary workplace heightens the likelihood of workplace knowledge becoming inaccessible. However, Mayo (2004) maintains the prevalence of technology expands capabilities for delivering and sharing knowledge.

Such workplace restructuring often results in experienced, competent workers being transferred to unfamiliar roles which require re-training to develop competency in their new position (Houldsworth *et al* 1997). The onus is repeatedly being placed on the worker to engage continually in lifelong learning in an effort to maintain and

expand their skill set (Keep 1997). Workers are intentionally focusing on WPL to improve their performance (Matthews 1999), particularly in the IT discipline (Lohman, 2005a).

In today's globalised economy, workers are taking more responsibility for their learning and CPD than before (O' Connor 2004). This is evident in the numerous lifelong learning policies developed by the Organisation for Economic Co-operation and Development (OECD). Engagement in lifelong learning is a key to worker success in today's labour market (OECD 2007; Svensson *et al* 2009).

From a demographic and structural perspective, workers' participation is also changing. There are more women in the workforce nowadays (OECD 2009). There are also an increasing number of disabled people in the workforce than before. Existing full-time workers are experiencing longer working hours incorporated with pressure to remain current and competent in their role. There is a rise in casual employment opportunities where workers are employed on a part-time or temporary basis (Livingstone and Eichler 2005), typically working longer hours. There is a belief that the era of 'jobs-for-life' has passed and that employees are faced with increasing insecurity in the labour market (Keep 1997; Darwin 2000). This is particularly relevant in the current global downturned economy. Employment stability has declined with down-sizing prevalent in the mid-1990s (Livingstone and Eichler 2005) and a sharp increase in redundancies from 2008 onwards (Department of Social Protection, 2012).

The emergence of the virtual workplace also allows workers geographical and social separation through teams located in different countries (Lipnack and Stamps 2000), shift work, or working from home (Lee *et al* 2004). Organisations should focus on minimising the gap between remote learners and their guides in order to improve WPL (Billett 2001).

In summary, the changes in work task and employee participation and pressures identified above emerged from the evolving nature of contemporary organisations. Not only do these changes place pressure on the organisation to learn quicker than their competition (Bratton 2001), they place pressure on the worker to adapt and

manage the change. The pressures that a contemporary organisation faces encourage them to consider the learning of their workforce (Matthews 1999). Workplaces routinely provide learners with authentic experiences for the development of required competencies, thereby explicitly advocating the survival of the organisation in today's economic environment (Billett 2001; 2004). However, the availability of authentic learning opportunities does not guarantee participation in WPL. Numerous factors contributing to and inhibiting participation in WPL are dispersed throughout this chapter.

The following section, 2.3, details the factors emerging from the literature relating to WPL guides. These factors include the levels of expert guidance available in the workplace, the selection of guides, the preparation of guides, and the influences on guide participation in WPL.

2.3 WPL guides

Doyle *et al* (2008) reported that interacting with others in the workplace facilitates learning. The role of the guide is one of the most crucial aspects in WPL. Cheetham and Chivers (2001) recognise that WPL is facilitated when a colleague is willing to provide help when required.

Harris *et al* (2001) maintain that the quality of the knowledge and skills learned is dependent on the ability, knowledge, values, enthusiasm, and mentoring skills of the guide. Consequently, important topics in the literature relating to guides include the levels of expert guidance, the selection and preparation of guides for WPL, and factors that influence guide participation in WPL initiatives. Each topic is discussed in the ensuing sections. The first evolution of the emergent theoretical framework underpinning this study is then presented.

2.3.1 Levels of expert guidance

Nordman and Hayward (2006) report that learning in the workplace is more efficient when experts are available to provide guidance while the novice worker is performing the task. Continuing in this vein, they ascertain that research has shown this approach to learning is very efficient and crucial to the development of vocational expertise.

Chivers (2006) argues that all professionals should accept a degree of responsibility for facilitating their colleagues' WPL.

Billett (2001; 2002b) developed a model containing three levels of guidance that are evident when experts support the WPL of novice workers through everyday activities (see Table 2-1). Billett (2002b) conducted a study in three departments within a large food manufacturing plant to evaluate the perceived effectiveness of this model for developing and extending vocational knowledge. The results showed that the model "demonstrated some potential" (p.100) for supporting guided learning in the workplace.

Table 2-1 Three level model of WPL guidance

Source: Billett (2002b, p.95)

Level 1 – Guided participation in work activities
Learning through undertaking everyday work activities Sequencing of tasks (from low to highly accountability [peripheral to full participation]) Opportunities to participate, observe and listen Opportunities to access goals required for performance
Level 2 - Guided learning at work; more intense guidance by experienced workers
Close guidance by experienced workers Use of modelling, coaching and scaffolding Use of techniques to engage workers in learning for themselves Use of techniques to develop understanding
Level 3 - Guided learning for transfer*
Use of questioning, problem solving and scenario building to extend learners' knowledge to novel situations

* transferable outcomes will also be developed at the other levels

Billett (2001; 2002b) suggested instructional strategies for guides operating at each of the three levels of guidance. To provide a more complete picture, these instructional strategies are merged with the details in Table 2-1 and presented in Table 2-2. Each of the three levels is discussed in turn.

The first level, guided participation in work activities, relates to the management and structuring of learners' experiences. It specifically relates to the access novices have to learning opportunities and the direct and indirect guidance provided for them by their workplace (Billett 2002b). The expert selects and makes accessible appropriate learning experiences, guides the learner through these experiences, and monitors progress. Depending on the learner's readiness, the expert then repeats this cycle with tasks of increasing responsibility. Billett (2001) ascertains that specifically structuring

workplace tasks to embed WPL practices into them facilitates learning in the workplace.

Table 2-2 Extended three level model of WPL guidance

Source: Adapted from Billett (2001; 2002b)

Level 1 – Participation in work activities and potential instructional strategies
Workplace experiences: Organising workplace experiences Sequencing of tasks from low to highly accountability
Everyday work activities: Learning through undertaking everyday work activities
Pathways of activities: Monitoring learners’ readiness to progress along pathways of activities that are structured according to increasing accountability and complexity
Learning opportunities available: Observe and listen
Goals and requirements for expert performance: Providing access to goals and sub-goals associated with the work practice
Level 2 - Guided learning at work and potential instructional strategies
Close guidance by experienced workers: Modelling and demonstrating of tasks to be performed Coaching using procedures associated with the activity Scaffolding Assisting with joint problem solving
Use of techniques to engage workers in learning for themselves
Use of techniques to develop understanding / access to goals to be learnt: Awareness of goals Understanding of goals and requirements
Monitoring learners’ progress
Making accessible knowledge that is hidden
Avoidance of learning inappropriate knowledge
Level 3 - Guided learning for transfer* and potential instructional strategies
Strategy use to extend learners’ knowledge to novel situations: Questioning Problem solving Scenario building
Engaging learners in opportunities to reflect on what they have learnt
Encouraging the comparison of individuals’ progress with that of others
Assisting learners to understand the breadth of the applicability of what they have learnt
Facilitating the abstraction of learning from one situation to another

*transferable outcomes will also be developed at the other levels

The second level of guidance, guided learning at work, is characterised by more intense direct guidance from the expert who pays increased attention to instilling an understanding of work practices and procedures in the novice learner. Guided learning strategies are a significant feature of this level (Billett 2002b). In particular, the cognitive apprenticeship approach, discussed in detail in section 2.7.1, is typically

located at this level of expert guidance. Collaborative problem solving is also a dominant approach adopted at this stage (Billett 2001).

The third level of guidance, guided learning for transfer, refers to adopting approaches that encourage the transferability of professional and vocational knowledge within and between workplaces. The transferability of knowledge from one work situation to the next is a crucial skill. Bratton (2001) maintains that learning transferable skills in the workplace enhances worker employability and access to external labour markets. Questioning and group discussions feature heavily at this level (Billett 2002b). Munby *et al* (2003) report that learners can continually turn to guides for clarification and advice or to fill gaps in knowledge and understanding. The transferability of knowledge when engaged in WPL episodes is discussed next.

2.3.1.1 Transferability of knowledge

WPL has been labelled as concrete, situational learning that is not transferable from one organisation or work situation to the next (Zuboff 1988) with many authors addressing this criticism (Billett 1995; Anderson *et al* 1996). Anderson *et al* (1996) suggest that it is erroneous to generalise that WPL is grounded and non-transferrable; rather, they believe that the degree of transferability is dependent upon similarities between the cognitive elements of the task at hand and those elements of a new situation. Billett (1995) ascertains that situated learning assists the transfer of knowledge through the authenticity of the activity and the context in which it is learned. Rogoff (1990) states that the learning that occurs in the workplace and in educational intuitions possesses equal potential for transfer.

Anderson *et al* (1996) conclude that the degree of transfer is dependent on the extent to which attention is drawn to it in the learning process. Specifically, training should be provided that draws attention to recognising and reusing skills and cognitive elements of tasks. At the third level of expert guidance, the novice learner reflects on his or her learning with a view to recognising its applicability to different workplaces and situations (Billett 2001). In particular, this level of guidance emphasises the extension of vocational knowledge, the generalisation of this knowledge, and the use

of colleagues as a benchmark for indicating learning progress. Each of these is discussed in turn:

- Extending vocational knowledge through guiding learning

Billett (2001) maintains that the strategies adopted during the third level of guidance intentionally foster the development of transferable vocational knowledge. At this level, the learner is encouraged repeatedly to self-regulate, self-assess, and monitor their actions and performances. In addition, learners can apply these skills when posing questions, developing scenarios, and reflecting on their responses. Guided learning strategies for extending vocational knowledge include coaching, scaffolding (Collins *et al* 1987), questioning, and diagrams (Billett 2001). These strategies, discussed in section 2.7.1, focus on the potential for applying the acquired knowledge in different contexts in the workplace.

- Generalising from what has been learnt

In addition to extending vocational knowledge, novice learners should focus on applying their learning to other situations within their discipline (Billett 2001). Guides should actively encourage them to generalise their learning by identifying situations where their newly acquired learning could be applicable and instances where it could have limited relevance (Billett 2001). Strategies used to encourage the generalisation of learning include questioning and ensuring that learners have sufficient exposure to diverse workplace practices, procedures, and standards in different settings (Billett 2001). In order to develop a rich body of transferable knowledge, learners should be afforded ample time to understand, reflect on, and reinforce their learning so that they can critically assess whether acquired knowledge is transferable to another situation (Billett 2001).

- Self-Assessment and comparison with other workers

In accordance with Kolb's (1984) experiential learning cycle, having completed a learning experience or work task, learners should reflect on and assess their performance. Billett (2001) recommends that learners, in particular, should benchmark their development by critically comparing their performance in the task with that of an experienced colleague. Learners would then be in a position to self-correct or fine tune their acquired knowledge accordingly.

In summary, when the three levels of expert guidance, as depicted in Table 2-2, are combined in the workplace, they contribute to the transferability of professional knowledge within and between workplaces (Billett 2001). Through this support, expert co-workers can aid in the progression of their novice colleagues to skilled worker level. As novice workers become more proficient in their role, their learning requirements abate and their productivity rises. Consequently, engendering this guided learning approach in an organisation offers considerable returns (Billett 2001).

2.3.2 Selecting the guide

WPL studies provide numerous guidelines for selecting appropriate WPL guides. Guides should have experience of working in the area that they intend guiding learners through (Sherman *et al* 2000) while also understanding what is required to perform the task to an expert level. In addition to possessing sufficient vocational knowledge, guides should also have the ability to facilitate the learning of their novice colleagues. Billett (2001) maintains that potential guides should possess knowledge of and have an appreciation of the guided learning process, whilst also having the ability to foster active as opposed to passive learning. Sherman *et al* (2000) suggests that guides should have a working knowledge of adult education theory.

Clutterbuck (1991) states that guides should be willing to commit time and energy to engage collaboratively in the learning process. Howell *et al* (2001) maintains that good guides develop a rapport with and take an interest in their learners' development. Sherman *et al* (2000) hold that guides should have excellent interpersonal skills and should, through collaborative problem solving, encourage novice workers to become active learners in the workplace. Billett (2001) identifies that it is crucial to the success of WPL that the guides possess the required competencies to mentor, organise, and support the learning of their novice colleagues.

2.3.3 Preparing the guide

Chivers (2006) recognises once willing learning guides have been selected, that it is important for organisations to prepare them for the expectations of the role in order to fully reap the benefits of WPL. Holland (2009) states that, due to the very different skill demands required when mentoring, many guides struggle with the role. Guide

preparation needs to extend beyond basic training in guided learning approaches. The guide needs to understand fully the guided learning process and how to use the guided learning tools, strategies and techniques in everyday tasks. Both of these sentiments are discussed in turn.

The instructional approach adopted by the expert affects WPL. To provide the best support possible, WPL guides should be thoroughly prepared so they fully understand guided learning principles at work and be proficient in their use. Billett (2001) cautions if the expert chooses to didactically teach rather than guide, the resulting learning could be inadequate. This necessitates a paradigm shift away from training skills and towards the use of facilitation skills (Sloman and Webster 2005; Rowden 2007). Guides should become advocates for learning (Rowden 2007), understand how people learn (O' Connor 2004), and understand how they construct knowledge and develop conceptual expertise (Billett 2001). Guides should also provide a supportive environment for learner exploration (Volkoff 1996) and be open to having their performance monitored and feedback furnished on their progress (Billett 2001).

Guides should be familiar with several guided learning strategies, be proficient with embedding them in everyday tasks (Billett 2001), and understand when best to use each strategy (Clutterbuck 1991; Hay 1995). Billett (2003) maintains that experience in using strategies facilitates their proficient use. Rowden (2007) recognises that guides also require a level of creativity when using these strategies. They should also understand procedures for developing valuable learning initiatives (O' Connor 2004). However, Chivers (2011) study of investment bankers WPL showed that guided learning strategies were used, albeit without much understanding of the numerous available strategies or which strategies best suited the specific learning needs of the novice.

2.3.4 Influences on guide participation

Many factors influence guide participation such as the relationship the guide shares with the learner, the reluctance of workers to participate, and the availability of expert guidance. Each of these is discussed in turn.

2.3.4.1 The learner-guide relationship

Learner-guide relationships range from informal, unplanned arrangements between a protégé and an experienced colleague to formally structured and planned operations controlled by the organisation (Metros and Yang 2006; Holland 2009). Allen (2007) maintains, regardless of the level of formality, the combined behaviour of both the guide and the learner is crucial to successful learning in the workplace. Billett (2001) reveals that better learning is achieved when a supportive, motivating, and collaborative relationship exists between the learner and the expert. Negativity of those involved in mentoring can adversely affect the outcomes (Billett 2002a; 2003) and Cheetham and Chivers (2001) recognised that such negativity can make it difficult for learners to volunteer mistakes. Potential guides and their learners should receive guidance on the nature of the learner-guide relationship (Clutterbuck 1991) and how best to foster a quality relationship so that collaborative learning can be achieved (Billett 2001). Day (1998) reported that collaborative learning was one of the “richest sources of informal learning” (p.32).

A study by Ashton (2004) found that networking and interpersonal relationships were perceived as pivotal for accessing necessary information and learning opportunities. Billett (2001) states that fostering quality learner-guide relationships, where learners have sufficient access to their guides and available learning experiences, can improve the perceived effectiveness of WPL practices in organisations. Nurturing relationships between the guide and the learner, so that there is shared understanding of what is required of both parties in the learning process (Billett 2001), would alleviate concerns that learners have regarding interactions with their guides (Billett 2003).

Okurame’s (2008) study shows that when management trains learners and guides, particularly in the area of co-operative supports and interaction, WPL is more successful. This concurs with Krams (1983) thinking where she believes that relationship-building interventions should be explored to support the learner-guide relationship. Billett’s (2003) study found that preparation for WPL should involve the mentors getting to know their learners while also observing and understanding their learner’s requirements. Others even go as far as defining a contract between the learner and their guide to support the relationship (for example George 1997, p.110).

Ultimately, it is the responsibility of both the learner and the guide to maintain a quality relationship that promotes WPL (Billett 2001).

However, numerous factors can affect this relationship – such as the learner feeling they are held back by their guide, the guide feeling threatened by the learner (Kram 1983), mismatching learners with an unsuitable guide, differing levels of commitment, inadequately defined learning and guiding roles, and lack of trust (Clutterbuck 1991). Okurame (2008) discloses that given a choice, learners would prefer to hand pick the person who will guide their learning. Bushardt *et al* (1982) details that learners, when selecting a guide, often look for guides that share similar values and ethics, possess the necessary knowledge, have communication skills conducive for constructive feedback, and that they trust. They generally want an expert who is confident in their role and one who has earned respect in the workplace.

2.3.4.2 Reluctance of workers to participate

Billett (2001) reveals that some workers can be reluctant to participate in WPL which contributes to weak learning outcomes and can be detrimental to the learning process. This reluctance could stem from a number of issues such as lack of information about the learning process, potential embarrassment about their existing knowledge or abilities (Billett 2001), the threat to organisational-wide job security or conditions of work that the worker perceives from learning new knowledge (Bratton 2001), or the threat the learner's increased competence could have on the guide (Munro *et al* 2000). Ashton (2004) recognises that experts can be reluctant to engage in WPL as they fear future displacement by the person whom they guided. Bratton (2001) states that such reluctance can manifest itself in a number of ways such as choosing to withhold or obscure knowledge and not use it in the workplace.

Organisations, when faced with this reluctance, need to develop measures to encourage non-participants to engage in WPL. Organisations should detail techniques for encouraging participation in WPL (Billett 2001) and also convey rewards and assurances relating to fear of displacement to guides (Billett 1995). In short, organisations should concentrate on reassuring experts regarding their role in WPL (Billett 2001).

2.3.4.3 Availability of expert guidance

Billett (2004) maintains that the presence of expert guidance in the workplace unlocks learning that novices could not access on their own. White *et al* (2000) reports that if an expert is not available to guide the novice worker, WPL can suffer. Experts may not be available due to the pressures experienced by contemporary organisations e.g. experts working different hours to the novice, working in geographically separated locations, low staffing levels, and significant changes in working practices (section 2.2).

Billett (2001) recognises that even though an individual may be assigned the role of guide, they may not be viewed as an expert. Volkoff (1996) identifies that the learners in the workplace appraise who they see as experts, that is, who they determine the reliable sources of information are; if expertise is not readily available in the workplace, it may be necessary to look outside the community for experts.

2.3.5 The emergent theoretical framework – iteration one

The role of the guide is one of the most crucial aspects in WPL and the following factors influence the perceived effectiveness of WPL:

- *Guide Selection* – includes choosing appropriate WPL guides that are skilled at sharing knowledge, have expertise in and knowledge of the area they would be supporting, have the ability to effectively support graduates WPL, and be willing to participate in WPL initiatives.
- *Guide Preparation* – includes the adequate preparation of guides for their WPL role.
- *Influences on Guide Participation* – includes good learner-guide relationships, reluctance of workers to provide guidance, and the availability of expert guidance.
- Levels of Expert Guidance and the Transferability of Knowledge

These factors are illustrated in Figure 2-1, the first iteration of the theoretical framework. As the literature review progresses, this framework evolves and matures. In total, there are six iterations. The final iteration is central to the study, underpins

the research instruments, structures future chapters, and is revised following the field research.

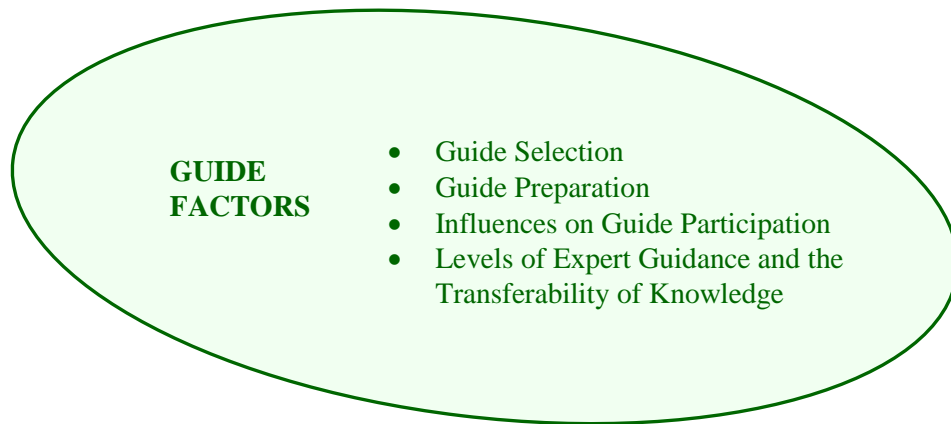


Figure 2-1 Theoretical framework - WCM and stakeholder influences (first iteration)

Source: Author

2.4 WPL learners

Learners engage with their social world through close encounters with individuals (Vygotsky 1978) and interactions with their physical and social workplace environment. Billett (2004) maintains that learning in the workplace is participatory between the learner, the guide, and their environment. The learners' selection of guides, learner preparation, influences on learner participation, engagement in routine and non-routine tasks, and the goals and requirements for expert performance are discussed the following sections. Following this, the second evolution of the emergent theoretical framework is presented.

2.4.1 Selecting the guide

Numerous criteria for selecting appropriate WPL guides were provided in section 2.3.2 and 2.3.4.1. Chivers (2006) suggests that, where feasible, learners should choose their guide. Volkoff (1996) states that learners consider their own individual needs and goals when selecting their guide. Such an approach facilitates learner-guide relationship compatibility (Chivers 2006), which is discussed in section 2.4.3 below. Volkoff (1996) recognises that learners often determine who they see as experts, however, a situation could arise where the learner is not aware of any experienced colleague that could support their learning.

2.4.2 Preparing the learner

Billett (2003) maintains that learners should be made aware of and prepared for WPL so they fully understand all facets of the process. This approach could address any concerns learners had regarding the process and their exchanges with mentors. Billett (2001) states that learners' attention should be drawn to the potential benefits they could reap by participating in WPL and that learners should receive a comprehensive orientation relating to WPL practices that they can expect to encounter. Billett (2001) suggests that typical induction could include the role of the learner and the guide, the organisational goals of WPL, and expected learning outcomes.

Cheetham and Chivers (2001) state that organisations should encourage novices to become self-directed learners who view all experiences as potential learning episodes. Chivers (2006) recognises that when employees are encouraged to become self-directed learners, they can possess the skills to seek out and recognise numerous opportunities for learning in the workplace which, in turn, enables workers to capitalise on these learning opportunities. The OECD (2007) ascertains that such encouragement is becoming increasingly important in contemporary labour markets which places pressure on the learner to engage in lifelong learning practices. Tikkanen (2002) maintains that learners should also be encouraged to identify their own learning needs and reflect on their WPL experiences. Cheetham and Chivers (2001) state that learners should be allowed adequate time and space to settle into their role.

Cheetham and Chivers (2001) suggest a range of techniques and skills that would assist novices to capitalise on their learning experiences. These include techniques for obtaining and utilising feedback and criticism, perspective switching, observation, and debriefing skills. They also suggest that novices should study theory such as experiential learning and learning cycles¹ and link these with actual experience. In addition, learners' awareness of their own learning style and ability to adopt a different learning style would be beneficial.

¹ For example: Kolb, D. (1984) *Experiential learning: Experience as the source of learning and development*, New Jersey: Prentice Hall.

2.4.3 Influences on learner participation

Learners determine their level of engagement in WPL and ultimately choose how and what they learn (Noe *et al* 2013). Billett (2002a) states that the learning opportunities afforded to an individual influence their perceptions of the workplace and, in turn, determine their level of participation in WPL. Continuing in this vein, Billett (2001) believes this selectivity approach enables learners to take control of their career development and trajectory.

Numerous authors categorise individual learner influences that are likely to enhance the frequency of participation in and the success of WPL. Marsick and Watkins (1990) identify pro-activity, creativity, and critical reflection as learner traits that contribute to successful WPL. Billett (2002a) believes that the learners' engagement often depends on their interest in the task, self-motivation, and satisfaction with their current performance. Learners are also aware that WPL is critical for successful career progression in contemporary organisations (Noe *et al* 2013). In addition, learner confidence, capability, prior knowledge (Chivers 2006), conflict, and confusion (Lehesvirta 2004) can also influence participation or provide an incentive for engaging in WPL.

Keep (1997) believes that the key to building a learning society is learner motivation. Billett (2004) states that even if learners are provided with learning opportunities and encouraged to participate, they can still decline to engage in them. Learners can exhibit varying degrees of participation for different tasks. Some tasks, they can choose to engage fully in, and others they can approach with reluctance. Billett (2002a) maintains that regardless of the learning opportunities offered to an individual, the learner chooses to participate in or disregard them. The learners' agency determines and regulates their intentions to participate and the benefits they reap from the opportunities afforded to them (Billett 2004).

Internal office politics can negatively influence learner participation. Boud and Solomon's (2003) study found that novice workers were often reluctant to label themselves as learners fearing the negative connotations that this would have on their perceived competence and their position within the workplace. Munro *et al* (2000)

concur with this sentiment and stating that learner engagement in WPL could be perceived as “an indicator of poor performance” (p. 526). However, Fuller and Unwin (2003b) ascertain that if the organisation recognises the novice worker as both a learner and an employee, the learning environment can be seen as expansive and supportive of WPL.

The above sentiments relating to the reluctance of learners to participate overlap with guides’ reluctance as discussed in section 2.3.4.2 which states that workers can be reluctant to participate if insufficient information exists about the process, if they are embarrassed about their existing knowledge or if they are concerned about their job security following learning episodes. In these situations, workers can withhold or obscure information. Organisations should develop measures to encourage and reassure non-participating workers.

Other influences on learner participation in WPL overlap with influences on guide participation; good learner-guide relationships (section 2.3.4.1) and availability of expert guidance (section 2.3.4.3). With regard to good learner-guide relationships, the literature suggests that learners’ should be aware of three considerations – their role in the relationship, mechanisms to foster a quality relationship with their guide, and approaches to maintain a quality relationship that promotes WPL. Also, when allowed to select their own guide, learners often choose guides they trust and who possess the appropriate knowledge, experience, workplace respect, interpersonal communication skills, values and ethics. As established in section 2.3.4.3, guides can be absent for a number of reasons including low staffing levels, significant changes in work practices, and the most applicable expert for a learner may work different hours or be geographically separated. In addition, the assigned guide may not have the appropriate knowledge, attitude or teaching approach (section 2.3.3).

2.4.4 Engagement in routine and non-routine tasks

According to the metacognitive functions of routines, everyday work activities can be conceptualised as routines that can be taught. Munby *et al* (2003) ascertain that routines give structure to the workplace and numerous routines can be combined to form a larger routine. Billett (2001) recognises that novice workers can participate in

activities that are routine or non-routine. Routine tasks are well-defined tasks that either occur frequently in the workplace or are familiar to the learner. Non-routine tasks are new tasks (either partially or in entirety) in which the learner has to construct new knowledge.

Munby *et al* (2003) reveal that as learners repeatedly perform a routine task, familiarity allows them to adapt and fine tune their response, thereby enhancing their overall performance. Billett (2001; 2002a; 2004) details that compilation of a routine task is achieved when the learner no longer has to conceptualise the individual steps involved in completing the task; rather, the task is completed in a single procedure with minimal cognitive thought. Billett (2001; 2004) ascertains that as progressively advanced approximations of routine tasks are achieved, the liberation of conscious thought enables the learner to perform higher order tasks such as monitoring progress or planning subsequent tasks simultaneously.

Non-routine tasks are new to the employee and engagement in them requires conscious thought as new knowledge is constructed. The learner draws on resources to understand the novel task and help gather the information required to complete it. In accordance with Piaget's theory of the far transfer of knowledge², Billett (2001) recognises that novice employees will be confronted with non-routine tasks more frequently than experts.

Skule (2004) states that a high degree of exposure to changes and demands, along with decision making and project management responsibilities are conducive to learning at work. Cheetham and Chivers (2001) believe that challenging or difficult work tasks, where the learner is thrown into the deep end can be particularly formative. Chivers (2006) encourages novice workers to welcome arduous tasks necessitating intense learning, as opposed to avoiding them. Such tasks are excellent learning experiences as they provide ample opportunity to develop new competencies, collaborate with skilled colleagues, and reflect on their own learning. This sentiment was echoed in Tikkanen's (2002) study where the learning potential of novice workers

² According to Subedi (2004, pp. 593) far transfer "refers to learning new skills or performing new tasks in situations that differ significantly from the situations of original learning".

increased when faced with non-routine tasks. In addition, newly appointed novice employees stated that working on tasks was synonymous with learning (Tikkanen 2002). However, care must be taken when choosing such tasks, so that the learner is not overwhelmed which can result in negative outcomes (Cheetham and Chivers 2001). Eraut (2007) cautions that learners' morale could be harmed if they are over-challenged or under-challenged as novices.

Billett (2004) advocates that the organisation should make allowances for novice workers to engage in learning opportunities for routine and non-routine tasks in order to improve their vocational competencies. For this reason, both routine and non-routine tasks will be analysed in this study.

2.4.5 Goals and requirements for expert performance

The process of determining what it means to be an expert in the field can provide the goals for learning. Simply participating in workplace tasks may not adequately develop an understanding of the goals for performance. Billett (2001) maintains that workplaces should concentrate on developing guidelines for ensuring learners have access to both routine and non-routine tasks while also making explicit the sub-goals and goals required for the expert performance of those tasks. Clifford (2007) concurs and states that the required outcomes for a task should be made clear to the learner along with a prescribed approach for learning them. Billett (2001) warns when access to workplace tasks is restricted, learners may never comprehend fully what is required of them for expert performance.

2.4.6 The emergent theoretical framework – iteration two

The encouragement of learners to advance their own learning was discussed in section 1.3 as an emerging research issue that does not significantly influence current WPL practices. The literature suggests the following areas for exploring this topic. These suggestions are merged with Figure 2-1 and displayed in Figure 2-2 below.

- *Guide Selection* – includes learners choosing their own guide. As the guide can be appointed by the learner or the guide themselves, it will be moved into the intersection between the learner and guide factors.

- *Learner Preparation* – includes the adequate preparation of learners for their WPL role, the organisational encouragement to become self-directed learners, and allowing adequate time to settle into the learning role. As the preparation of learners significantly overlaps with the guide preparation, it will be moved into the intersection between the learner and guide factors.
- *Influences on Learner Participation* – includes good learner-guide relationships, reluctance of workers to provide guidance, and the availability of expert guidance. As the influences on learner participation significantly overlap with the guide influences, it will be moved into the intersection between the learner and guide factors.
- *Engagement in Routine and Non-Routine Tasks* – organisations should provide opportunities for learners to engage in both routine and non-routine tasks.
- *Goals and Requirements for Expert Performance* – the goals required for the expert performance of tasks should be made explicit to the learner.

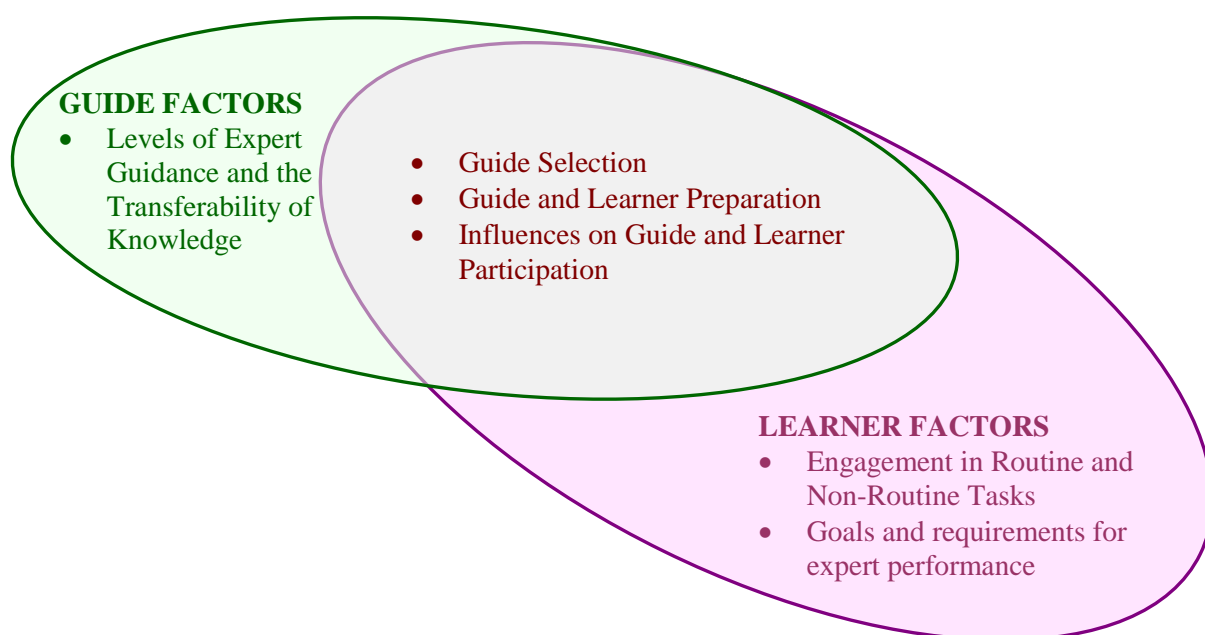


Figure 2-2 Theoretical framework - WCM and stakeholder influences (second iteration)

Source: Author

2.5 Organisational supports

Day (1998), reporting on a WPL study conducted by the Education Development Centre stated that the managers felt it was necessary to establish an environment conducive to informal learning both from a physical and an emotional perspective.

More recent studies found that organisational supports hugely facilitate WPL (Doyle *et al* 2008; Crouse *et al* 2011) and an unsupportive organisation inhibits WPL (Lohman 2005a). However, the junior pharmacists in Noble and Hassell's (2008) study felt that the support from the organisation and management was minimal.

Organisations have a distinct role in selecting the guide, preparing the guides and learners for WPL, and influencing guide and learner participation. They can also develop learning resources and policies to support WPL, whilst also providing for remote learning situations and catering for production demands overshadowing learning. The invitational nature of the workplace can also influence participation in WPL. Restricting learning opportunities, ineffective team structures, and insufficient time allocation directly hinder WPL. All of these points are discussed in the following sections. Following this, the third evolution of the emergent theoretical framework is presented.

2.5.1 Selecting the guide

Numerous guidelines for selecting appropriate WPL guides were provided in section 2.3.2 and the option for learners to choose their own guide was discussed in section 2.4.1. Billett (2001) maintains that when organisations are selecting a learning guide, they typically select the supervisor. However, this may not always be the best approach. Boud and Middleton's (2003) study reveals that supervisors were not always approached as the first port of call when learning. Hughes (2002) concurs with this sentiment. In Chivers (2011) study of investment bankers' WPL, peer team members and senior colleagues were informally chosen as guides rather than supervisors.

Sherman *et al* (2000) state that learners can be uncomfortable with their supervisor guiding their learning while also carrying out their performance evaluations. Volkoff (1996) concurs with this sentiment and recommends that performance appraisals should remain separated from the mentoring process. Le Maistre *et al* (2006) studied the conflicting dual role of the mentor and the evaluator. They found that the dual role worked when the learner was good, but stress was introduced when the learner

was not performing. Consequently, their recommendation was to separate the role of mentor and evaluator.

2.5.2 Preparing the guide and learner

Guide preparation was first discussed in section 2.3.3 where the importance of the preparation emerged. In particular, it held that organisations should intentionally prepare guides so they fully understand guided learning principles, active learning, knowledge construction, development of conceptual knowledge, the strategies and techniques that can be used, when to use these strategies, embedding strategies into work tasks, and the value of their relationship with their novice. Guides should also be open to having their performance monitored and feedback supplied on their progress.

The discussion on learner preparation (section 2.4.2) held that learners should be prepared by their organisation for WPL so that they understand the process and the typical approaches used. In addition, preparation should also address any concerns they may have, ensure benefits arising from engagement in learning are made explicit, develop self-directed learning techniques, make learners aware of their own learning style, help learners to grow to identify their own learning needs, and reflect on their WPL experiences. Typical induction could also include the role of the learner and the guide, the organisational goals of WPL, and expected learning outcomes. Learners should be allowed adequate time and space to settle into their role. Overall, the literature suggests that the organisation has a distinct responsibility to prepare both guides and learners for WPL.

2.5.3 Influences on guide and learner participation

In general, workers are willing to engage in WPL activities. Billett (2001) stated that organisations should strive to both meet the needs and engage the interests of its workers in WPL activities. Fuller and Unwin (2003a) recognise that an expansive WPL environment strives to develop both individual and organisational capability.

Billett (2001) recognises that in order for WPL to succeed and to maximise worker participation, the workers must trust the organisation's motives. Skule (2004)

maintains that organisational support should exist for the inclusion of and encouragement to engage in WPL practices. In particular, Fuller and Unwin (2003a) maintain that quality WPL environments reify their WPL practices through numerous artefacts such as documents, tools, symbols, and so on. Continuing in this vein, they state that these artefacts are made available to novices, whose status as a learner is explicitly recognised and supported in the workplace.

As discussed in sections 2.3.4.1 and 2.4.3, the relationship between the guide and the learner is crucial for successful learning in the workplace. Equally, it is crucial for organisations to nurture good learner-guide relationships. The previous discussion suggests that organisations should foster quality learner-guide relationships by imparting guidance on the nature of the learner-guide relationship and how best to foster a quality relationship so that collaborative learning can be achieved. When organisations prepare learners and guides involved in WPL, specifically in the area of co-operative supports and interaction, WPL is more successful.

In sections 2.3.4.2 and 2.4.3 it emerged that weak learning outcomes can occur when workers are reluctant to participate in WPL. These sections held that measures should exist that would reward those engaged in the process and allay experts' fears relating to job security as a consequence of engaging in the learning process. Particular attention should be afforded by organisations to encourage reluctant workers to participate.

As presented in sections 2.3.4.3 and 2.4.3, if experts are not available to guide the novice, WPL can suffer. Experts may be unable to provide guidance if they are geographically separated, work different shifts, too busy, use ineffective teaching methods, or perceived by the novice as an unreliable source for information. If expertise is not readily available in the workplace, organisations may have to look outside the community for experts.

2.5.4 Learning resources and policies

Fuller & Unwin (2003b) analysed three company's approaches to conducting apprenticeships in the steel industry. One company developed a comprehensive set of

learning resources for up skilling the novice worker. Each learning resource contained detailed learning objectives and a list of aims and procedures for achieving the particular task. A nominated mentor ensured that novice workers had the opportunity to access the learning resources and obtained the skills required for mastery. As the novice worker encountered each learning resource, the nominated mentor documented their skills acquisition. These records, when compiled together, formed a portfolio of achievements for the novice worker. This reification of learning resources strengthened WPL through the development of an explicit workplace curriculum while also ensuring novice workers had adequate access to learning opportunities. Fuller & Unwin (2003b) believe that an expansive WPL environment is structured and provides access to learning resources; such a pedagogical approach facilitates and improves deep learning of novice workers in the workplace.

Organisations can have formal WPL policies detailing a multitude of aspects related to learning in the workplace. They can be developed at organisational, departmental, or individual level (Clifford, 2007). Preston (2000), when referring to such policies, noted that they can include an annual target number of hours of WPL experiences for full-time workers along with typical strategies that would contribute to the hours such as self-directed learning, shadowing, and conferences.

2.5.5 Provide support for remote learning

Section 2.2 previously noted that virtual workplaces allow workers geographical and social separation and organisations should work towards minimising the gap between remote learners and their guides in order to improve WPL.

2.5.6 Production demands overshadowing learning

Tikkanen (2002) and Moore (2004) both recognise that the primary focus of contemporary organisations is production rather than the CPD of their workforce. Hagar (2004b) maintains that recent globalisation demands encourage the treatment of workers as economic units of labour as opposed to viewing the workforce as individuals wishing to engage in CPD. Moore (2004) ascertains that such a commercial perspective encourages workers to organise tasks in a manner that

facilitates job completion, as opposed to intentionally structuring them for learning purposes.

Harris *et al* (2001) suggest that the pressures and demands of a production environment can inhibit learning. The junior pharmacists in Noble and Hassell's (2008) study felt that their workplaces rated informal learning opportunities second to the provision of a service. Billett (2002a; 2003) cautions that insufficient learning opportunities can arise from the intensity of the workload or irregularities in production such as low staffing levels, variable production flows, and legislation changes. These demands reduce the opportunities for employees to engage in the learning process, irrespective of company learning policies and procedures that may be in place (Bélanger and Larivière 2005) and learning only takes place when time permits (Tikkanen 2002). Mentoring is not always welcomed during busy periods (Billett 2001) as it takes time and effort to engage in (Billett 2002a). This is an unfortunate dilemma, as busy periods often present numerous opportunities for learning (Billett 2002a).

2.5.7 Invitational nature of the workplace

Doyle *et al* (2008), when examining WPL barriers and facilitators, reported an "encouraging environment" (p.87) as one of the strongest facilitators of WPL. Lehesvirta (2004) reports learners' values, perspectives, and sentiments together with the culture of the learning environment strongly influence WPL processes. Billett (2002a) defines the co-participational nature of WPL as learner's cooperation combined with the invitational nature of the workplace. He suggests that understanding the co-participational nature of the workplace, learning opportunities made available through daily work practices and the use of WPL strategies, that valuable insights into WPL practices could be developed. However, it must be noted that just because a workplace provides for learning opportunities, it does not guarantee that workers will engage in the learning. Similarly, Lee *et al* (2004) believe that when a workplace is not specifically structured for learning it does not imply that learning will not occur. Two aspects that can particularly influence the invitational nature of the workplace are the team approach adopted in the organisation and the adequate provision of time to participate in learning opportunities.

2.5.7.1 Team approach to work

Section 2.3.4.1 identified that collaborative learning is one of the “richest sources of informal learning” (Day 1998, p.32). Working in teams and close supervision facilitate WPL by increasing the chances of engagement in it (Allen *et al* 1997; Cheetham and Chivers 2001; Nordman and Hayward 2006). Bélanger and Larivière (2005) conducted a study of research and development teams in pharmaceutical companies. This research found that the division of work and the allocation of tasks amongst team members have a significant impact on participation in WPL. In particular, if the tendency of experienced team members is to allocate mundane tasks to novice workers, opportunities for learning from experts will be limited, particularly as the novice employee would typically work in isolation on such tasks. However, if task democracy is practised, where novices are exposed to tasks of increasing responsibility, interaction is encouraged, thereby facilitating inter-learning relationships and nurturing WPL efforts. Cheetham and Chivers (2001) ascertain that WPL is particularly effective when teams are confronted with novel or challenging work.

2.5.7.2 Adequate time to practice and participate

Those engaging in WPL should be afforded adequate time to utilise learning resources and practice (Allen *et al* 1997; Dale and Bell 1999; Skule 2004, Crouse *et al* 2011). Studies examining the barriers to and facilitators of WPL report the lack of time as a significant barrier to successful WPL (Lohman 2005a; Hicks *et al* 2007, Doyle *et al* 2008, Noble and Hassell 2008).

Lohman (2005a) recommends that IT professionals should be afforded more ‘unencumbered’ time which they could devote to WPL. Doyle *et al* (2008) suggest that organisations could help with the identification of suitable, quality learning opportunities whilst also offering time-management courses to those participating in WPL.

2.5.8 The emergent theoretical framework – iteration three

The organisational structure and an encouraging environment can significantly impact the quality of WPL and the level of support the learner receives. Arising from the

above literature review, the following organisational supports are presented for exploration. These points are merged with Figure 2-2 and displayed in Figure 2-3.

- *Guide Selection* – includes the organisation carefully choosing the guide and the choice of the supervisor or alternative expert as the guide. Currently this topic is located in the intersection between the learner and the guide. However, as the organisation can have a significant influence on the selection of the guide, this topic is placed in the intersection between the learner, guide, and organisational supports.
- *Guide and Learner Preparation* – currently this topic is located in the intersection between the learner and the guide. As the organisation has an explicit role in preparing the guides and learners for their WPL role, this topic is placed in the intersection between the learner, guide, and organisational supports.
- *Influences on Guide and Learner Participation* – currently this topic is located in the intersection between the learner and the guide. As the organisation should strive to both meet the needs and engage the interests of its workers in WPL activities, this topic is placed in the intersection between the learner, guide, and organisational supports.
- *Learning Resources and Policies* - developing structured learning resources, providing access to them and monitoring the learner's progress with the resources can facilitate and improve deep learning for entry-level workers in the workplace.
- *Provide Support for Remote Learning* - organisations should provide for remote learning by minimising the gap between geographically and socially separated learners and their guides.
- *Cater for Production Demands Overshadowing Learning* - the pressures of a production environment can reduce the number of learning opportunities for novices to engage in, thereby inhibiting WPL.
- *Invitational Nature of the Workplace* – this can influence participation in WPL. Organisations should encourage workers to participate in WPL. Factors directly hampering the invitational nature of an organisation include ineffective team structures and not providing enough time to participate in WPL.

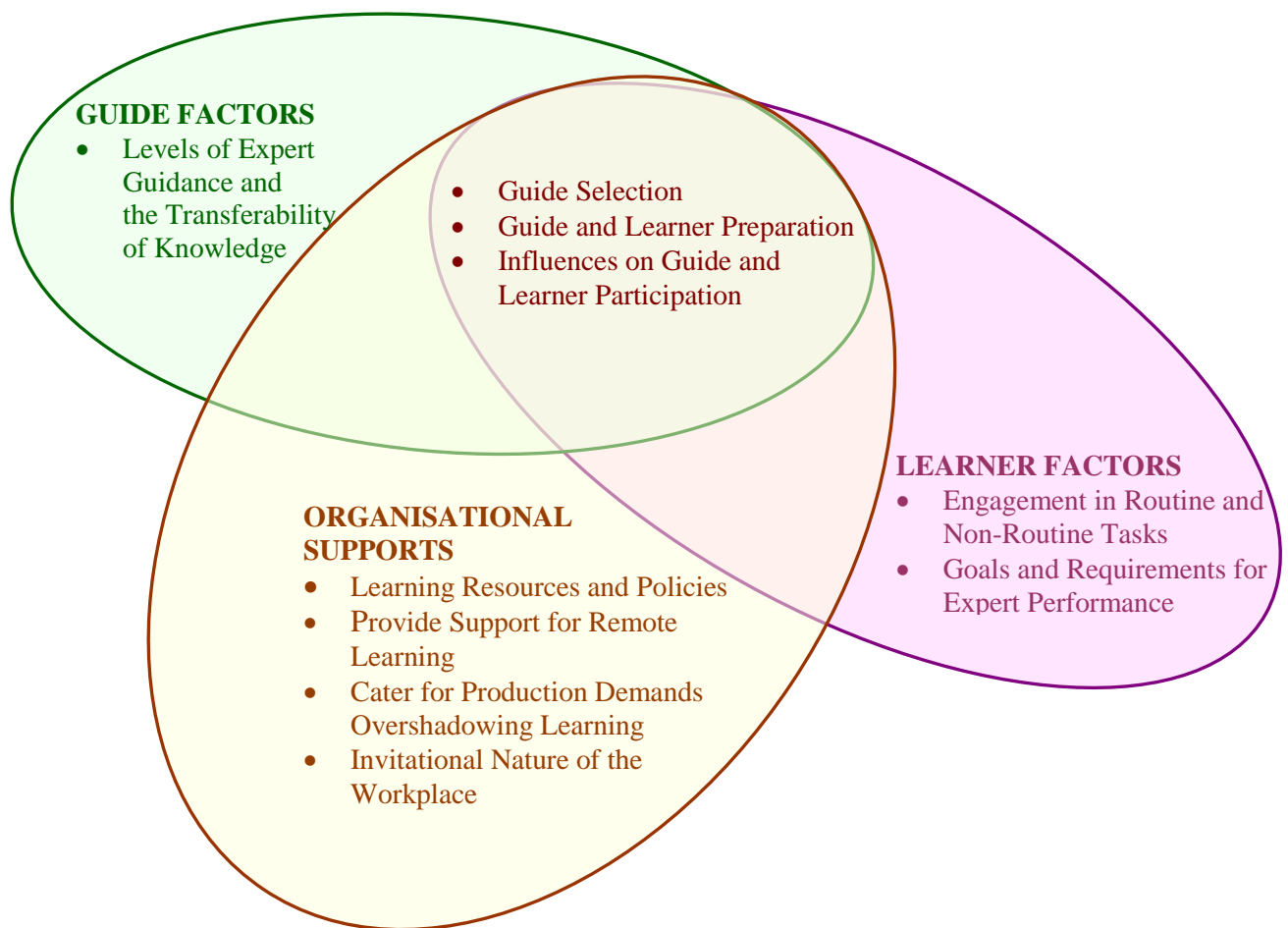


Figure 2-3 Theoretical framework - WCM and stakeholder influences (third iteration)

Source: Author

2.6 Learning opportunities

Sufficient access to learning opportunities in the workplace is crucial for WPL as is the safeguarding of novices against learning inappropriate or incorrect knowledge. Opaque or hidden knowledge such as the conceptual knowledge associated with a task can be difficult to learn through WPL. Each of these points is addressed in the following sections. Following this, the fourth evolution of the emergent theoretical framework is presented.

2.6.1 Access to learning opportunities

Honey (1994, p. 182) defines learning opportunities as “everything that happens, nice or nasty, planned or unplanned, trivial or substantial” and suggests organisations should actively encourage workers to seek out their own learning opportunities.

Workplaces invite their employees to engage in learning opportunities (Honey, 1994). The respondents in Armson and Whiteley's (2010) study appeared to pursue learning opportunities. Billett (2001) maintains that the types of activities that learners are exposed to in the workplace shape the learning process with numerous workplace factors and interests determining an individual's level of exposure to these learning opportunities.

Keep (2000) and Bryson *et al* (2006) recognise that workplaces are contested terrains, often deliberately restricting opportunities for certain workers to engage in WPL. Stroud and Fairbrother (2008) found that access to learning opportunities can be irregular and often inaccessible for some workers. Munro *et al* (2000) maintain that supervisors can act as gatekeepers and can be pivotal to novices accessing learning opportunities.

Ashton (2004) found that regular access to workplace activities is necessary in order to develop vocational expertise in the workplace. Billett (2001) maintains that if access to these activities, particularly non-routine activities, is restricted for an individual, it follows that their learning will be curtailed. This, he believes, could result in difficulty appreciating the requirements for expert performance, which in turn could inhibit their ability to demonstrate expert performance.

Following a review of contemporary literature, Lee *et al* (2004) report workplace factors influencing the availability and intensity of learning opportunities can comprise racial, linguistic, gender or tenure discrimination. Other selectivity decisions can include age, gender (Munro *et al* 2000), company size, employee tenure, employee qualification (Keep 2000), industry type, employee turnover rate, and unionisation (Frazis *et al* 1998; Stange 2002).

Both Ashton (2004) and Lee *et al* (2004) also found that workers keen to protect their position in the organisation, view knowledge as a competitive resource, and often adopt the 'knowledge is power' stance. Ashton (2004) also found that experienced co-workers can limit novices' access to knowledge and learning opportunities as they may fear future displacement or promotional competition from the novice. Bryson *et al*s (2006) study found that managers may restrict access to learning if it is not in line

with their overall objectives and competitive strategies. Billett (2004) maintains that curtailing an individual's access to learning has a direct impact on the quality of their learning experiences. Reluctance to participate in WPL can negatively affect both the novice learner and the organisation (Billett 2001). Wertsch (1998, cited in Vaughan 2008) stated that workers can be reluctant to engage in the process if they perceive that only the employer's needs are being met and there is no benefit for the individual worker.

2.6.2 Safeguard against learning inappropriate knowledge

When learning in the workplace, it is inevitable that learners can acquire undesirable work practices or inappropriate knowledge such as inept short cuts, bad habits (Dale and Bell 1999), and unsafe or dangerous practices. Billett (2001) maintains that, in addition to inappropriate work practices, learners can exhibit inappropriate attitudes, values and intolerances that are readily accessible and rewarded in the workplace. When inappropriate practices and behaviours are exhibited in the workplace, these are likely to influence the learning that occurs there. Such inappropriate learning can have a negative effect on organisational performance (Turner and Jackson-Cox 2002). Billett (1995) found that the organisation may need to select experts and activities in order to avoid novices obtaining inappropriate knowledge.

2.6.3 Difficulty learning opaque knowledge

Billett (1995) raised the concern that sufficient understanding and conceptual knowledge is not being achieved through engagement in everyday work practices. Conceptual knowledge is often obscured from learners in the workplace. Billett (2001) maintains where conceptual knowledge is accessible, it may be incomplete, disjointed or insufficient for developing a comprehensive understanding of the task being learned. Prawat (1993) suggests that situated learning, such as WPL, typically favours the development of procedural knowledge at the expense of conceptual knowledge. Berryman (1993) stated that the increasing complexity of contemporary work renders acquiring conceptual knowledge a crucial task.

As conceptual knowledge is very important for technology-driven enterprises (Berryman 1993), it is important to maximise its development through efficient WPL

practices. Billett (1995) reported that in order to make opaque knowledge visible, instructional interventions may be called for. Billett (2001) states that expert guidance, structuring of workplace experiences, instructional approaches, access to theory, or other strategies could render understanding and conceptual knowledge accessible to the novice worker.

2.6.4 The emergent theoretical framework – iteration four

Research into procedural aspects such as the provision of learning opportunities could provide a richer understanding of WPL (section 1.3). Arising from the above discussion, the following topics associated with learning opportunities should be explored. These topics are merged with Figure 2-3 and displayed in Figure 2-4.

- *Access to Learning Opportunities* – as numerous workplace factors can influence the availability and intensity of learning opportunities, the natural location for this topic lies in the intersection between organisational supports and learning opportunities.
- *Safeguard Against Learning Inappropriate Knowledge* – it is inevitable that novices can acquire bad habits, short cuts, and mimic unsafe practices as well as exhibit inappropriate attitudes and values when learning in the workplace. As the literature suggested intervention from the organisation in these situations, this topic will be placed in the intersection between organisational supports and learning opportunities.
- *Difficulty Learning Opaque Knowledge* - conceptual knowledge is often obscured from learners in the workplace and when it is accessible, it may be incomplete, disjointed or insufficient. The literature calls for general interventions such as access to theory, expert guidance, instructional approaches, and structuring of workplace experiences. As these suggestions imply organisational support, this topic will be placed in the intersection between organisational supports and learning opportunities.
- *Goals and Requirements for Expert Performance* – this topic was originally discussed in section 2.4.5 and placed in the learner area of the theoretical framework. Clear goals and expectations for all involved facilitates WPL. As each learning opportunity has its own specific goals and requirements for expert

performance, it stands to reason that this topic should be moved into the intersection between the learner and the learning opportunity.

2.7 WPL strategies

Professionals acquire significant knowledge and skills through WPL and do so using a wide variety of approaches (Chivers 2006). Hicks *et al* (2007) found that learners use various learning strategies. Gerber *et al* (1995) state that there is no limit to the amount of strategies pertinent for learning in the workplace. Honey (1994) detailed 101 strategies for developing people. Eraut (2007, p. 420) calls for learners, guides, and management to “have greater awareness of the range of ways through which people can learn in the workplace”.

Numerous authors identified a range of strategies through WPL studies. Gerber *et al* (1995) studied the self-directed learning of 21 white-collar employees working in four different organisations. Dale and Bell (1999) identified several strategies facilitating WPL. Harris *et al* (2001) studied the contributions of the workplace environment to both on-the-job and off-the-job learning of apprentices in the construction industry. Cheetham and Chivers (2001) conducted empirical research across 20 professions to determine which WPL strategies contributed most to becoming fully competent in their discipline. Tikkanen (2002) identified numerous WPL and problem solving supports used in technology-intensive Small and Medium-sized Enterprises (SMEs). The Learning at Work Survey (LAWS) quantitatively measured the importance of various activities for improving work performance (Felstead *et al* 2004a). Skule (2004) studied eleven different organisations in both private and public sectors, in conjunction with a large scale explorative study, in an effort to identify the factors most conducive to learning at work. The Bélanger and Larivière (2005) study listed several forms of support for WPL activities among participating Bio-Pharm organisations. Billett (2001; 2003), in his extensive work on WPL, identified several techniques. Livingstone (2001) recommended that future research on adults’ WPL should clearly distinguish between individual and group self-directed learning and informal education that involve mentors. Table 2-3 correlates these studies into five strategy categories – Instructional Model of Learning, Other Inter-collegial, Self-directed, Intra-organisational, and Extra-organisational Strategies.

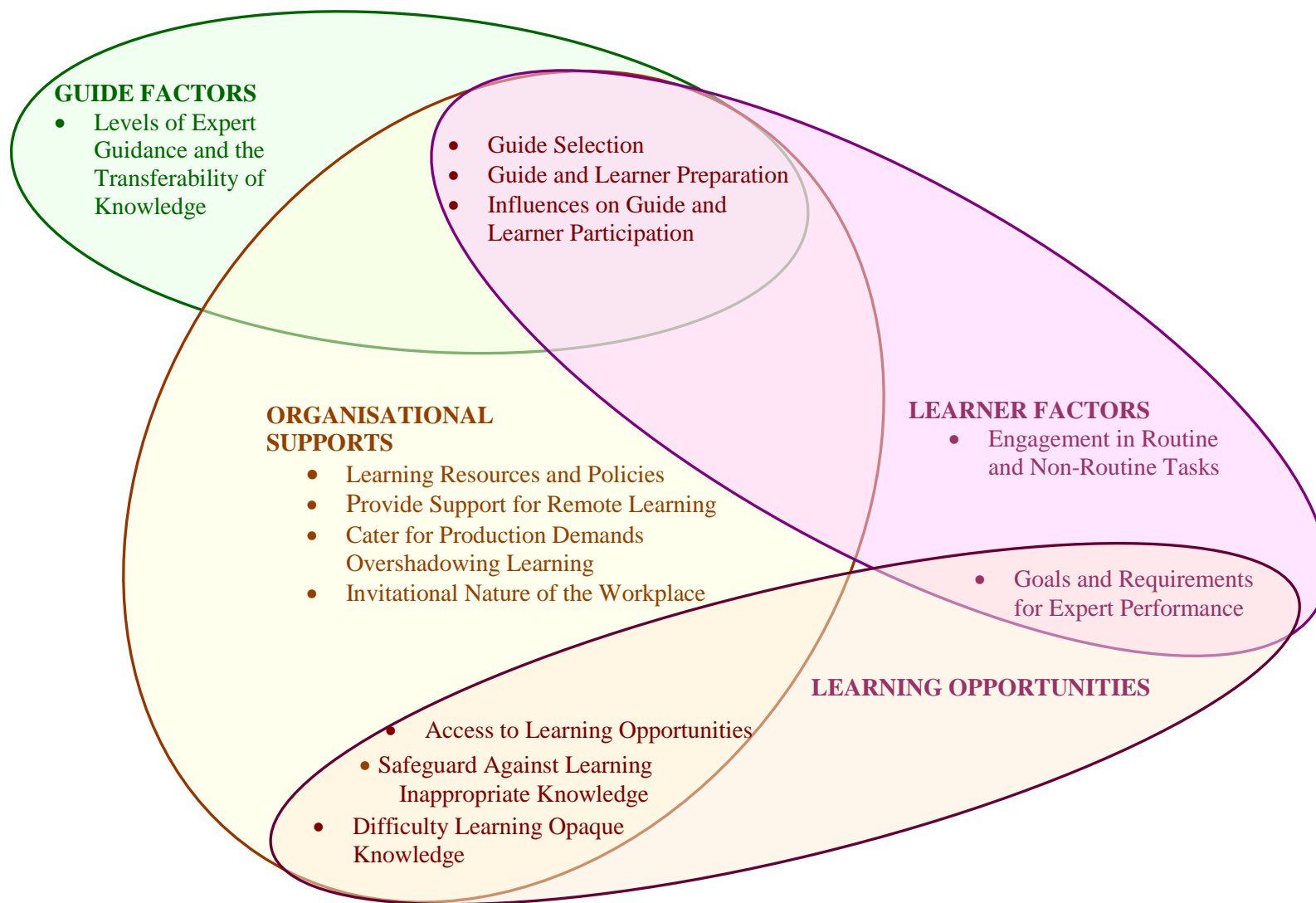


Figure 2-4 Theoretical framework - WCM and stakeholder influences (fourth iteration)

Source: Author

Table 2-3 Studies of WPL strategy use

Source: Author

	Gerber <i>et al</i> (1995)	Dale and Bell (1999)	Harris <i>et al</i> (2001)	Cheetham & Chivers (2001)	Tikkanen (2002)	Felstead <i>et al</i> (2004a)	Skule (2004)	Bélanger & Larivière (2005)	Billett (2001; 2003)
Instructional Model of Learning (Collins <i>et al</i> 1987)									
Modelling (Direct instruction / Demonstration)		√	√	√		√			√
Analogies									√
Diagrams									√
Coaching		√		√				√	√
Scaffolding and fading			√	√					√
Articulation				√					√
Questioning		√	√						√
Learning through teaching others	√			√					
Discussion	√	√			√				√
Reflection	√	√		√	√	√			
Learning from mistakes	√	√	√	√		√			
Exploration			√						
Other Inter-collegial Strategies									
Observation	√	√	√	√		√			
Shadowing		√		√					
Feedback	√			√			√		
Performance appraisal system	√	√		√		√			
Maintaining learning logs		√		√					
Self-directed Strategies									
Practice and repetition		√	√	√					
Access to learning materials and resources	√	√			√	√	√	√	
Intra-organisational Strategies									
Individualised career development plans								√	
Rewards for proficiency and achievement	√	√					√		
Mechanisms for integrated exchange	√				√			√	
Knowledge bases of previous problem solutions					√		√		
Stretching activities				√			√	√	
Perspective switching				√					
Extra-organisational Strategies									
Networking	√			√			√	√	
Contact with customers / suppliers				√	√		√		

To facilitate WPL, there should be greater participant awareness of the appropriate use of strategies (Billett 2001). When identifying suitable WPL approaches, workplace

educators are encouraged to explore several different strategies, rather than focusing on one in particular (Chivers 2006). Crouse *et al* (2011), when studying the individual and organisational outcomes arising from the WPL of HRM practitioners, found that strategies that involved the learner carrying out work tasks tended to be used more frequently. Often, the choice of strategy will greatly depend on its suitability for everyday use and aptitude to develop knowledge and understanding (Billett 2001). Workplaces have been noted for their ability to develop vocational and procedural knowledge but criticised for their aptitude to instil conceptual knowledge (Billett and Rose 1997, cited in Harris *et al* 2001). The following sections explain each strategy listed in Table 2-3 and include, where applicable, any pertinent barriers or facilitators associated with their use.

2.7.1 Instructional Model of Learning

Cheetham and Chivers (2001) define instruction as “the inculcation of specific knowledge or skill-related principles to one or more individuals at the same time” (p.257). Collins *et al* (1987) provided a model of instruction that comprises six strategies as can be seen in Figure 2-5.

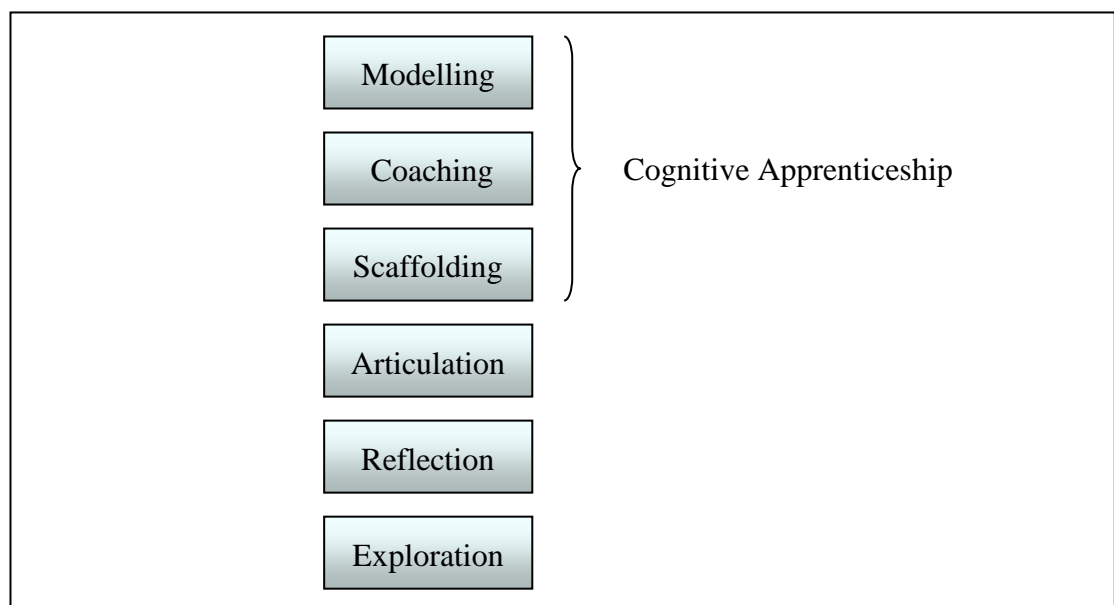


Figure 2-5 Instructional Model of Learning

Source: Collins *et al* (1987)

The cognitive apprenticeship approach is typical of the traditional trade apprenticeship model where learning is achieved when novices and experts interact to complete

authentic tasks (Dennen 2004). The cognitive apprenticeship approach comprises the first three Instructional Model of Learning strategies – modelling, coaching, and scaffolding. These are typically used sequentially in the workplace. This apprenticeship approach enables novices to obtain cognitive and meta-cognitive skills through observation and supported learning (Collins *et al* 1987). The frequency and duration with which these three strategies are used will be determined by the learner's needs and also the task requirements (Billett 2001). When scaffolding, workplace educators should be cognisant of when and how to fade, in order to nurture self-directed workers (Harris *et al* 2001). The cognitive apprenticeship is hailed as the best method for fostering WPL (Prawat 1992).

In order to develop self-correction and evaluation techniques, two further elements were appended to the cognitive apprenticeship model, namely articulation and reflection (Collins *et al* 1987). The final element completing the Instructional Model of Learning – exploration, facilitates learners' self-sufficiency by encouraging them to frame their own problems requiring resolution (Collins *et al* 1987). Each of the components of the Instructional Model of Learning are discussed in the following sections.

2.7.1.1 Modelling

Modelling is a WPL approach involving instruction and demonstration techniques (Dale and Bell 1999) and where the novice observes the expert performing different parts of particular tasks (Collins *et al* 1991). Often details are furnished to the learner throughout the demonstration (Harris *et al* 2001). This strategy usually employs telling and showing techniques (George 1997). When modelling, the expert will often show the novice the “target processes” (Collins *et al* 1991, p.7).

One typical modelling approach involves experienced worker initially demonstrating the task at the normal speed so the novice can understand the task and develop their own goals for overall task performance. The task is then demonstrated at a slower pace, where it is divided into subtasks that must each be understood by the novice employee (Billett 2001). This form of imitation is known as behavioural modelling (Dennen 2004).

Modelling assists the novice's understanding of workplace tasks in two ways. Firstly, it makes learning accessible by uncovering goals for performance that typically would not be revealed through discovery learning alone. Secondly, it allows novices to observe and understand both the desired and undesired goals for performance while also providing them with an opportunity to 'operationalise' their new knowledge by attempting to perform the task themselves. Modelling facilitates learner-guide socialisation and provides a mechanism for monitoring learner's progress (Billett 2001).

In Billett *et als* (1998) study on the use of WPL strategies, guides believed that they would use modelling regularly when engaging in future WPL practices. It also emerged that learners who were exposed to frequent modelling in the workplace reported obtaining a great deal of conceptual knowledge. Dennen (2004) reports that better learning transpired when individuals intentionally engaged in and structured the modelling process. Some limitations of the modelling process did emerge in the Billett *et al* (1998) study. Guides identified difficulty in modelling technical systems and consequently believed this approach was not suitable for all disciplines. Other concerns included: difficulties associated with modelling in geographically and operationally dispersed workplaces, the time intensive nature of the approach, and placing the learner in a passive role.

Two specific modelling strategies are discussed in the following sections – analogies, and diagrams and models. In Billett *et als* (1998) study, the most frequently used strategy was questioning, followed by coaching, modelling, analogies, and finally, diagrams and models. Coaching is discussed in section 2.7.1.2 and questioning is discussed in section 2.7.1.4.

Analogies

An analogy can be used as a learning intervention to relate one familiar concept with another, less known one. Pedone *et al* (2001) state that numerous studies have shown analogies can be successfully used when problem solving. Craig (2010) maintains that analogies are used to explain concepts and facilitate understanding. Nokes' (2009) study found that analogies are used a knowledge transfer mechanism.

Billett (2001) recognises that analogies can make learning relevant, facilitate the retention of information, and be valuable when explaining difficult concepts. Accepting this, he considers that it can be time consuming to develop worthwhile, relevant analogies and the desired inferences between the well-known concept and the new concept were not always evident to the learner, often resulting in the learner drawing incorrect associations.

In Billett *et als* (1998) study on the use of WPL strategies, guides reported not using analogies frequently nor did they widely report their intentions to use the approach in the future. This could be attributed to the lack of mentor preparation to use this strategy. Guides cited difficulty with developing the right analogy.

Diagrams and models

Pedone *et al* (2001) recognise that diagrams can be used as analogies. Diagrams and models can be used to illustrate concepts that are difficult to explain. They are readily accessible to learners and can provide concise explanations of concepts that would prove more time consuming to explain by alternative means (Billett 2001). Diagram and model use may not be applicable to all concepts and disciplines. However, the strategies are particularly relevant for the computing discipline where they can be used to explain a plethora of concepts from flow of control in systems to organisational structures. High quality diagrams and models are time consuming to generate and often mentors do not possess the required skills to develop them. Diagram and model use also encourages passive learning (Billett 2001).

In Billett *et als* (1998) study on the use of WPL strategies, diagrams and models were the least used strategy within the cognitive apprenticeship, however, guides suggested that they intended to use the strategy in the future.

2.7.1.2 Coaching

Coaching occurs when novice employees perform tasks while experts monitor their performance, offer feedback (Collins *et al* 1987), and oversee their learning (Collins *et al* 1991). Thorpe and Clifford (2003) go further to define coaching as “the process of helping people enhance or improve their performance through reflection on how they apply a specific skill and/or knowledge” (p. 34). Clifford (2007) reveals that coaching

is useful for enhancing performance, transferring learning to other situations, and as a form of induction for new employees.

Billett (2001) identified a coaching process where initially, the novice attempts the task based on the information acquired during the modelling process. Then, close guidance and monitoring enables the novice to attempt numerous increasingly mature approximations of the task, or subtasks, eventually realising finely tuned performance at expert level. Such an approach to coaching provides an opportunity for learners to obtain conceptual knowledge and to engage in collaborative learning.

In the Chartered Institute of Personnel and Development's (CIPD) *Annual Learning and Development* survey (2009), 90% of the respondent organisations used coaching. This figure was up from their 2006 survey which reported 79% of respondents used coaching. In Jarvis *et als* (2006) study, line manager coaching was used by 88% of the organisations with significant increases in its use expected in the years following the study. This study also revealed that coaching was used primarily to improve workers' performance, productivity, and skills and the case study organisations reported the use of internal coaches was effective. In Billett *et als* (1998) study of WPL strategy use, guides reported widely using coaching, however they did report difficulties associated with it i.e. engaging remote learners, the approach being time consuming, and deciding when coaching is the most suitable approach.

2.7.1.3 Scaffolding (and fading)

Vygotsky (1978) proposed the 'zone of proximal development' which describes the gap between the tasks the learner can perform on their own and the tasks the learner can complete with assistance or guidance. Building on this concept, Wood *et al* (1976) used the term 'scaffolding' to describe the process where guides support learners whilst they are attempting a task just outside their zone of proximal development.

Scaffolding allows the learner to practise tasks autonomously while being supported and guided by experts. Thorpe (2002) states that with such support, learners generally attempt tasks exceeding their immediate capability that they cannot yet perform

independently. Harris *et al* (2001) maintain that experts can stay with the novice to provide extra support or start a task and get the novice to finish it, or vice-versa.

Before implementing a scaffolding approach, Le Maistre *et al* (2006) report that the learner's skills levels must be considered in order to determine their readiness for a particular task; it should be just beyond their capabilities. When learners are ready for a task, they attempt the task whilst being monitored and supported by experts (Collins *et al* 1987).

Le Maistre *et als* (2006) study of mentoring relationships found that withdrawing scaffolds was essential in the learning process. As future attempts are made at the task, 'fading' is implemented where the support system is progressively removed until the learner can perform the task both unaided and expertly (Dennen 2004). Machles (2003) state that the expert could remain nearby to assist if required.

It is important that the correct balance between scaffolding and fading is achieved so that novices are allowed freedom to develop and learn through trial-and-error approaches (Cheetham and Chivers 2001). Striking this correct balance engenders learners' confidence in their abilities and encourages them to approach tasks in a self-directed manner (Harris *et al* 2001).

2.7.1.4 Articulation

Articulation occurs when learners offer a dialogue of their thought processes and problem solving approaches. It can involve many techniques such as questioning learners or getting them to explain their reasoning while actively working on a task (Collins *et al* 1987). Articulation can also involve the learner engaging in verbal reflection (Dennen 2004), giving lectures, presenting at conferences, writing articles, and developing learning materials (Collins *et al* 1987).

Respondents in Cheetham and Chivers' (2001) study found oral and written articulation practices to be an important strategy for learning. Engaging in this process encouraged learners to explain, critically appraise, and justify their approach to work tasks. In a later study, Chivers (2011) learned that writing reports or giving

presentations were powerful learning experiences. Three specific articulation strategies, questioning, learning through teaching others, and discussion are now presented.

Questioning

Dale and Bell (1999) consider questioning as an instructional technique that encourages deeper understanding. It involves the experienced practitioner posing questions to learners, to which the learner provides an answer. According to Honey (1994), questions can be open or closed; closed questions typically require a direct answer and generally don't encourage further discussion whereas open questions provide better learning opportunities as they stimulate more complex answers, thereby provoking further discussion. Posing multiple questions encourages the learner to clarify and rationalise their reasoning which actively develops their conceptual thinking (Billett 2001).

In Billett *et als* (1998) study, guides used questioning more so than any other technique specifically designed to develop conceptual learning. It emerged that the guides found it a straightforward way engage learners in tasks while also providing the ability to supervise learner's progress, understand their requirements, and guide their learning. However, concerns emerged in the study regarding learner perceptions of this technique; if not used appropriately, it could appear interrogatory and threatening in nature. Success with this learning technique could rest with the learner's view of questioning as a learning approach rather than a surveillance technique. The findings from this study further highlight the importance of preparing the guides for their role and fostering solid relationships between the learner and the expert (see section 2.3.4.1).

Learning through teaching others

In the Cheetham and Chivers (2001) study, many respondents identified that they actively learned when teaching others. The sentiment was echoed a decade later when Crouse *et al* (2011) studied the WPL of HRM practitioners. In this study, learning through teaching others emerged strongly as a WPL strategy with one respondent maintaining that teaching courses improved her understanding.

Gerber *et al* (1995) identified that learning through teaching others, facilitating learning in the workplace, developing training materials, and planning learning episodes contributed to WPL.

Discussion

In Dale and Bell's (1999) study, discussion was encouraged as a WPL strategy. Lohman (2005a), when studying the informal learning strategies of IT practitioners, reported talking with others as the second most popular strategy after using the Internet.

Gerber *et al* (1995) state that talking to fellow workers and experts facilitated WPL. Support from group discussions and incidental discussions, such as informal chats over coffee breaks, also contributed to WPL and were considered as important as pre-arranged meetings and discussions (Tikkanen 2002). Honey (1994) states that discussions at meetings provide learners with opportunities to learn about the subject matter, meeting structure, and participant behaviour throughout the meeting.

2.7.1.5 Reflection

Kolb's (1984) learning cycle identifies reflection on experiences as one of the four stages in learning. Clifford (2007) continues in this vein, recognising reflection as an essential component in the learning process. In many disciplines, reflecting on learning is characteristic of professional learning (Roberts *et al* 2005). Schön (1983) advocates that reflection can occur when a professional is currently in the midst of working on a task or it can occur after a task has been completed. In Dale and Bell's (1999) study, all respondents were encouraged to reflect on their learning.

Learners can reflect on their performance, thought processes and problem solving approaches by comparing them with those of an expert or peer (Collins *et al* 1987). They can also reflect on how they learn, the resources they used, and their engagement in WPL (Gerber *et al* 1995). This enables them to adjust their performance accordingly until they reach expert level (Collins *et al* 1987). Houldsworth *et al* (1997) suggested that effective learning can be achieved when workers reflect on tasks they encounter in the workplace and apply their reflections to future tasks.

A number of respondents in Cheetham and Chivers' (2001) study identified reflection, both individual and group, as a valuable approach when learning informally. They cited several reflective techniques for evaluating the learning experience such as self-assessment, collaborative reflection, learning from mistakes, maintaining reflective journals, and reflecting on others activities.

Eraut (2007) maintains learning from mistakes can involve not only learning from one's own mistakes but also from colleagues' mistakes. Honey (1994) states that making mistakes can provide valuable opportunities for learning, if they are handled in a non-accusatory manner. Day (1998) reported organisational cultures that encourage workers to learn from their mistakes whilst also openly discussing them facilitate WPL.

In the Gerber *et al* (1995) study, the interviewees reported learning through trial and error approaches such as attempting to solve a problem using any approach or means available to them. Interestingly, reflection is a strategy in the third level of Billett's (2001) model of expert guidance where learners are encouraged to self-assess their progress and compare it with that of other workers (section 2.3.1). Section 2.9 highlights that quality WPL environments provide for planned time off-the-job for reflection (Fuller and Unwin 2003a).

2.7.1.6 Exploration

Exploration is where learners autonomously problem-solve when all supports have been faded out (Collins *et al* 1987). At this stage of the Instructional Model of Learning, learners should be encouraged to frame their own problems requiring resolution (Collins *et al* 1987). In the Harris *et al* (2001) study, learners were encouraged to 'find their own way' or try their own approaches prior to seeking assistance.

2.7.2 Other Inter-collegial Strategies

Other strategies, based on learner-guide interactions, considered outside Collins *et als* (1987) Instructional Model of Learning are discussed in this section. These include observation and feedback.

2.7.2.1 Observation

The workplace environment also provides indirect guidance to novice workers through observing and listening to other workers (section 2.8.3.2, principle 4). Many skills are learned in this way. Learning-by-watching is a legitimate WPL approach where the novice worker learns by observing and listening to experienced colleagues while they undertake work tasks or discuss these tasks with other workers. By observing experienced workers, the novice can understand the goals and requirements for expert performance through the cues and clues available in the workplace. Observation also provides the novice with a benchmark for comparing their task performance (Billett 2001). Eraut (2007) states that observing and listening to other workers can help provide insight into their tacit knowledge. Nordman and Hayward (2006) suggest that observing experienced colleagues contributes greatly to 'human capital accumulation'. However, Lohman (2005a) found that observing others was the least used WPL strategy by IT professionals.

Chivers (2006) maintains experienced workers should be cognisant that their behaviour and task performance could be monitored closely by their novice colleagues and could be proving highly formative for them.

Through the observation, two types of learning can occur, namely imitation and identification. When learners imitate, they actively copy the behaviours of others. Identification involves the learner trying to be the same kind of individual whom they are learning from. However, this type of learning can be affected by concentration levels of novices and their desire to learn (Cheetham and Chivers 2001).

Observation can involve techniques such as shadowing, structured or informal observation of others, and using role models (Dale and Bell 1999; Cheetham and Chivers 2001). Shadowing is a formal extension of observation (Eraut 2007) and occurs when the learner works alongside and observes another colleague performing their job (George 1997). Clifford (2007) ascertains that learners watch, listen and observe without performing any of the tasks themselves. Shadowing sessions can be duration from an hour to much longer depending on the nature of the job and the learning objectives. The respondents in Cheetham and Chivers' study (2001) found

observation extremely valuable when developing their competence and most stated that they used established frameworks to facilitate critical and intense observation tactics.

2.7.2.2 Feedback

Honey (1994) asserts that providing feedback is a basic requisite for learning and development. Skule (2004) maintains that superior feedback is conducive to learning in the workplace. However, the respondents in Noble and Hassell's (2008) study reported receiving very little feedback. They felt that the absence of clear performance indicators and reports on their overall progress was a core barrier to their learning.

Feedback should be given constructively to facilitate learners to self-assess their performance (Dale and Bell 1999). The Dornan *et al* (2007) study of medical students' WPL found that positive feedback improved the students' confidence. Numerous respondents in Cheetham and Chivers' study (2001) stressed the importance of obtaining and listening to continuous feedback relating to their performance; in particular, constructive criticism was viewed as a valuable source of learning and negative criticism as having potential to damage the confidence or competence of the learner. Honey (1994) suggests, when criticism is given, that partnering it with praise makes the feedback session more effective.

Peer reviews, appraisals, and performance reviews are all forms of feedback. According to Honey (1994), appraisals review current performance and provide suggestions on how to improve. Gerber *et al* (1995) emphasise the crucial role of performance appraisal systems when providing feedback as they provide an effective manner for identifying learning needs, setting standards for assessing these needs, and measuring the achievement of the learning. Dale and Bell (1999) concurred, stating that performance standards should be put in place, known, assessed, and maintained.

Clifford (2007) identifies reflective logs as a record of the learning that ensues following a reflection on experiences. Honey (1994) defined learning logs to contain three elements – details of the learning experience, the conclusions reached about the

experience, and the plan on how to change behaviour based on the experience. Maintaining such learning logs and reflective journals facilitates the appraisal process through the recognition of progress (Dale and Bell 1999; Cheetham and Chivers 2001).

2.7.3 Self-directed Strategies

Day (1998) reported that workers must be encouraged to foster their own learning. Clifford (2007) ascertains that learners, when prompted to engage in self-study, take responsibility for their own learning by choosing what they want to learn, the method with which to learn it by, and when to stop learning (i.e. when they have learnt sufficient material). Billett's (2001) third level of expert guidance, discussed in section 2.3.1, features the utilisation of self-regulated learning approaches. Clifford (2007) advocates that self-study is time and cost effective, is flexible, suited to studying conceptual material, and encourages self-reliance. However, Smith's (2000) study of vocational learners found that they preferred directed learning as opposed to self-directed, independent learning. Self-directed Strategies identified in Table 2-3 include practice, repetition, and access to learning materials and resources.

2.7.3.1 Practice and repetition

Novices value learning opportunities where they can repeatedly practice new skills (Harris *et al* 2001). Repetition and practice are important for effective performance as it enables the learner to become proficient in a specific activity (Cheetham and Chivers 2001). It is important that time is allowed for practising (Dale and Bell 1999). Often experts demonstrate what is required and let the novice practice it (Harris *et al* 2001).

2.7.3.2 Access to learning materials and resources

The physical workplace environment provides indirect guidance to workers through the provision of tools and artefacts (Billett 2001). Self-directed learning is facilitated when the organisation makes learning materials available (Allen *et al* 1997; Tikkanen 2002). These learning materials can include books, manuals, catalogues, professional journals, the Internet, and internal handbooks (Tikkanen 2002). Other supports include university libraries and CDs (Bélanger and Larivière 2005).

The graduate engineers in Tikkanen's (2002) study reported referring to books and manuals for help when solving problems prior to approaching their colleagues. However, the extent that self-directed learning takes place greatly depends on the individual's characteristics, interests, and motivations. The ability of the individual to recognise their competencies and shortfalls also greatly impacts on the extent that they actively engage in self-directed learning (Tikkanen 2002). Lohman (2005a) reported that IT professionals cited using the Internet as the most popular informal learning strategy and they frequently shared materials and resources with each other.

Instructional media / computer-based training

Billett (1995) cautions against over reliance on instructional media i.e. computer-based training (CBT) as the knowledge obtained is often low-level, requires transfer to specific contexts in the workplace, and is unlikely to result in the achievement of complex work performance. Not all research finds this media in such poor light; indeed, Medarova *et al* (2012) maintain that current literature holds instructional media in good esteem. When Pirolli and Recker (1994) studied the use of a computer-based tutor to teach LISP (acronym derived from LISt Processing) to programming students they found, when students reflected on their problem solutions, that it appeared to help them understand the domain and improve learning.

2.7.4 Intra-organisational Strategies

Intra-organisational Strategies cover internal approaches directly supported by the organisations structure and policies. Six such strategies are discussed in the following sections.

2.7.4.1 Individualised career development plans

Individualised career development plans can be used as a strategy for WPL. Effective learning can be achieved when workers devise a plan, supported by the company, for their professional development (Houldsworth *et al* 1997). Some of the organisations studied by Munro *et al* (2000) had personal development plans for all employees supported by regular development meetings and others had adopted a similar but less formal approach of identifying the development needs of individuals.

2.7.4.2 Rewards for proficiency and achievement

Learning intensive workplaces reward proficiency (Skule 2004). WPL is maximised when organisations recognise achievement (Dale and Bell 1999). Rewards for proficiency and achievement offered by the organisation include achievement awards for high levels of accomplishment (Gerber *et al* 1995; Dale and Bell 1999). They can also include pay increases and promotion (Dale and Bell 1999).

Lohman (2005a) found that the use of monetary rewards and recognition for engagement in WPL did not significantly influence their engagement in WPL. Conversely, Billett (2001) states that if an expert is not recognised or rewarded for their WPL efforts they are less likely to offer assistance in current and future learning episodes. The reluctance of workers to participate in WPL was first touched upon in section 2.3.4.2.

2.7.4.3 Mechanisms for integrated exchange

WPL is supported through formally organised mechanisms for integrated exchange such as suggestion boxes, company newsletters, and frequent information sessions (Bélanger and Larivière 2005). Other organisationally supported mechanisms for integrated exchange include company bulletins and memos (Gerber *et al* 1995; Tikkanen 2002).

2.7.4.4 Knowledge bases of problem solutions

Tikkanen's (2002) study reported that learners referred to previous successful problem resolutions for assistance when engaging in work tasks. Skule (2004) concurred stating that access to databases of information contributed to WPL. In a study by Drohan (2005), several SE practitioners utilised knowledge bases as a tool for solving SE problems.

2.7.4.5 Stretching activities

Many of the respondents in Cheetham and Chivers' (2001) study identified that they learned a considerable amount by engaging in stretching activities such as working above their current grade, engaging in demanding, innovative or challenging work tasks, and being thrown in the deep end. Skule (2004) concurs suggesting that

exposure to demanding tasks and increased responsibility promotes WPL. Engaging in challenging work, when proper supports are in place, can increase motivation and improve learner confidence (Eraut 2007). Innovative organisations, by their very nature, create a demand for WPL (Bélanger and Larivière 2005). Fuller and Unwin 2003a maintain that quality WPL environments foster employee development through the provision of opportunities for boundary crossing (see section 2.9 for more detail).

2.7.4.6 Perspective switching

Switching perspectives involves initiatives such as deliberate role transfer, secondments, and working abroad. Mayo (2004) ascertains that secondments provide the opportunity for valuable learning through real-life experiences which usually take place abroad whilst Clifford (2007) maintains they enable the learner to gain wider experience, develop new skills and practice them in an alternative position. Noble and Hassell (2008) found, when junior pharmacists were rotated to different wards, it posed as a barrier to informal learning. This resulted in the learner having to forge new learning relationships which they maintain, can result in surface learning approaches being adopted.

Cheetham and Chivers (2001) believe that engaging in perspective switching initiatives enables a worker to see their role from another standpoint which could offer alternative approaches to tackling work activities. Fuller and Unwin (2003a) maintain that quality WPL environments increase breadth of learning through the fostering of cross-company experiences (this sentiment is expanded upon in section 2.9). However, Honey (1994) draws attention to the inconvenience associated with rotating an individual from a familiar role into a role where they would be inexperienced.

2.7.5 Extra-organisational Strategies

Extra-organisational Strategies, the final category identified in Table 2-3, cover WPL approaches found outside the organisation. These include networking and contact with customers or suppliers.

2.7.5.1 Networking

Honey (1994) defines networking as bringing people together, formally or informally, to discuss a common topic or exchange ideas. Many respondents in Cheetham and Chivers' (2001) study identified networking, both extra- and intra-organisational, as an important strategy for learning in the workplace. Ashton (2004) also found that networking was pivotal for accessing necessary information and learning opportunities (section 2.3.4.1).

Networking can take on many manifestations. Clifford (2007) identifies the trade fair as a networking opportunity; individuals with similar interests would gather there and learners could readily access diverse information sources. Previous studies have suggested involvement in external formal peer networks (e.g. professional bodies), specialised research centres or attendance at conferences and seminars as WPL strategies (Gerber *et al* 1995; Skule 2004; Bélanger and Larivière 2005).

Cheetham and Chivers (2001) maintain networking helps the learner by providing problem solving assistance and reaffirmation that the correct approach was adopted when tackling workplace tasks. Clifford (2007) states that networking can provide access to knowledgeable specialists, information about changes and developments, latest thinking, a chance to observe others' behaviours, and opportunities to develop accepted interpersonal skills.

As section 2.9 highlights, extensive professional contacts are conducive to WPL (Skule 2004) and quality WPL environments boast extensive participation in multiple communities of practice both internal and external to the workplace (Fuller and Unwin 2003a).

2.7.5.2 Contact with customers / suppliers

Contact with customers was identified as a WPL strategy in Cheetham and Chivers' (2001) study. Respondents learned through a number of avenues such as customer insights into solving their own problems and obtaining feedback from customers on performance. Direct contact with suppliers also included obtaining both information and technical support from them (Cheetham and Chivers 2001; Tikkanen 2002; Skule

2004). Eraut (2007) identified that engaging with customers involves learning about the customer and learning by dealing with their problems and requests.

2.7.6 The emergent theoretical framework – iteration five

Section 2.7 identified strategies found in a number of WPL studies and classified them into five distinct categories, namely, the Instructional Model of Learning, Inter-collegial Strategies, Intra-organisational Strategies, Extra-organisational Strategies and Self-directed Strategies. These five categories are merged with Figure 2-4 and displayed in Figure 2-6.

The next area to explore within the WPL theory is the environment in which these strategies are deployed. Consequently WPL pedagogy, embedded curricula, and motivations for developing WCMs are covered in section 2.8.

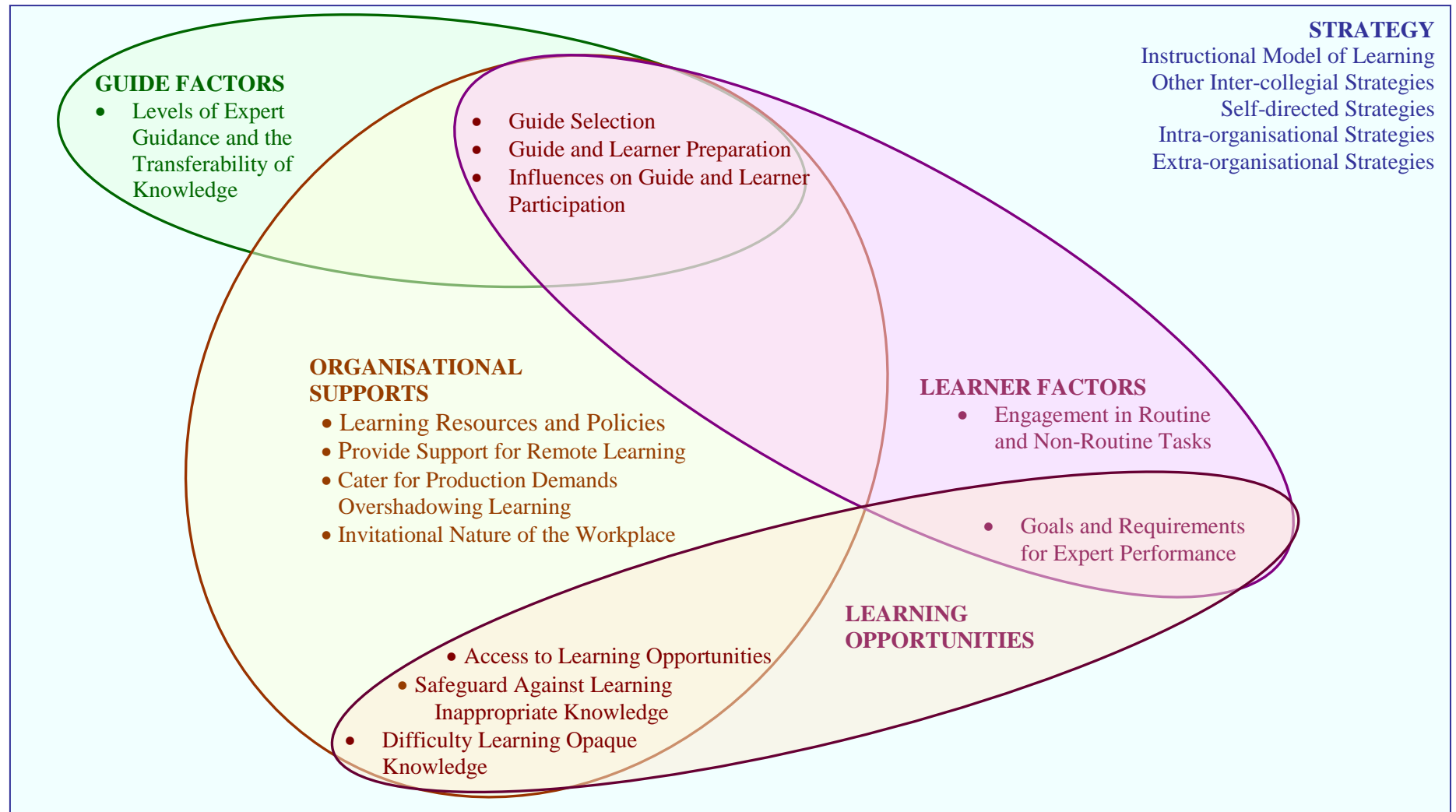


Figure 2-6 Theoretical framework - WCM and stakeholder influences (fifth iteration)

Source: Author

2.8 Workplace pedagogy

Moore (2004) defines workplace pedagogy as “the social organisation of the process by which newcomers [and members of the situation] encountered, engaged and used new forms of knowledge” (p.326). Billett (2004) stated that the participatory nature of WPL lies at the core of any workplace pedagogy and those establishments that have developed workplace pedagogies can use them to facilitate an understanding of the learning that is occurring in their workplace. Through this understanding, workplaces can respond to the plethora of elements threatening its survival. Billett (2002a) advocates the importance of the development of workplace pedagogy capable of supporting a learning culture of dynamic vocational expertise, highly responsive to change. Curriculum theory, which is central to pedagogy, is now discussed in the context of the workplace. Following that discussion, the motivations for developing a workplace curriculum are presented along with three existing WCMs from the literature.

2.8.1 Workplace curriculum

Workplaces have a form of “naturally-occurring curriculum” (Moore 2004, p.325) that is a socially organised, situational specific body of knowledge. Moore (2004) believes that this deliberate and evolutionary curriculum is experienced by both novice and expert workers as they engage in new tasks. Accepting and understanding this curriculum can result in a greater understanding of WPL. Moore (2004) ascertains that gaining insight into a workplace’s curriculum means understanding the manner in which knowledge is delineated, structured, and utilised.

The aim of workplace curricula is to develop both technical and non-technical competencies in order to become an expert in a particular role. Billett (2001) maintains that workers can gain expertise by engaging in WPL practices with skilled colleagues, undertaking work of increasing responsibility, and implicit guidance from the social work setting. He advocates that organisations wishing to realise their full potential in everyday WPL practices should consider specifically planning and structuring their learning opportunities through the development of a WCM. The same sentiment is echoed by other authors; Harris *et al* (2001) suggest that learning is achieved when the workplace environment is engineered to support it and Dornan *et*

al (2007) found that a structured workplace curriculum with clear learning objectives encouraged participation.

2.8.2 Motivation for developing a WCM

Tikkanen (2002) conducted a study of WPL in two SMEs. Four employees, both experienced and novice, in each organisation were interviewed individually for their perspectives' on the learning that they encountered in their role. The study found that WPL was abundant in the organisations with the majority of learning being 'casual and non-formal by nature'. Little or no structuring of these learning experiences existed. Other studies were conducted in this area. Bélanger and Larivière (2005) found that support was afforded to WPL at some levels, but was not specifically defined. Bryson *et al* (2006) conducted a WPL study in a winery. Their findings suggest that organisations should focus on embedding professional development practices into their employees' job design in order to reap the maximum benefits from WPL. Boud and Middleton (2003) believe that WPL should be made explicit so that work practices could be structured to maximise potential learning.

Cheetham and Chivers (2001) found that structuring WPL is supportive for novices. Tikkanen (2002) also suggests that organisations would benefit if their WPL was structured which would require management to adopt a longitudinal approach to the development of learning in the workplace. Billett (2001) maintains that developing a WCM benefits both the learners, by developing their competencies required for expertise in the vocation, and the organisation, by effectively managing their WPL.

Billett (2001) identified four motivations for proposing a WCM, which are:

1. Learning is not solely restricted to classroom settings. Learning is an on-going process and is inevitable in daily activity and thought. Therefore, learning in the work setting is unavoidable. Without WCM support, valuable learning opportunities could be overlooked resulting in the organisation not realising its full learning potential.
2. The WCM should not be based on the instructional design and curriculum principles adopted by educational institutions; rather the practices and

situations available in the workplace should form the foundations of a WCM.

3. 'Learning by doing' is not sufficient. WPL is constrained when inadequate guidance, structure, and support prevails.
4. Access to learning opportunities is not always uniformly distributed amongst employees. Regardless of discipline, worker's engagement in social practices in the organisation is intentionally structured (Billett 2004).

However, Billett (2001) maintains that a WCM can only be effective if the organisation commits to it while also continually preparing and encouraging their employees to engage in WPL. He believes a WCM is necessary for the intentional guidance, structuring, organisation, conceptualisation, and support of WPL. Such a pedagogical model would identify the extent to which workplace experiences enhance performance while also fostering the transferability of the learning to new situations encountered in the workplace. Nabi and Bagley (1998) ascertain transferability of skills is of crucial importance to career progression in contemporary employment.

2.8.3 Designing ideal WPL environments

Brown and Duguid (1992) state that designing and improving WPL environments to enable novices to learn effectively and acquire knowledge is a challenge. Billett (2001) upholds that attention should be paid to enhancing the transferability of knowledge from one work situation to the next. Dale and Bell (1999) caution against narrowly based learning experiences, as these can result in shallow, surface learning which can threaten transferability. Chivers (2006) advises against being too prescriptive when developing learning episodes as learners can find different experiences formative. Consequently, Cheetham and Chivers (2001) uphold that adherence to one approach should be avoided and efforts made to provide learners with exposure to as many strategies as possible. In addition, Billett (2001) recommends that the designers of the WCM should identify the activities and guidance practices that both contribute to and inhibit learning in the workplace. Through the identification of such inhibitors, the designers of the WCM can take the necessary steps to overcome them.

Matthews (1999) recommends that organisations, when designing WPL episodes, should have managerial commitment from the outset. Billett (2001) corroborates this sentiment, stating that if a collaborative approach between workers and management is adopted when planning and developing the WCM, there is a greater prospect of participation and acceptance once implemented.

Many authors published frameworks and/or advice for designing WPL environments, such as:

- Collins *et als* (1987) framework for designing ideal WPL environments (section 2.8.3.1)
- Billett's (2001) Workplace Curriculum Model (WCM) (section 2.8.3.2).
- Moore's (2004) features of a workplace curriculum (section 2.8.3.3).
- Ashton's (2004) organisational structure and cultural impact on the learning process (section 2.8.3.4)

2.8.3.1 Collins *et als* framework for designing ideal WPL environments

Table 2-4 details Collins *et als* (1987) framework for designing ideal WPL environments. Collins *et al* (1987) suggest that designers should consider each of the dimensions and its characteristics when constructing or evaluating WPL environments. The authors also state that this framework provides a mechanism for determining the strengths and weaknesses of WPL environments.

Table 2-4 Framework for Designing Ideal WPL Environments

Source: Collins *et al* (1987)

Dimension	Characteristics	Explanation
Content	Domain knowledge	Includes vocational conceptual, factual, and procedural knowledge that is explicitly available. While essential, it can provide insufficient clues and context for actively problem solving in the workplace.
	Heuristic Strategies	Problem solving strategies and approaches for effectively completing tasks.
	Control Strategies	Managing problem solving through the selection of appropriate problem solving strategies.
	Learning Strategies	Strategies for learning any of the above, i.e., domain knowledge, heuristic, and control strategies.
Sequence	Increasing Complexity	Involves sequencing tasks in increasing order of complexity for novice learners.
	Increasing Diversity	Involves the construction of sequences of task requiring an increasing amount of diverse skills and strategies to complete.
	Global before Local Skills	Sequencing activities so that global tasks of lower complexity are learned prior to local, more complex tasks.
Method	Instructional Model of Learning	Includes modelling, coaching, scaffolding, articulation, reflection, and exploration, each of which is covered at length in section 2.7.1.
Sociology	Situated Learning	Involves learners undertaking tasks within the context of where they will face the tasks in the future.
	Culture of Expert Practice	Where the environment is specifically geared towards discussing and working on tasks using expert practice.
	Intrinsic Motivation	Involves developing learning environments where learners are intrinsically motivated to engage in tasks through interests or goals.
	Exploiting Cooperation	Encouraging learning through cooperative problem solving provides additional sources of scaffolding and different approaches to tasks.
	Exploiting Competition	Giving the same task to several learners and comparing the results upon completion.

2.8.3.2 Billett's Workplace Curriculum Model (WCM)

Billett's (2001) WCM explicitly structures guided learning in the workplace in an effort to fully exploit learning opportunities that arise when conducting everyday tasks. This structuring aims to reduce or remove learning inhibitors impeding the development of expert competencies in the workplace. The WCM should be used when novice workers engage in everyday tasks. Ideally, learning should focus primarily on the identified WCM as opposed to relying on direct teaching methods.

Billett (2001) suggests, when structuring a WCM, consideration should be given to four core principles that are central to learning at work, namely:

- Movement from peripheral to full participation
- Access to knowledge that is difficult to learn
- Direct guidance of experts and others
- Indirect guidance by physical and social environments

Each of these principles is now discussed in turn.

Principle 1 - Movement from peripheral to full participation

Lave and Wenger (1991) define active engagement in genuine work tasks, albeit to a limited degree with restricted responsibility, as legitimate peripheral participation. Through actively performing increasingly mature approximations of the task, the learner becomes an expert, moving from the peripheral zone to full participation for that task (Lave and Wenger 1991; Bjorke 2005).

Level one of Billett's (2001) three level model of expert guidance (section 2.3.1) maintains that pathways of work activities should be structured to guide the novice from peripheral participation in minimum responsibility tasks to full participation in highly accountable ones. In particular, these pathways of activities should commence with global tasks of lower complexity, ending with local activities of higher complexity. Collins *et al* (1987) state that by providing access to these pathways of activities, the novice learner gains an appreciation of the necessary steps required to effectively complete the task. Fuller and Unwin (2003a) believe that quality WPL

environments promote a gradual transition from peripheral to full participation. This sentiment is also echoed by Billett (2001) who states that the novice worker can be guided through the identified pathways of work activities at a pace that is conducive to their learning. This paced guidance in conjunction with the predefined structure of the pathways enables the learner to build on previously acquired knowledge. Conversely, Harris *et al* (1996, cited in Billett 1995) uphold if no pathway of learning experiences exist for a novice that will take them from peripheral to full participation in the vocational, learning will be limited in the workplace.

According to Billett (2001), developing learning pathways comprises the identification of the work area and the requirements for effective performance. Once these are delineated, the pathway or pathways of learning activities can be developed. Each of these is discussed in turn.

- Identifying work areas.

Work areas could be identified as functions, departments, or systems. When work areas are delineated, it is easier to appreciate what needs to be learned and to suggest typical learning approaches best suited for this learning. These work areas would then become the focus for learning in the organisation. Within the identified work areas, tasks and activities should be continually examined to determine the knowledge that should be acquired through WPL and the most appropriate strategies to use to achieve this end (Billett 2001).

- Determine goals and requirements of effective performance.

A good starting point when developing a WCM is to determine what constitutes effective performance because simply participating in workplace tasks may not develop a clear understanding of the goals and requirements for expert performance. This sentiment was first discussed in section 2.4.5. As workplaces differ, it follows that WPL goals and requirements will vary across organisations. Organisations should make explicit to learners the goals and requirements for expert performance and provide access to them.

- Delineating the learning pathway.

According to Billett (2001), learning pathways identify sequences of activities that, when completed, contribute towards full participation in a task. Dale and Bell (1999) state that subdividing tasks in this manner structures learning by

charting the learner's progress while also setting standards and highlighting subtask reuse across distinct activities. To identify learning pathways, experts could be asked to determine the sequence in which they engaged with the activity when learning it. These sequences of activities could then be compared with the learning experiences of newcomers, distributed to the wider community for feedback and utilised to develop effective learning pathways. In addition, Collins *et al* (1987) uphold that these pathways of learning experiences should be structured to encourage the use of a wider set of diverse skills within different contexts. This aids the learner to distinguish which skills apply or don't apply to different contexts.

Principle 2 - Access to knowledge that is difficult to learn

Many learning experiences are readily available to novices in the workplace; however, some remain elusive, inaccessible or difficult to learn through discovery learning alone. This sentiment was first discussed in section 2.6.3. When knowledge is difficult to learn, organisations need to intervene to ensure that novice learners understand the task and its associated goals and requirements for expert performance. If learners are unaware of the existence of a task, or the significance of it, they may never learn what is required to complete the task.

To make inaccessible learning experiences available, Billett (2001) maintains they should be arranged in the WCM into distinct, interconnected learning units taking organisational and individual learning needs into account. Continuing in this vein, he states that these pathways of experiences should detail the best approaches and motivations for completing the task as well as steps explicitly listed steps to assist experts directly guiding novices in these tasks.

Principle 3 - Direct guidance of experts and others

As discussed in section 2.3, direct guidance from experienced colleagues supports the development of a learner's vocational expertise; the greater the quality and contribution of the direct guidance, the stronger the learning outcomes will be. According to Billett (2001), direct guidance typically involves the experienced co-worker providing models, clues, and explanations that will facilitate the novice worker to develop accepted procedures for arriving at successful task completion. Of the

strategies listed in Table 2-3, the following table (Table 2-5) identifies the direct strategies.

Table 2-5 Direct guidance WPL strategies

Source: Author

Instructional Model of Learning (Collins <i>et al</i> 1987)
Modelling (Instruction / Demonstration)
Analogies
Diagrams
Coaching
Scaffolding
and fading
Articulation
Questioning
Other Inter-Collegial Strategies
Feedback
Performance appraisal system
Intra-Organisational Strategies
Individualised career development plans

Direct guidance, according to Billett (2001), enables the guide to select tasks appropriate for the learner's ability, help protect the novice learner from learning inappropriate knowledge, and monitor learner's progress and determine their readiness for progressing along pathways of learning activity or moving onto more complex tasks. Rogoff 1995 (cited in Billett 2004) states that experienced co-workers can, through collaboration, make learning materials available to the learner that would otherwise remain inaccessible or hidden.

Principle 4 - Indirect guidance by physical and social environments

Direct guidance occurs when there is close expert guidance, whereas indirect guidance occurs when the physical and social environments in the workplace assist novices' learning. Of the strategies listed in Table 2-3, the following table (Table 2-6) identifies the indirect strategies.

Billett (2001) maintains that when the physical and social environment provide indirect guidance for learning experiences, the organisation should structure these learning experiences in an effort to provide support for learners engaging in them. In order for indirect guidance to take place, learners should have an opportunity to engage in tasks and work collaboratively (Billett 2001). However, Hodkinson and

Bloomer (2002 cited in Billett 2004) state that the novice worker ultimately decides on their level of participation in indirect guidance practices.

Table 2-6 Indirect guidance WPL strategies

Source: Author

Instructional Model of Learning (Collins <i>et al</i> 1987)
Learning through teaching others (Articulation strategy)
Discussion (informal chats) (Articulation strategy)
Discussion (team meetings) (Articulation strategy)
Reflection
Learning from mistakes
Exploration
Other Inter-Collegial Strategies
Observation
Shadowing
Maintaining learning logs (Feedback strategy)
Self-Directed Strategies
Practice and repetition
Access to learning materials and resources (Books)
Access to learning materials and resources (Manuals)
Access to learning materials and resources (Internet)
Access to learning materials and resources (Professional Journals)
Access to learning materials and resources (Third level libraries)
Access to learning materials and resources (CDs)
Access to learning materials and resources (DVDs)
Access to learning materials and resources (CBT)
Intra-Organisational Strategies
Rewards for proficiency and achievement (Promotion)
Rewards for proficiency and achievement (Wage increases)
Rewards for proficiency and achievement (Awards for accomplishment)
Rewards for proficiency and achievement (Allocation of more responsible tasks)
Mechanisms for integrated exchange (Company suggestion boxes)
Mechanisms for integrated exchange (Company newsletters)
Mechanisms for integrated exchange (Company information sessions)
Mechanisms for integrated exchange (Company bulletins/memos)
Knowledge bases of problem solutions
Stretching activities (Working above grade)
Stretching activities (Engaging in demanding work)
Stretching activities (Thrown in deep end)
Perspective switching (Deliberate role transfer)
Perspective switching (Working abroad)
Extra-Organisational Strategies
Networking (External professional or occupational networks)
Networking (Trade fairs)
Networking (Specialised research centres)
Networking (Conferences/Seminars)
Contact with customers / suppliers (Discussions)
Contact with customers / suppliers (Technical support)

2.8.3.3 Moore's features of a workplace curriculum

Moore (2004) identified the following six features of a situated WCM:

- **Technical** - In this WCM, the technical aspect pertains to knowledge of the steps required to perform or complete a particular work task. This bears similarities to the development of learning pathways (see principle 1 in section 2.8.3.2). Technology regularly features in this area.
- **Social** - Social encompasses the learner's perceptions of their co-workers' behaviours and the extent to which they mimicked such behaviours. This is similar to the WPL strategy, observation, discussed previously in section 2.7.2.1.
- **Pragmatic** - Pragmatism involves placing the knowledge required to complete work activities in the context of its importance to the organisation. Some work-related knowledge has little impact on the overall functioning of the organisation, whereas other knowledge is central to its success and survival. In addition, some knowledge is more enviable and influential to obtain than others. This realistic perception of work-related knowledge greatly influences the novice's engagement with the work activity.
- **Classification** - is the clear grouping of knowledge into distinct categories. These classifications can be strong or weak. Strong classifications exist when boundaries are clear and distinct. Weak classifications exist when the boundaries between knowledge categories are blurred and overlap.
- **Frame** - describes the social and political organisation of knowledge accessibility in the workplace. In essence, it describes the level of access the learner is allowed to the knowledge and their encounters with it.
- **Demandedness** - In accordance with job role, the workplace expects learners to engage in knowledge with varying degrees of competence.

2.8.3.4 Ashton's organisational structure and cultural impact on the learning process

Ashton (2004) highlighted concerns regarding the dearth of attention afforded to the organisational structure in the WPL literature. Building on the research of Koike and Inoki (1991), Darrah (1996) and Koike (2002), Ashton developed a model proposing

how such organisational structures impact the WPL process and skill development (Figure 2-7).

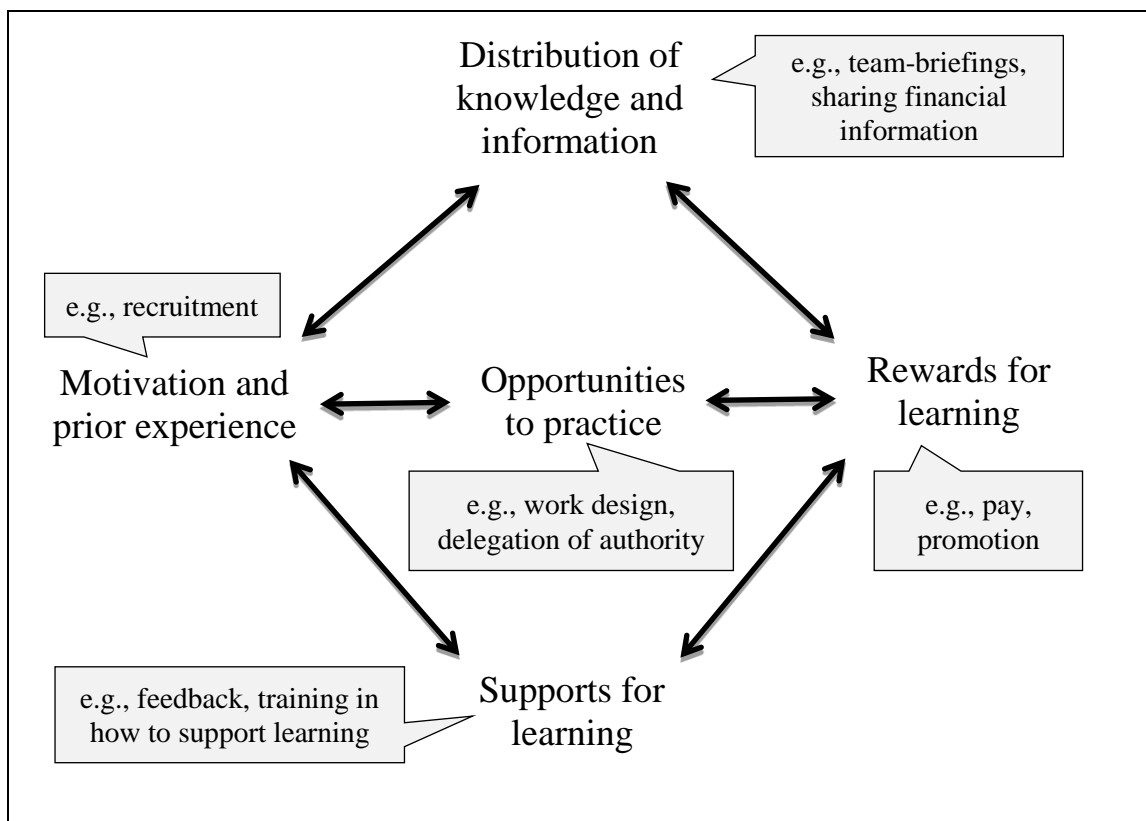


Figure 2-7 Areas where organisational structure and culture impact on the learning process

Source: Ashton (2004)

Ashton, using a case study approach, tested this model to determine the extent that organisational structures and work activity design impacted the process of learning in the workplace, and in particular how it influenced worker participation in WPL practices and, hence, their skill development. Each aspect of this model is of particular relevance to this study and is discussed below. As Ashton (2004) considers ‘Motivation and prior experience’ to be a subset of the other four areas, note that there is no separate discussion on this topic. Likewise, the topic distribution of knowledge and information and the topic opportunities to practice are discussed together as they complement each other.

- Distribution of knowledge and information and
- Opportunities to practice

Ashton (2004) found that the distribution of knowledge, information, and

opportunities to practice is generally associated with the structure of the organisation. Organisations can have, as discussed in section 2.5.4, comprehensive sets of learning resources for up skilling the novice worker. Fuller & Unwin (2003b) recognise that an expansive WPL environment would incorporate the existence of a workplace curriculum that structures these learning resources and provides access to them. They believe such a pedagogical approach would facilitate and improve deep learning for novice workers in the workplace. Access to learning opportunities and opportunities to practice was discussed previously in section 2.6.1.

- Supports for learning

Ashton (2004) found that supports for learning were closely coupled with the participational qualities of the experienced colleague guiding the learning, their ability to support learning, and their interpersonal relationship with the learner. However, the importance that the organisation placed on learning did impact the level of support the learner received in the workplace. This broad heading covers numerous topics discussed previously, such as feedback (section 2.7.2.2), preparing the guide (section 2.3.3), preparing the learner (section 2.4.2), and organisational supports (section 2.5), to name but a few.

- Rewards for learning

Billett's (2003) study found that management were failing to acknowledge and support the efforts of experienced employees engaged in mentoring roles. The study also found that, in these workplaces, mentoring success depended on the mentor's diligence rather than managerial supports the learner and mentor received. The study concluded that organisations cannot continually rely on the willingness of guides to voluntarily engage in such a demanding process without reciprocated acknowledgement and support for their efforts; the guides contribution and efforts should be duly acknowledged by the organisation. Ashton's (2004) study concurred with this sentiment and found that rewards for learning, such as recognition by superiors, pay, and promotion were perceived as crucial to workers continuing engagement in WPL. Rewards for proficiency and achievement were identified in section 2.7.4.2 as a WPL strategy.

Overall, Ashton's (2004) study found that the organisational structure has a significant impact on the quality of the learning achieved in the workplace. These findings were corroborated by Felstead *et al* (2004b) whose study suggests that the organisation of work has a significant impact on the perceived effectiveness of WPL.

2.8.3.5 Theoretical framework for designing ideal WPL environments

Table 2-7 merges the frameworks identified by Collins *et al* (1987), Billett (2001), Ashton (2004), and Moore (2004) relating to designing ideal WPL environments and curricula. However, the last element of Collins *et als* (1987) framework, Sociology, is outside the scope of this research project; it is accepted that WCMs are embedded in situated learning theory and cultures of expert practice that exploit collaborative practices. Consequently, this element is not included in the table.

2.8.4 The emergent theoretical framework – iteration six

Research into how WCMs structure, organise, and conceptualise the workplace to support WPL will provide a richer understanding of the WPL environment. The entire 'Method' dimension identified in Table 2-7 above was previously placed in the fifth iteration of the emergent theoretical framework (Figure 2-6). However, a clear distinction between direct and indirect strategies was not made. This strategy distinction can now be seen in the sixth iteration of the framework (Figure 2-8). A subset of the topics identified in the 'Content' and 'Sequence' dimensions were also previously placed in the emergent theoretical framework. However, the remaining topics in these dimensions need to be explored (see Figure 2-8):

- *Content dimension - Knowledge and content*

The tasks and activities found in the workplace should form the foundations of a WCM. Knowledge should be clearly grouped into distinct categories with clear and distinct boundaries. Conceptual, factual, and procedural knowledge relating to these tasks and activities, and the strategies for learning them needs to be readily available when designing WPL environments. Such an approach makes it easier to appreciate what needs to be achieved through WPL.

Information can be gathered from written documentation or interviews with / observation of those recently performing the tasks. These interviews or

observations could also determine the scope of the activities, be it daily, weekly, monthly, or annually.

- *Sequence dimension - Sequencing of learning opportunities*

Specifically sequencing learning opportunities facilitates WPL. Workplace tasks can be sequenced according to increasing participation, complexity or diversity:

- *Gradual transition from peripheral (global) to full (local) participation:* Vocational expertise should be developed through the identification of effective learning pathways of work activities structured to guide the novice from peripheral participation in minimum responsibility tasks (global) to full participation in highly accountable ones (local). Tasks should be sequenced in order of increasing complexity for the novice learner. Quality WPL environments promote a gradual transition from peripheral to full participation.
- *Increasing diversity:* This involves grouping tasks into sequences so that an increasing amount of diverse skills are required to complete the sequence

Table 2-7 Designing ideal WPL environments and curricula

Source: Adapted from Collins *et al* (1987), Billett (2001) and Moore (2004)

Dimension	Subset of Characteristics of Ideal WPL Environments (Collins <i>et al</i> 1987)	Billett's WCM (Billett 2001)	Organisational Structure and Cultural Impact on the Learning Process (Ashton 2004)	Features of a WCM (Moore 2004)
Content	<ul style="list-style-type: none"> Domain Knowledge Heuristic Strategies Control Strategies Learning Strategies 	<p>Structure Learning Experiences:</p> <ul style="list-style-type: none"> Delineate Work Areas - Identify the Work Area, Sources of Information, and Scope of Activities. Determine the Requirements/Goals for Performance Identify Work Tasks that are Difficult to learn about / where learning is hard. 	Distribution of knowledge and information	Technical - knowledge of the steps required to complete a task
				Classification - clear grouping of knowledge into distinct categories: strong, clear boundaries or weak, blurred boundaries
				Pragmatism - placing knowledge in the context of its importance to the organisation
Sequence	<ul style="list-style-type: none"> Global before Local Skills Increasing Complexity Increasing Diversity 	<p>Develop a Pathway or Pathways of Learning Experiences/Activities:</p> <ul style="list-style-type: none"> Movement from Peripheral to Full Participation Provide Access to Goals for Performance and Knowledge that are difficult to learn. 	Opportunities to practice	Frame – level of learner access to and encounters with workplace knowledge
				Demandness – Level of learner engagement depending on job role
Method	Instructional Model of Learning (as depicted in Figure 2-5)	Direct Guidance by Experienced Co-Workers and Others	Supports for learning	
		Indirect Guidance in the Workplace provided by the Physical and Social Environment.	Rewards for learning	Social - learner perception and mimicking of co-worker behaviour

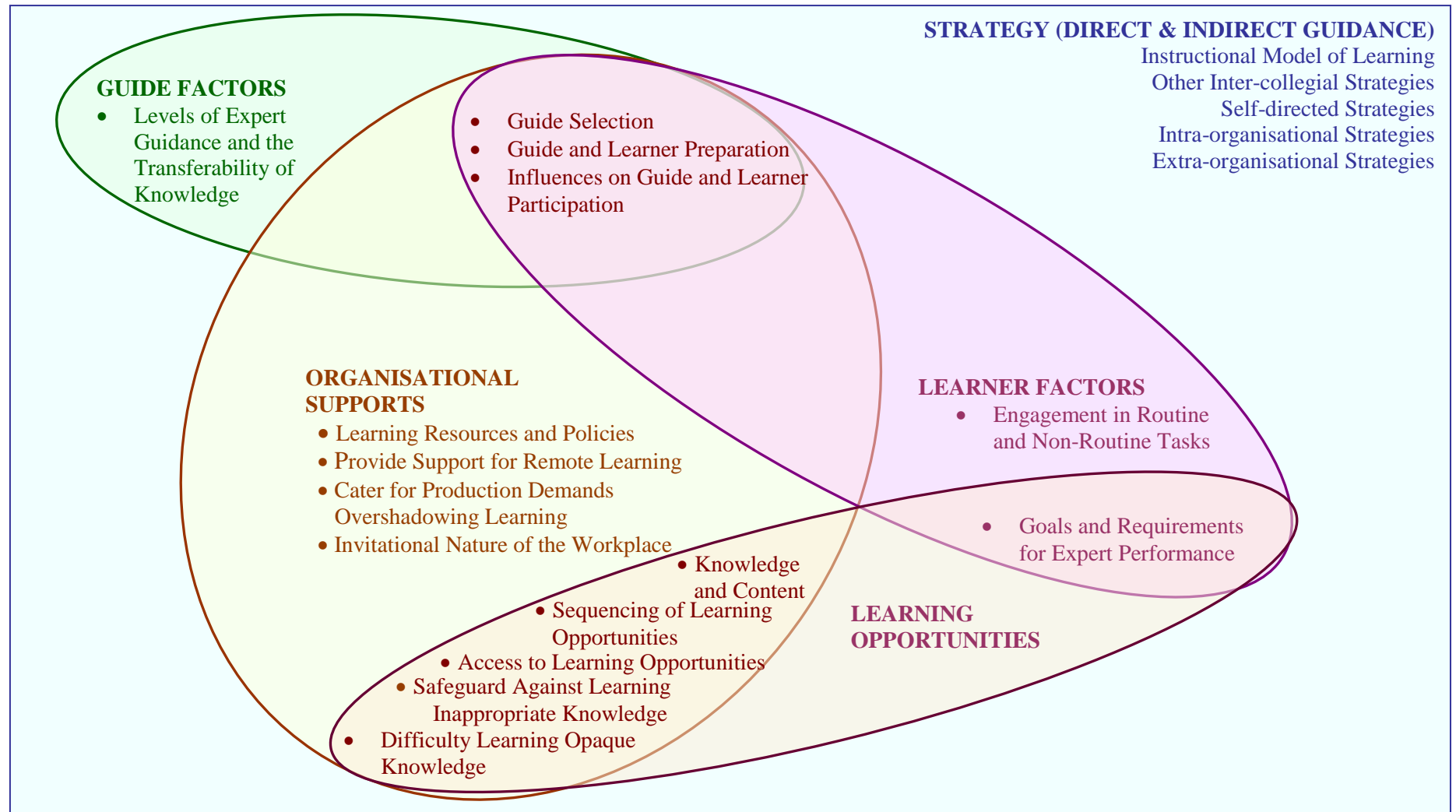


Figure 2-8 Theoretical framework - WCM and stakeholder influences (sixth iteration)

Source: Author

2.9 Measuring WPL environments

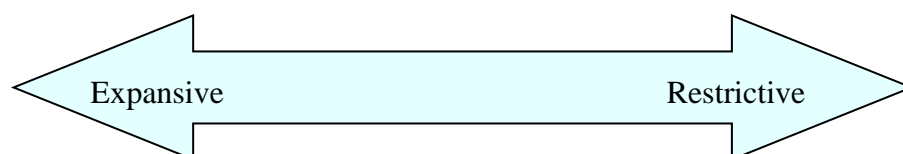
The previous section identified and correlated the key elements of ideal WPL environments. The aim of this study is to measure the contribution of this WPL environment to determine the level of structure and support it provides for WPL. However, Skule (2004) draws attention to the lack of models that exist for measuring the quality of WPL environments, suggesting that this shortfall is attributable to deficient WPL theory.

Lave and Wenger's (1991) conceptual model of participative learning is closely linked with craft-based WPL (e.g. tailors, butchers). As contemporary organisations are more complex, Fuller and Unwin's (2003b) model for analysing the quality of the WPL environment expands upon Lave and Wenger's (1991) model to include three overlapping themes of participation, personal development, and institutional arrangements (Table 2-8). This model places these key themes in the WPL environment along a scale that determines their restrictiveness or expansiveness for developing novice workers' expertise in the contemporary workplace. An expansive WPL environment is one that stimulates and supports the development of vocational expertise, whereas a restrictive environment curtails the professional development of its workers (Evans and Kersh 2004). This expansive/restrictive framework was developed by modelling strategies and practices rather than specific structures, thereby providing a 'dynamic collective process' through which WPL can be conceptualised and studied (Lee *et al* 2004).

Fuller and Unwin (2003a) argue that this framework is a valuable method for investigating WPL environments encountered by apprentices. Recent studies have used this model to assess the quality of the WPL environment in their target sample, for example, Evans and Kersh (2004) and Bryson *et al* (2006). Certain features of institutional arrangements, coloured green, and participation, coloured blue, are applicable for this study with the remaining measures considered outside the scope of this study.

Table 2-8 The expansive/restrictive continuum

Source: Fuller and Unwin (2003a)



Participation in multiple communities of practice inside and outside the workplace	Restricted participation in multiple communities of practice
Primary community of practice has shared 'participative memory': cultural inheritance of apprenticeship	Primary community of practice has little or no 'participative memory': no or little tradition of apprenticeship
Breadth: access to learning fostered by cross-company experiences built in to programme	Narrow: access to learning restricted in terms of tasks/knowledge/location
Access to range of qualifications including knowledge-based vocational qualification	Access to competence-based qualification only
Planned time off-the-job including for college attendance and for reflection	Virtually all-on-job: limited opportunities for reflection
Gradual transition to full participation	Fast – transition as quick as possible
Apprenticeship aim: rounded expert/full participant	Apprenticeship aim: partial expert/full participant
Post-apprenticeship vision: progression for career	Post-apprenticeship vision: static for job
Explicit institutional recognition of, and support for, apprentice's status as learner	Ambivalent institutional recognition of, and support for, apprentice's status as learner
Apprenticeship is used as a vehicle for aligning the goals of developing the individual and organisational capability	Apprenticeship is used to tailor individual capability to organisational need
Apprenticeship design fosters opportunities to extend identity through boundary crossing	Apprenticeship design limits opportunity to extend identity: little boundary crossing experienced
Reification of apprenticeship highly developed (e.g., through documents, symbols, language, tools) and accessible to apprentices	Limited reification of apprenticeship, patchy access to reificatory aspects of practice

Skule (2004), expanding upon the work of Skule and Reichborn (2002) and through the analysis of a quantitative survey, set out to identify a model of conducive conditions for learning at work, which he recommends as a framework for measuring

WPL environments. This framework consists of seven learning conditions that are conducive to learning at work (Table 2-9).

Table 2-9 Seven learning conditions conducive to learning at work

Source: Skule 2004

No.	Learning condition	Explanation of the variables included in each learning condition
1	A high degree of exposure to changes	Learning intensive jobs are characterised by more frequent changes in technology (products and processes) and working methods.
2	A high degree of exposure to demands	Learning intensive jobs are characterised by more exposure to demands from customers, managers, colleagues or the group/chain that the company belongs to.
3	Managerial responsibilities	Learning intensive jobs are characterised by accompanying managerial responsibilities in the job. These are not high-level managerial responsibilities, as 40% of the responsibilities respondents claimed to have them. Rather it may typically be allocated responsibilities for decision making concerning certain tasks, project management, work group management and so forth.
4	Extensive professional contacts	Learning intensive jobs are characterised by better opportunities to participate in professional forums outside the company, professional or occupational networks, trade fairs, conferences, etc., and by more extensive learning conducive contacts with customers or suppliers.
5	Superior feedback	Learning intensive jobs are characterised by better opportunities to learn from seeing direct results of the work.
6	Management support for learning	Learning intensive jobs are characterised by a stronger feeling by the employee that management is supportive and encouraging of learning.
7	Rewarding of proficiency	Learning intensive jobs have organisational surroundings that reward proficiency by means of higher wages, allocation of more interesting tasks or improved career opportunities.

The methodology adopted by the original Skule and Reichborn (2002) study was criticised by Felstead *et al* (2004b). Felstead *et al* (2004b) accept, even though the findings are an important, worthwhile contribution, that the methodology is somewhat flawed as learning intensity is dependent on specific learning opportunities interviewees chose to report. However, as Felstead *et al* conceded that the study, regardless of its methodological flaw, is an important step forward in current thinking, it will form part of this study. Other recent studies have taken this approach and used Skule's (2004) framework, either partially or in entirety. For example, Kyndt *et al*

(2009) investigated the relationship between the prevalence of certain learning conditions in the WPL environment and the characteristics of employees and organisations in that workplace (used certain aspects of the Skule framework). Daehlen and Nyen (2009) also adopted Skule's (2004) methodology in the annual Learning Conditions Monitor survey which studies conditions for learning, particularly in the workplace.

This study utilised both the Fuller and Unwin (2003a) and the Skule (2004) model to explore the perceived effectiveness of the WCM for supporting WPL.

2.10 Research questions

Following a review of the literature pertinent to the research aim and objectives identified in Chapter 1, three research questions were defined. Overall, the research questions focus on measuring the perceived reality of WCMs (WPL strategies along with learning opportunities and their sequencing) and the stakeholders involved in the WCMs (guide, learner and the organisation). Each of the three research questions, presented below, contains several sub questions.

2.10.1 Research question 1

What are the WPL supports and strategies that a SE graduate encounters while participating in everyday work practice and activities in an entry-level SE position?

This research question comprises five sub-questions:

- a. **Guide:** Who are the guides and how were they selected? Are they prepared for their role? What support do they provide? What influences/motivates them to participate?
- b. **Learner:** Are the learners prepared for their learning role and what influences/motivates them to participate?
- c. **Workplace / Organisation:** What supports does the organisation provide for WPL? Have organisations developed formal WPL policies and learning resources?
- d. **Learning opportunity:** What learning opportunities are available in the workplace? How are they structured? What access is provided to these

learning opportunities? How are pathways of learning opportunities sequenced?

- e. **Strategy:** What learning strategies are used when entry-level SE graduates engage in WPL? What level of direct guidance do guides provide to entry-level SE graduates? What indirect guidance does the physical and social environment provide to entry-level SE graduates?

2.10.2 Research question 2

How effective are the WPL supports and strategies for enabling SE entry-level graduates to become competent in their SE role?

This research question addresses the perceived effectiveness from the following perspectives:

- a. Guide
- b. Learner
- c. Workplace / Organisation
- d. Learning opportunity
- e. Strategy

2.10.3 Research question 3

Having evaluated the research findings, what are the implications for entry-level SE professionals regarding their role in WPL, organisational WPL practices, and higher education teaching approaches?

2.11 Alignment of the research questions with the objectives

Table 2-10 presents the alignment of the three research questions with the research objectives that were first presented in Chapter 1.

Table 2-10 Alignment of research questions with the research objectives

Source: Author

Research question	Research objective
1 (a to e)	1, 2, 4
2 (a to e)	1, 3, 4
3	1, 4, 5

2.12 Cross referencing the theoretical framework with the research questions

Figure 2-9 cross references the final (sixth) iteration of the theoretical framework with the first two research questions. Note that research question three is an outcome of the research and consequently is not cross referenced with the theoretical framework.

2.13 Conclusion

This chapter reviewed the theory associated with participating in WPL in contemporary organisations, the stakeholders involved in WPL, typical strategies used, designing ideal WPL environments, and frameworks for assessing these environments. Throughout the literature review, the theoretical framework continually evolved based on the theories discussed. With a focus on this theoretical framework, the research questions were defined, while remaining cognisant of the research issues identified in Chapter 1. The study used this framework, along with the research questions, to investigate the organisation of the workplace to support SE graduate WPL.

The next chapter addresses in detail, the methodological considerations appropriate for this study. In particular, the most suitable paradigm is selected followed by the methodology and method.

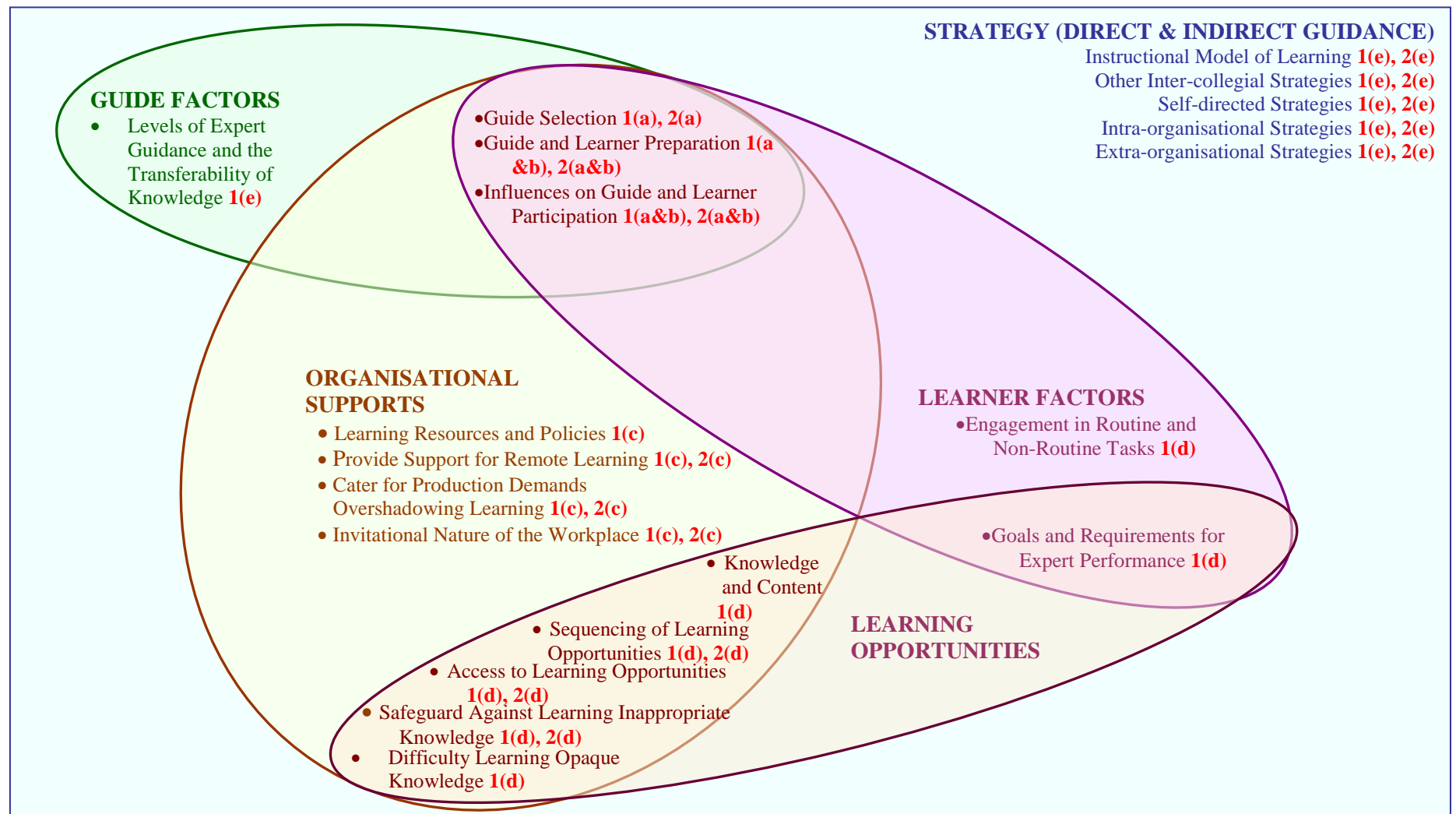


Figure 2-9 Theoretical framework – cross-referenced with the research questions

Source: Author

CHAPTER 3

METHODOLOGICAL CONSIDERATIONS

3.1 Introduction

This chapter presents the most appropriate methodology for answering the research questions posed in Chapter 2. Myers and Avison (2002) define a research methodology as a “strategy of enquiry which moves from the underlying philosophical assumptions to research design and data collection” (p.5). This definition determined the core structure of this and the next chapter, as is shown in Figure 3-1. This chapter discusses the research methodology by revisiting the research problem, addressing the underlying philosophical assumptions, selecting an appropriate research design, and selecting the method and data collection instruments, all within the context of the research problem. As a mixed method, self-administered survey was selected for the research, existing survey use in WPL research was discussed along with any known issues relating to it. Chapter 4 then focuses on the methods, particularly the data gathering and analysis techniques.

3.2 Revisiting the research problem

The aim of this study was to map the terrain of the WPL environment that entry-level SE graduates encountered whilst engaged in everyday work practices and activities and to compare it to the rhetoric that exists in the literature. This comparison, allied with the broader literature from the traditional education field, could lead to an improved theoretical and practical framework of WPL. Adopting this approach could better prepare entry-level SE professionals for their active role in WPL and inform both WPL and higher education teaching practices.

In general, the research questions focused on obtaining a snapshot of the WCM (WPL strategies along with learning opportunities and their sequencing) and the stakeholders involved in the WCM (guide, learner, and the organisation). At a fundamental level,

this research is an exploratory investigation of the WCM for entry-level SE graduates and, as a result, has defined no hypothesis or propositions.

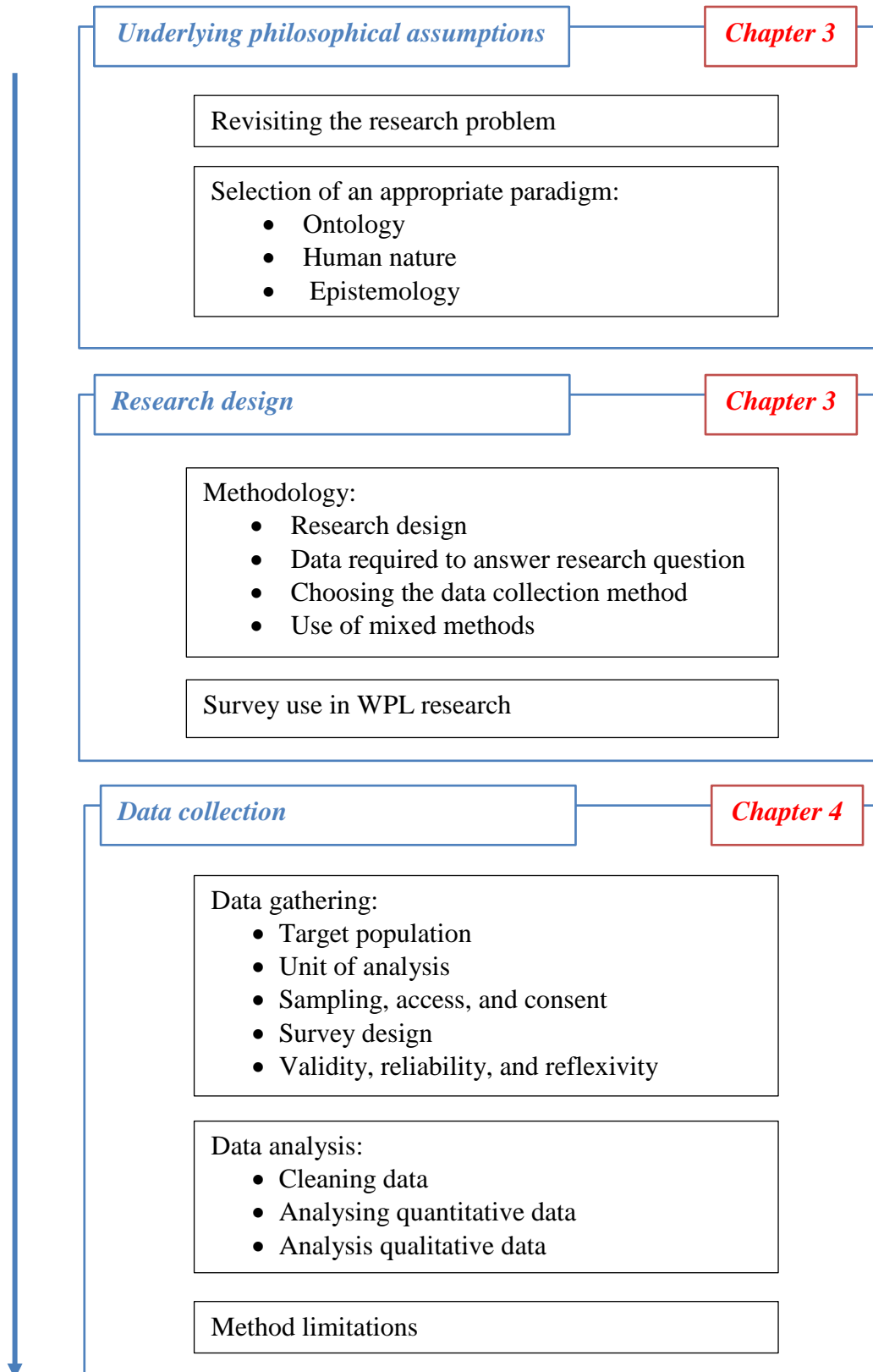


Figure 3-1 Structure of Chapter 3 and 4

Source: Author

3.3 Selection of an appropriate paradigm for the study

Prior to selecting an appropriate paradigm for a study, Falconer and Mackay (1999) state that it is essential that the researcher is clear about the underlying philosophical assumptions for the phenomena under investigation. Burrell and Morgan (1979) identified a scheme for analysing the assumptions about the nature of social science using ontology, human nature, epistemology, and methodology. A year later, Morgan published, along with Smircich (1980) a more comprehensive scheme detailing six different paradigms along the ontological, human nature, and epistemological spectrum. The researcher merged both of these schemes into one in order to better analyse the specific problem domain for this study (see Figure 3-2).

Ontology, human nature, and epistemology are discussed next in the context of the research problem. An appropriate position on each spectrum (encircled in red in Figure 3-2) is selected prior to identifying the selected methodology for the research.

3.3.1 Ontology

Ontology is concerned with “*what is out there to know about?*” (Grix 2002, p.175). Ontology refers to the nature of existence (Pryor and Yates 2005) and beliefs about the world being studied. Burrell and Morgan (1979) ascertain that the researcher should determine if the phenomenon under investigation is nominalist or realist. Morgan and Smircich (1980) go further and contend that a position on the nominalist-realist spectrum should be selected.

Returning to the research problem, the WPL environment, its’ supports, and strategies exist in literature, practices, and beliefs. Many direct and indirect WPL guidance strategies are used when learning in the workplace (Gerber *et al* 1995; Dale and Bell 1999; Harris *et al* 2001; Cheetham and Chivers 2001; Tikkanen 2002; Felstead *et al* 2004a; Skule 2004; Bélanger and Larivière 2005; Billett 2001, 2003), workplaces have a naturally-occurring curriculum that is deliberate and organised (Moore 2004), and WCMs structure guided learning in the workplace (Billett 2001). Models measuring WPL concepts also exist such as Skule’s (2004) model for measuring the learning conduciveness of work and Fuller and Unwin’s (2003a) model for

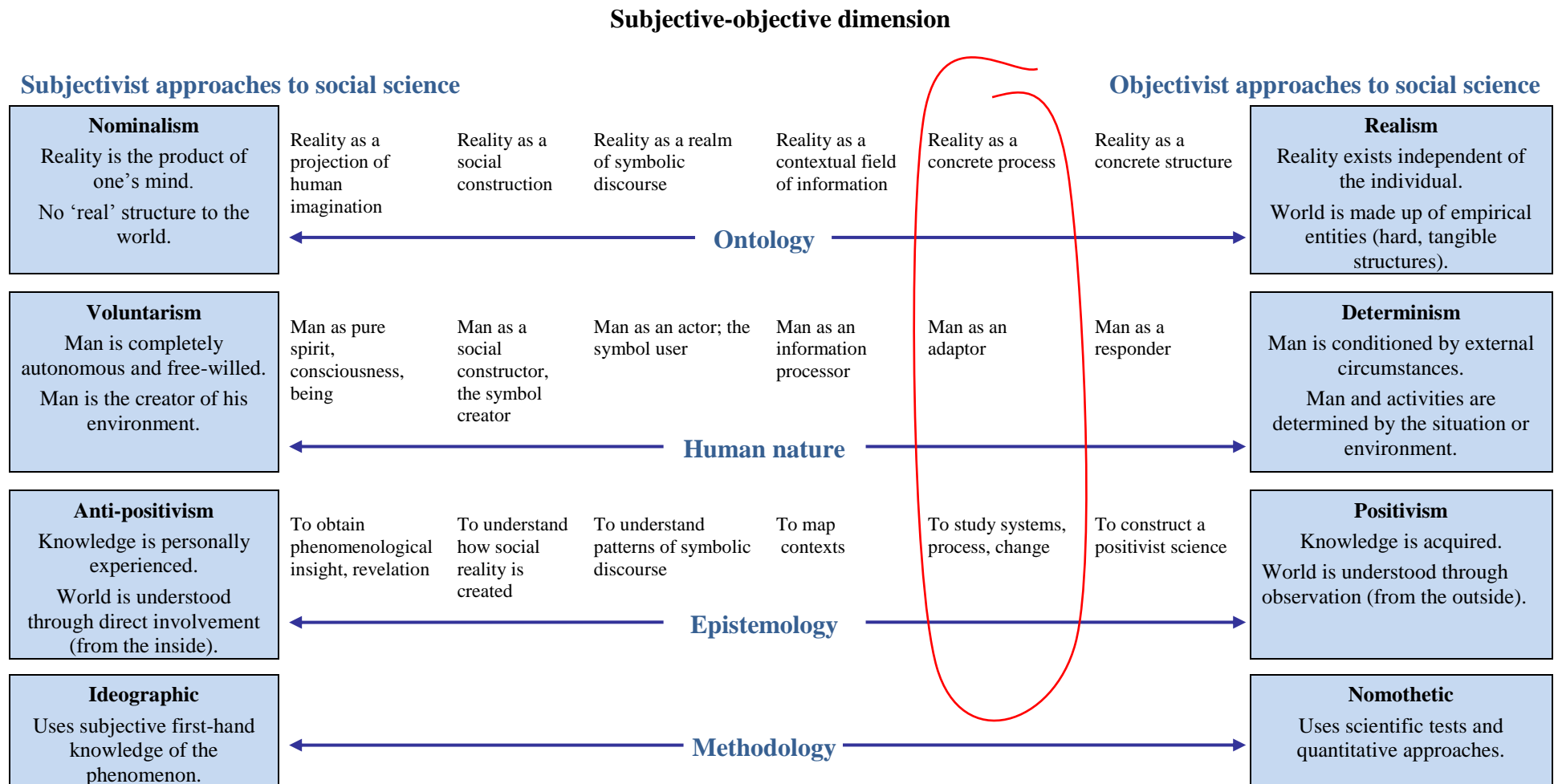


Figure 3-2 Network of basic assumptions characterising the subjective-objective debate within social science (with the study assumptions encircled in red)

Source: Adapted from Burrell and Morgan (1979, pp.1-8) and Morgan and Smircich (1980, p. 492)

determining the expansiveness/restrictiveness of a workplace. As the WPL environment comprises such empirical entities, this study subscribes to the realist ontological stance.

When discussing ‘reality as a concrete process’, Morgan and Smircich (1980) state that the social world is “fluid and creates opportunities for those with appropriate ability to mould and exploit relationships in accordance with their interests” (p. 495). As the WPL environment is defined as a process (section 1.5.1) and is not static, this study can further refine the realist stance by selecting ‘reality as a concrete process’.

3.3.2 Human nature

Burrell and Morgan (1979) define human nature as “*the relationship between human beings and their environment*” (p. 2). As the human and their experiences in the WPL environment are central to this study, the question remains whether the humans in this environment behave in a voluntaristic fashion, a deterministic fashion, or somewhere in between. Many social scientists position their assumptions in between these extreme poles (Burrell and Morgan 1979) along Morgan and Smircich’s (1980) voluntarism-determinism spectrum (Figure 3-2).

When discussing the deterministic view of ‘humans as adaptive agents’, Morgan and Smircich (1980) state that “human beings exist in an interactive relationship with their world...the individual seeking to interpret and exploit the environment to satisfy important needs, and hence survive” (p.495). Learners engage in their social world through close encounters with individuals (Vygotsky 1978) and interactions with their physical and social workplace environment. Lave and Wenger (1991) state that learners actively engage in genuine work tasks (i.e. WPL), so they can become legitimate participants in the workplace. As these WPL sentiments concur with the deterministic view of ‘humans as adaptive agents’, it follows that this study should select the ‘man as an adaptor’ position on the voluntarism-determinism spectrum.

3.3.3 Epistemology

Epistemology is concerned with “*what and how can we know about it?*” (Grix 2002, p.175). Epistemological assumptions delineate the approach used to obtain, construct,

and evaluate knowledge relating to phenomena (Orlikowski and Baroudi 1991; Myers and Avison 2002). Burrell and Morgan (1979) ascertain that it helps the researcher to understand the world and disseminate this knowledge. Positivism and anti-positivism exist at polar opposites of the epistemological spectrum (Figure 3-2).

Turner (2004) ascertains that positivism is generally more quantitative in nature. Positivists in the natural sciences subscribe to the objective, factual view of reality to measure, understand, and explain phenomena (Easterby-Smith *et al* 1997). Positivists believe that fixed relationships exist between phenomena (Fitzgerald 1998) while also emphasising the objectivity and repeatability of the research findings (Chen and Hirschheim 2004).

Robson (2002) states that, in social science research, positivism typically involves using the quantitative approaches prevalent in the physical sciences in a social context. People are considered as objects under scrutiny as opposed to human beings and group behaviour is reported upon as statistics (Turner 2004). Crossan (2003) maintains that understanding and explaining human feelings, attitudes, and behaviours appear outside the positivist realm which critics argue can yield superficial comprehension of the phenomenon under scrutiny.

At the other end of the spectrum, anti-positivist (interpretative) research focuses on observing phenomenon from a subjective perspective (Fahy 1995; Silverman 1998) favouring qualitative, narrative, and in-depth understandings of phenomena (Orlikowski and Baroudi 1991; Chen and Hirschheim 2004). Cohen *et al* (2007) maintain “the central endeavour in the context of the interpretative paradigm is to understand the subjective world of human experience” (p.21) through observation and immersion in the social world.

In order map the WPL terrain experienced by entry-level SE graduates, resulting in a detailed WCM, several concepts needed to be measured. These included the prevalence and perceived effectiveness of numerous WPL supports and strategies, the level of direct guidance experienced by graduates, the guide supports, the learner supports, the organisational supports, and the availability, structure and access to learning opportunities. This measurement, quantification, and development of a

WCM would suggest a positivist approach. The models and theories identified in the literature review as measurement instruments would be more suitable as opposed to immersion in the social world.

To provide depth and context for the WCM, detailed accounts of the influences and motivations that encourage guides and learners to participate, their preparation for their role, and the learning opportunities available were also required. These detailed accounts suggested an interpretive approach.

As both positivist and interpretive approaches apply in this study, a pertinent epistemology on the spectrum must be selected. Morgan and Smircich (1980) state that the epistemology, 'to study systems, process, change', which moves away from the extreme positivist view of the world as a closed system views the world as an open system, comprising processes, that can evolve through time. This study defined WPL as a process (1.5.1) and identified many theories modelling the WCM and its contents. The SE workplace is constantly evolving due to rapid advances in technology, so it only follows that the WPL taking place in this discipline is evolving also. Consequently, this study selected 'to study systems, process, change' as its location on the epistemology spectrum.

3.3.4 Methodology

Methodology is concerned with "*how we go about acquiring the knowledge which exists*" (Grix 2002, p.178). Falconer and Mackay (1999) maintain that selecting the most suitable research methodology is essential. Myers and Avison (2002) caution, as the research methodology influences the data collection techniques, that due care should be taken to ensure that the methodology is completely appropriate for the phenomena being studied.

Burrell and Morgan (1979) state that methodology exists along a spectrum ranging from ideographic (subjective, first-hand knowledge) to nomothetic (scientific tests, quantitative approaches). The appropriate position on this spectrum can be decided by reviewing the three research designs [the quantitative approach, the qualitative approach, and mixed methods research (Creswell 2003)], identifying the data required

to answer the research questions, resulting in the choice of research design and most suitable method of data collection.

3.3.4.1 Research design

The tenets of qualitative and quantitative research are described by their key differences in Table 3-1. The mixed method approach is defined by Leech and Onwuegbuzie (2009) as the use of both qualitative and quantitative methods for data gathering and analysis when researching a given phenomenon.

Table 3-1 Differences between qualitative and quantitative research

Source: Adapted from Kumar (2005, pp. 17-18)

Difference with respect to:	Quantitative research	Qualitative research
Approach to inquiry	Structured/rigid/predetermined methodology	Unstructured/flexible/open methodology
Main purpose	To quantify extent of variation in a phenomenon, situation, issues, etc.	To describe variation in a phenomenon, situation, issue, etc.
Measurement of variables	Emphasis on some form of either measurement or classification of variables	Emphasis on description of variables
Dominant research topic	Explains prevalence, incidence, extent, nature of issues, opinions and attitude; discovers regularities and formulates theories	Explores experiences, meanings, perceptions, and feelings.
Analysis of data	Subjects variables to frequency distributions, cross-tabulation, or other statistical procedures	Subjects responses, narratives or observation data to identification of themes and describes these
Communication of findings	Organisation more analytical in nature, drawing inferences and conclusions, and testing magnitude and strength of a relationship	Organisation more descriptive and narrative in nature

3.3.4.2 Data required to answer research questions

The data required to answer the research questions was explored so that the most applicable research design could be selected. The first research question asks - *what are the WPL supports and strategies that a SE graduate encounters while participating in everyday work practice and activities in an entry-level SE position?* The main focus of this research question was to obtain a snapshot of the WCM (WPL strategy use along with learning opportunities and their sequencing) and the stakeholders involved in the WCM (prevalence of guide, learner and organisational factors) at one point in time. Clear and objective measurements of each factor needed to be gathered so that they could be combined to structure the WCM of entry-level SE graduates. Individual observable heterogeneity of the stakeholders was outside the

scope of this study. For these reasons, quantitative data was deemed applicable. As this data was gathered at one point in time with no follow up study, this necessitated a cross-sectional approach. A cross-sectional study obtains a snapshot of a group at one particular point in time, either in the present or in the past, often relying on more than one type of survey (Fink 1995b).

A secondary focus of research question one was to gain an understanding of how guides and learners were prepared, how they were influenced and motivated to participate, and the learning opportunities they were exposed to. Additionally, insight into the contents of learning resources and formal WPL policies was also required. Obtaining such views necessitated using open-ended questions, producing qualitative data.

The second research question asks - *how effective are the WPL supports and strategies for enabling SE entry-level graduates to become competent in their SE role?* This purpose of this research question was to examine the perceived effectiveness of the WCM and the stakeholders involved in the WCM, that emerged from research question one. As the effectiveness data was to be compared and merged with the WCM and the stakeholders involved in the WCM, the data had to be gathered using a similar approach adopted in research question one i.e. quantitatively.

The third research question asks – *having evaluated the research findings, what are the implications for entry-level SE professionals regarding their role in WPL, organisational WPL practices, and higher education teaching approaches?* In the main, no new data needed to be gathered to answer this question. However, clear and objective measurements of the use of WPL strategies and supports in the higher education classroom were required so that the findings from research question one and two could be accurately reflected into higher education. Quantitative data, gathered at one point in time, was required in this case, once again, indicating a cross-sectional study.

As the three research questions necessitated the gathering of quantitative data, with research question one gathering some qualitative data, it followed that the mixed method research design was applicable, with quantitative being the dominant method

and qualitative, the subsidiary method. The next section discusses the choice of method for gathering the quantitative and the qualitative data.

3.3.4.3 Choosing the data collection method

The previous section selected the mixed method approach for this study. This section decides on the most appropriate methods to gather the quantitative (closed-ended questions) and qualitative data (open-ended questions). Gorard and Taylor (2004) state that surveys can contain open and closed questions. Kumar (2005) maintains that structured interviews can also utilise open- and closed-ended questions. This section argues why self-administered surveys as opposed to interviews are more appropriate to gather the data.

Denscombe (2010) stated that the feasibility of the interview method should be determined prior to making any decision to use them. In particular, he asserted that the researcher should be confident that they can secure access to the respondents and that the interviews are viable in terms of time and cost. Both of these points are addressed here:

- In relation to the first point, the researcher was confident that she could not gain interview access to a sufficient number of respondents due to contemporary target population constraints discussed in the subsequent chapter (4.2.1). As respondents can complete self-administered surveys in their own time (Krishnaswami and Satyaprasad 2010) as opposed to adhering to an imposed, scheduled time for an interview, the researcher believed that the survey method would be more sympathetic to busy SE professionals and hence could potentially improve the response rate.
- Dealing with the second point, the researcher felt that the time and cost of conducting interviews, and the resultant data that would be gathered, did not warrant their use. Even though this study was exploratory in nature, it had clearly delineated boundaries delimited by the three well-defined research questions. These research questions called for the gathering of predominantly quantitative data with some supplementary qualitative data. As the qualitative approach is subsidiary to the quantitative approach and the amount of qualitative data required is minimal in comparison with the quantitative data,

the researcher felt it would not warrant the added time and cost incurred to conduct interviews as opposed to using self-administered surveys. If the research questions were more open-ended in nature, interviews would have been more applicable than surveys.

Krishnaswami and Satyaprasad (2010) state that interviews, typically used to gather qualitative data, can gather factual data as well as data on sensitive and personal issues. As interviews are more suited to studying complex phenomena and gaining insights, Denscombe (2010) states that if the data to be gathered is straightforward, surveys could emerge as a more cost-effective method than interviews. As this study had well-defined research questions requiring simplistic, uncontroversial data, it could easily be gathered by self-administered surveys, rendering the interview method unnecessary.

As the survey method is an appropriate method used in WPL studies (section 3.4) and based on the above reasoning, the self-administered survey was selected to gather both the qualitative and quantitative data. However, in choosing the survey method, the researcher was conscious of the challenges associated with self-reporting which are discussed in the following chapter in section 4.2.5.5.

3.3.4.4 Use of mixed methods in the study

Leech and Onwuegbuzie (2009) report that mixed method research has, since 1960, become an increasingly popular educational research design. Blaikie (2000) cautions that, when mixing methods, the same ontological and epistemological assumptions should underlie each method; otherwise the ontological and epistemological shifts must be clearly identified. In this study, the same assumptions underlie both the qualitative and quantitative approaches.

Denscombe (2010) suggests that mixed method research can offer a ‘more complete picture’ of the phenomenon being studied and this is particularly the case when complementary data is gathered using multiple methods; qualitative data can provide insight into the gathered quantitative data. Rossman and Wilson (1985) report that the use of mixed methods at analysis stage can *corroborate*, *elaborate* or *initiate* the

findings. In this study, the qualitative data will be used to corroborate and elaborate on gathered quantitative data and also initiate new findings independent of quantitative data. Details of each approach are covered in section 4.3.3.

Denscombe (2010) maintains, when using the mixed method approach, the researcher must identify how the methods are linked, decide the order in which they are to be combined, and if one should be of greater importance than the other. Table 3-2 below covers these criteria and more. This table shows that quantitative and qualitative methods will be used simultaneously. The quantitative approach will be the dominant method, with qualitative being subsidiary.

Table 3-2 Mixed method approach summary and rationale for adoption in study

Source: Adapted from Denscombe (2010, pp. 137-147, 346-351)

	Adoption	Rationale
Mixed method adoption	Quantitative and qualitative combined within each survey instrument	The main emphasis of the field study is to measure the prevalence of WPL supports and strategies along with their perceived effectiveness. The type of data required to answer the research questions is primarily quantitative, however, there is a need to obtain narrative on certain areas of the WPL. The research topic was best served by combining both quantitative and qualitative methods (section 3.3.4.2).
Sequence of methods	Simultaneous	As this is a cross-sectional study, the quantitative and qualitative methods are used concurrently on the survey instruments (section 3.3.4.2).
Dominant method	Quantitative	Each research question calls for, in the main, quantitative data in order to map the terrain of the WPL environment. For this reason, quantitative was selected as the dominant approach (section 3.3.4.2).
Subsidiary method	Qualitative	
Methodological triangulation (between-methods)	At analysis stage, data will be used to corroborate, elaborate, or initiate the findings.	Denscombe (2010) suggests that mixed method research can improve the validity of the research by comparing similar data gathered using both methods. Adopting this approach will provide a fuller picture of the WPL terrain experienced by entry-level SE graduates. Analysis of the qualitative data in the context of the quantitative data is discussed in section 4.3.3.

3.4 Survey use in WPL research

Turner (2004) holds that statistical surveys have proven powerful in developing our understanding of education processes. Table 3-3 presents numerous studies that used a survey approach. The general research objective of these studies is also included in the table.

Table 3-3 Examples of existing survey research in the WPL field

Source: Author

Study	General research objective
Dostie and Montmarquette (2007)	<i>Workplace and Employee Survey</i> : Investigate classroom based and on-the-job training and its impact on company performance.
Bryson <i>et al</i> (2006)	Identify factors contributing to and hindering skill and capability development in organisations, from the employee and management perspectives.
Nordman and Hayward (2006)	Provide information on numerous aspects of respondents' jobs which includes training measures.
Snape <i>et al</i> (2006)	<i>National Adult Learning Survey (NALS)</i> : Gather data on both taught and self-directed learning, from the learners' perspective.
Lohman (2005a; 2005b)	Investigate the informal learning strategies professionals use, the environmental barriers to informal learning, and the personal characteristics that motivate workers to engage in informal learning.
Felstead <i>et al</i> (2004b)	<i>Learning at Work Survey (LAWS)</i> : Examine learning sources associated with everyday work practice and their perceived importance.
Skule (2004)	Identify the factors most conducive to learning at work.
Spilsbury (2002)	<i>Learning and Training at Work study</i> : Record workforce development and learning opportunities from the employers' perspective.
Skule and Reichborn (2002)	Identify conditions conducive to learning-intensive environments.
Livingstone (1999)	<i>New Approaches to Lifelong Learning (NALL) study</i> : Investigate diverse aspects of informal learning in the workplace, at home, in the community, and through general interests from the respondents' perspectives.
Department for Education and Employment (1997)	<i>Family and Working Lives Survey (FWLS)</i> : Longitudinal, detailed study of participation in training.

3.4.1 Issues associated with survey use in WPL research

Livingstone (2001) stated that using surveys requires respondents to self-report which can provide comprehensive profiles of learning practices, albeit at a high-level (note that respondent bias is covered in section 4.2.5.5). However, there are a number of known errors and issues identified when conducting survey research in the WPL field. These criticisms are detailed below. Note that the tactics adopted for minimising each criticism are addressed in the next chapter when discussing survey design (section 4.2.5.4).

3.4.1.1 Correctly measure learning as a process

Felstead (2006) ascertains that gathering data on learning as a product often implies surveys or similar methods of capturing duration and exposure, with learning as process implying case studies of individuals performing work and approaches for improving perceived effectiveness. However, he also suggests that learning as a process can be measured and this approach was successfully adopted for the APLS study. Within the APLS study, a module called LAWS measured, using five-point Likert scales and lists of activities, learning sources associated with everyday work practices and their perceived importance for improving work performance. Felstead *et al* (2004b) following a review of previous WPL studies ascertain that the innovative approach of providing a list of activities as prompts reduced incidents of underreporting and resulted in a more accurate representation of WPL. Felstead *et al* (2004a) believe that reporting on a list of activities offers a more comprehensive perspective of WPL as it deals with learning from the product and process stance.

Campanelli *et al* 1994 (cited in Fuller *et al* 2003) concur suggesting that a better approach for eliciting information on learning activities is to ask respondents how they learned their role and to identify a list of the activities as a prompt as opposed to asking open-ended questions relating to learning activities.

3.4.1.2 Clearly delineate the WPL timeframe for interviewees

Nordman and Hayward (2006) ascertain that the on-going nature of WPL often means that there is no identifiable start or end to it. Sicherman (1990) states that all

questions relating to the timing of WPL should be specific and clearly understood by the interviewee; the research instruments should be very clear on the timeframe with which the questions pertain to.

3.4.1.3 Clearly define the key terms

Felstead *et al* (2004a) state that researchers typically view WPL in a broader context than respondents; respondents often limit their view to formal training courses, whereas employers ring fence WPL from a monetary perspective or as something they initiate. It is very important when designing research instruments that both the respondents and researchers understanding of the key terms coincide.

3.4.1.4 Clearly phrase WPL questions

Sicherman (1990) states that the WPL an employee experiences is interwoven with the performance of their work tasks and this interconnection can contribute to the observational difficulties experienced when attempting to measure WPL. Other studies considered the possibility that respondents could interpret WPL as formal training provided by the organisation (Nordman and Hayward 2006). Loewenstein and Spletzer (1999) believe if questions are phrased correctly, employees can distinguish on-the-job training incidents from their daily work tasks and accurately report on them.

3.4.1.5 Determine graduate respondents prior related work experience

Steffes (2004) report that the number of students engaging in internship programmes is increasing significantly. To qualify for inclusion in this study and reduce potential measurement errors, it is crucial that the learners have no significant prior SE work experience. Typical internships are acceptable for inclusion in the study, but work experience stretching beyond these are questionable and require investigation to determine suitability.

3.4.1.6 Ensure objective measures for key variables

The study by Kitching and Blackburn (2002) measured the association between WPL and individual performance. However, the validity of the measure of association has been criticised as it was the employer's perspectives that were measured (Fuller *et al*

2003). Chivers (2006) believe that one of the strengths in Eraut *et als* (1997) study lay in the fact that the employees reported on their own WPL rather than asking management or those responsible for training. It is crucial that the key variables identified in the study are objectively measured and perceptions are obtained from the relevant participants.

3.4.1.7 Use more than one source

Wall and Wood (2005) reported that the over-reliance previous studies placed on single source respondents should be taken into consideration in future WPL research. They suggest that, to improve reliability and validity, multiple sources (e.g., learners, guides, human resource (HR) personnel, etc.) should be invited as respondents.

3.5 Conclusion

By reflecting on the research problem, this study viewed the WPL environment as a non-static, concrete process containing empirical measurable entities (ontology, approaching realist). The learners and guides were considered adaptive agents, engaging in an interactive relationship with their WPL environment (human nature, approaching determinism). Both positivist and interpretive approaches were applicable for the open system that is WPL (epistemology, approaching positivist).

The mixed method approach was selected, where quantitative was considered the dominant approach and qualitative was subsidiary. A cross-sectional study, deploying self-administered surveys simultaneously using both quantitative and qualitative approaches was most suited to addressing the research questions. The known issues with survey research in the WPL field were also presented.

The next chapter delves into the data gathering and analysis pertinent for the survey instruments.

CHAPTER 4

DATA GATHERING AND ANALYSIS

4.1 Introduction

The previous chapter selected mixed methods as the research methodology and surveys as the research instrument. From a philosophical perspective, the study viewed reality as a concrete process (approaching realism), viewed man as an adaptor (approaching determinism), and studied systems, process, and change (approaching positivism). Within this context, this chapter discusses the data gathering and analysis techniques used in the study.

Topics covered under the data gathering umbrella include identifying the target population, the unit of analysis, the sampling techniques used, and access and consent considerations. It also addresses survey design through the identification of the main constructs, data management and coding, ethics, confidentiality, anonymity, and the pilot study. The final topic included under data gathering encompasses the development of high quality instruments by considering validation, reliability, and reflexivity.

The data analysis techniques included cleaning the quantitative data prior to analysis followed by the approaches used to analyse both the quantitative and the qualitative data.

Finally, the limitations relating the methodology and method are presented. Limitations associated with the gathered data and subsequent analyses are presented in the final chapter.

4.2 Data gathering

This section details the target population for the study (graduate, guide, organisational, and undergraduate populations) prior to selecting web-based, self-administered survey

tools for the instruments. It identifies the unit of analysis, the sampling techniques, and response rate considerations. The survey design is then detailed and the main concepts used in the surveys are defined. Research considerations such as ethics, confidentiality, and anonymity are presented. The pilot study, along with its recommended changes, are identified prior to discussing techniques for ensuring high quality research instruments such as validity, reliability, and reflexivity. The tactics used to reduce the presence of known WPL survey research criticisms are discussed.

4.2.1 Target population

This section narrowly defines the population of interest in this study. As research questions 1, 2, and 3(a) required the opinions of three distinct groups in the workplace (graduates, guides, and the organisation), three separate surveys were designed:

- Graduate survey
- Guide survey
- Organisational survey

The rationale for designing a fourth survey for undergraduate SE students is detailed in section 4.2.1.4, followed by the identification of the target population.

Prior to defining the profile of graduates, guides, organisations, and undergraduates, it was necessary to address two constraints that reduced the available target population for this study. Firstly, the recent global downturn resulted in graduate redundancies, significant unemployment, and emigration. Central Statistics Office (CSO) figures showed 68,600 graduates were unemployed in March 2010 compared with 25,400 in March 2008 (Murphy and Storn 2010). These CSO live register numbers did not reflect graduates that emigrated. Secondly, Condon and McNaboe (2008) reported that, over the period 2000-2007, Central Applications Office acceptances for level 8 computing courses dropped by almost 48% resulting in a significant decline in graduate output. This study commenced field research mid-2010 when the numbers of recent SE graduates was known to be low.

4.2.1.1 Graduate profile

In order to maximise the number of responses, graduates within their first three years of work following graduation were permitted in this study. Using a three year window was legitimate; participants were only asked to reflect back a maximum of two years to their WPL that took place during their first year of employment when WPL and their commercial SE role were then new experiences. WPL would still be fresh in their minds as it is an on-going process, particularly in the SE discipline.

As the study focused on the WPL supports and strategies for SE graduates, it was key that the graduate sample selected for the study was representative of the discipline, particularly in relation to the significant male gender bias. When all graduate responses were analysed, the graduate sample emerged with a gender bias (86% male, 14% female) that is reflective of the gender bias in the SE industry.

In order to qualify for inclusion in the study, SE graduates needed to have less than two years SE experience prior to graduation, so that their WPL would be truly new to them. Seventeen respondents had prior work experience, however, based on the start and end dates supplied, their work experience generally ranged from six months to one year which is typical of student internships. One respondent did have two years prior work experience; however, his responses generally conformed to the other respondents and contained no outliers. Consequently, no respondents were eliminated on the basis of having prior significant work experience.

4.2.1.2 Guide profile

WPL guides were experienced workers supporting the WPL of SE graduates, fitting the profile identified in the previous section. To confirm the suitability of each guide for inclusion in the study, the guide survey explicitly asked respondents whether they supported the WPL of SE graduates in their first year of employment, and, if so, to identify the number of these graduates they supported. In the event that an experienced worker who never supported graduates attempted to fill in the survey, they were immediately directed to the end of the survey and thanked for their contribution.

4.2.1.3 Organisation profile

Any size organisation, national or international where some level of SE took place was suitable for this study. In order to maximise the number of responses, organisations that hired graduates in the past three years were considered suitable. The timescale of three years was selected so the organisation filtering process would be in line with the graduates' as outlined above. Within suitable organisations, senior management overseeing or responsible for staff development and training were considered representative of the organisation.

4.2.1.4 Undergraduate profile

In order to accurately reflect the findings from the three WPL surveys into SE higher education (research question 3), Waterford Institute of Technology (WIT) undergraduate opinions were sought on the prevalence and perceived effectiveness of WPL strategies and supports in the classroom. The rationale for developing this fourth survey was to provide a snapshot of the current usage of WPL strategies in higher level SE education and the perceived effectiveness of these strategies from the student perspective. This snapshot provided a grounded starting point for reflecting the findings of the three workplace surveys into third level SE education so that recommendations for future SE teaching practices and approaches could be made.

The respondents for this survey were undergraduate students currently studying SE at third level. As teaching occurred in all four years of undergraduate education it was legitimate to include SE graduates at any stage of a level 7 or 8 SE course. Non-computing students pursuing a one year, level 8 graduate diploma in Applied Computing were also legitimate respondents as they would be, upon graduation, entry-level software engineers.

Age and current year of study were gathered solely to ensure that the sample represented the general spread of SE undergraduates across all academic years in WIT. At the time of this study, WIT had a significantly large number of first and second year SE students when compared with SE student numbers in third and fourth year and those undertaking a graduate diploma. Half of the third year SE student cohort were on industrial placement at the time of the field research and were not

available to take part in the study. When all SE undergraduate responses were analysed, the sample reflected the numbers at each year of study in WIT.

4.2.1.5 Web-based surveys highly suitable for the target population

Sills and Song (2002) stated that technically savvy respondents favour web-based surveys. Evans and Mathur (2005) maintain that web-based survey tools are cost effective, can yield higher response rates, and provide immediate preliminary analysis of the gathered responses. In addition, Sills and Song (2002) stated that on-line tools facilitate data cleaning and analysis, which Denscombe (2010) asserts removes data transcription errors. Van Selm and Jankowski (2006) remind that web-based surveys enable the allocation of codes for closed-ended questions during survey deployment. Denscombe (2010) drawing on recent research, states that there is little, if any, difference between the quality of responses gained from web-based and traditional mail based surveys.

The graduate, guide, and undergraduate target populations were technically savvy due to their chosen profession and area of study. Taking this into consideration, along with the advantages of web-based surveys listed above, a web-based survey hosting tool was chosen to deploy the research instruments (<http://www.surveymonkey.com>).

4.2.2 Unit of analysis

The aim of this study was to measure the reality and see how it compared to the rhetoric with regard to the organisation of the workplace to support the WPL that entry-level SE graduates encounter whilst engaged in everyday work practices and activities. This comparison, allied to the contribution of the broader literature from the traditional education field, led to an evolved theoretical and practical framework of WPL. This framework could better prepare entry-level SE professionals for their active role in WPL and inform both WPL and higher education teaching practices. The delimitations associated with the aim of this study are presented, prior to selecting the unit of analysis.

4.2.2.1 Delimitations

Focus on individual learning rather than team learning

The aim of the research resulted in a focus on individual learning both in the workplace and in higher education. In the workplace, the WPL experiences of SE graduates was mapped across several organisations from the graduate, guide, and organisational perspective all the while recognising learning as an individual and personal process. In higher education, the research focused on SE graduates' exposure to the applicable WPL strategies and supports used in the classroom, while also recognising learning as an individual and personal process. Consequently, the research was delimited to individual learning rather than team-based learning; team-based learning would form the basis of a different body of research, necessitating extensive research into communities of practice, collective learning, group dynamics, etc.

Focus on processes and practices rather than relationships

This research focused on the strategies and supports for the individual rather than the relationship between the guide, the graduate, and the organisation. Studying such a relationship is a separate research topic that would require extensive research into relationship dynamics, office politics, interpersonal relationships, etc.

In the above delimitations, the unit of analysis was the individual along with the WPL supports and strategies they experienced. Note that the delimitations are briefly discussed in the recommendations for future research in the final chapter.

4.2.3 Sampling, access, and consent

Sampling, access, and consent are discussed in terms of the three workplace surveys first, followed by the undergraduate survey. The sample size of each of the four groups in this study is then presented followed by the techniques used for improving the response rate of web-based surveys, the actual response rate, and the timeframe for the study.

4.2.3.1 Workplace surveys

Non-probability sampling was used for the three workplace surveys. Within this, a combination of convenience and snowball sampling was applied. Convenience sampling was used to contact organisations who then utilised snowball sampling to secure responses from graduates and guides. Convenience sampling was also used to contact individual guides who were also asked to use snowball sampling to secure responses from the organisation, graduates, and guides.

Table 4-1 displays the strategies used during the convenience sampling phase to identify potential respondents. The first section of this table displays the strategies used to locate suitable organisations. The second section displays the strategies used to locate suitable guides. For each section the number contacted, the number that participated in the study, the number that declined to participate, and the number that did not respond was recorded. Note that these numbers only relate to the respondents arising from the convenience sampling phase of this study; it does not represent the numbers arising from the snowball sampling phase. The total number of respondents for each survey is presented later in section 4.2.3.5.

Once suitable organisations were identified as potential respondents, an initial cold-call email was sent to the individual responsible for SE graduate recruitment and training (Appendix A). This email detailed the study, the commitment from the organisation, and the links to the surveys. If no response was received within a few weeks, a reminder email was sent (Appendix B). In cases where organisations consented to participate, the individual responsible for SE graduate recruitment and training completed the organisation survey and used the snowballing strategy to secure consent from their suitable employees to complete the graduate and guide surveys. Organisations were encouraged to provide as many graduate and guide respondents as possible through the snowballing strategy.

When suitable guides were identified as potential respondents, the same cold-call email that was sent to organisations was sent to the guides. This ensured that all potential respondents were presented with the same information. When guides

consented to participate, they were asked to approach other suitable colleagues interested in completing the graduate, guide, and organisation surveys.

Since the unit of analysis was delimited to the individual, participating organisations were free to complete as many categories of WPL survey (organisation, guide, and graduate) as they wished. All three WPL surveys did not have to be completed by each participating organisation.

4.2.3.2 Undergraduate survey

Non-probability, convenience sampling was also used for the undergraduate survey which was deployed on a single-site, WIT. An email was sent to all SE lecturers asking them to post the attached details of the study and the survey link in all of their undergraduate SE modules in Moodle, the Virtual Learning Environment in WIT. This enabled all SE students to decide whether to participate or not in the study. The text of the email sent to SE lecturers is available in Appendix C.

Table 4-1 Access to respondents and their involvement in the study

Source: Author

Source: Author							
Date started	Convenience sampling strategy for identifying respondents	Number contacted	Number participated	Declined to participate			No response
				No graduates	Workload	No reason	
Locating organisations (who used snowball sampling to secure graduate and guide responses)							
29 th Jun 2010	WIT Careers Centre Website (list of companies)	34	0	3	1	0	30
29 th Jun 2010	Grad Ireland	38	2	8	1	0	27
29 th Jun 2010	Irish recruitment websites	101	7	22	2	1	69
17 th Aug 2010	WIT Email – Advertised Vacancies	5	2	2	1	0	0
18 th Aug 2010	ICT Ireland	5	0	0	0	0	5
19 th Aug 2010	Dublin Chamber of Commerce	1	0	0	0	0	1
24 th Aug 2010	European Commission recruitment site http://ec.europa.eu/	8	0	2	0	0	6
2 nd Sep 2010	LinkedIn – Company search	23	2	2	0	0	19
8 th Sep 2010	Golden pages (search: ‘computer consultancy’ and ‘computer software’)	1	0	0	0	0	1
8 th Sept 2010	Kompass directory: http://ie.kompass.com/ (search: ‘software development’)	1	0	0	0	0	1
27 th Sep 2010	LinkedIn – Groups	3	0	0	0	0	3
18 th Nov 2010	Target IT Magazines	23	0	2	2	0	19
3 rd Feb 2011	Irish Software Association members lists: http://www.software.ie/Sectors/ISA/ISADoclib3.nsf/wvMembers?OpenView	6	0	0	0	0	6
SUB TOTAL (locating organisations)		249	13	41	7	1	187
Locating guides (who used snowball sampling to secure additional graduate, guide, and organisation responses)							
14 th Sept 2010	Through WIT colleagues	1	1	0	0	0	0
27 th Sep 2010	LinkedIn – Individual Contacts	55	15	0	0	10	30
27 th Sept 2010	Researcher’s past SE colleagues not in LinkedIn	7	7	0	0	0	0
SUB TOTAL (locating guides)		63	23	0	0	10	30
OVERALL TOTAL		312	36	41	7	11	217

4.2.3.3 Sample size

Cohen *et al* (2007) ascertain that larger samples improve reliability and facilitate the use of more sophisticated statistics. They suggest that at a minimum, researchers should aim for 30 respondents per variable. According to Freyens (2006) targeting multiple organisations dilutes potential outliers resulting in a more objective perspective. Due to the target population limitations discussed in section 4.2.1, gaining access to a large number of organisations and respondents proved difficult. Of the 312 target respondents contacted, 36 (11%) took part, 217 (70%) did not reply, 41 (13%) stated that they had not hired SE graduates in the past three years, and the remaining 18 (6%) replied but were not in a position to take part. The breakdown of these figures can be seen in Table 4-1.

For all surveys, some responses were deemed unusable as they were only partially completed. These responses were discarded. This information along with the number of responses for each survey can be viewed in Table 4-2.

Table 4-2 Sample size for all four surveys

Source: Author

Survey	Completed	Unusable	Usable
Graduate	43	2	41
Guide	39	7	32
Organisation	11	1	10
Undergraduate	108	39	69

With regard to the three WPL surveys, this table shows the usable sample size for the organisation was 10, the graduate survey was 41, and the guide survey was 32.

This table also shows that the usable sample size for the undergraduate survey was 69. A large number of surveys were barely started by undergraduates and had to be discarded. One explanation for the high abandonment rate could be that the students were using college computers to take the survey. If the student chose to leave the survey and return to complete it later, they would more than likely using a different computer and would therefore have a different IP address. In this case, the survey software would not recognise the respondent and would start a new survey rather than returning to their partially completed one. This suspicion cannot be verified as no

personal information was gathered to confirm this. However, lecturers did inform the researcher that the students were taking the survey during computer lab time.

4.2.3.4 Response rate considerations

This section covers three specific techniques that can improve response rates: the use of incentives, sending personalised invitations, and reminding potential respondents of the study.

Incentives in mail-based surveys

Bourque and Fielder (1995) drew attention to the contentious debate surrounding the use of incentives, both monetary and material, to improve response rates. They reported one side arguing that the results emerging from respondents receiving such incentives were unreliable with respondents paying little attention to the items on the questionnaire. They conveyed that the opposing side believed it was a perfectly reliable method of securing the response rate with the incentive used as a way of thanking the respondent for their valuable time.

Incentives in web-based surveys

This contentious debate continued into the realm of web-based surveys. Cook *et al* (2000) conducted a meta-analysis of web-based survey response rates. They reported that the use of incentives in web-based surveys can be counter-productive by reducing response rates whereas, Göritz's (2006) meta-analysis of web-based surveys reported that material incentives increased both response and retention rates. However, Göritz (2006) cautioned that using incentives can cause problems with data validity in that the incentive might:

- attract a certain type of individual that could result in a biased sample group
- put off an individual that would ordinarily have taken part if an incentive were not offered
- encourage some respondents to submit multiple copies of the survey to get the incentive many times
- encourage respondents to choose any answers just to fill out the questionnaire quickly in order to be rewarded the incentive

Owing to the concerns relating to the validity of the data, incentives were not offered to respondents in this study.

Personalised email invitations

Both Heerwegh's (2005) and Muñoz-Leiva *et als* (2010) studies suggested that using personalised email invitations increased web-based survey response rates. Consequently, all emails sent to the prospective WPL respondents were personalised by addressing the respondent by name and citing their organisation name in-text in the email.

Reminder emails

Van Selm and Jankowski (2006) maintain, when conducting web-based surveys, that reminder emails should be sent to respondents to increase the response rate. This approach was adopted in this study.

4.2.3.5 Response rate achieved

It proved difficult to calculate the response rate for each of the three workplace surveys due to the sampling approach adopted. Convenience sampling was used to contact organisations who then utilised snowball sampling to secure responses from graduates and guides. Convenience sampling was also used to contact individual guides who were also asked to use snowball sampling to secure responses from the organisation, graduates, and guides. As a result, the researcher had no way of determining how many respondents were initially sent the workplace surveys. As no distinct target population could be defined, the response rate for the organisation, guide, and graduate surveys was not calculated. However, of the 312 workplace respondents contacted directly, 36 took part, yielding an overall response rate for the convenience sampling approach of 12% (Table 4-1). It is worth noting that the use of individual LinkedIn contacts and the researcher's past SE colleagues proved the most successful approach for securing participants. This is in line with Cook *et al* (2000) who posit that using personal contacts increases the response rate. Cold calling organisations proved an inferior strategy for securing respondents.

At the time of the field research, 550 SE students were registered in the School of Science in WIT. The researcher contacted all lecturers teaching these undergraduates. As 69 completed surveys, this represents a response rate of 13% for the undergraduate survey.

4.2.3.6 Data collection timeframe

Table 4-1 displays the convenience sampling strategies used to identify and gain access potential respondents for the study. It also contains the start date that each strategy was initially adopted. The first strategy took place on the 29th June 2010 and the final strategy was initiated on the 3rd February 2011. In total, when all email traffic ceased, the field research took ten months.

4.2.4 Survey design

Table 4-3 presents, for each of the four surveys, the associated sections and a brief description of data gathered in each section. Each of the four research instruments had a similar introduction page describing the study, the importance of participation, the significance of the results, the confidentiality, and the expected completion time for the survey. The time that it took in the pilot study (discussed later in section 4.2.4.4) to complete the survey is also included in the table. The surveys can be viewed in Appendices D, E, F, and G.

Several WPL models and theories were presented in the literature review and the research questions emerged from them. Each question appearing on the surveys is directly related to one or more of the research questions. The majority of individual questions on the surveys can be combined to form specific concepts. It is important to clearly define these main concepts and the individual questions that comprise these concepts. These definitions are presented in the following section.

Table 4-3 Structure of the four surveys

Source: Author

Graduate Survey: gathers information on participant:		
Section A	Background, work experience, and current employment.	Took 30 minutes to complete survey in the pilot study
Section B	Perspectives on the frequency and perceived effectiveness of WPL strategies.	
Section C	Perspectives on the supports and management of their WPL.	
Section D	Perspectives on what motivates them to engage in WPL and how they were prepared for WPL.	
Section E	Perceptions of the organisational support and encouragement they experienced when engaging in WPL.	
Section F	Perspectives of the WPL opportunities available for graduates.	
On-the-job Learning Guide Survey: gathers information on participant:		
Section A	Background, work experience, and current employment.	Took 25 minutes to complete survey in the pilot study
Section B	Perspectives on the frequency and perceived effectiveness of WPL strategies.	
Section C	Supports they provided for graduates and the management of their WPL. Also gathers information on how the organisation prepared guides for their WPL role.	
Section D	Perceptions of the organisational support and encouragement they experienced when engaging in WPL. Also provides information on organisational recognition of guide contribution to WPL.	
Section E	Perspectives of the WPL opportunities available for graduates.	
Organisation Survey: gathers information on organisational:		
Section A	Size and the individual answering the survey on behalf of the organisation.	Took 15 minutes to complete survey in the pilot study
Section B	Formal WPL policies and learning resources.	
Section C	Supports for WPL.	
Section D	Selection of employees to support WPL.	
Section E	Preparation of employees for the expectations of WPL.	
Section F	Overall support for WPL.	
Undergraduate Survey: gathers information on participant:		
Section A	Background, work experience, and current employment.	Took 10 minutes to complete survey in the pilot study
Section B	Perspectives on the frequency and perceived effectiveness of WPL strategies appearing in undergraduate tertiary education courses.	

4.2.4.1 Defining the main constructs

Kumar (2005) stated that it is important for studies to define the main constructs used and their measures. Formative and reflective are two types of measurement model (Howell *et al* 2007). Freeze and Raschke (2007) maintained that researchers should identify the type of measurement model used for constructs as the chosen model directly affects the validity and reliability measures that can be used. Jarvis *et al* (2003) identified a set of criteria for identifying the reflective or the formative model for specific constructs. Referring to these criteria, this study defines formative and reflective constructs as:

- *Formative constructs* assume little or no correlation exists between the measures comprising the construct. If a measure is removed from a formative construct model, this could alter the meaning of the construct as each individual measure has an impact on the construct. For example, Freeze and Raschke (2007) state that the Socio-Economic Status measurement model is formative. It uses three measures – education, income and occupational prestige – and dropping one of these measures would alter the meaning of the construct.
- *Reflective constructs* assume a correlation exists between the measures comprising the construct. If a measure is removed from a reflective construct, this should have no effect on the meaning of the construct as the remaining measures should adequately represent the construct. For example, Freeze and Raschke (2007) state that the Perceived Ease of Use measurement model is reflective. It uses six measures – easy to learn, controllable, clear and understandable, flexible, easy to become skilful, and easy to use – and dropping one of these measures, due to their correlation, would not alter the perceived ease of use.

Based on the above definitions and examples, all the constructs used in this study were formative; if a measure was removed from any of the constructs, the meaning of the construct would be altered. Figure 4-1 presents the theoretical framework containing the main constructs in the study. In this figure, each construct

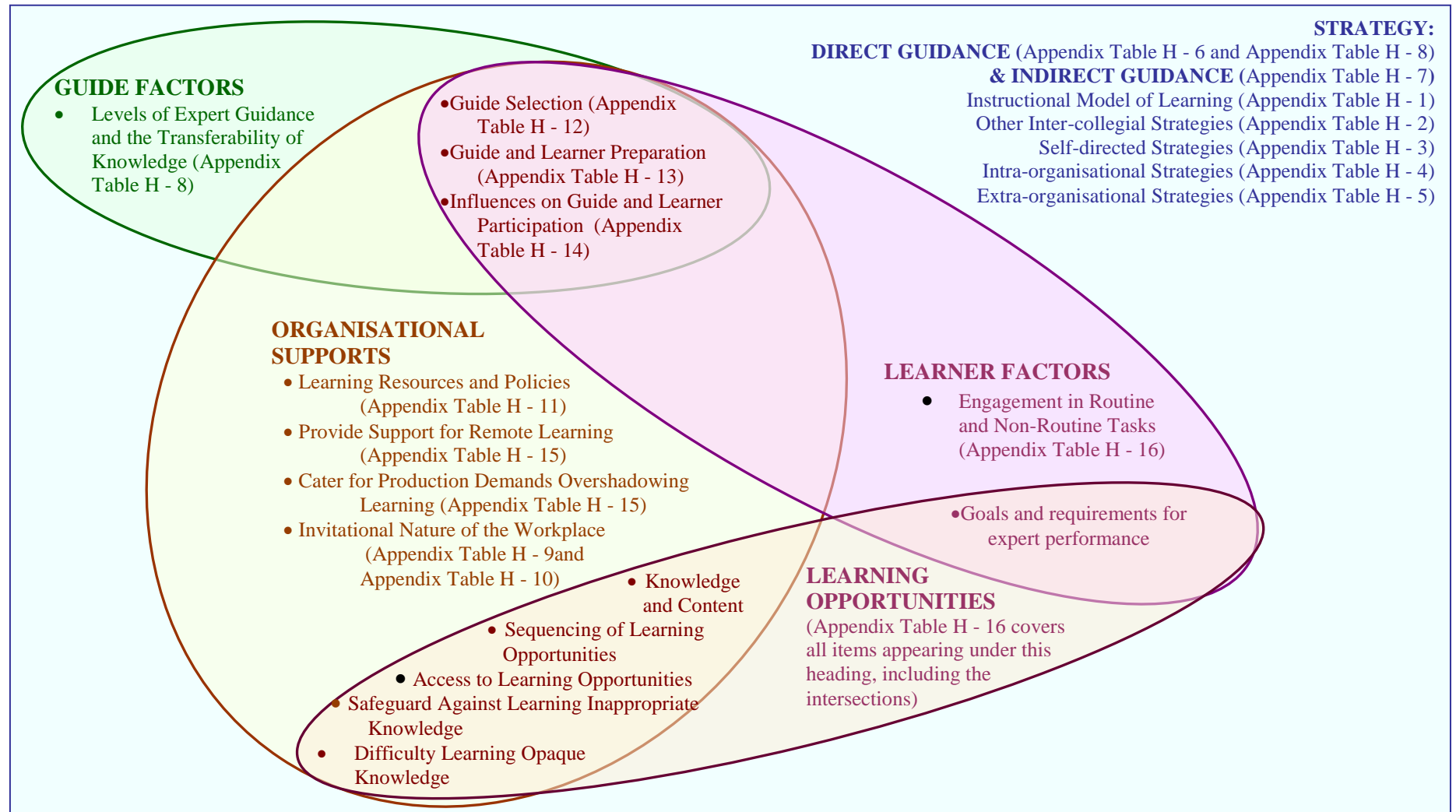


Figure 4-1 Defining the main concepts on the theoretical framework

Source: Author

is cross-referenced with a table in Appendix H, which defined the construct. Defining a construct involved cross-referencing the applicable models and theories presented in the literature review with the relevant question item on the research instrument. Taking this approach enabled distinct traceability between the research instruments, the research questions, and the main concepts in the study.

In Appendix Table H - 1 to Appendix Table H - 7, each question typically measures both the frequency of use and the perceived effectiveness of WPL strategies. In cases where N/A appears as the question item, there was no relevant question on that particular questionnaire. This occurs when that class of respondent is not directly involved in the support or strategy.

4.2.4.2 Data management and coding

At an elementary level, Denscombe (2010) ascertains that quantitative data is associated with numerical data whereas qualitative data takes the form of words and images. Closed-ended questions are typically considered quantitative data and open-ended questions are typically qualitative data. All four surveys used both closed and open-ended questions which is consistent with the mixed method approach. The closed-ended questions were, by far, the dominant method in the research instruments.

Quantitative data (closed-ended questions)

The closed-ended questions yielded non-parametric data. Nominal data represented categories of information such as gender, employment status, etc.

Robson (2002) stated that summative rating scales (e.g., Likert and Likert-type) are extensively used to measure attitude. Cohen *et al* (2007) attribute their popularity to the ability of the scale to jointly gather opinion with measurement; such quantification allowing the researcher to calculate frequency and perform other pertinent statistical analysis.

As well as measuring attitude, Likert-type scales, particularly five-point scales, are commonly used to measure perceived effectiveness and competence. Using a five-point Likert-type scale, Felstead (2006) reported that the LAWS instrument, measured the perceived importance of activities and learning sources for improving work

performance, Sudhakar and Patil (2006) measured employees' perception on the effectiveness of various internal communication tools, Sahinidis and Bouris (2008) measured perceived training effectiveness, Salminen *et al* (2009) measured student nurse teachers' self-reporting on their effectiveness, Hou *et al* (2011) measured nursing faculty competence, and McMillan and Shannon (2011) measured program effectiveness and perceived student competency.

Notwithstanding the interpretation errors that are standard with such scales (i.e. one respondents' 'agree' might be another respondents' 'strongly agree'), Likert-type scales are used to measure degrees of perceived effectiveness, agreement, frequency and extent. These scales yield ordinal data (Kumar 2005) where a rank or order is prevalent (e.g., low to high, more or less) and the intervals between the ranks is not necessarily equal (Babbie and Halley 1995; Black 1999).

When developing a rating scale, the number of categories in the scale and whether to label the categories needs to be decided (Dillman 2000). Both are discussed next, in the context of this study.

Rating scale categories

Many authors addressed the conflicting argument in the literature relating to the optimum number of categories in a scale. Jyothibabu *et al* (2010) and Croasmun and Ostrum (2011) stated that some studies alleged the reliability and validity of a scale is independent of the number of categories whereas other studies reported validity increased as the number of scale items increased, up to an optimum of seven categories. Dawis (1987) draws attention to large research instruments and how the available space for scales can restrict scale design. Peterson (2000) indicates that self-administered questionnaires should ideally have five or less rating scale categories due to space limitations. Peterson (2000) also suggests when comparing groups of respondents, particularly when a large number of rating scales are used, that five categories are sufficient.

Jyothibabu *et al* (2010) state that there is confusion in the literature about a mid-point category on a scale in relation to the effect its presence or absence has on reliability and validity. Cohen *et al* (2007) state on one hand, that participants tend towards the

mid-point of the scale and on the other, if a respondent wishes to sit on the fence they should be allowed to do so. Peterson (2000) suggests that if an indifferent or neutral response logically exists and there is no requirement to force the respondent to answer one way or another, then an odd number of rating scale categories should be chosen. Croasmun and Ostrum (2011) maintain that, by providing a mid-point, the respondent, if they wish to remain neutral is not forced to provide an answer one way or another and this can reduce response bias.

Based on the above, the research instruments used an odd number of scale categories as the researcher did not want to force the respondents to answer one way or another, if they were indifferent. Each rating scale was bi-polar with five categories owing to the large number of questions using rating scales and also the limited on-screen space in web-based questionnaires (www.surveymonkey.com).

Category labelling

Dillman (2000) believes that labels provide the respondent with a meaning for each category on the scale which Croasmun and Ostrum (2011) argue, can reduce response bias. Fowler (2002) states that “people respond to the ordinal position of categories as well as to the descriptors” (p. 92). For these reasons, both labels and numbers were assigned to each of the five categories in the rating scales. Making this decision eliminated all forms of semantic differential scale³ and resulted in the Likert-type scale being selected. This permitted the unambiguous use of the indifferent category (i.e. Average, Neutral, Neither effective or ineffective) which clearly occupied the midpoint of the Likert-type scale.

The numerical value was also included for two reasons. The first reason was to support the respondent by making the scale as user-friendly as possible and the second reason was to facilitate the use of descriptive statistics such as mean and standard deviation on the Likert-type responses⁴. For the numerical value, the most positive aspect was assigned the highest point value (i.e. 5) with the lowest value (i.e. 1)

³ A scale that only labels the extreme categories

⁴ Making the assumption that the ordinal data is quasi-interval

assigned to the most negative aspect of the scale. An example of a Likert-type scale used in this study is:

- Very ineffective (1)
- Ineffective (2)
- Neither effective or ineffective (3)
- Effective (4)
- Very effective (5)

Qualitative data (open-ended questions)

Open-ended questions were used for two specific reasons:

1. They accompanied quantitative questions in an effort to obtain further insight, clarification, or additional information relating to respondents reasoning behind their answers. This approach provided “additional corroborative data by way of validation” (Cohen *et al* 2007, p.105).
2. They were used as stand-alone questions when quantitative questions were not appropriate and would not have yielded rich data. One such question was used to gather information on the respondent’s motivations behind participating in WPL.

4.2.4.3 Research considerations

Ethics approval, the confidentiality of responses, and the option for respondents to remain anonymous were considerations when designing the instruments and conducting this research.

Ethics approval

All field research projects require ethics approval in WIT. The researcher sat before the convened ethics committee at the outset of the research in 2006. Ethics approval was sought and granted for the study in general and the graduate, on-the-job learning guide, and organisation surveys in particular. However, as the research evolved and it emerged that the opinions of undergraduates would be required, the researcher returned to the ethics committee to seek adjunct approval for the additional research instrument in 2010. The approval was granted. Consequently, this research and all the research instruments used have full ethics approval.

Confidentiality

The introduction page of each research instrument assured the participants of the confidentiality of their responses. The graduate and on-the-job learning guide research instruments contained the following statement:

All information supplied in this survey will be kept strictly confidential and individual responses will NOT be made available to your employer.

Through the following statement, organisations were assured that their responses were confidential and that their organisation's name would not be explicitly reported upon:

All information supplied in this survey will be kept strictly confidential and only reported upon in summative form.

Undergraduates were also assured that their responses were confidential and that their individual responses would not be made available:

All information supplied in this survey will be kept strictly confidential and individual responses will NOT be made available to anyone.

In addition to these statements appearing on each survey, the cold-call email (Appendix A) for establishing initial contact with target organisations also re-iterated the confidentiality of the responses with the following statement:

All information supplied in the surveys will be kept strictly confidential. The organisation name will never be published and findings from this study will be disseminated as summative statistics and anonymous quotes from participants.

Anonymity

The undergraduate survey did not ask for any information that could identify particular students. For the remaining three surveys, anonymity was permitted, if the respondent wished to remain anonymous. The fields in Section A of each survey that could identify a respondent are presented in Table 4-4. For the graduate and on-the-job learning guide surveys, the organisation name was mandatory so that the researcher could follow up with organisations that agreed to participate but didn't complete the surveys.

Table 4-4 Respondent anonymity**Source: Author**

Survey	Field on Survey	
Graduate	Name	Optional
	Age	Optional
	Gender	Optional
	Organisation name	Mandatory
On-the-job Learning Guide	Name	Optional
	Organisation	Mandatory
	Job Title	Optional
Organisation	Organisation name	Optional
	Your name	Optional
	Your current job title	Optional
Undergraduate	<i>No personal information was gathered that could identify any student.</i>	

4.2.4.4 Pilot study

Dawis (1987) states that pilot testing can provide preliminary indications of the ease with which the instrument instructions can be adhered to, the time it takes to complete the instrument, and the appropriateness of the instrument for the target population. Litwin (1995) states that pilot testing affords the researcher an opportunity to rework the instruments to cater for errors, omissions, confusing wording, formatting issues and so on prior to deploying them.

A workplace pilot study was conducted in a suitable local organisation that wished to remain anonymous. In total, five learners, two on-the-job learning guides, and one organisation provided valid responses. Written feedback from these respondents indicated that the suggested completion time for each survey was accurate.

The findings of the pilot were written up and analysed in order to identify potential data gathering and analysis problems and oversights in the three research instruments. Numerous general changes arose from the pilot study, which included:

- All Likert-type scales were changed to include a numerical representation with the textual categories e.g., Very effective (5), Effective (4), Neither effective or ineffective (3), Ineffective (2) and Very ineffective (1).
- All the Likert-type scales were re-ordered to range from the lowest to the highest values e.g., Very ineffective (1), Ineffective (2), Neither effective or ineffective (3), Effective (4), and Very effective (5). This was necessary to

simplify the data input into the Statistical Package for the Social Sciences (SPSS).

- A WPL guide that partook in the pilot study suggested including wikis in the list of materials and resources in the Self-directed Strategies category. However, the Internet was included in this list and if wikis were included, there would be a need to include other media such as blogs, social bookmarking, forums, social networks, instant messaging, content communities, listservs, podcasts, etc. As a result, no changes were made to the research instruments based on this suggestion.

Table 4-5 describes other specific changes to questions on the workplace surveys based on the pilot study. It shows the question numbers and the before and after phrasing.

The undergraduate pilot study took place after the workplace pilot study. All the changes made to the workplace surveys were reflected into the undergraduate survey prior to the pilot study taking place.

For the undergraduate pilot study, the survey was completed by three undergraduates selected by the researcher from her first year programming class. As these undergraduates were high achievers who regularly engaged in dialogue in class, the researcher was confident they would complete the questionnaires diligently and report back on issues they encountered. They completed the survey in 10 minutes but did not have any comments or issues with the research instrument.

Table 4-5 Changes to research instruments following pilot study

Source: Author

Survey Name and Question Number		Question on the pilot study survey	Changes made to field study survey	Reason for change
Graduate	26	How were you prepared for your learning role in on-the-job learning?	How <i>did your organisation prepare you</i> for your learning role in on-the-job learning?	These questions gathered information relating to the preparation of the worker for WPL. These questions were largely misunderstood based on the feedback from the pilot respondents and the responses provided to the questions. Consequently, these needed rephrasing to make them clearer and more explicit.
	27	Did your organisation provide any training courses/activities to help you learn on-the-job?	Did your organisation provide any training courses/activities that taught you how to learn on-the-job?	
	29e	In your first year of your employment, to what extent were you adequately prepared to get the most out of your on-the-job learning?	In your first year of your employment, to what extent <i>did your organisation adequately prepare you</i> to get the most out of your on-the-job learning?	
Guide	20	How were you prepared to support the on-the-job learning of these graduates?	How <i>did your organisation prepare you</i> to support the on-the-job learning of these graduates?	
	21	Did your organisation provide any training courses/activities to help you support on-the-job learning?	Did your organisation provide any training courses/activities <i>that taught you how to</i> support on-the-job learning?	
	24e	To what extent were you adequately prepared to support on-the-job learning?	To what extent <i>did your organisation adequately prepare you</i> to support on-the-job learning?	

4.2.5 Validity, reliability and reflexivity

The section discusses the quality and accuracy of the research design, instruments, and constructs under the headings of validity in research design, validity in instrument design, reliability, general tactics used to improve reliability and validity, and reflexivity.

4.2.5.1 Validity in research design

Validity is the degree that the gathered data is accurate and measures what it proposed to measure at the outset (Kimberlin and Winterstein 2008). Tojib and Sugianto (2006) state that it is crucial valid instruments are developed. Internal and external are two broad types of validity (Arnell and Sim 1993) associated with research design and these will be discussed next.

Internal validity

Black (1999) defines internal validity as the process of:

Ensuring that the design takes into account a clear causal relationship and allows for the control of all other possible contributing extraneous variables (p. 72).

Hale and Astolfi (2011) refer to internal validity as the accuracy or “the design integrity of the study” (p.342). Bergh *et al* (2004) ascertain that studies boasting high internal validity yield results that are not subjected to flaws. Internal validity threats vary dependent on the research design (Campbell and Stanley 1963).

Bergh *et al* (2004) analysed numerous cross-sectional studies to ascertain the extent that they catered for internal validity threats, using the metrics identified in Table 4-6. The first two columns in this table shows their results, which indicate that the majority of cross-sectional studies did not control for the majority of metrics. They concluded that social studies are particularly vulnerable to internal validity threats. Based on the research conducted by Bergh *et al*, the third column in Table 4-6 details the consideration given to each of the threats to internal validity in this study and the extent, where practicable, each threat was controlled for.

Table 4-6 Threats to internal validity in cross-sectional designs

Source: Adapted from Bergh *et al* (2004)

Threat	Not controlled for (%)	Consideration of the threat in this study
History <i>When events occur between measurement periods</i>	51.4	The history effect was not controlled for in this study for two reasons. Firstly, pre-tests followed by post-tests did not feature in the research design. Secondly, the unit of analysis was the individual. If the unit of analysis was the organisation-guide-graduate team, the research design would have needed to control for events that could occur during the data gathering timeframe i.e. whilst securing responses from all three WPL respondents (organisation, graduate and guide).
Maturation <i>When effect may be due to passage of time such as variation in age or experience</i>	42.9	This threat is most relevant for pre-test / post-test studies and relates to the respondent changing their views or becoming more experienced with the area as the field research progresses. As this study was cross-sectional in nature, lacking a time dimension, it was highly unlikely that the respondents would experience the maturation effect whilst completing their questionnaire.
Selection <i>Subjects are selected because they possess a trait related to study variables</i>	74.3	The sampling effect was pertinent as the sample was non-random due to the non-probability sampling approach adopted. This was discussed as a method limitation in section 4.4.3 which indicated that the sample groups were indicative of the entire population, based on the background information gathered.
Testing <i>Familiarity with test</i>	Not included	This threat is most relevant for pre-test / post-test studies and relates to the respondent becoming familiar with the research instrument when repeatedly deployed. As this study was cross-sectional in nature, this effect was not applicable, and hence, not controlled for.
Selection – history <i>Selection of subjects on the basis of an event of interest</i>	91.0	Additional threats can emerge when history, maturation, and testing effects interact with selection. These effects are applicable for multiple group research designs (Campbell and Stanley 1963) e.g. treatment groups, control groups, pre- and post-test groups, etc. In the main, these effects are not relevant in this study as multiple groups of this nature were not used.
Selection – maturation <i>Selection of subjects on the basis of life cycle, size</i>	85.0	
Selection – testing <i>Selection of subjects on basis of test results</i>	92.0	
Ambiguity about causal inference <i>When the direction of causal inference among relationships is unclear</i>	77.1	This threat is relevant for cross-sectional designs. However, this research does not infer any causal relationships; it is primarily concerned with ranking constructs and determining perceived effectiveness.

In addition to the threats outlined by Bergh *et al* (2004), Black (1999) identified a further three pertinent threats to internal validity: no comparison across groups, instrument reliability, and sample stability. These are presented in Table 4-7 along with the consideration given to each threat and the extent, where practicable, each was controlled for.

Table 4-7 - Threats to internal validity of cross-sectional designs

Source: Adapted from Black (1999, p. 73)

Threat	Consideration of the threat in this study
No comparison across groups <i>Just one group</i>	Four different classes of respondent were used in this study. The graduate and guide questionnaires had two groups for many of the questions (guides selected by graduate and guides selected by the organisation). The study compared the findings from both these groups. The organisation and undergraduate questionnaires only had one group each. Multiple groups, such as control groups, treatment groups, pre- and post-test groups were not applicable in this cross-sectional study.
Instrument reliability <i>Low reliability</i>	Due to the use of formative scales, typical measures of internal consistency reliability (which test whether the items in the scale interconnect well) were not applicable. However, previous studies of WPL survey research were examined in order to develop a list of existing errors and problems, each of which were addressed when developing the four surveys (Table 4-9).
Selection: sample stability <i>Such as loss of respondents over time</i>	As this study was cross-sectional in nature, sample stability did not emerge as a concern.

External validity

When a survey's design boasts external validity, it is permissible to generalise the results to the target population (Fink 1995b). For external validity to apply, the sample must be representative of the overall population (Black 1999).

Due to the non-random sampling approach adopted, strictly speaking, the findings from this study only apply to the sample and cannot be generalised to the wider SE population. However, it is always difficult to assess how generalisable research is in the social sciences as studies involve particular people, each boasting observable heterogeneity. Based on the background data gathered, the respondents in this study could be said to be typical of the target population, and therefore generalisable to the extent that they are representative. The research instruments in this study could be considered externally valid.

4.2.5.2 Validity in instrument design

Having discussed the internal and external validity of the research design, specific measures of validity at instrument level will be explored next. Bannigan and Watson (2009) quantify that thirty five different terms exist in the validity literature. Lee (2004), in her paper about survey research, suggests that validity be classified under three headings:

- Content validity
- Criterion-related validity
- Construct validity

Several authors explicitly define face validity as separate from content validity (Arnell and Sim 1993; Fink 1995a; Litwin 1995; Bannigan and Watson 2009) and this study will adopt that approach. To ensure the validity of the research instruments for this study, translational validity techniques (DeVon *et al* 2007) i.e. face and content validation were applied. Criterion-related and construct validity were not considered applicable. Each form of validity is discussed below with reasons cited for not their use or non-use.

Face validity

Arnell and Sim (1993) state that face validity is a very basic form of validity. It is a “casual assessment of item appropriateness” (Litwin 1995 p.35) by the research subjects or by individuals not necessarily familiar with the area. Face validity involves the items on the survey being reviewed to assess their comprehension such as the use of appropriate language and level (Fink 1995a) and also for perceived relevance (Arnell and Sim 1993). Fink (1995a) maintains that existing literature and theoretical models are generally not considered at this stage.

Dawis (1987) suggests, when designing the questions for the research instruments that care should be taken to ensure the wording is appropriate to the respondent level.

For this reason, WPL terminology and jargon was specifically avoided on the surveys. Instead, definitions were provided as part of the question. For example, the term ‘coaching’ may not be specifically understood by all respondents so rather than asking:

Did you perform work tasks while being coached?

the question was rephrased to include a definition of coaching, thereby ensuring simpler, more understandable terms for the respondent:

Did you perform work tasks while experienced colleagues closely monitored your performance and provided feedback on it?

Having considered comprehension and language use at the research instrument design phase, a PDF file of graduate, guide, and organisational surveys were attached to the initial email sent to organisations and guides. The email drew attention to these PDFs stating that they were included for information purposes. This afforded the prospective respondents an opportunity to apply face validation to the questionnaires (e.g., were the questions answerable, reasonable, understandable, or unnecessarily personal? Were they comfortable forwarding on the questionnaires? etc.) prior to agreeing to participate in the study. Resultant participation in the study was viewed as acceptance of the research instruments.

Content validity

Kimberlin and Winterstein (2008) maintain that content validation assesses the extent that the measures developed accurately define and quantify all relevant aspects of the underlying concept. Bannigan and Watson (2009) believe that this validation is the minimum requisite for determining a research instrument's validity and can be done by expert panel review, by assessing the measures with the literature on the topic, or both.

From an expert panel review perspective, content validity was utilised prior to conducting the field research in the workplace. Two experts possessing knowledge of the theories and models relevant to the research were asked to conduct content validation. The first expert was an experienced software engineer with a doctorate currently working in academia and the second expert was an experienced academic with a doctorate in education. Both reviewed the three WPL surveys to ensure the constructs were accurately reflected. The overall feedback from this review and the resultant amendments are detailed in Table 4-8. All constructs on the undergraduate

Table 4-8 Changes made to research instruments following content validity review

Source: Author

Survey & Item		Question on the pilot study surveys	Changes made to field study surveys	Reason for change
Graduate	14h	Term used is CATP (computer assisted training programs)	Changed to use the more general term CBT (Computer-based Training).	The CBT term would encompass newer technologies such as m-learning and e-learning in addition to any form of computer-based instructional media.
Guide	9h			
Graduate	15	For the fading portion of the question, the options were: <ul style="list-style-type: none"> • Yes • No • Didn't use this strategy. 	For the fading portion of the question, the new options are: <i>Never(1), Occasionally(2), Average(3), Often(4), Very often(5), N/A (didn't use strategy).</i>	For uniformity reasons, the questions were changed so that the fading portion was no longer a yes/no answer but rather a Likert-type scale measuring the extent that fading occurred. All other strategies were measured on a Likert-type scale except for fading.
Guide	10			
Graduate	22	Question phrasing remained the same, a new item, k, was added to the list.	k) Help you understand the breadth of the applicability of what you have learnt?	This measure was omitted from the surveys and was required as it was an item on Billett's levels of expert guidance (third level)
Guide	15		k) Help them understand the breadth of the applicability of what they have learnt?	
Graduate	22a	Phrase used was 'structure your on-the-job learning'	Changed phrase to 'organise your on-the-job learning'.	These questions relate to the first level of Billett's three levels of expert guidance and needed to be restructured to reflect this measure more closely.
Guide	15a			
Graduate	28	Question relating to sufficient time allocated to WPL used the scale: too much for the demands of your software engineering role, about right for the demands of your software engineering role, too little for the demands of your software engineering role, not applicable - no on-the-job learning was required, not applicable - no time was allocated. There was no measure of competence.	Scale changed to <i>Not at all (1) → Large extent (5)</i> Likert-type scale.	A common measure was needed across all three surveys so that descriptive statistics could be applied and comparisons drawn across the three surveys. Also a measure of competence was required.
Guide	23		A second column was added to measure competence using the Likert-type scale: <i>Very ineffective (1) → Very effective (5).</i>	
Organisation	14	Question used the <i>Not at all (1) → Large extent (5)</i> Likert-type scale. There was no measure of competence.	The scale remained unchanged here. A second column was added to measure competence using the Likert-type scale: <i>Very ineffective (1) → Very effective (5).</i>	
Graduate	33	Question phrasing remained the same, a second column was added.	Likert-type scale added: <i>Very ineffective(1) → Very effective(5)</i>	
Guide	18			

survey were directly gleaned from the WPL surveys. The development of the undergraduate survey took place when the WPL field research was being conducted. As content validity was conducted for those WPL surveys and the resultant changes made to the surveys, it was deemed unnecessary to repeat the process for the undergraduate survey.

In relation to assessing the measures with the literature on the topic, the main constructs in the study were defined in section 4.2.4.1 and cross-referenced with the relevant questions on each research instrument (Appendix H). This provided excellent traceability and enabled content validity to be easily conducted. No anomalies or suggested changes were documented during this validation phase.

Finally, to ensure that all factors identified in the theoretical framework belonged to a research question, the framework was cross-referenced with the research questions (Figure 2-9) which demonstrated that no factor was orphaned from the research questions.

Content validity has been labelled the weakest form of validity due to its subjective nature (Trochim 2001, cited in DeVon *et al* 2007). However, a degree of subjectivity is inevitable when people are involved and this is taken into account during the analysis phase.

Criterion-related validity

This type of validity comprises predictive and concurrent validity (Kimberlin and Winterstein 2008). With regard to predictive validity, Lee (2004) stated that it is related to the “ability of the survey instrument or question to predict or estimate” (p.212). Kumar (2005) defines concurrent validity as the comparison of how well one instrument compares with another, when deployed within in the same timeframe. Kimberlin and Winterstein (2008) suggest that concurrent validation is often done when a new instrument has been developed with the intention of replacing an already validated pre-existing (gold-standard) instrument. Concurrent validation typically compares the new with the old.

Forecasting and extrapolation behaviours are outside the scope of this study. There are no predictive instruments, gold-standard instruments, or appropriate pre-validated instruments similar to the surveys in this study. Therefore, adopting criterion-related validity measures was not plausible.

Construct validity

Construct validity, the validity of measurement, is the most complex of the validity approaches presented here. Kumar (2005) states that construct validity, which uses statistics, is more sophisticated than criterion-related validity. Zait and Berteau (2011) define construct validity as the ability of the chosen instrument to measure variables and concepts. It comprises convergent, discriminant, and nomological validity which are defined as follows:

Convergent validity implies that several different methods for obtaining the same information about a given trait or concept produce similar results (Litwin 1995, p. 43).

Discriminant validity assumes that items should correlate higher among them than they correlate with other items from other constructs that are theoretically supposed not to correlate (Zait and Berteau 2011, p. 217).

Nomological (law like) validity is based on the explicit investigation of constructs and measures in terms of formal hypotheses derived from theory. Nomological validation is primarily "external" and entails investigating both the theoretical relationship between different constructs and the empirical relationship between measures of those different constructs (Peter 1981, p. 135).

This study used formative measurement models. Freeze and Raschke (2007) state that convergent and discriminant validity are not pertinent for this measurement model as the measures are not expected to correlate.

Freeze and Raschke (2007) ascertain that nomological validity approaches can be relevant for formative measurement models. However, Litwin (1995) states that construct validity is usually only conducted after surveys have been deployed over a number of years by many researchers. Peter (1981) states that construct validation cannot be established from a single study. As this suite of research instruments have only been deployed in one cross-sectional study, by one researcher, this form of validity is not suitable. Instead, Appendix H defined all the main constructs in tabular

format and cross referenced them with each of the research instruments. This ensured that no questions on the research instruments were orphaned and that all measures comprising the construct were included.

4.2.5.3 Reliability

DeVon *et al* (2007) state that reliability refers to the repeatability and consistency of the research. That is, if another researcher conducted the same research at a later date, using the same research instruments, the results would be the same. Reliability is concerned with the precision of the research instruments. Fink (1995a) maintains that surveys should be reasonably free of measurement errors. According to Bannigan and Watson (2009), the following tests can be used to determine reliability:

- Test-retest reliability
- Inter-rater reliability
- Inter-item reliability

Test-retest reliability

Test-retest is also termed stability reliability (Fink 1995a). Using the test-retest reliability approach, the same research instrument is completed by the same respondents at different time intervals, and the correlation between the scores is calculated (Pallant 2005). However, this approach is not applicable where perceptions change following interventions (DeVon *et al* 2007). As respondents were asked to report on their perception that the frequency of use of WPL supports improved their competency, this test was not deemed suitable. Respondents are continually learning in the workplace and their responses could differ based on increased exposure to certain WPL strategies or supports over time. In addition, the low response rate attributed to both high workload and low availability of potential respondents due to the down-turn in the global economy, the researcher considered it fortunate if a respondent completed the survey once.

Inter-rater reliability

The inter-rater reliability approach, which assesses responses obtained by different researchers (Kimberlin and Winterstein 2008), was not applicable for this study as there was only one researcher involved.

Inter-item reliability

Kimberlin and Winterstein (2008) stated that inter-item reliability measures internal consistency by testing “the equivalence of sets of items from the same test” (p.2276). As a result the research instruments only need to be deployed once (Cohen 2007), which would be practical for cross-sectional studies.

Studies use Cronbach’s alpha to appraise internal consistency reliability (Jarvis *et al* 2003) and it is the most commonly used inter-item reliability measure (Pallant 2005). However, Freeze and Raschke (2007) state “with formative models, high correlation between the indicators is not expected, required, or a cause for concern” (p.1843). As Cronbach’s alpha measures correlation, it is not applicable for the formative construct models in this study.

4.2.5.4 General tactics used to improve reliability and validity

Care was taken when designing the research instruments to ensure that each of the criticisms relating to survey research in the WPL field (outlined in section 3.4.1) were addressed with a view to either minimising or completely eliminating them. Table 4-9 presents each of these criticisms and describes how it is eliminated or minimised through the effective design of the research instruments. Adopting this approach improved the general reliability and validity of the research instruments.

De Vaus (2002) suggests that, when using Likert-scales a standard approach to improve reliability is to use multiple items that ask the same question in different ways. These items could then be compared for consistency of responses. However, he continues to say that this may not be applicable for all surveys and it might be pertinent to only ask one question. As the surveys in this study were very large in nature, this approach was not used as it would have considerably increased the size of the surveys.

4.2.5.5 Reflexivity

Reflexivity involves developing an awareness of and assessing the relationship the researcher has with the phenomenon being studied (Johnson and Duberley 2003). The main threats to reflexivity include reactivity, respondent bias, and researcher bias

(Lincoln and Guba 1985). This section details these biases and the precautions taken to minimise or eliminate them in the study.

Reactivity

Robson (2002) states that reactivity is concerned with the potential for the researcher's presence to interfere with the research setting or with the respondent behaviours. To minimise this bias, the researcher sent cold-call emails to the HR representatives and guides in the target organisations (Appendix A). This ensured that the researcher did not talk to or meet with potential respondents or influence the study by her presence. The researcher did not discuss the study with any potential respondents outside of this email.

Respondent bias

Kimberlin and Winterstein (2008) ascertain that when filling out surveys, respondents self-report on phenomena and researchers use these findings to measure the phenomena. However, Robson (2002) has concerns with self-reporting, stating that respondents can introduce bias, for example through the with-holding of information or providing responses that they believe the researcher wants to gather. Kimberlin and Winterstein (2008) also raises concerns that respondents could be providing responses that are socially acceptable and also estimating frequency for phenomena. Marsick (2003 p.391) states that "the very nature of informal learning makes it prone to self-distortion because it is, by its very nature, tacit, opportunistic, and not typically highly conscious".

Kimberlin and Winterstein (2008) state that while self-reporting can contain bias, there is often no other acceptable means for measuring certain phenomena. This was the situation with this study as surveys were considered the best research instrument to obtain a cross-sectional view of entry-level SE graduate WPL (section 3.3.4). Marsick (2003) suggested a strategy of gathering the views of other respondent types and analysing the scores as a unit. The research design followed Marsick's advice and gathered data from three sources, the graduates, the guides, and the organisation and presented the data as a unit.

Table 4-9 Approach adopted to increase the validity and reliability of the research instruments

Source: Author

Issues in WPL survey research	Addressing the issues in the research instruments
Correctly measure learning as a process	Lists of activities were included in all questions relating to WPL strategies.
Clearly delineate the WPL timeframe for interviewees	The information page for each of the four surveys state that the purpose of the study is to obtain information regarding the WPL that SE graduates receive in their first year of employment following graduation. On each of the surveys, interviewees were constantly reminded of this timeframe when a question directly related to WPL appeared on the survey instruments e.g., <i>“Please answer these questions in relation to your on-the-job learning in your first year of employment following graduation”</i>
Clearly define the key terms	Each of the surveys re-labelled WPL to the more commonly understood term of ‘on-the-job learning’ and defined it as: <i>“any workplace learning that takes place OUTSIDE of formal classes and workshops”</i> .
Clearly phrase WPL questions	De Vaus (2002) suggests that wording questions carefully can improve reliability. The audience for the surveys were educated individuals possessing a strong command of the English language. The researcher was mindful of the survey audience when phrasing all questions and did not use WPL jargon and educational terminology at all. Great care was also taken when developing the rating scale categories and labelling these categories (4.2.4.2). In addition, this point further strengthened the argument for including lists of activities in all questions relating to WPL strategies.
Determine graduate respondents prior related work experience	The graduate survey gathered information on prior SE work experience incidences, duration, and typical duties. College internships and summer jobs were not considered significant prior SE work experience and respondents matching these criteria were accepted for the study. However, those respondents possessing SE experience of minimum one year in duration were examined for suitability for inclusion in the study.
Ensure objective measures for key variables	In this study, data was gathered from four distinct sources, namely, graduates, guides, undergraduates, and organisations. Respondents were only asked to provide an opinion if they were commenting on their own involvement or experience e.g., the guide has no involvement or control over certain strategies and as a result, these strategies did not appear on the guide survey.
Use more than one source	Gathering data from multiple sources (graduates, guides, undergraduates, and organisations) addressed Wall and Wood’s (2005) concern relating to an over-reliance on single-source data as an escalating criticism of the reliability and validity of WPL survey research. By having the three different classifications of WPL sources and asking similar questions from each, the data, when compared as a unit, provided a more accurate and holistic representation of the WPL supports and strategies. It would also indicate convergence between the groups.

Researcher bias

The researcher needs to make explicit the impact their beliefs, past experiences, and background could have on the research and continually appraise the influence any of these potential biases would have on the research study (Brannick and Coghlan 2006). The researcher can influence the study through the selection of the respondents (Robson 2002). This bias was combated by contacting the HR representative in target organisations and asking them to select the individuals to complete the questionnaires.

The researcher is an experienced computing and education lecturer in addition to possessing nine years industrial SE experience. The researcher, when starting out in her SE career, directly experienced the learning process as an entry-level SE graduate. Upon accumulation of many years of SE industrial experience, the researcher also guided the learning of other entry-level SE graduates, whilst, on the academia side, taught many SE subjects to undergraduates. This academia-industrial mix is viewed by the researcher as beneficial rather than a bias as it provides a unique, experiential insight into all areas of the research study. The researcher used this background knowledge and experience to inform the analysis, make observations and build theory. However, adopting Brannick and Coghlan's (2006) advice, any likely biases introduced in this process will be explicitly recognised and will form part of the written account.

4.2.6 Summary of the data gathering techniques

The target population for the graduate, guide, organisation, and undergraduate was clearly outlined. Constraints that reduced the available WPL population for this study were also presented namely the recent global downturn and the decline in SE graduate output. Web-based surveys were chosen as the research instruments because they are highly suitable for technically savvy respondents. The unit of analysis was defined as the individual. The study had ethical approval from the WIT's ethics committee. The field research started mid-2010 and ceased ten months later.

For the three WPL groups, non-probability sampling was chosen in general, and convenience and snowball sampling in specific. Convenience sampling was used to cold-call organisations and also to contact the researcher's previous SE colleagues.

When an individual contacted via convenience sampling agreed to participate, they were asked to use snowball sampling to identify other respondents i.e. graduates, guides, and organisations. To improve the response rate of the WPL surveys, incentives were considered but rejected based on the concerns highlighted by Göritz (2006). However, personalised email invitations and reminder emails, reported to improve response rates were sent. The convenience sampling approach produced a response rate of 12% for the WPL surveys. It was not possible to calculate an accurate response rate for each of the three WPL surveys as there was no way of ascertaining how many individuals were contacted via snowball sampling. For the undergraduate survey, non-probability, convenience sampling was used and the response rate was 13%.

The four research instruments promised respondents that any information provided would be confidential and they could remain anonymous if preferred. When designing the surveys, the formative constructs were defined and cross referenced with the theoretical framework. For the closed-ended questions, all Likert-type scales had five categories each labelled with a descriptor and a number. Open-ended questions were used to obtain further insight, clarification or additional information regarding the closed-ended questions. They were also used as stand-alone questions when closed-ended questions were not appropriate. The three WPL questionnaires were piloted in a local company and changes were made prior to conducting the field research. The undergraduate questionnaire was also piloted but no changes were suggested.

Validity was discussed from both the research and the instrument design perspectives. Research design encompassed both internal and external validity. Cross-sectional studies are particularly vulnerable to internal validity threats. Each threat was addressed and, where applicable, controlled for in the study. The study did not have external validity, due to the non-probability sampling approach adopted. Instrument design validity was discussed from the face, content, criterion-related, and construct validity perspectives. The research instruments had face validity as WPL technical jargon was avoided and definitions were provided where necessary. Potential respondents were also sent a PDF of the questionnaires so they could review them prior to agreeing to participate. The research instruments also had content validity as

an expert panel review was conducted to establish that the questionnaires accurately reflected the underlying constructs and items appearing on the questionnaires were not orphaned from the research questions. Both criterion-related and construct validity were not applicable to the research instruments.

Reliability, which is concerned with the precision of the research instruments, was addressed from the test-retest, inter-rater, and inter-item reliability perspectives. Test-retest was not applicable as the design was cross-sectional in nature and the respondents were continually learning in the workplace. Inter-rater reliability was also not applicable as there was only one researcher. Inter-item reliability was also not relevant as the instruments comprised formative scales rendering typical measures of internal consistency, such as Cronbach's alpha, redundant. To further improve the research instruments' validity and reliability, criticisms relating to previous WPL survey research were identified and either addressed or eliminated in this study.

Reflexivity, which assesses the relationship between the researcher and the phenomena under study, was discussed from three perspectives – reactivity, respondent bias, and researcher bias. To minimise reactivity bias, the researcher contacted potential respondents via cold-call email and did not meet or talk with them. All follow up communication was conducted through email. The researcher was cognisant of the respondent bias associated with self-reporting phenomena and was mindful of this when analysing the findings. As the researcher has considerable experience in both academia and the SE field, this was viewed by the researcher as beneficial rather than a bias in that it provided a unique, experiential insight into all areas of the research study.

4.3 Data analysis

This section presents details of how the quantitative data was cleaned prior to analysis followed by the quantitative and qualitative analysis techniques used in the study.

4.3.1 Cleaning quantitative data prior to analysis

Data cleaning identifies and rectifies errors in the dataset prior to analysis (Van den Broeck *et al* 2005). This approach improves the quality, consistency and validity of

the data by checking it for obvious errors, general inconsistencies, unlikely responses, and missing values (Ranstam 2008).

As the four datasets in this study were exported from <http://www.surveymonkey.com> and imported into SPSS, data cleaning was particularly crucial to ensure valid, complete datasets were used in the analysis process. The cleaning process, as outlined by Mason *et al* (2011), involved the detection and the correction of the following erroneous or implausible data:

- Missing values were identified and coded as '999'.
- Non-applicable or blank data was identified and coded as '0'.
- Cross-checked to ensure the right data was imported into the correct column/variable in SPSS.

4.3.2 Analysing quantitative data

Bouma and Atkinson (1995) ascertain that quantitative data can be analysed qualitatively. This study will use this data transformation technique where the gathered quantitative data in this study will be presented using quantitative techniques however, the analysis and synthesis will be qualitative, where numerous qualitative judgements will be made in order to map the WPL terrain. This qualitative approach can be seen in summary tables (for example Table 5-23, Table 5-38, Table 5-47, Table 5-93) whose only purpose is to provide a general sense of the WPL supports and strategies from the graduate, guide, and organisational perspective.

The closed-ended questions yielded non-parametric data, both nominal and ordinal. Frequency tables, pie charts, and bar charts were used to present the nominal data and no descriptive statistics were used. However, descriptive statistics measuring central tendency and variability were applied to the gathered ordinal data. In particular, mean and standard deviation were used to report on the findings. The mean determined the rank order of many strategies and supports and was used for comparison purposes. For example, strategy comparison (across the three WPL surveys) was facilitated through the measurement of each strategy on the same five-point Likert-type scale, calculating the mean, and comparing them. Frequency tables, line charts, and clustered column graphs were also used to represent ordinal data. Note that the

findings chapter does not draw specific attention to or discuss the standard deviation when presenting the data; it is solely there to add context to the mean.

Interdependence between gathered data was expressed using cross tabulation. These cross tabulations indicated the degree and magnitude of the relationship between two phenomena, regardless of whether they were nominal or ordinal. These cross tabulations do not imply a cause-and-effect relationship, nor do they imply causality; Cohen *et al* (2007) state that such relationships would require deeper field research.

Inferential statistics were also considered in this study, in particular analysis of variance and difference testing. Tests measuring the analysis of variance, such as ANOVA, were not applicable as three or more independent groups did not exist in any one survey. The Mann-Whitney U test, the non-parametric version of the t-test (Cohen *et al* 2007), shows whether statistically significant differences exist between two independent samples. It tests for the difference between two medians, based on ranked data. In this study no groups were evident in the organisational and undergraduate surveys. The graduate and the guide surveys had two independent groups, namely guides selected by the organisation and guides selected by the graduate. However, only a limited number of items were analysed using the group split e.g., guide availability, guide skill at sharing knowledge, etc. The Mann-Whitney U test was applicable for these items. However, it was not used for the following reason. Overall, this study combined the results of the four surveys to map the terrain of the WPL field from multiple perspectives. As the Mann-Whitney U test was only applicable to two of the four surveys, and only to certain items on these surveys, this this could only be used in a very limited capacity, and was therefore not deemed appropriate.

SPSS software was used to calculate the statistics and generate the associated graphs and charts for the study. For simplicity purposes, some graphs were generated using Excel (for example, the clustered column graphs).

4.3.3 Analysing qualitative data

Qualitative data was not prevalent in this study. Therefore, no specific software, such as NUD.ist, was required for analysis. The responses for each question were copied into a table and the content was analysed manually for common themes and sentiments. Rossman and Wilson (1985) report that the use of mixed methods at analysis stage can *corroborate*, *elaborate* or *initiate* the findings.

Table 4-10 outlines the location of qualitative questions on each research instrument and whether the data corroborated or elaborated on the quantitative data, or was a standalone finding itself. Note that the quantitative questions that collected background information were not included in this table.

Table 4-10 Qualitative questions on the four surveys and their use in the analysis

Source: Author

Survey	Question number - full question	Impact on findings	Question number - part of a question e.g., <i>Other, please specify</i>	Impact on findings
Graduate	11	Initiate	20	Elaborate
	18	Elaborate	21	Elaborate
	25	Initiate	24	Elaborate
	26	Initiate	27	Elaborate
	31	Initiate	34	Corroborate
Guide	11	Elaborate	14	Elaborate
	19	Initiate	21	Elaborate
	20	Initiate	27	Corroborate
	26	Initiate		
Organisation	10	Initiate	6	Elaborate
	16	Initiate	9	Elaborate
			12	Elaborate
			20	Elaborate
	17	Initiate	21	Elaborate
			22	Corroborate
Undergraduate	8	Elaborate	None	N/A

4.4 Method limitations

This section presents limitations of the study in the context of general method limitations, target population limitations, and sampling limitations. Throughout, any relevant constraints and limitations previously discussed are drawn upon.

4.4.1 General method limitations

This study measured general opinion and did not take the individual heterogeneity into account. Respondents' differing morals, cultures, beliefs, etc. could be an important influencing factor on the use of and perceived effectiveness of WPL support and strategies. Cross-sectional studies have no time dimension. Including the time aspect could have provided a timeline of changes in the frequency of use and perceived effectiveness of WPL support and strategies. To cater for both these limitations, future research could perform an in-depth longitudinal study, using the revised theoretical framework as a starting point, to ascertain the impact, if any, that personal characteristics and beliefs have on WPL and its perceived effectiveness. Such a longitudinal study would allow the time dimension to be studied to determine its impact on WPL.

The undergraduate study was a single-site survey in WIT which resulted in only one institute's perspective. Given more time, it would have been more practicable to survey a multitude of institutions regarding the use of WPL strategies in the undergraduate classroom.

As discussed in section 4.2.5.5, researchers are always concerned about self-reporting bias when respondents self-administer questionnaires. Particular concerns include respondents' with-holding information, providing responses they believe the researcher wants, providing socially acceptable responses, and estimating frequency. However, self-administered questionnaires in a cross-sectional study were the best approach for this study (section 3.3.4) based on the research problem. The researcher was aware of the issues with self-reporting and was cognisant of them when synthesising and drawing conclusions.

4.4.2 Target population limitations

A number of organisations, applicable for the study, declined to participate due to their heavy workload. This reduced the number of responses received in the study. This was a concern as the available graduate population at the time of the field research was already constrained due to the downturned economy, as discussed in section 4.2.1.

In 2009 when a graduate job was advertised, there were on average 90 applicants compared to an average of 12 in the two preceding years (Walshe 2009). When the field research was carried out, the recruitment pool available to fill each graduate vacancy was larger. This could imply stronger candidates being successfully hired. This could skew the findings of the research as stronger graduates in the workplace may require less WPL and could potentially be active self-directed learners. However, this would require further research as it cannot be determined from the field research carried out.

4.4.3 Sampling limitations

Non-probability sampling was used in this study; random sampling was not possible due to the absence of resources providing details of the overall population. With non-probability sampling, it is not possible to generalise the findings to the overall population, as, in theory, the sample is not directly representative of the population. Based on the background data gathered, the respondents in this study could be said to be typical of the target population, and therefore generalisable to the extent that they are representative. However, this sampling limitation should be borne in mind when critiquing this study.

For the three WPL questionnaires, convenience sampling was used to cold-call organisations and to contact past SE colleagues of the researcher. When willing respondents were identified using convenience sampling, they used snowball sampling to recruit other respondents. Researchers have little control over snowball sampling and run the risk of respondents selecting other 'like' respondents with similar views and characteristics, ultimately leading to sampling bias. As discussed in the previous paragraph, the background information indicates that the four sample groups were

representative of the population. That being said, the researcher kept the potential existence of a sampling bias in mind when synthesising and drawing conclusions.

4.5 Conclusion

This chapter discussed the data gathering and analysis techniques. The target population for the graduate, guide, organisation, and undergraduate were clearly outlined. Constraints that reduced the available population were presented namely the recent global downturn and the decline in SE graduate output. Web-based surveys were selected as the research instrument for the study and the unit of analysis was the individual.

For the three WPL groups, non-probability convenience and snowball sampling was used. Convenience sampling was used to cold-call organisations and the researchers' previous SE colleagues. Snowball sampling was used to encourage participating respondents to identify other potential respondents. Convenience sampling produced a response rate of 12% for the WPL surveys. No incentives were given to respondents but personalised email invitations and reminder emails, reported to improve response rates were sent. For the undergraduate survey, non-probability, convenience sampling was used and the response rate was 13%. No incentives were given to these respondents either. The research instruments promised anonymity, if desired, and confidentiality. The three WPL questionnaires were piloted and recommended changes were made. The undergraduate questionnaire was also piloted but no changes were suggested.

Formative constructs were used on the questionnaires, which also used both closed and open-ended questions. The closed-ended questions were five point Likert-type scales each labelled with a descriptor and a number. These questions were cleaned prior to analysis. Frequency tables, pie charts, and bar charts were used to present the nominal data. For the ordinal data, mean, standard deviation, frequency tables, clustered column graphs, and line charts were used. Interdependence was expressed using cross-tabulation. Inferential statistics, such as ANOVA and Mann-Whitney, were considered, but ruled out as not appropriate. The open-ended questions were used to obtain further insight, clarification or additional information regarding the

closed-ended questions. They were also used as stand-alone questions when closed-ended questions were not appropriate. This data was analysed manually for common themes and sentiments.

The research design was assessed for internal and external validity. Internal validity threats, to which cross-sectional studies are particularly vulnerable, were addressed and, where applicable, controlled for in the study. The research instruments were considered externally validity to the extent that the sample population was representative of the overall population based on the background data. The instrument design had both face and construct validity however, criterion-related and construct validity did not apply to the research instruments. With regard to reliability, test-retest, inter-rater, and inter-item reliability were not applicable to the research instruments. The criticisms relating to the validity and reliability of previous WPL survey research were identified and either addressed or eliminated in this study.

Reflexivity was addressed from three perspectives – reactivity, respondent, and researcher bias. Reactivity bias was reduced through the researcher contacting potential respondents via cold-call email, not meeting or talking with them, and using email for follow up communication. The researcher was aware of the bias associated with self-reporting and was mindful of this when analysing the findings. The researcher has considerable experience in academia and SE; this was viewed as beneficial rather than a bias in that it provided a unique, experiential insight into all areas under study.

The general method limitations included the respondents' individual heterogeneity not taken into account, the undergraduate survey being a single site survey, and the bias associated with self-reporting. The target population limitations included the heavy workload of SE practitioners affecting their ability to participate and the potentially stronger, more competent SE entry-level workforce. The sampling limitations included the use of a non-random sample and the little control the researcher had over the snowballing technique.

The next chapter presents the findings structured according to each research question.

CHAPTER 5

FINDINGS

5.1 Introduction

This chapter presents the findings of the field research. Initially, the profiles of the respondents are presented. The remaining sections organise the core findings in the context of the three research questions under the following headings:

- WPL supports for SE graduates (Research Question 1)
- Perceived effectiveness of the WPL supports and strategies (Research Question 2), and
- Undergraduate use and perceived effectiveness of WPL strategies (Research Question 3).

The WPL supports and perceived effectiveness are then summarised followed by the conclusion for the chapter.

5.2 Profile of respondents

This section presents the profile for each of the four categories of respondent in this study, namely, the guides, the learners, the organisation, and the undergraduate.

5.2.1 Guide profile

A guide was considered suitable for the study if they had supported the WPL of SE graduates at any point in the career. All thirty two guides stated that they had supported the WPL of SE graduates at some point in their career, thereby confirming their suitability for inclusion in the study. Their years of experience varied greatly, as can be seen in Figure 5-1. The least experienced guide had three years working in the field, whereas the most experienced had 30 years. Guides were also asked to supply their job title. These were grouped into four distinct categories as can be seen in Figure 5-2. Three quarters of the guides were senior software engineers (28%) or

team leaders / managers (47%). This indicated that the vast majority of guides were accomplished in their careers.

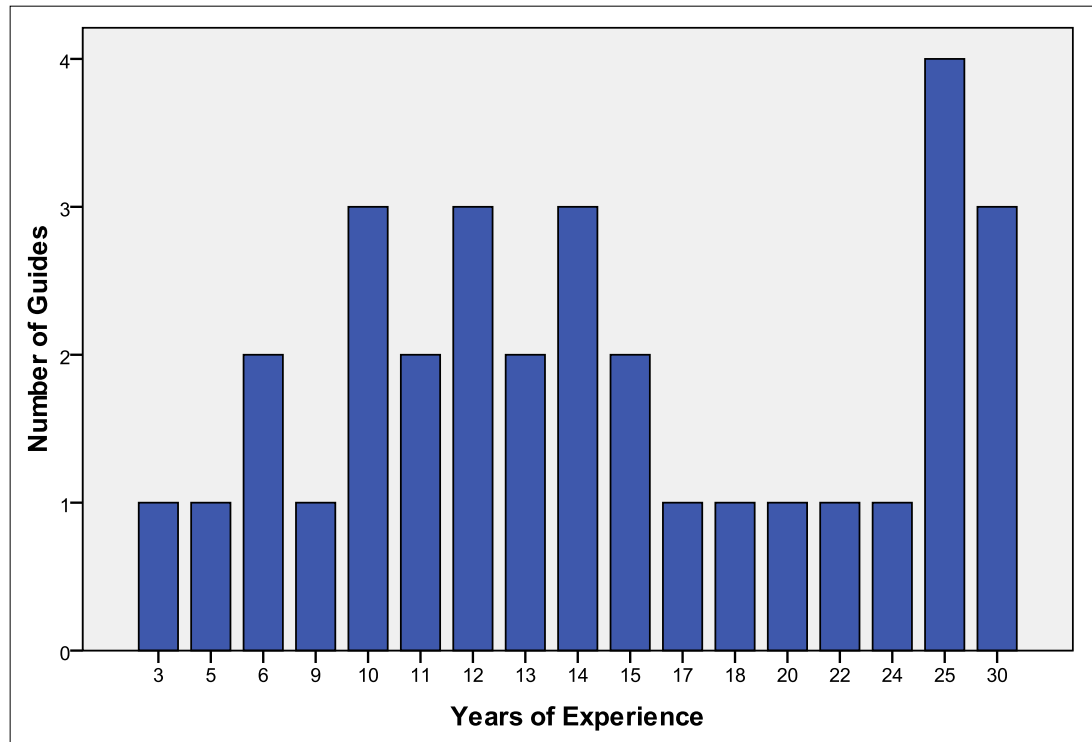


Figure 5-1 Guide profile - years of experience

Source: Author

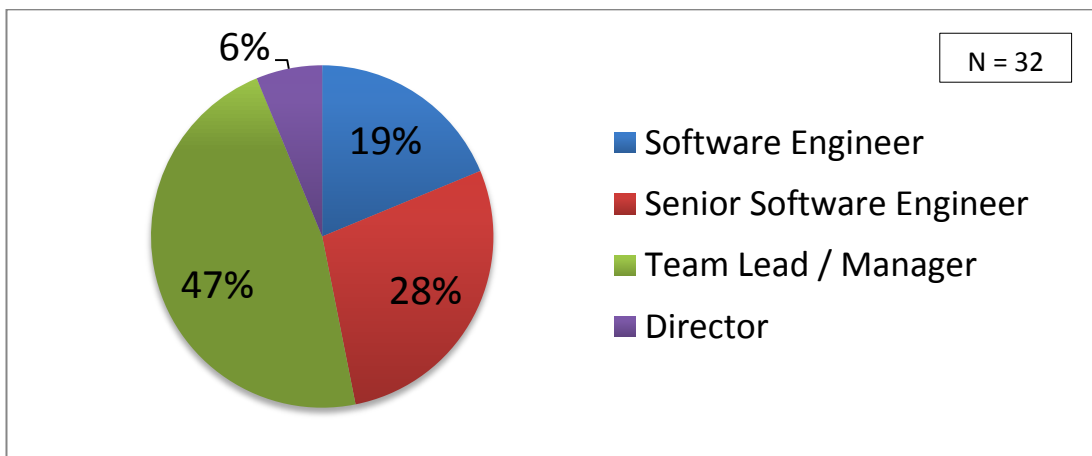


Figure 5-2 Guide profile – job title

Source: Author

5.2.2 Learner profile

Of the forty one SE graduate respondents, 86% were male and 14% were female. 83% were permanent full-time with 15% non-permanent full-time and 2% non-

permanent part-time. The average graduate age was 27 with a standard deviation of 3.81, indicating a spread in ages. The oldest graduate was 40 years of age. The job titles supplied by the SE graduates indicated that all respondents were working in entry-level roles.

5.2.3 Organisation profile

Ten individuals responsible for the recruitment of SE graduates answered the organisation survey. Table 5-1 cross tabulates the number of employees in the respondent organisations against the number of SE graduates recruited worldwide in the past three years. The ten respondent organisations varied from having a small number of employees (three organisations) to very large organisations with in excess of 2,000 employees (four organisations). Typically, the larger the organisation, the more graduates they recruited over the past three years and vice-versa.

Table 5-1 Organisation profile - number of worldwide employees versus graduate recruitment

Source: Author

Number of employees worldwide	Number of SE graduates recruited in the past three years						Total
	1-4	5-9	10-24	25-49	50-99	100+	
1-49	3	-	-	-	-	-	3
50-99	1	-	-	-	-	-	1
100-499	-	1	-	-	-	-	1
500-1999	-	-	1	-	-	-	1
2000+	-	2	1	-	-	1	4
Total	4	3	2	0	0	1	10

5.2.4 Undergraduate profile

Figure 5-3 shows that, of the sixty nine undergraduate respondents, just over half were aged between 17 to 21 years old. One third of the sample were mature students (≥ 23 years of age).

Figure 5-4 displays the percentage of respondents in each year of study. Three quarters of the undergraduate respondents were either in their first or second year of study in WIT with very few fourth years and graduate diploma students answering the questionnaire.

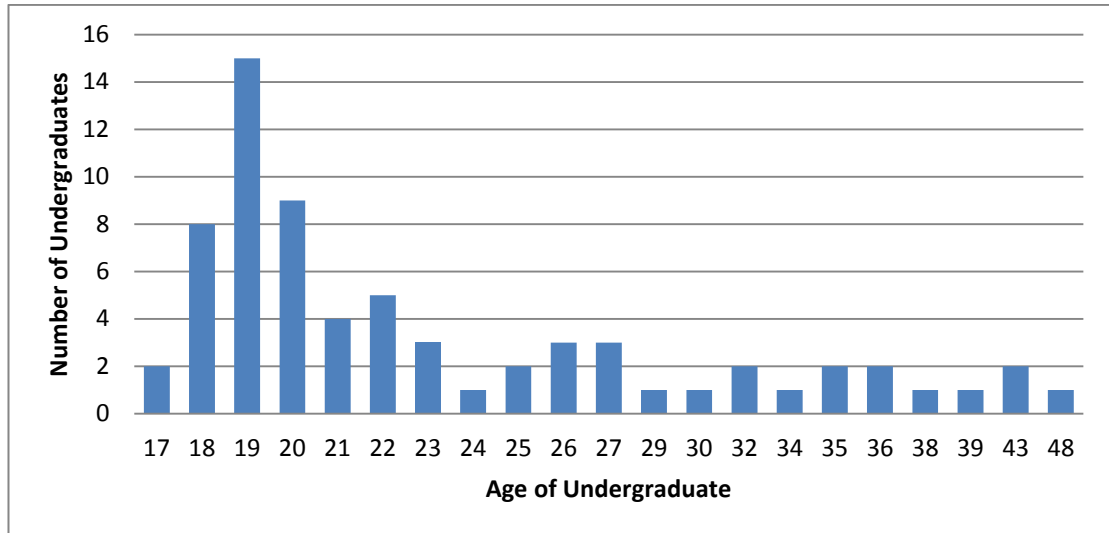


Figure 5-3 Undergraduate profile – age

Source: Author

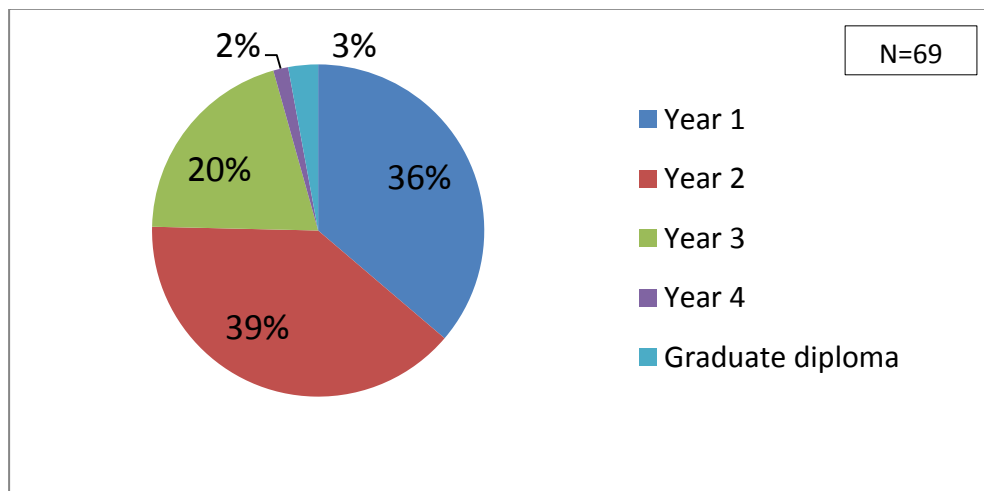


Figure 5-4 Undergraduate profile - year of study

Source: Author

5.3 WPL supports for SE graduates

This section presents the gathered data pertaining to the first research question:

What are the WPL supports and strategies that a SE graduate encounters while participating in everyday work practice and activities in an entry-level SE position?

As this research question is divided into five sub-questions, the findings pertinent for each sub-question are presented in the following five sections: Guides, Learners, Organisational supports provided for WPL, Learning opportunities and their learning pathways, and Frequency of learning strategy use.

5.3.1 Guides

Research Question 1(a): Who are the guides and how were they selected? Are they prepared for their role? What support do they provide? What influences/motivates them to participate?

Following the structure of Research Question 1(a), the findings are presented in four distinct categories:

- Guide selection
- Guide preparation
- Guide supports
- Influences on guide participation

Where applicable, the findings in this section are presented in accordance with the selection of the guide i.e. guide appointed by the organisation, guide selected by the graduate, and ignoring guide selection method. Taking this approach provided additional insight into the findings.

5.3.1.1 Guide selection

This section presents the findings according to the selection of the guide, the organisations' criteria for selecting guides, the guides' skill at sharing knowledge, and whether they were the best choice for learning on-the-job.

Guide selection profile

Table 5-2 cross tabulates the guide selection with the guides' working relationship with the graduate. This table shows that two thirds of graduates reported that their WPL guides were allocated by the organisation with one third being selected by the SE graduate themselves. When guides were selected by the organisation, senior colleagues of the graduate that were not their managers were selected two thirds of the time (66.6%). When no guides were allocated by the organisation, the majority

(91.7%) of graduates turned to their managers or senior colleagues that were not their managers. The remaining graduates (8.3%) did not specify their relationship with their guide.

Table 5-2 Guide selection and guide working relationship with graduate (graduate perspective)

Source: Author

Guide selection	Guide relationship with graduate					
	Supervisor / Manager	Colleague - Junior	Colleague – Peer	Colleague - Senior, but not your manager	Customer / Client / Supplier	None of the these
By organisation (N=24)	16.7%	0	16.7%	66.6%	0	N/A
By graduate (N=12)	50%	0	0	41.7%	0	8.3%

Table 5-3 cross tabulates the selection of guides with the number of graduates they guided to date. This table shows when guides were asked to report on their selection process, they reported the inverse ratio to the graduates; approximately one third stated they were allocated by the organisation with two thirds being selected by the SE graduate. When guides were selected by the organisation, they typically guided more graduates to date (67% supported 6 or more graduates). Those guides that were selected by the graduates typically supported fewer graduates (70% supported 5 or less graduates).

Table 5-3 Guide selection and number of graduates they guided (guide perspective)

Source: Author

Guide selection	Number of graduates guide supported to date				
	1-2	3-5	6-10	16+	Total
By organisation (N=10)	11%	22%	34%	33%	100%
By graduate (N=19)	40%	30%	25%	5%	100%

Organisations' criteria for selecting guides

All ten organisations reported that they selected WPL guides to support SE graduates in their first year of employment following graduation; no organisation left it up to the graduate to self-select their guide. Table 5-4 shows the extent to which certain criteria were considered when organisations selected these WPL guides. This table shows that all four criteria were strongly considered by organisations when selecting guides for SE graduates.

Table 5-4 Organisations' criteria for selecting WPL guides

Source: Author

N=10

Criteria	Extent (%)					Mean	SD
	1	2	3	4	5		
Knowledge of the area they would be supporting	0	0	0	0	100	5.0	0.000
Expertise in the area they would be supporting	0	10	0	50	40	4.2	0.919
Ability to effectively support graduates WPL	0	0	10	10	80	4.7	0.675
Willingness to participate in WPL initiatives	0	0	0	60	40	4.4	0.516

Key: 1: Not at all 3: Neutral 4: Certain extent
 2: Limited extent 5: Large extent

Skilled at sharing knowledge

Table 5-5 displays the extent that graduates felt their WPL guides were skilled at sharing knowledge and also the extent that guides felt they were skilled at sharing knowledge. Both graduates and guides felt, regardless of how the guide was selected, that the WPL guide was skilled at sharing knowledge through on-the-job learning.

Table 5-5 Extent guides are skilled at sharing knowledge

Source: Author

Perspective	Guide selection	Extent (%)					Mean	SD
		1	2	3	4	5		
Graduate (N = 41)	By organisation	0	4	8	46	42	4.3	0.794
	By graduate	0	8	17	50	25	3.9	0.900
	Ignoring guide selection method	0	6	11	47	36	4.1	0.833
Guide (N = 32)	By organisation	0	10	5	53	32	3.9	1.101
	By graduate	0	10	30	20	40	4.0	0.911
	Ignoring guide selection method	0	10	14	41	35	4.0	0.964

Key: 1: Not at all 3: Neutral 4: Certain extent
 2: Limited extent 5: Large extent

Best choice for supporting WPL

Table 5-6 displays the extent that graduates felt their guides were the best choice for supporting WPL and also the extent that guides felt they were the best choice for supporting WPL. This table shows that the guide emerged as a good choice for supporting on-the-job learning. Both graduates and guides reported that guides selected by the organisation were the best choice for learning on-the-job.

Table 5-6 Extent guides are the best choice for supporting WPL**Source: Author**

Perspective	Guide selection	Extent (%)					Mean	SD
		1	2	3	4	5		
Graduate (N = 41)	By organisation	0	8	25	42	25	4.3	0.989
	By graduate	0	8	13	25	54	3.8	0.937
	Ignoring guide selection method	0	8	17	31	44	4.1	0.979
Guide (N = 32)	By organisation	0	0	13	64	23	4.2	1.033
	By graduate	0	21	26	37	16	3.5	1.020
	Ignoring guide selection method	0	18	18	46	18	3.6	1.066

Key: 1: Not at all
2: Limited extent

3: Neutral

4: Certain extent
5: Large extent

5.3.1.2 Guide supports

Graduates and guides were asked to comment on the frequency of use of seven guide supports. The graduate perspectives can be seen in Appendix Table J - 1 and the guide perspectives can be seen in Appendix Table J - 2. Figure 5-5 displays the mean scores from these two tables. In this figure, the line chart displays a very similar trend for each group. Regardless of how the guide was selected, guides typically rated their support higher than graduates rated their guides' support. For all the supports identified, guides that were selected by the organisation rated their support higher than the other three groups. Graduates that selected their own guides rated the majority of the guide supports the lowest. `

Table 5-7 merges the graduates' and guides' perspectives on the frequency of use of each of the seven guide supports. For each support, the overall mean is displayed in accordance with the manner in which the guide was selected. This table shows that:

- When a guide was selected by the organisation, they were more likely to organise graduate on-the-job learning, monitor graduate performance when learning on-the-job, and encourage graduates to engage in problem solving activities with colleagues/peers when compared with guides that were selected by the graduate.
- Irrespective of how the guide was selected, the best guide supports included encouraging graduates to transfer their learning to other situations and encouraging graduates to engage in problem solving activities with colleagues/peers. They were not encouraged to compare their task performance with that of experienced colleagues.

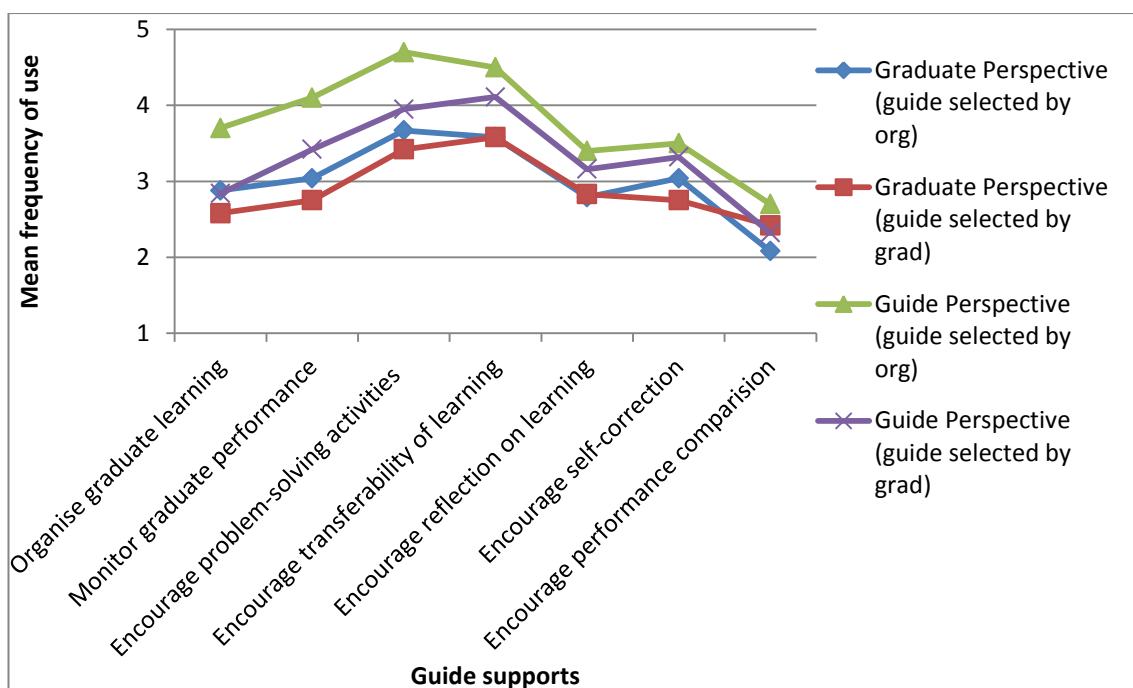


Figure 5-5 Guide supports for WPL (graduate and guide perspective)

Source: Author

Key: 1: Not at all 2: Limited extent 3: Neutral 4: Certain extent 5: Large extent

Table 5-7 Merging graduate and guide perspectives on guide supports

Source: Author

Guide Support	Guide selection (mean)	
	By organisation	By graduate
Organise graduate on-the-job learning	3.3	2.7
Monitor graduate performance when learning on-the-job	3.6	3.1
Encourage graduates to engage in problem solving activities with colleagues/peers	4.2	3.7
Encourage transferability of learning	4.1	3.9
Encourage graduates to reflect on their learning	3.1	3.0
Encourage graduate self-correction based on reflections	3.3	3.1
Encourage graduates to compare their task performance with that of experienced colleagues	2.4	2.4

Key: 1: Not at all 2: Limited extent 3: Neutral 4: Certain extent 5: Large extent

5.3.1.3 Guide preparation

Table 5-8 displays the extent that guides felt they were prepared for their WPL role and the extent that organisations felt they prepared their guides for their WPL role. This table shows that:

- Guides, when allocated by the organisation, were adequately prepared for their WPL role. These guides provided insight into how their organisations prepared them for their WPL role and the quotes associated with each insight are displayed in Appendix Table I - 2. This insight showed that five guides were given little or no preparation. Two guides had learning objectives set out to prepare them for their WPL role. One guide stated that the preparation training varies from organisation to organisation, whereas, another guide relied on replicating their own WPL experiences as a graduate.
- Guides, when selected by the graduate, were inadequately prepared to support WPL. These guides provided insight into the organisations preparation for their WPL role and the quotes associated with each insight are displayed in Appendix Table I - 3. Twelve guides were given little or no preparation but three guides attended training courses to prepare them for their WPL role.
- Organisations adequately prepared their guides for their WPL role and this was done through induction programmes, identifying skills gaps, or through discussion. The associated quotes are available in Appendix Table I - 4.

Table 5-8 Extent guides were prepared for their WPL role

Source: Author

Perspective	Guide selection	Extent (%)					Mean	SD
		1	2	3	4	5		
Guide (N = 32)	By organisation	10	20	30	30	10	3.1	1.197
	By graduate	26	16	37	21	0	2.5	1.124
	Ignoring guide selection method	21	17	35	24	3	2.7	1.162
Organisation (N = 10)	By organisation	0	10	20	70	0	3.6	0.699

Key: 1: Not at all 3: Neutral 4: Certain extent
2: Limited extent 5: Large extent

Guides were specifically asked if they attended any training courses to prepare them for their WPL role (Table 5-9). This table shows that very few guides, whether appointed by their organisation or selected by the graduate, undertook formal training courses to teach them how to support on-the-job learning.

The few guides that did attend formal training courses provided some details about the courses and the quotes associated with these details are in Appendix Table I - 5. One

guide stated that soft skills training appeared on the syllabus of their internal training programme. Others reported that Instructional Model of Learning strategies such as mentoring, coaching, and questioning along with learning theories and practical examples of learning support appeared on their curricula.

Table 5-9 Training courses provided for guides to prepare them for their WPL role (guide perspective)

Source: Author

N = 32

Guide selection	Training course provided		Total
	Yes (%)	No (%)	
By organisation	10	90	100%
By graduate	26	74	100%
Ignoring guide selection method	21	79	100%

5.3.1.4 Influences on guide participation

This section presents the findings pertaining to the influences on guide participation, namely, the learner-guide relationship, the reluctance of guides to participate, the fear of displacement, the availability of expert guidance, and motivation to participate in WPL.

Learner-guide relationship

Table 5-10 Prevalence of good learner-guide relationships

Source: Author

Perspective	Guide selection	Extent (%)					Mean	SD
		1	2	3	4	5		
Graduate (N = 41)	By organisation	0	4	8	21	67	4.5	0.834
	By graduate	0	0	16	42	42	4.3	0.754
	Ignoring guide selection method	0	3	11	28	58	4.4	0.806
Guide (N = 32)	By organisation	0	0	10	20	70	4.6	0.699
	By graduate	0	5	5	11	79	4.6	0.831
	Ignoring guide selection method	0	3	7	14	76	4.6	0.775
Organisation (N = 10)	N/A – nurture learner-guide relationship	0	0	0	40	60	4.6	0.516

Key: 1: Not at all 3: Neutral 4: Certain extent
2: Limited extent 5: Large extent

Table 5-10 displays the extent that graduates and guides had a good learner-guide relationship and the extent that organisations nurtured these relationships. This table

shows that regardless of how guides were selected, graduates had a very good relationship with their guide and vice-versa. The organisation reported that they strongly nurtured learner-guide relationships. Overall, graduates, guides and the organisation were very positive about the relationship between learners and guides.

Reluctance to participate

Table 5-11 shows that guides, regardless how they were selected, were not at all reluctant to provide guidance to SE graduates in the workplace; they were very willing participants.

Table 5-11 Extent guides were reluctant to participate in WPL (guide perspective)

Source: Author

N = 32

Guide selection	Extent (%)					Mean	SD
	1	2	3	4	5		
By organisation	90	10	0	0	0	1.1	0.316
By graduate	85	0	5	5	5	1.5	1.172
Ignoring guide selection method	86	3	4	4	3	1.3	0.974

Key: 1: Not at all 3: Neutral 4: Certain extent
2: Limited extent 5: Large extent

Fear of displacement

Table 5-12 displays the extent that guides feared displacement in their roles by those whose WPL they supported. This table shows that regardless of how the guide was selected, guides were not at all afraid of being displaced by graduates they supported.

Table 5-12 Extent guides feared displacement by the graduates they supported (guide perspective)

Source: Author

N=32

Guide selection	Extent (%)					Mean	SD
	1	2	3	4	5		
By organisation	90	0	0	10	0	1.3	0.949
By graduate	100	0	0	0	0	1.0	0.000
Ignoring guide selection method	97	0	0	3	0	1.1	0.557

Key: 1: Not at all 3: Neutral 4: Certain extent
2: Limited extent 5: Large extent

Availability of expert guidance

Graduates were asked to comment on the availability of their guides to support their WPL and guides were asked to comment on their availability to provide support (Table 5-13). Both graduates and guides reported that expert guidance was commonly available. When a guide was selected by the organisation they appeared more available when compared with a guide selected by the graduate.

Table 5-13 Extent the guide was available to support WPL

Source: Author

Perspective	Guide selection	Extent (%)					Mean	SD
		1	2	3	4	5		
Graduate (N = 41)	By organisation	0	4	8	29	59	4.4	0.830
	By graduate	8	8	17	8	59	4.0	1.414
	Ignoring guide selection method	3	6	11	22	58	4.3	1.059
Guide (N = 32)	By organisation	0	0	10	30	60	4.5	0.707
	By graduate	0	21	5	37	37	3.9	1.150
	Ignoring guide selection method	0	14	7	34	45	4.1	1.047

Key: 1: Not at all 3: Neutral 4: Certain extent
2: Limited extent 5: Large extent

Motivation to participate in WPL

When guides were asked to comment on what motivates them to participate in WPL, five distinct themes emerged which include maintaining project/team health, developing standalone employees, gaining a sense of satisfaction from helping graduates, maintaining organisational health, and evolving their own knowledge. Table 5-14 presents these sentiments along with the number of guides that reported each sentiment. The quotes associated with each theme are displayed in Appendix Table I - 6.

Table 5-14 Guide motivations for participating in WPL

Source: Author

N=32

Motivation	Number of guides reporting this sentiment
Project / team health	9
Developing standalone employees	7
A sense of satisfaction	7
Organisational health	3
Opportunity to learn new skills / knowledge	2

Table 5-15 displays the extent that guides felt they were rewarded for supporting SE graduates' WPL according to four criteria: promotion, wage increase, allocation of more responsible tasks, and awards for accomplishment. This table shows that regardless of how the guide was selected, guides felt that they were not rewarded to any appreciable extent.

Table 5-15 Frequency guides are rewarded for engaging in WPL (guide perspective)

Source: Author

N = 32

Reward	Frequency (%)					Mean	SD
	1	2	3	4	5		
Promotion							
Guide selected by the organisation	50	20	10	10	10	2.1	1.449
Guide selected by the graduate	48	26	21	5	0	1.9	0.958
Ignoring guide selection method	48	24	17	7	4	1.9	1.132
Wage increase							
Guide selected by the organisation	70	10	10	0	10	1.7	1.337
Guide selected by the graduate	63	21	11	0	5	1.6	1.065
Ignoring guide selection method	66	17	10	0	7	1.7	1.143
Allocation of more responsible tasks							
Guide selected by the organisation	40	10	20	20	10	2.5	1.509
Guide selected by the graduate	32	21	10	16	21	2.7	1.593
Ignoring guide selection method	35	17	14	17	17	2.7	1.542
Awards for accomplishment							
Guide selected by the organisation	50	20	20	0	10	2.0	1.333
Guide selected by the graduate	47	32	11	5	5	1.9	1.150
Ignoring guide selection method	48	28	14	3	7	1.9	1.193

Key: 1: Never 2: Occasionally 3: Average 4: Often 5: Very often

Table 5-16 Extent guides were encouraged by the organisation to participate (guide perspective)

Source: Author

N = 32

Guide selection	Extent (%)					Mean	SD
	1	2	3	4	5		
By organisation	0	10	10	40	40	4.1	0.994
By graduate	11	26	16	26	21	3.2	1.357
Ignoring guide selection method	7	21	14	31	27	3.5	1.299

Key: 1: Not at all 2: Limited extent 3: Neutral 4: Certain extent 5: Large extent

Table 5-16 displays the guides' perspective on the extent they were encouraged by their organisation to participate in WPL. This table shows that all guides were

encouraged to participate, however guides selected by the organisation were encouraged more by their organisation than those guides selected by the graduate.

5.3.1.5 Summarising the findings for WPL guides

Respondents' opinion on the selection of guides varied greatly. According to the graduates, two thirds were allocated guides by the organisation with one third selecting their own guide. Approximately one third of guides stated they were allocated by the organisation with two thirds being selected by the SE graduate. All the organisations reported that they selected WPL guides and did not leave it up to the graduate to self-select their guide. When selecting guides, the organisation strongly considered the guides' ability to effectively support graduates, their willingness to participate in WPL initiatives, and their knowledge of and years of experience in the area they would be supporting.

When guides were asked to comment on what motivates them to participate in WPL, five distinct themes emerged. These are: sense of satisfaction from helping graduates, opportunity for guides to learn new knowledge, maintaining organisational health, maintaining project/team health, and developing standalone employees.

The opinions of guides, graduates, and the organisation in relation to WPL guide supports and strategies were merged and displayed in Table 5-17. This table provides a rough idea of the supports and strategies that guides experienced in the workplace and it is not totally statistically defensible. This table was developed based on the following rules:

- The first block details what guides were more likely to do and less likely to do, irrespective of how they were selected as a guide. Items qualified for inclusion in this category if the range of their mean score for selection by the graduate versus selection by the organisation was less than 0.5.
- When the range was 0.5 or larger, the items were typically included in the second and third blocks in the table. The second block details the supports and strategies that guides, when selected by the organisation, were more likely to engage in. The third block details what guides were more likely and less likely to do when selected by the graduate.

- The measure ‘Be experienced at supervising SE graduates’ is an exception to the above rules. As it is a frequency distribution, its position was determined by the spread of responses.

Table 5-17 Merging graduate, guide, and organisational perspectives of guide supports and strategies

Source: Author

Guide selection	Guides were more likely to:	Guides were less likely to:
Ignoring guide selection criteria	Be considered skilled at sharing knowledge	Be rewarded for their WPL role
	Encourage graduate transferability of learning	Encourage graduates to compare task performance with that of experienced colleagues
	Encourage graduates to reflect on their learning	
	Be very willing to provide guidance	
	Not at all fear displacement in their role by the graduate they supported	
	Encourage graduate self-correction based on reflections on their learning	
	Have a very good relationship with their learner	
By the organisation	Be available to support SE graduates	
	Be experienced at supervising SE graduates	
	Be the best choice for WPL support	
	Be adequately prepared for their WPL role	
	Be encouraged to participate	
	Organise graduate WPL	
	Monitor graduate performance	
By the graduate	Encourage graduates to engage in problem solving activities with colleagues	
	Be available to the SE graduate	Be experienced at supervising SE graduates
	Be the best choice for WPL role	Be adequately prepared for their WPL role
	Be encouraged to participate	Organise graduate WPL
	Monitor graduate performance	
	Encourage graduates to engage in problem solving activities with colleagues	

5.3.2 Learners

Research question 1(b): Are the learners prepared for their learning role and what influences/motivates them to participate?

Following the structure of Research Question 1(b), the findings are presented in two distinct categories:

- Learner preparation
- Influences on learner participation.

Where applicable, the findings in this section are presented depending on the selection of the guide i.e. guide appointed by the organisation, guide selected by the graduate, and ignoring guide selection method. Taking this approach provided additional insight into the findings.

5.3.2.1 Learner preparation

Table 5-18 displays the extent that graduates felt they were adequately prepared to get the most out of their WPL. It also shows the extent that organisations felt they prepared graduates for their WPL role. Regardless of how the guide was selected, graduates reported being prepared, but only just. In particular, this table shows:

- Graduates, whose guide was allocated by the organisation, were prepared for their WPL role. These graduates provided insight into how they were prepared for their WPL role (Appendix Table I - 7). Seven graduates stated that they were not prepared at all with five of the seven coming from the same company (Company 13). Three graduates reported that they attended training courses but provided no details of the syllabi. Other graduates elaborated on the training courses and graduate workshops in which some were provided with graduate learning and development packs whereas others were allocated time to train in self-selected subjects. Some graduates reported using specific WPL strategies as preparation for their role.
- Graduates, who selected their own guides, felt they were inadequately prepared.
- Organisations reported that they prepared graduates for their WPL role.

Table 5-18 Extent graduates were prepared for their WPL role**Source: Author**

Perspective	Guide selection	Extent (%)					Mean	SD
		1	2	3	4	5		
Graduate (N = 41)	By organisation	4	4	34	54	4	3.5	0.834
	By graduate	27	27	28	9	9	2.5	1.293
	Ignoring guide selection method	11	11	32	40	6	3.2	1.098
Organisation (N = 10)	By organisation	10	10	10	50	20	3.6	1.265

Key: 1: Not at all 3: Neutral 4: Certain extent
 2: Limited extent 5: Large extent

Graduates were asked whether they attended specific training courses that taught them how to learn on-the-job (Table 5-19) and if they did go on such courses, to provide details of what was involved.

Table 5-19 Graduate attendance at training courses to prepare them for their WPL role**Source: Author**

N=41

Guide selection	Training Course Attendance		Total
	Yes	No	
By organisation	61%	39%	100%
By graduate	18%	82%	100%
Ignoring guide selection method	53%	47%	100%

Table 5-19 shows that sixty one percent of graduates, when allocated a guide by the organisation, attended formal training courses to teach them how to learn on-the-job. When graduates selected their own guide only eighteen percent attended formal training courses. Overall, fifty three percent of the graduates attended training courses to prepare them for their WPL role.

When graduates attended training courses to prepare them for their WPL role, several provided details of these courses (Appendix Table I - 8). Four graduates included technical training as an approach that taught them how to learn on-the-job. As technical training is outside the scope of this study, these responses were discarded, but attention must be drawn to the credibility of the quantitative data in Table 5-19 and whether graduates responded yes to the question based on attending technical training as opposed to training that taught them how to learn on-the-job. Of the remaining qualitative responses, no specific details of the training courses or activities were provided; most graduates just included high-level comments.

5.3.2.2 Influences on learner participation

This section presents the findings pertaining to the learner-guide relationship, the reluctance of learners to participate, and learner motivation to participate in WPL.

Learner-guide relationship

Section 5.3.1.3 shows that, regardless of how the guide was selected, learners had a very good relationship with their guide, and vice versa.

Reluctance to participate

Table 5-20 presents the extent that graduates were reluctant to participate in WPL. Regardless of how the guide was selected, graduates were not reluctant to participate in WPL; they were very willing to engage in WPL.

Table 5-20 Extent graduates were reluctant to participate in WPL (graduate perspective)

Source: Author

N=41

Guide selection	Extent (%)					Mean	SD
	1	2	3	4	5		
By organisation	54	21	17	8	0	1.8	1.021
By graduate	73	18	9	0	0	1.4	0.674
Ignoring guide selection method	60	20	14	6	0	1.7	0.938

Key: 1: Not at all 3: Neutral 4: Certain extent
2: Limited extent 5: Large extent

Motivation to participate in WPL

Table 5-21 displays the extent that graduates felt they were encouraged by the organisation to engage in WPL.

Table 5-21 Extent graduates were encouraged by the organisation to engage in WPL (graduate perspective)

Source: Author

N=41

Guide selection	Extent (%)					Mean	SD
	1	2	3	4	5		
By organisation	0	12	13	33	42	4.0	1.042
By graduate	0	27	27	37	9	3.3	1.009
Ignoring guide selection method	0	17	17	34	32	3.8	1.079

Key: 1: Not at all 3: Neutral 4: Certain extent
2: Limited extent 5: Large extent

This table shows that graduates were encouraged more by the organisation to participate in WPL when their guide was allocated by the organisation rather than selected by the graduate. However, regardless of how the guide was selected, graduates were encouraged by the organisation to engage in WPL.

When graduates were asked to comment on what motivates them to participate in WPL, four distinct themes emerged. These are the opportunity to learn new skills, job security and mobility, a sense of satisfaction, and an interest in the job (Table 5-22). The quotes associated with each theme are displayed in Appendix Table I - 9.

Table 5-22- Graduate motivations for participating in WPL

Source: Author

N=41

Motivation	Number of graduates reporting this sentiment
Opportunity to learn new skills / knowledge	12
Job security and mobility	7
A sense of satisfaction	6
An interest in their job	5

5.3.2.3 Summarising the findings for WPL learners

The opinions of guides, graduates, and the organisation in relation to learners were merged and displayed in Table 5-23. This table provides a rough idea of the supports and strategies that learners experienced in the workplace and it is not totally statistically defensible. This table followed similar rules to Table 5-17. These are:

- The first block details what learners were more likely to do and less likely to do, irrespective of how their guide was selected. Items qualified for inclusion in this category if the range of their mean score for selection by the graduate versus selection by the organisation was less than 0.5.
- When the range was 0.5 or larger, the items were typically included in the second and third blocks in the table. The second block details the behaviours that graduates, when their guide was selected by the organisation, were more likely to engage in. The third block details what learners were more likely and less likely to do when they selected their own guide.

- The measure ‘Attended training courses to prepare them for their WPL role’ is an exception to the above rules. As it required a yes/no answer, its position was determined by the extent graduates agreed with the question.

Table 5-23 Merging graduate, guide, and organisational perspectives of learners

Source: Author

Guide selection	Graduates were more likely to:	Graduates were less likely to:
Ignoring guide selection criteria	Be very willing to engage in WPL.	
	Have a very good relationship with their guide.	
By the organisation	Attend training courses to prepare them for WPL.	
	Be adequately prepared for their WPL role.	
	Encouraged to engage in WPL.	
By the graduate	Encouraged to engage in WPL.	Attend training courses to prepare them for their WPL role.
		Be adequately prepared for their WPL role.

When graduates were asked to comment on what motivates them to participate in WPL, four distinct themes emerged. Table 5-24 displays these themes which are the opportunity to learn new skills, job security and mobility, a sense of satisfaction, and an interest in the job. This table is cross referenced with the guide motivations originally presented in Table 5-14. Two criteria overlap: opportunity to learn new skills/knowledge and a sense of satisfaction. Note that the numbers in brackets in this table represent the number of respondents reporting each motivation.

Table 5-24 Cross referencing graduate and guide motivations for participating in WPL

Source: Author

Motivation	Graduate (N = 41)	Guide (N = 32)
Opportunity to learn new skills / knowledge	Yes (12)	Yes (2)
Job security and mobility	Yes (7)	
A sense of satisfaction	Yes (6)	Yes (7)
An interest in their job	Yes (5)	
Project / team health		Yes (9)
Developing standalone employees		Yes (7)
Organisational health		Yes (3)

Accepting that some graduates attended formal training courses to prepare them for WPL, little or no details were provided on the syllabi or contents. When graduates were asked whether they attended a training course to teach them how to learn on-the-job, there appeared to be some confusion with the question where some graduates reported technical training as opposed to training that would help them improve their skills for learning on-the-job. Consequently, the results pertaining to the attendance at training courses should be treated with some trepidation in the study.

5.3.3 Organisational supports provided for WPL

Research question 1(c): What supports does the organisation provide for WPL? Have organisations developed formal WPL policies and learning resources?

Following the structure of Research Question 1(c), the findings are presented in eight distinct categories:

- The importance of WPL to the organisation
- WPL philosophy for SE graduate WPL
- Guide and learner preparation
- Influences on guide and learner participation
- Learning resources and policies
- Provide support for remote learning
- Cater for production demands overshadowing learning
- Invitational nature of the workplace

5.3.3.1 Importance of WPL to the organisation

Organisations were asked to comment on the importance they placed on the WPL of SE graduates in their first year of employment following graduation. Figure 5-6 shows that eighty percent of organisations considered it important or very important.

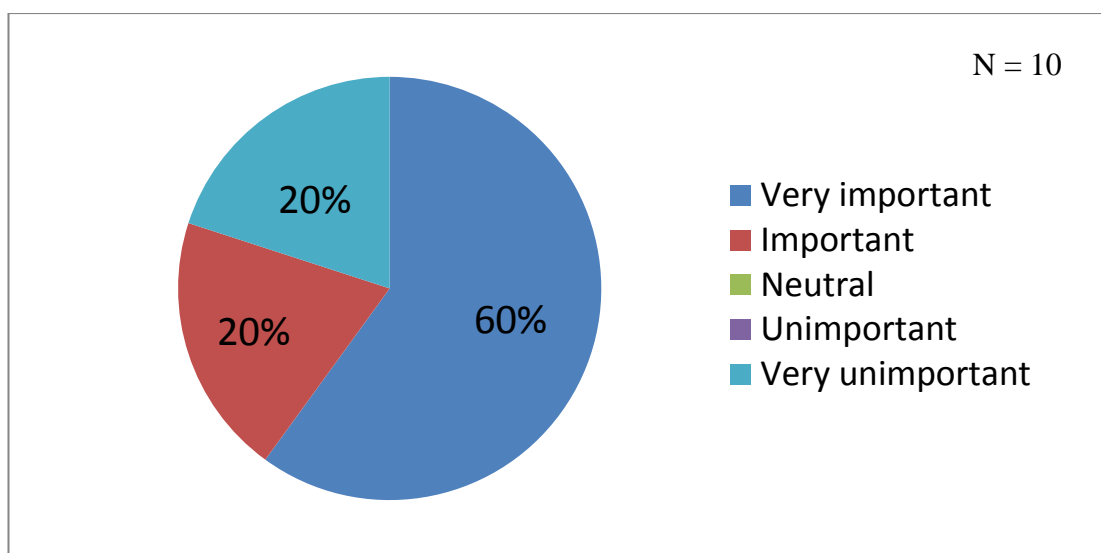


Figure 5-6 Importance of SE graduate WPL to the organisation

Source: Author

5.3.3.2 WPL philosophy for SE graduate WPL

When organisations were asked about their WPL philosophy for SE graduates, they were divided. Table 5-25 shows that half of the organisations had a philosophy of gradually training their SE graduates over a long period of time and the other half preferred to intensively train their SE graduates over a short period of time. There appears to be no correlation between the WPL philosophy and the existence of formal WPL policies in the organisation.

Table 5-25 WPL philosophy and the existence of formal WPL policies (organisational perspective)

Source: Author

N = 10

Philosophy	Organisation has formal WPL policies?		Total
	Yes	No	
Gradually train - long period of time	2	3	5
Intensively train - short period of time	3	2	5
Total	5	5	10

5.3.3.3 Guide and learner preparation

Organisations felt they prepared both graduates and guides for their role in WPL. Section 5.3.1.3 presented the findings relating to guide preparation and section 5.3.2.1 covered the learner preparation findings.

5.3.3.4 Influences on guide and learner participation

Five criteria were used to measure the extent that organisations encouraged guides and graduates to participate in WPL. Table 5-26 displays the results.

Table 5-26 Encouraging guides and graduates to engage in WPL (organisational perspective)

Source: Author

N = 10

Encouragement Criteria	Extent (%)					Mean	SD
	1	2	3	4	5		
Encourage reluctant workers to engage in WPL	10	10	20	40	20	4.3	0.675
Draw attention to the professional development benefits through WPL engagement	0	0	10	50	40	3.5	1.269
Monitor performance of WPL guides	0	10	20	40	30	3.9	0.994
Provide feedback to WPL guides on their performance in their WPL role	10	20	10	30	30	3.5	1.434
Monitor performance of graduates	0	0	0	30	70	4.7	0.483

Key: 1: Not at all 3: Neutral 4: Certain extent
2: Limited extent 5: Large extent

All five measures were commonly used by organisations. In particular, organisations encouraged reluctant workers to engage in WPL and also monitored the performance of graduates.

5.3.3.5 Learning resources and policies

Formal WPL policies structure the WPL in an organisation. Learning resources detail how to learn particular tasks to the standard required by the organisation. The organisations were asked to comment on whether they had developed formal WPL policies and specific learning resources. Formal WPL policies will be discussed first, followed by learning resources.

Formal WPL policies

Table 5-27 shows that half of the organisations developed formal WPL policies to structure the WPL of SE graduates. Three of the organisations that developed formal WPL policies also developed learning resources. These formal WPL policies were often developed with multiple stakeholders. All organisations developed them in conjunction with experienced staff / WPL guides, 20% with graduates / WPL learners, 60% with the training department, and 60% with the HR department. The policies ranged from specifying the learning strategies to be used for new hires to specifically detailing performance milestones, approaches for developing syllabi, and the use of

training matrices to bridge skills shortfalls. The quotes underlying these sentiments are in Appendix Table I - 10.

Table 5-27 Organisations that developed formal learning policies and learning resources

Source: Author

N = 10

Developed formal WPL policies	Developed learning resource documents		Total
	Yes	No	
Yes	3	2	5
No	2	3	5
Total	5	5	10

Learning resources

Table 5-27 shows that half of the organisations developed learning resources. All organisations developed them in conjunction with experienced staff / WPL guides, 40% with graduates / WPL learners, 40% with the training department, and 40% with the HR department. One organisation, when developing these learning resources used practice leads:

Practice Lead - person in charge of a discipline or "practice" takes charge of the ongoing training

(Company 9)

Table 5-28 Considerations when developing learning resources (organisational perspective)

Source: Author

N = 10

Criteria	Extent (%)					Mean	SD
	1	2	3	4	5		
Contents based on tasks and activities found in the workplace	0	0	0	0	100	5.0	0.000
Grouping of learning resources into distinct categories	0	0	20	40	40	4.2	0.837
Clear strategies detailed for learning the contents and skills relating to each learning resource	0	0	20	40	40	4.2	0.837
Learning objectives of each learning resource are detailed	0	0	0	60	40	4.4	0.548
Includes details on how an expert would perform the task being learned	0	0	20	40	40	4.2	0.837
Contains theory that is difficult to learn through on-the-job learning alone	0	20	20	40	20	3.6	1.140

Key: 1: Not at all
2: Limited extent

3: Neutral

4: Certain extent
5: Large extent

Table 5-28 presents the extent that six specific criteria were considered when developing learning resources. This table shows that each of the six criteria was commonly used. In particular, learning resources were heavily based on tasks and activities found in the workplace and the learning objectives were detailed. Accepting that all criteria were used, learning resources were least likely to contain conceptual theory that is difficult to learn through on-the-job learning.

5.3.3.6 Provide support for remote learning

Table 5-29 presents the organisational perspective on the extent that they supported remote WPL (i.e. when either the graduate or the WPL guide was not present in the office at the same time). Organisations were less inclined to support remote WPL.

Table 5-29 Extent organisations provide support for remote learning (organisational perspective)

Source: Author

N = 10

Criteria	Extent (%)					Mean	SD
	1	2	3	4	5		
Provide support for remote learning	20	10	30	40	0	2.9	1.197

Key: 1: Not at all 3: Neutral 4: Certain extent
2: Limited extent 5: Large extent

5.3.3.7 Cater for production demands overshadowing learning

Table 5-30 displays the graduate, guide and organisational perspective regarding the extent that production demands overshadowed learning. This table shows that production demands restricted opportunities for participation in WPL with organisations reporting a larger restriction than graduates and guides.

Table 5-30 Extent that production demands overshadow learning

Source: Author

Perspective	Extent (%)					Mean	SD
	1	2	3	4	5		
Graduate (N = 41)	11	15	26	37	11	3.2	1.190
Guide (N = 32)	3	14	10	52	20	3.7	1.066
Organisation (N = 10)	0	10	10	40	40	4.1	0.994

Key: 1: Not at all 3: Neutral 4: Certain extent
2: Limited extent 5: Large extent

5.3.3.8 Invitational nature of the workplace

The invitational nature of the workplace is measured in this study using two different approaches. The first approach obtains graduate and guide perspectives on three measures: organisational encouragement, supports, and inhibitors. The second approach obtains graduate, guide and organisational perspectives relating to Skule's (2004) seven conditions for a learning conducive workplace (Table 2-9).

Table 5-31 displays the findings relating to the first approach. This table shows that organisations encouraged both graduates and guides to participate in WPL and supported the graduates' and guides' role in WPL. Both graduates and guides also felt that the organisation did not inhibit their learning either (note that a low score for this measure indicates that the organisation did not inhibit WPL).

Table 5-31 Invitational nature of the workplace

Source: Author

Source: Author							
Invitational measures	Extent (%)					Mean	SD
	1	2	3	4	5		
<i>Graduate perspective (N = 41)</i>							
Encouraged graduate participation in WPL	0	17	17	34	32	3.8	1.079
Supported graduate role in WPL	3	17	20	29	31	3.7	1.183
Inhibited graduate WPL	49	20	20	11	0	1.9	1.083
<i>Guide perspective (N = 32)</i>							
Encouraged guides to support WPL	7	21	14	31	27	3.5	1.299
Supported guide role in WPL	7	21	24	34	14	3.3	1.162
Inhibited guides when supporting WPL	55	21	17	7	0	1.8	0.988

Key: 1: Not at all 3: Neutral 4: Certain extent
2: Limited extent 5: Large extent

For the second approach, the findings relating to Skule's (2004) seven conditions for a learning conducive workplace are presented in the following three tables:

- Table 5-32: all seven learning conditions from the graduates' perspective.
- Table 5-33: the four relevant learning conditions from the guides' perspective.
- Table 5-34: three relevant learning conditions from the organisations' perspective.

Each table presents the frequency distribution and the mean for each measure in each learning condition. It also provides the overall mean for each learning condition.

Note that the purpose of this overall mean is to provide a rough idea of the learning conduciveness of the workplace and is not totally statistically defensible.

Table 5-32 shows that graduates' rated five of the seven learning conditions as contributing to a learning conducive workplace:

- Learning condition 1 (LC1) - A high degree of exposure to change
- Learning condition 2 (LC2) - A high degree of exposure to demands
- Learning condition 3 (LC3) - Managerial responsibility
- Learning condition 5 (LC5) - Superior feedback
- Learning condition 6 (LC6) - Management support for learning

However, two learning conditions were not prevalent in the participating organisations:

- Learning condition 4 (LC4) - Extensive professional contact
- Learning condition 7 (LC7) - Rewarding of proficiency

Table 5-32 Learning conduciveness of the workplace (Skule, 2004) (graduate perspective)

Source: Author

N = 41

Learning conditions	Agreement (%)					Mean	SD	Overall Mean
	1	2	3	4	5			
<i>Learning Condition 1 (A high degree of exposure to change) #</i>								
My job exposes me to frequent changes in technology, products and processes	0	5	17	63	15	3.9	0.723	3.9
<i>Learning condition 2 (A high degree of exposure to demands) #</i>								
My customers are very demanding	2	15	35	38	10	3.4	0.952	3.1
My company is very demanding	0	17	37	44	2	3.3	0.789	
My managers are very demanding	7	17	34	42	0	3.1	0.944	
My colleagues are very demanding	15	29	37	19	0	2.6	0.972	
<i>Learning condition 3 (Managerial responsibility) #</i>								
My job requires that I engage in decision making concerning certain tasks	0	0	12	61	27	4.2	0.615	3.9
My job requires that I engage in project management tasks	2	10	19	59	10	3.6	0.888	
Learning conditions	Extent (%)					Mean	SD	Overall Mean
	1	2	3	4	5			
<i>Learning Condition 4 (Extensive professional contact) +</i>								
Informal chats	6	30	24	35	5	3.1	1.053	2.1
Discussions with customers	38	30	19	13	0	2.1	1.064	
Technical support from customers	43	19	24	14	0	2.1	1.115	
Team meetings	0	30	27	32	11	3.2	1.011	
External professional networks	57	27	11	3	2	1.7	0.973	
Trade fairs	81	11	5	0	3	1.3	0.818	
Specialised research centres	84	5	5	3	3	1.4	0.919	
Conferences/seminars	51	35	11	3	0	1.7	0.789	
<i>Learning condition 5 (Superior feedback) +</i>								
Feedback	14	25	33	20	8	2.8	1.159	3.0
Performance appraisal system	13	16	26	32	13	3.2	1.242	
<i>Learning condition 6 (Management support for learning) +</i>								
Encouraged graduate participation	0	17	17	34	32	3.8	1.079	3.6
Supported graduate role in WPL	3	17	20	29	31	3.7	1.183	
Time allocated to participate	9	20	34	17	20	3.2	1.232	
<i>Learning condition 7 (Rewarding of proficiency) +</i>								
Promotion	59	22	19	0	0	1.6	0.803	2.2
Wage increases	28	33	36	3	0	2.1	0.867	
Awards for accomplishment	55	28	14	3	0	1.6	0.833	
Allocation of more responsible tasks	8	8	42	28	14	3.3	1.091	

Agreement key:

1: Strongly disagree

3: Neither agree or

4: Agree

2: Disagree

disagree

5: Strongly agree

+ Extent key:

1: Not at all

3: Neutral

4: Certain extent

2: Limited extent

5: Large extent

Table 5-33 shows that guides' rated two of the four applicable learning conditions as contributing to a learning conducive workplace:

- Learning condition 5 - Superior feedback
- Learning condition 6 - Management support for learning

However, two learning conditions were not prevalent in the participating organisations:

- Learning condition 4 - Extensive professional contact
- Learning condition 7 - Rewarding of proficiency

Table 5-33 Learning conduciveness of the workplace (Skule, 2004) (guide perspective)

Source: Author

N = 32

Learning conditions	Extent (%)					Mean	SD	Overall Mean
	1	2	3	4	5			
<i>Learning Condition 4 (Extensive professional contact)</i>								
Informal chats	12	22	22	28	16	3.1	1.289	2.2
Discussions with customers	34	28	22	16	0	2.2	1.091	
Technical support from customers	31	38	12	19	0	2.2	1.091	
Team meetings	0	16	19	37	28	3.8	1.039	
External professional networks	50	25	9	13	3	1.9	1.190	
Trade fairs	78	19	0	3	0	1.3	0.634	
Specialised research centres	75	19	0	6	0	1.4	0.793	
Conferences/seminars	48	39	3	7	3	1.8	1.023	
<i>Learning condition 5 (Superior feedback)</i>								
Feedback	9	22	22	34	13	3.2	1.203	3.2
<i>Learning condition 6 (Management support for learning)</i>								
Encouraged guide participation	7	21	14	31	27	3.5	1.299	3.2
Supported guide role in WPL	7	21	24	34	14	3.3	1.162	
Time allocated to participate	11	36	25	25	3	2.8	1.076	
<i>Learning condition 7 (Rewarding of proficiency)</i>								
Promotion	48	24	17	7	4	1.9	1.132	2.1
Wage increase	66	17	10	0	7	1.7	1.143	
Allocation of more responsible tasks	35	17	14	17	17	2.7	1.542	
Awards for accomplishment	48	28	14	3	7	1.9	1.193	

Key: 1: Not at all 3: Neutral 4: Certain extent
2: Limited extent 5: Large extent

Table 5-34 shows that organisations rated all three applicable learning conditions as contributing to a learning conducive workplace:

- Learning condition 5 - Superior feedback
- Learning condition 6 - Management support for learning
- Learning condition 7 - Rewarding of proficiency

Table 5-34 Learning conduciveness of the workplace (Skule, 2004) (organisational perspective)

Source: Author

N = 10

Learning conditions	Extent (%)					Mean	SD	Overall Mean
	1	2	3	4	5			
<i>Learning condition 5 (Superior feedback)</i>								
Provide feedback to WPL guides on their performance in their WPL role	10	20	10	30	30	3.5	1.434	3.5
<i>Learning condition 6 (Management support for learning)</i>								
Guide preparation	0	10	20	70	0	3.6	0.699	4.0
Monitor performance of WPL guides	0	10	20	40	30	3.9	0.994	
Graduate preparation	10	10	10	50	20	3.6	1.265	
Monitor performance of graduates	0	0	0	30	70	4.7	0.483	
Instilling awareness in SE graduates of their WPL role	0	0	10	40	50	4.4	0.699	
Encourage reluctant workers to engage in WPL	10	10	20	40	20	4.3	0.675	
Organisation allocated sufficient time to settle into WPL role	0	0	0	40	60	4.6	0.516	
Time allocated to participate	0	10	10	20	60	4.3	1.059	
Provide support for remote learning	20	10	30	40	0	2.9	1.197	
<i>Learning condition 7 (Rewarding of proficiency)</i>								
Draw attention to the professional development benefits through WPL engagement	0	0	10	50	40	3.5	1.269	3.5
Reward workers when they engage in WPL	10	10	20	50	10	3.4	1.174	

Key: 1: Not at all
2: Limited extent

3: Neutral

4: Certain extent
5: Large extent

Figure 5-7 graphs the perspectives of the graduate, guide, and the organisation with regard to Skule's (2004) seven conditions of a learning conducive workplace. Of the fourteen data points on the diagram, four were not prevalent in the participating organisations; Extensive professional contact (graduate and guide perspective) and Rewarding of proficiency (graduate and guide perspective). Graduates, guides, and organisations all rated Superior feedback and Management support for learning as contributing to a learning conducive workplace. Overall, the SE workplaces in this study appeared conducive for learning.

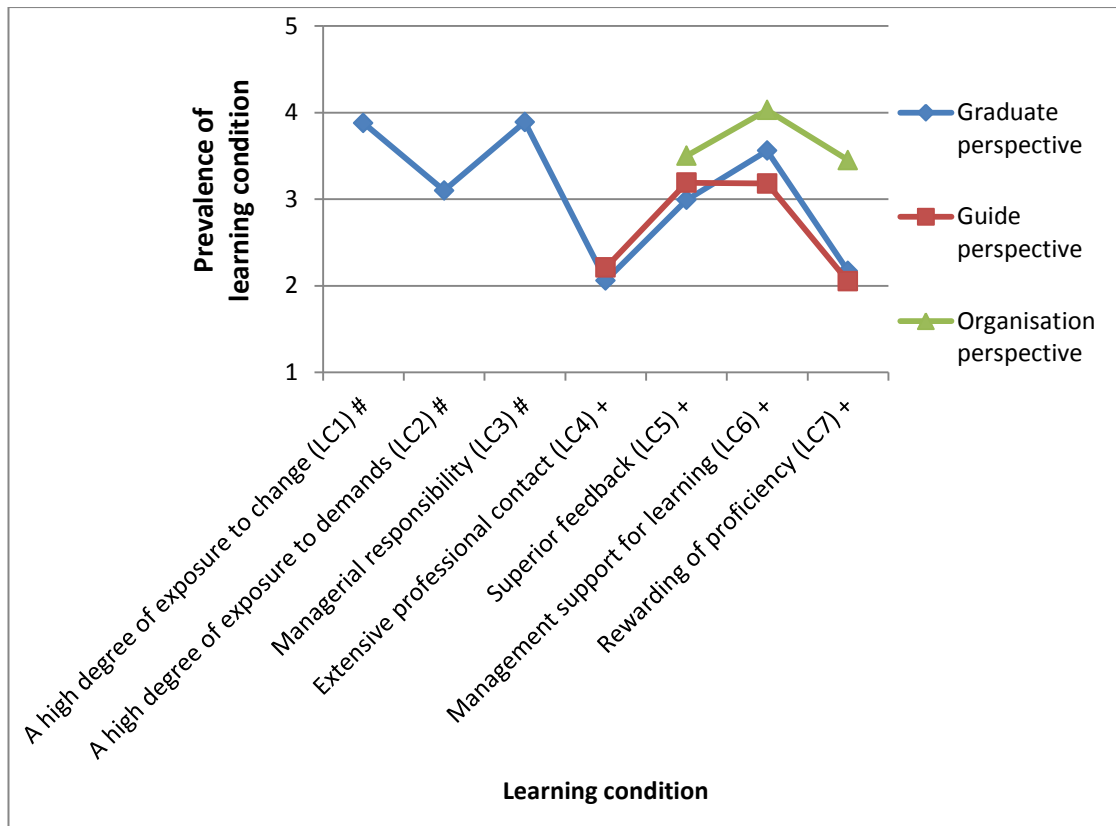


Figure 5-7 Perspectives on the seven learning conditions of learning conducive workplaces

Source: Author

Agreement key: 1: Strongly disagree 3: Neither agree or disagree 4: Agree
2: Disagree 5: Strongly agree
+ Extent key: 1: Not at all 3: Neutral 4: Certain extent
2: Limited extent 5: Large extent

Team approach to work

Table 5-35 shows that team structures capable of providing opportunities for collaborative learning were prevalent in the workplace. Organisations felt they were more prevalent than graduates and guides.

Table 5-35 Extent that team approaches to work were prevalent

Source: Author

Perspective	Extent (%)					Mean	SD
	1	2	3	4	5		
Graduate (N = 41)	6	11	29	37	17	3.5	1.095
Guide (N = 32)	4	14	10	48	24	3.8	1.091
Organisation (N = 10)	0	10	0	40	50	4.3	0.949

Key: 1: Not at all 3: Neutral 4: Certain extent
2: Limited extent 5: Large extent

Adequate time to participate

Table 5-36 displays the extent that graduates and guides were allocated adequate time by the organisation to participate in WPL. It also displays the extent that organisations felt they allocated sufficient time for their employees to partake in WPL. This table shows that graduates and organisations felt adequate time was allocated; whereas, guides felt they were not allocated sufficient time to participate in WPL.

Table 5-36 Extent that adequate time was allocated to participate in WPL

Source: Author

Perspective	Extent (%)					Mean	SD
	1	2	3	4	5		
Graduate (N = 41)	9	20	34	17	20	3.2	1.232
Guide (N = 32)	11	36	25	25	3	2.8	1.076
Organisation (N = 10)	0	10	10	20	60	4.3	1.059

Key: 1: Not at all 3: Neutral 4: Certain extent
2: Limited extent 5: Large extent

When guides were asked to provide any additional WPL strategies they used in the workplace, the following comment was provided. It is very pertinent to this section and could provide insight into the low score for guides:

The most important thing is that you build time into plans to allow both the graduate and their mentor (I would always assign a mentor) the space to 'learn / coach'.

(Company 22, Guide A)

5.3.3.9 Summarising the findings for organisational supports for WPL

Eighty percent of organisations considered the WPL of SE graduates important or very important to them. Half of the organisations surveyed had developed formal WPL policies and learning resources. Organisations that developed formal WPL policies did not necessarily develop learning resources too. All of these organisations developed these policies and learning resources in conjunction with experienced staff / WPL guides. Graduates / WPL learners were less likely to be included in the development of these policies and resources. The typical contents of these resources are displayed in Table 5-37.

Table 5-37 Formal WPL policy and learning resources - typical contents

Source: Author

	Typically:
Formal WPL policies	Detail the learning strategies to be used for new hires
	Include performance milestones
	Detail approaches for developing new syllabi
	Include the use of training matrices to bridge skills shortfalls
Learning resources	Are heavily based on tasks and activities found in the workplace
	Include learning objectives
	Are grouped into distinct categories, with strategies outlined for learning the material and detailed of how an expert would perform the tasks.
	Contain some conceptual theory that is difficult to learn through on-the-job learning alone.

There was no agreement on the philosophy of the WPL of SE graduates. Half of the organisations preferred to gradually train their SE graduates over a long period of time whereas the remaining half preferred to intensively train their SE graduates over a short period of time. There appeared to be no correlation between the organisations WPL philosophy and the existence of formal WPL policies in the organisation.

Table 5-38 merges the graduate, guide and organisations' perspective of the frequency of use of organisational supports. This table shows that:

- All organisational supports for preparing graduates and guides for their WPL role were commonly used.
- All organisational supports for encouraging graduates and guides to engage in WPL were commonly used.
- Organisations did not fully support remote learning and production demands did take precedence over WPL.
- The workplace was invitational in nature and conducive for learning.

Table 5-38 Merging graduate, guide, and organisational perspectives of the frequency of use of organisational supports

Source: Author

Classification of supports	Organisational supports	Frequency of use
WPL Participant Preparation	Instilling awareness in graduates of their WPL role ⁺	4.4
	Learner preparation*	3.4
	Guide preparation*	3.2
WPL Participant Influences on Participation	Encourage reluctant workers to engage in WPL ⁺	4.3
	Draw attention to the professional development benefits through WPL engagement ⁺	3.5
	Monitor performance of WPL guides ⁺	3.9
	Provide feedback to WPL guides on their performance in their WPL role ⁺	3.5
	Monitor performance of graduates ⁺	4.7
WPL Participant Support	Support remote learning ⁺	2.9
	Production demands taking precedence over WPL*	3.7
Invitational nature	Invitational nature of the workplace: Encouraged participation in WPL*	3.7
	Supported WPL role*	3.5
	Inhibited WPL*	1.9
	Skule (2004) seven conditions of a learning conducive workplace*	3.1
	Team approach to work*	3.9
	Allocating adequate time to participate*	3.4
	Allowing adequate time for graduates to settle into their role ⁺	4.6

Frequency Key: 1: Not at all 3: Neutral 4: Certain extent
2: Limited extent 5: Large extent

+ Key: 1: The Frequency of use figure was taken directly from the preceding tables in this section.

* Key: 1: The Frequency of use figure was calculated directly from the preceding tables in this section. The calculation involved averaging the perspectives of the guide, graduate, and organisation means. This approach provides a rough idea of the organisational supports and is not totally statistically defensible.

5.3.4 Learning opportunities and their learning pathways

Research question 1(d): What learning opportunities are available in the workplace? How are they structured? What access is provided to these learning opportunities? How are the pathways of learning opportunities sequenced?

Following the structure of Research Question 1(d), the findings are presented in six distinct categories:

- Learning opportunities available in the workplace
- Structure of learning opportunities
- Access to learning opportunities
- Safeguard against learning inappropriate knowledge
- Difficulty accessing hidden knowledge
- Sequencing of pathways of learning opportunities

5.3.4.1 Learning opportunities available in the workplace

Table 5-39 displays the ratio of routine tasks to non-routine tasks available to graduates on a daily basis in their SE role. This provides an overall view of the classification of learning opportunities available to SE graduates. This table shows that close to half of the guides (48%) reported that graduates encounter the ratio of 80% routine: 20% non-routine when they are working in their SE graduate role. Graduates were much divided about the ratio of tasks they encountered with the mode being the ratio 40% routine: 60% non-routine.

Table 5-39 Ratio of routine to non-routine tasks

Source: Author

Perspective	Routine : Non-routine (% frequency)						TOTAL
	0% : 100%	20%: 80%	40%: 60%	60%: 40%	80%: 20%	100%: 0%	
Graduate (N = 41)	3	21	31	21	21	3	100%
Guide (N = 32)	4	10	17	21	48	0	100%

When guides were asked to detail the learning opportunities available in the workplace for SE graduates, one guide provided a comprehensive account. It included SE tasks such as change management and documentation review, understanding the larger picture of where their SE role fits into the overall company structure, and understanding the processes and procedures in place:

*Understand overall structure of [company name removed], where their work sits, what its responsible for and how it enables thw business / customer.
Understand processes and procedures in place in [company name removed] and guiding prncipals of IT related change. Attending review sessions to help their understanding of the function/system under change. reviewing existing documentation. Meet with experts / customers. assist on change.*
(Company 13, Guide A)

Another guide stated that the learning opportunities are decided upon by senior colleagues:

Opportunities are decided by the project leads which make this a very subjective situation.

(Company 21, Guide A)

Overall, graduates and guides put forward four main themes as learning opportunities: immersion in real projects/tasks, collaborative learning, working on projects specifically designed for WPL, and use of problem solving techniques. Each theme is elaborated upon in Table 5-40 based on the associated quotes in Appendix Table I - 11.

Table 5-40 Learning opportunities identified by the respondents

Source: Author

Type of learning opportunity	Description of learning opportunity
Immersion in real projects / tasks	Observing the functional specification process.
	Fixing defects prior to implementing features.
	Developing minor features.
	Developing prototypes.
	Involved in complete work requests.
	Using documentation as a support.
	Work with support and testing teams.
	Managing non-critical tasks.
Working on projects designed specifically for WPL	Case study projects specifically developed as learning opportunities.
Problem solving techniques	Basic problem analysis
Collaborative learning	Pair programming
	Working with other teams
	Peer teaching

5.3.4.2 Structure of learning opportunities

Table 5-41 displays the extent that learning opportunities were structured in the workplace according to three criteria: the extent that guides helped graduates to understand work practices and procedures, the extent that graduates were made aware of the learning outcomes, and the extent that graduates were made aware of the goals and requirements for expert performance. This table shows that learning opportunities were structured according to the three criteria. Both graduates and guides reported that guides helped graduates to understand work practices and procedures more so than the other two criteria.

Table 5-41 Structure of learning opportunities**Source: Author**

Structuring criteria	Extent (%)					Mean	SD
	1	2	3	4	5		
<i>Graduate perspective (N = 41)</i>							
Help graduates understand work practices and procedures	0	8	14	36	42	4.1	0.950
Made aware of learning outcomes	15	9	29	38	9	3.2	1.193
Made aware of goals and requirements for expert performance	12	15	23	47	3	3.2	1.105
<i>Guide perspective (N = 32)</i>							
Help graduates understand work practices and procedures	0	0	17	35	48	4.3	0.761
Make graduates aware of learning outcomes	0	14	17	31	38	3.9	1.067
Make graduates aware of goals and requirements for expert performance	3	0	10	52	35	4.1	0.875

Key: 1: Not at all 3: Neutral 4: Certain extent
 2: Limited extent 5: Large extent

5.3.4.3 Access to learning opportunities

Table 5-42 displays extent that graduates were provided with access to learning opportunities in the workplace.

Table 5-42 Extent graduates were provided with access to learning opportunities**Source: Author**

Access criteria	Extent (%)					Mean	SD
	1	2	3	4	5		
<i>Graduate perspective (N = 41)</i>							
Access to appropriate learning opportunities	22	17	11	28	22	3.1	1.508
Sufficient access to learning opportunities	3	8	26	34	29	3.8	1.060
<i>Guide perspective (N = 32)</i>							
Access to appropriate learning opportunities	17	3	4	48	28	3.7	1.396
Sufficient access to learning opportunities	0	17	24	45	14	3.6	0.948
<i>Organisational perspective (N = 10)</i>							
Equal access to learning opportunities	0	0	10	10	80	4.7	0.675

Key: 1: Not at all 3: Neutral 4: Certain extent
 2: Limited extent 5: Large extent

This table shows that:

- Graduates did have access to appropriate learning opportunities.
- Graduates were provided with sufficient access to learning opportunities.

- The majority of organisations ensured, to a large extent, that graduates had equal access to learning opportunities.

5.3.4.4 Safeguard against learning inappropriate knowledge

Table 5-43 displays the extent that graduates felt they learned something through WPL that they later found out to be incorrect or inappropriate. In a similar vein, it also displays extent that organisations felt they protected graduates from learning incorrect or inappropriate information through WPL.

Table 5-43 Perspectives on learning inappropriate / incorrect knowledge

Source: Author

Perspective	Strategy	Extent (%)					Mean	SD
		1	2	3	4	5		
Graduate (N = 41)	Learn something through WPL that you later discovered was wrong	35	35	21	9	0	2.0	0.969
Organisation (N = 10)	Safeguard graduates from learning inappropriate knowledge	0	20	20	30	30	3.7	4.00

Key: 1: Not at all 3: Neutral 4: Certain extent
2: Limited extent 5: Large extent

This table shows that graduates typically didn't learn incorrect or inappropriate information through WPL and the organisations did try to safeguard graduates from learning inappropriate knowledge.

5.3.4.5 Difficulty accessing hidden knowledge

Table 5-44 displays the extent that graduates felt they had difficulty learning opaque or hidden knowledge through WPL alone. In a similar vein, it also displays the extent that guides felt they had difficulty making accessible hidden knowledge through WPL alone.

Table 5-44 Perspectives on accessing hidden knowledge

Source: Author

Perspective	Strategy	Extent (%)					Mean	SD
		1	2	3	4	5		
Graduate (N = 34)	Difficulty learning hidden knowledge through WPL alone	18	15	38	23	6	2.9	1.158
Guide (N = 29)	Difficulty making hidden knowledge accessible through WPL alone	27	28	17	28	0	2.5	1.183

Key: 1: Not at all 3: Neutral 4: Certain extent
2: Limited extent 5: Large extent

This table shows that graduates and guides typically felt there was little difficulty accessing opaque or hidden knowledge through WPL alone.

5.3.4.6 Sequencing of pathways of learning opportunities

Table 5-45 presents the extent that SE graduates' learning opportunities were sequenced in the workplace. This table shows that all sequencing strategies were used in the workplace. The most popular sequencing strategy reported by both graduates and guides is increasing responsibility.

Table 5-45 Sequencing of learning opportunities

Source: Author

Perspective	Sequencing strategies	Extent (%)					Mean	SD
		1	2	3	4	5		
Graduate (N=41)	Increasing difficulty	8	9	21	56	6	3.4	1.048
	Increasing diversity	9	12	20	53	6	3.4	1.070
	Increasing responsibility	6	9	21	52	12	3.6	1.034
	Work area	18	6	41	23	12	3.1	1.229
Guide (N=32)	Increasing difficulty	7	0	14	31	48	4.1	1.125
	Increasing diversity	4	17	17	38	24	3.6	1.147
	Increasing responsibility	7	3	0	35	55	4.3	1.131
	Work area	20	14	7	21	38	3.4	1.615

Key: 1: Not at all 3: Neutral 4: Certain extent
2: Limited extent 5: Large extent

Table 5-46 presents the extent that guides considered learners' progress prior to the introduction of learning opportunities requiring increased responsibility. This table shows that learner progress was monitored before introducing tasks of greater responsibility. Guides reported that progress was taken into consideration more so than graduates did.

Table 5-46 Monitor learner progression prior to introducing learning opportunities of increased responsibility

Source: Author

Perspective	Extent (%)					Mean	SD
	1	2	3	4	5		
Graduate (N = 41)	14	19	17	33	17	3.2	1.327
Guide (N = 32)	3	14	14	24	45	3.9	1.223

Key: 1: Not at all 3: Neutral 4: Certain extent
2: Limited extent 5: Large extent

When asked to detail the learning opportunities available in their workplace, three guides indicated that the learning opportunities were sequenced along learning pathways:

*Fixing defects (both test and production), moving from low to higher priority.
Working on code development from detailed specs, to developing from higher level specs, to writing own specs*

(Company 22, Guide A)

We would get the graduates to work on the easier parts of the system such as screen design and get them used to compiling and testing their code within the overall system. Once we were happy with their work at this level, we would start them working on the programming code behind the screens and take them through more difficult / complex tasks

(Company 29, Guide B)

Managing tasks of increasing responsibility on System deployments

(Company 21, Guide C)

5.3.4.7 Summarising the findings for learning opportunities

Close to half of the guides (48%) reported that graduates work on routine problems 80% of the time. Graduates were much divided about the ratio of tasks they encountered in their SE role with the most popular ratio being 40% routine: 60% non-routine.

When graduates and guides were asked to detail the learning opportunities available in their workplace, four broad types of learning opportunity emerged. These learning opportunities are immersion in real projects, working on projects specifically designed for WPL, use of problem solving techniques, and engagement in collaborative learning (Table 5-40).

Table 5-47 merges the graduate, guide, and the organisational perspective on learning opportunities in the workplace. This table shows that:

- All measures for structuring learning opportunities were commonly used. Graduates were made aware of learning outcomes and goals and requirements for expert performance. In particular, guides helped them to understand work practices and procedures.

- All measures relating to access to learning opportunities were commonly used. Graduates had sufficient access to appropriate learning opportunities and organisations ensured that graduates had equal access to learning opportunities.
- In relation to access to knowledge, graduates were not sufficiently safeguarded against learning inappropriate knowledge however they had little difficulty accessing hidden knowledge.
- All measures relating to sequencing learning opportunities were commonly used. Learning opportunities were sequenced by increasing responsibility, increasing difficulty, increasing diversity, and work area. Learners' progress was monitored prior to introducing learning opportunities of increased responsibility.

Table 5-47 Merging graduate, guide and organisational perspectives on learning opportunities and their sequencing

Source: Author

Category	Learning Opportunity	Frequency of use
Structure of learning opportunities	Help graduates understand work practices and procedures*	4.2
	Make graduates aware of learning outcomes*	3.6
	Make graduates aware of goals and requirements for expert performance*	3.7
Access to learning opportunities	Access to appropriate learning opportunities*	3.4
	Sufficient access to learning opportunities*	3.7
	Equal access to learning opportunities ⁺	4.7
Access to knowledge	Safeguard against learning inappropriate knowledge*	2.9
	Difficulty accessing hidden knowledge*	2.7
Sequencing of learning opportunities	Increasing difficulty*	3.8
	Increasing diversity*	3.5
	Increasing responsibility*	4.0
	Work area*	3.3
	Monitor learner progression prior to introducing learning opportunities of increased responsibility*	3.6

Frequency Key: 1: Not at all 3: Neutral 4: Certain extent
2: Limited extent 5: Large extent

+ Key: 1: The Frequency of use figure was taken directly from the preceding tables in this section.

* Key: 1: The Frequency of use figure was calculated directly from the preceding tables in this section. The calculation involved averaging the perspectives of the guide, graduate, and organisation means. This approach provides a rough idea of the organisational supports and is not totally statistically defensible.

5.3.5 Frequency of learning strategy use

Research question 1(e): What learning strategies are used when entry-level SE graduates engage in WPL? What level of direct guidance do guides provide to entry-level SE graduates? What indirect guidance does the physical and social environment provide to entry-level SE graduates?

Following the structure of Research Question 1(e), the findings are presented in seven distinct categories:

- Instructional Model of Learning
- Other Inter-collegial Strategies
- Self-directed Strategies
- Intra-organisational Strategies
- Extra-organisational Strategies
- Direct guidance
- Indirect guidance of the physical and social environment.

Any additional strategies supplied by the graduates and guides are presented prior to summarising the findings for the frequency of learning strategy use. In the frequency of use tables in this section, the results are presented using percentage frequency distribution and summative statistics using mean and standard deviation.

5.3.5.1 Instructional Model of Learning

This category comprises the cognitive apprenticeship (which includes modelling, coaching and scaffolding), articulation, reflection and exploration. Table 5-48 displays the graduates' perspective on how often they encounter these learning strategies in the workplace. In order of decreasing popularity, the most commonly used Instructional Model of Learning strategies in the workplace were:

- Fading
- Modelling
- Learning from mistakes
- Scaffolding
- Exploration
- Discussion (team meetings)

- Diagrams
- Discussion (informal chats)
- Articulation

Table 5-48 Instructional Model of Learning - frequency of use (graduate perspective)

Source: Author

N=41

Learning strategy	Frequency of use (%)					Mean	SD
	1	2	3	4	5		
Modelling (Instruction/ Demonstration)	3	18	21	29	29	3.6	1.172
Analogies	16	24	34	24	2	2.7	1.083
Diagrams	5	26	21	37	11	3.2	1.119
Coaching	13	24	29	29	5	2.9	1.134
Scaffolding	5	14	31	36	14	3.4	1.076
and fading	0	6	24	35	35	4.0	0.921
Articulation	5	26	34	32	3	3.0	0.959
Questioning	11	34	21	34	0	2.8	1.044
Learning through teaching others	11	41	27	16	5	2.7	1.060
Discussion (informal chats)	6	30	24	35	5	3.0	1.053
Discussion (team meetings)	0	30	27	32	11	3.2	1.011
Reflection	11	29	29	21	10	2.9	1.171
Learning from mistakes	0	16	29	34	21	3.6	1.001
Exploration	0	21	34	32	13	3.4	0.970

Key: 1: Never 3: Average 4: Often
 2: Occasionally 5: Very often

Table 5-49 displays the guides' perspective on how often they use these learning strategies. In order of decreasing popularity, the most commonly used Instructional Model of Learning strategies in the workplace were:

- Discussion (team meetings)
- Fading
- Diagrams
- Scaffolding
- Learning from mistakes
- Articulation
- Questioning
- Coaching
- Discussion (informal chats)
- Exploration
- Modelling

- Analogies

Table 5-49 Instructional Model of Learning – frequency of use (guide perspective)

Source: Author

N=32

Learning strategy	Frequency of use (%)					Mean	SD
	1	2	3	4	5		
Modelling (Instruction/ Demonstration)	0	35	31	28	6	3.0	0.948
Analogies	10	31	19	31	9	3.0	1.191
Diagrams	6	16	22	37	19	3.5	1.164
Coaching	6	38	12	22	22	3.2	1.322
Scaffolding	3	22	19	37	19	3.5	1.135
and fading	3	11	14	54	18	3.7	1.013
Articulation	12	19	16	31	22	3.3	1.355
Questioning	6	28	16	28	22	3.3	1.281
Discussion (informal chats)	12	22	22	28	16	3.1	1.289
Discussion (team meetings)	0	16	19	37	28	3.8	1.039
Reflection	22	47	19	9	3	2.3	1.016
Learning from mistakes	3	25	16	44	12	3.4	1.100
Exploration	6	25	31	25	13	3.1	1.129

Key: 1: Never 3: Average 4: Often
 2: Occasionally 5: Very often

Figure 5-8 displays the graduates' and guides' mean frequency of use of all the Instructional Model of Learning strategies. Both graduates and guides reported that the majority of these strategies were commonly used. Both groups reported scaffolding and fading in their top four strategies used in this category. They also reported a modelling strategy in their top four, however, graduates reported instruction / demonstration whereas guides reported using diagrams frequently.

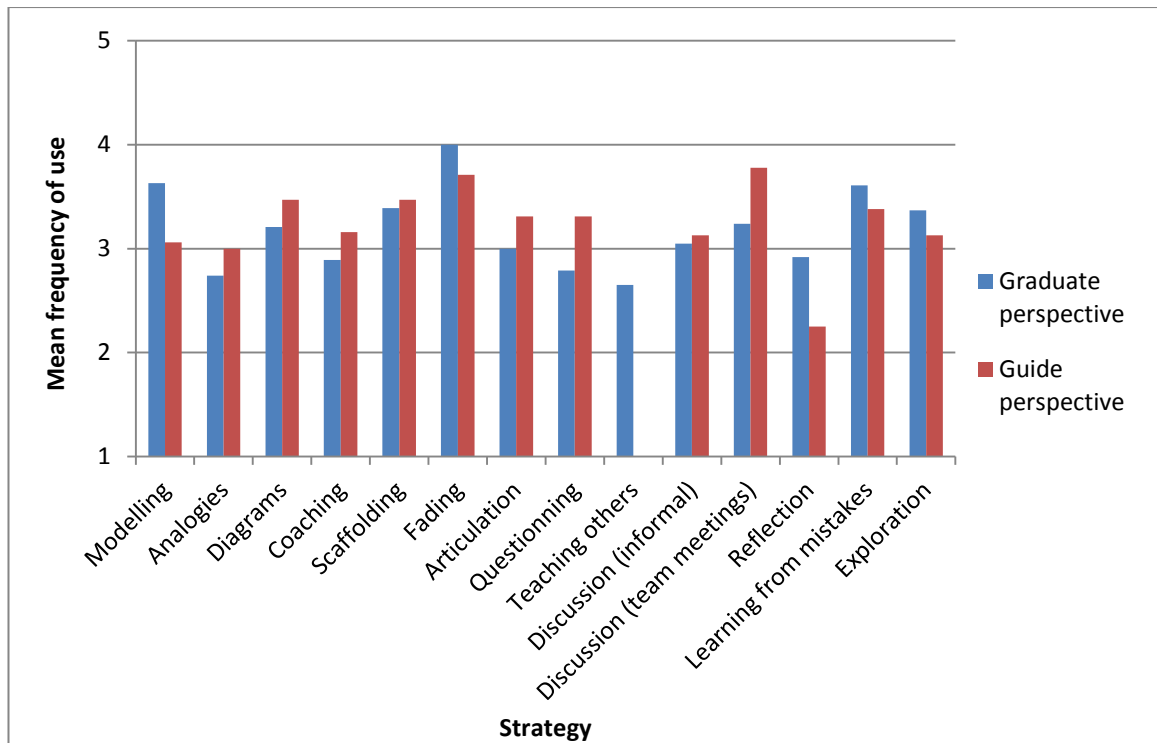


Figure 5-8 Instructional Model of Learning – mean frequency of use

Source: Author

Key: 1: Never 3: Average 4: Often
2: Occasionally 5: Very often

5.3.5.2 Other Inter-collegial Strategies

This category comprises observation and feedback. Table 5-50 displays graduates' perspective on how often they encounter these learning strategies in the workplace. This table shows that two strategies in this category (observation and performance appraisal system) were used to any appreciable extent.

Table 5-50 Other Inter-collegial Strategies - frequency of use (graduate perspective)

Source: Author

N=41

Learning strategy	Frequency of use (%)					Mean	SD
	1	2	3	4	5		
Observation	13	26	21	32	8	3.0	1.207
Shadowing	26	37	13	21	3	2.4	1.172
Feedback	14	25	33	20	8	2.8	1.159
Performance appraisal system	13	16	26	32	13	3.2	1.242
Maintaining learning logs	40	26	8	18	8	2.3	1.374

Key: 1: Never 3: Average 4: Often
2: Occasionally 5: Very often

Table 5-51 displays the guides' perspective on how often they use these learning strategies. This table shows that only one strategy in this category (feedback) was used to any appreciable extent.

Table 5-51 Other Inter-collegial Strategies - frequency of use (guide perspective)

Source: Author

N=32

Learning strategy	Frequency of use (%)					Mean	SD
	1	2	3	4	5		
Observation (Shadowing)	57	31	6	6	0	1.6	0.871
Feedback	9	22	22	34	13	3.2	1.203
Maintaining learning logs	69	13	3	6	9	1.8	1.344

Key: 1: Never 2: Occasionally 3: Average 4: Often 5: Very often

Figure 5-9 displays the graduates' and guides' mean frequency of use of all the Other Inter-collegial Strategies. This figure shows that both graduates and guides reported that only one strategy was used to any appreciable extent.

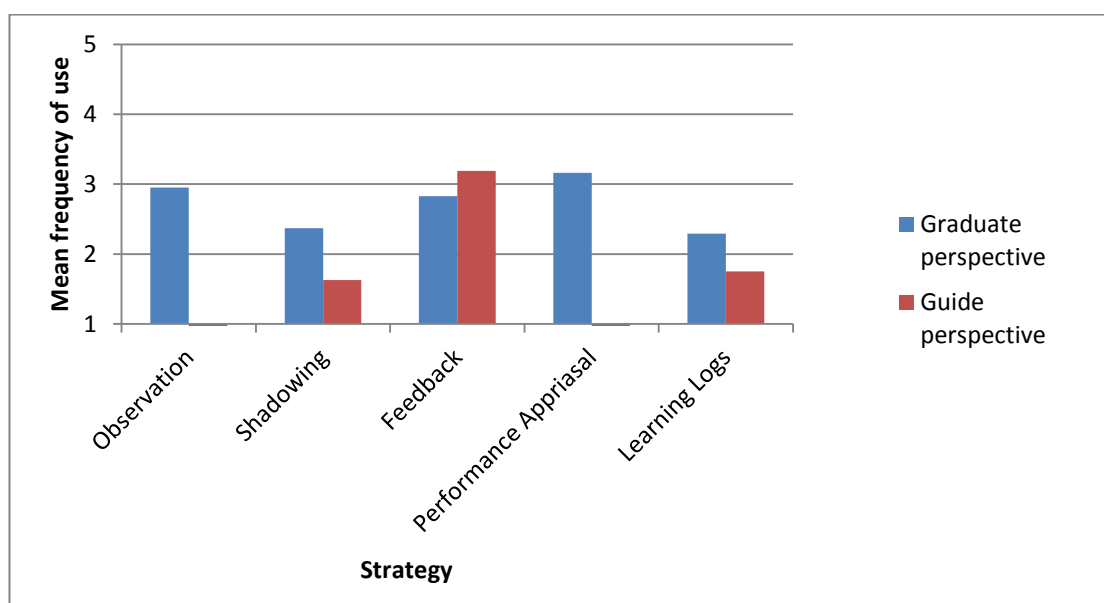


Figure 5-9 Other Inter-collegial Strategies - mean frequency of use

Source: Author

Key: 1: Never 2: Occasionally 3: Average 4: Often 5: Very often

5.3.5.3 Self-directed Strategies

This category comprises practice and repetition along with access to learning materials and resources. Table 5-52 cross tabulates the organisations responses

regarding the extent to which they encouraged graduates to become self-directed learners and the effect this encouragement had on their competency.

Table 5-52 Self-directed Strategies - perceived effectiveness of organisational encouragement (organisational perspective)

Source: Author

N=10

Extent organisations encouraged graduates to become self-directed learners	Perceived effectiveness (frequency)					Total
	1	2	3	4	5	
Not at all	-	-	-	-	-	-
Limited Extent	-	-	-	-	-	-
Neutral	-	-	-	-	-	-
Certain Extent	-	-	-	3	2	5
Large Extent	-	-	1	1	3	5

Key: 5: Very effective
4: Effective

3: Neither effective or ineffective

2: Ineffective
1: Very Ineffective

Five organisations stated that, to a large extent, they encouraged their SE graduates to become self-directed learners and the remaining five encouraged their SE graduates to a certain extent. Overall, encouraging SE graduates to become self-directed learners appeared important to all organisations and they felt that this encouragement was effective for developing SE graduate competence.

Table 5-53 Self-directed Strategies - frequency of use (graduate perspective)

Source: Author

N=41

Learning strategy	Frequency of use (%)					Mean	SD
	1	2	3	4	5		
Practice and repetition	8	26	32	26	8	3.0	1.090
Access to learning materials & resources							
Books	11	40	27	19	3	2.6	1.010
Manuals	16	40	22	19	3	2.5	1.070
Internet	3	11	16	24	46	4.0	1.155
Professional journals	46	27	3	16	8	2.1	1.378
Third level libraries	65	21	11	0	3	1.5	0.900
CDs	81	8	8	3	0	1.3	0.747
DVDs	84	8	5	3	0	1.3	0.693
CBT	27	24	19	24	6	2.6	1.281

Key: 1: Never
2: Occasionally

3: Average

4: Often
5: Very often

Table 5-53 displays the graduates' perspective on the frequency of use of Self-directed Strategies. In order of decreasing popularity, only two strategies in this category were used to any appreciable extent:

- Internet
- Practice and repetition

Table 5-54 displays the guides' perspective on the frequency of use of Self-directed Strategies. In order of decreasing popularity, the most commonly used Self-directed Strategies in the workplace were:

- Internet
- Manuals
- Practice and repetition
- Books

Table 5-54 Self-directed Strategies - frequency of use (guide perspective)

Source: Author

N=32

Learning strategy	Frequency of use (%)					Mean	SD
	1	2	3	4	5		
Practice and repetition	6	16	34	38	6	3.2	1.008
Access to learning materials & resources							
Books	12	22	22	22	22	3.2	1.355
Manuals	9	16	34	22	19	3.3	1.218
Internet	0	9	9	25	57	4.3	0.991
Professional journals	37	41	19	0	3	1.9	0.928
Third level libraries	72	25	0	0	3	1.4	0.793
CDs	78	22	0	0	0	1.2	0.420
DVDs	75	19	3	0	3	1.4	0.833
CBT	25	16	25	12	22	2.9	1.489

Key: 1: Never 3: Average 4: Often
 2: Occasionally 5: Very often

Figure 5-10 displays the graduates' and guides' mean frequency of use of all the Self-directed Strategies. Both graduates and guides reported that few of these strategies were used to any appreciable extent. Resources containing static information such as professional journals, third level libraries, CDs, and DVDs were used infrequently by the graduates and the guides alike whereas the Internet and practice and repetition were commonly used.

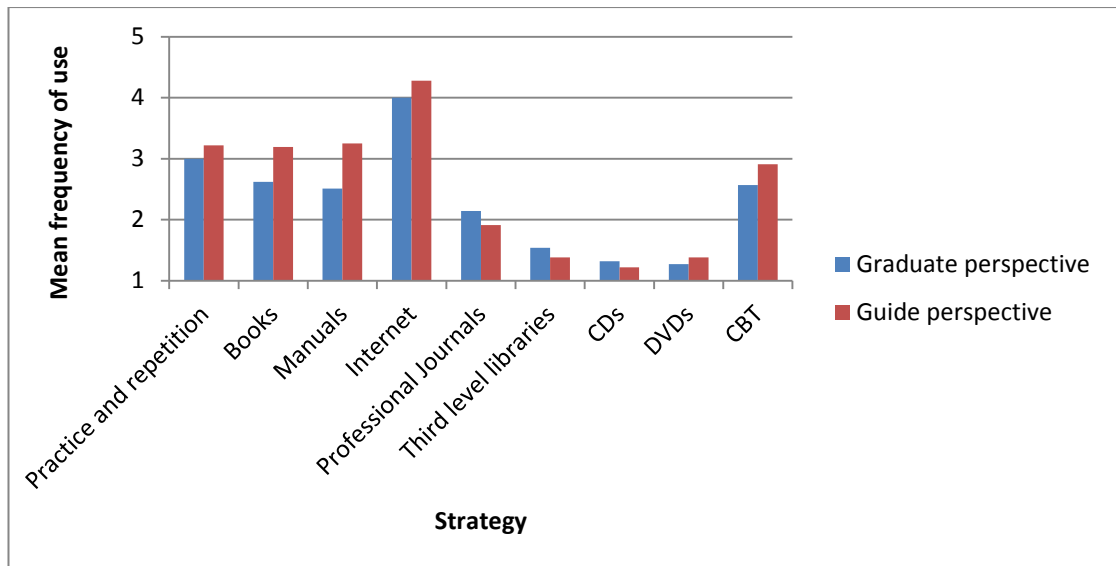


Figure 5-10 Self-directed Strategies - mean frequency of use

Source: Author

Key: 1: Never 2: Occasionally 3: Average 4: Often 5: Very often

5.3.5.4 Intra-organisational Strategies

This category comprises individualised career development plans, rewards for proficiency and achievement, mechanisms for integrated exchange, knowledge bases of previous problem solutions, stretching activities, and perspective switching. Table 5-55 displays the graduates' perspective on the frequency of use of these learning strategies. In order of decreasing popularity, the most commonly used Intra-organisational Strategies in the workplace were:

- Allocation of more responsible tasks
- Thrown in deep end
- Knowledge bases of previous problem solutions
- Engaging in demanding work

The mode for all four measures under the mechanisms for integrated exchange umbrella is Never (1) indicating that these mechanisms were never used in the workplace as a means for learning on-the-job (highlighted in bold and italics in Table 5-55).

Table 5-55 Intra-organisational Strategies - frequency of use (graduate perspective)

Source: Author

N=41

Learning strategy	Frequency of use (%)					Mean	SD
	1	2	3	4	5		
Individualised career development plans	50	16	16	8	10	2.1	1.398
Rewards for proficiency and achievement							
Promotion	59	22	19	0	0	1.6	0.803
Wage increases	28	33	36	3	0	2.1	0.867
Awards for accomplishment	55	28	14	3	0	1.6	0.833
Allocation of more responsible tasks	8	8	42	28	14	3.3	1.091
Mechanisms for integrated exchange							
Company suggestion boxes	95	5	0	0	0	1.1	0.229
Company newsletters	73	21	3	3	0	1.4	0.676
Company information sessions	43	35	19	3	0	1.8	0.845
Company bulletins/memos	62	32	6	0	0	1.4	0.603
Knowledge bases of previous problem solutions	11	11	30	40	8	3.2	1.116
Stretching activities							
Working above grade	19	18	26	26	11	2.9	1.282
Engaging in demanding work	16	18	18	32	16	3.1	1.339
Thrown in deep end	3	26	29	24	18	3.3	1.137
Perspective switching							
Deliberate role transfer	45	16	26	8	5	2.1	1.234
Working abroad	71	13	13	3	0	1.5	0.830

Key: 1: Never 3: Average 4: Often
 2: Occasionally 5: Very often

Table 5-56 displays the guides' perspective on the frequency of use of these learning strategies. This table shows that only one strategy in this category was used to any appreciable extent:

- Knowledge bases of previous problem solutions

The mode for three of the four measures under the heading of mechanisms for integrated exchange is Never (1), with the remaining measure scoring a mode of Occasionally (2) (highlighted in bold and italics in Table 5-56). This indicates that these mechanisms were never or rarely used in the workplace as a means for learning on-the-job. The mode for all four measures under the heading of rewards for proficiency and achievement is Never (1). This indicates that guides never used these measures when learning on-the-job.

Table 5-56 Intra-organisational Strategies - frequency of use (guide perspective)

Source: Author

N=32

Learning strategy	Frequency of use (%)					Mean	SD
	1	2	3	4	5		
Rewards for proficiency and achievement							
Promotion	48	24	17	7	4	1.9	1.132
Wage increase	66	17	10	0	7	1.7	1.143
Awards for accomplishment	48	28	14	3	7	1.9	1.193
Allocation of more responsible tasks	35	17	14	17	17	2.7	1.542
Mechanisms for integrated exchange							
Company suggestion boxes	69	22	3	6	0	1.5	0.842
Company newsletters	56	22	13	9	0	1.8	1.016
Company information sessions	28	37	16	16	3	2.3	1.143
Company bulletins/memos	44	38	6	9	3	1.9	1.088
Knowledge bases of previous problem solutions	16	6	31	28	19	3.3	1.301

Key: 1: Never 2: Occasionally 3: Average 4: Often 5: Very often

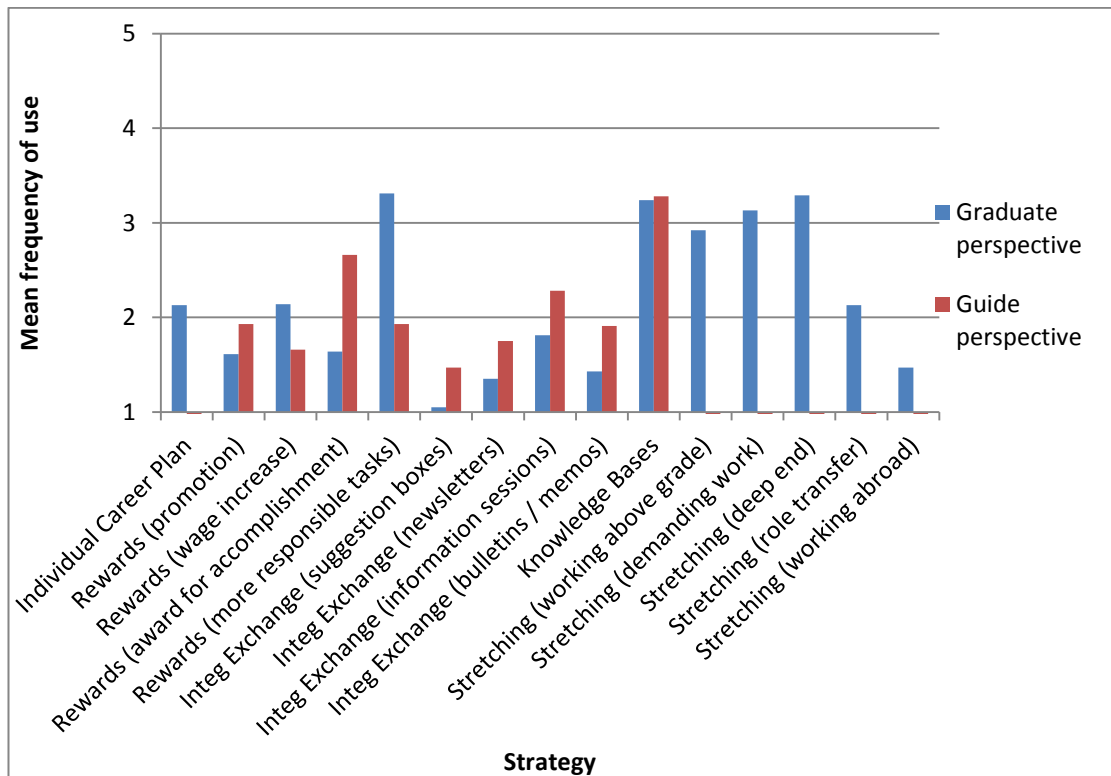


Figure 5-11 Intra-organisational Strategies - mean frequency of use

Source: Author

Key: 1: Never 2: Occasionally 3: Average 4: Often 5: Very often

Figure 5-11 displays the graduates' and guides' mean frequency of use of all the Intra-organisational Strategies. Both graduates and guides reported that the majority of these strategies were not used to any appreciable extent. The strategies comprising mechanisms for integrated exchange were reported by both graduates and guides as being never or rarely used for learning on-the-job. However, both graduates and guides did use knowledge bases of previous problem solutions commonly.

5.3.5.5 Extra-organisational Strategies

This category comprises networking and contact with customers and suppliers. Table 5-57 displays the graduates' perspective on the frequency of use of these learning strategies. This table shows that no strategies in this category were used by graduates to any appreciable extent with the mode response for each strategy being Never (1).

Table 5-57 Extra-organisational Strategies - frequency of use (graduate perspective)

Source: Author

Source: Author

N=41

Learning strategy	Frequency of use (%)					Mean	SD
	1	2	3	4	5		
Networking							
External professional or occupational networks	57	27	11	3	2	1.7	0.973
Trade fairs	81	11	5	0	3	1.3	0.818
Specialised research centres	84	5	5	3	3	1.4	0.919
Conferences/Seminars	51	35	11	3	0	1.7	0.789
Contact with customers/suppliers							
Discussions with customers /clients /suppliers	38	30	19	13	0	2.1	1.064
Technical support from customers/clients/suppliers	43	19	24	14	0	2.1	1.115

Key: 1: Never 3: Average 4: Often
2: Occasionally 5: Very often

Table 5-58 displays the guides' perspective on the frequency of use of these learning strategies. This table shows that no strategies in this category were used to any appreciable extent by guides with the mode response for five out of six strategies being Never (1).

Table 5-58 Extra-organisational Strategies - frequency of use (guide perspective)

Source: Author

N=32

Learning strategy	Frequency of use (%)					Mean	SD
	1	2	3	4	5		
Networking							
External professional or occupational networks	50	25	9	13	3	1.9	1.190
Trade fairs	78	19	0	3	0	1.3	0.634
Specialised research centres	75	19	0	6	0	1.4	0.793
Conferences/Seminars	48	39	3	7	3	1.8	1.023
Contact with customers/suppliers							
Discussions with customers /clients /suppliers	34	28	22	16	0	2.2	1.091
Technical support from customers/clients/suppliers	31	38	12	19	0	2.2	1.091

Key: 1: Never 2: Occasionally 3: Average 4: Often 5: Very often

Figure 5-12 displays the graduates' and guides' mean frequency of use of all the Extra-organisational Strategies. The mode of all the graduate responses was Never (1). The mode of all the guide responses, bar one, was also Never (1). This indicates that this classification of learning strategies was virtually never used in the workplace to support the WPL of SE graduates.

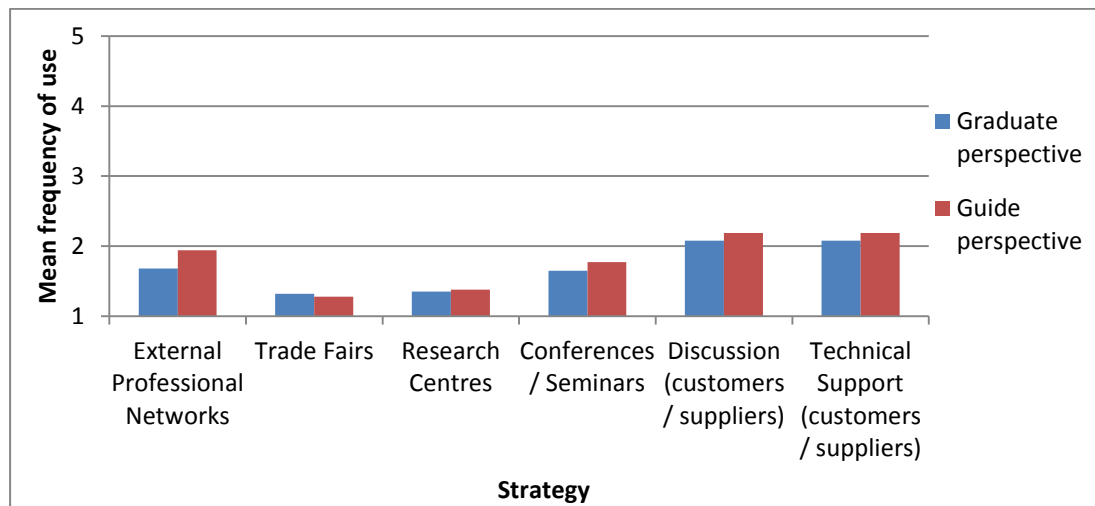


Figure 5-12 Extra-organisational Strategies - mean frequency of use

Source: Author

Key: 1: Never 2: Occasionally 3: Average 4: Often 5: Very often

5.3.5.6 Direct guidance

Direct guidance occurs when there is close expert guidance. These findings are presented, firstly, using Billett's (2001; 2002b) three level model of WPL guidance (Table 5-59 and Table 5-60) and, secondly, presenting the frequency of use of specific direct guidance WPL strategies (Table 5-61).

Using Billett's (2001; 2002b) three level model of WPL guidance, the mean frequency of both graduates' and guides' perspectives are presented in Table 5-59. For traceability, the question number associated with each item can be viewed in Appendix Table H - 8. Note that the majority of these measures are presented in more detail (i.e., percentage frequency distribution and standard deviation) in their relevant sections in the findings chapter.

Table 5-60 further summarises each of the three levels of direct guidance. It calculates, for each level, the overall mean, the percentage of items that scored 3.0 or above, and the percentage of items that scored below 3.0. This table shows that the guides used each of the three levels of guidance more than graduates did. For both graduates and guides, level 1 was used most. For guides all three levels were commonly used. For the graduates, level 1 and 2 were commonly used.

Table 5-59 Three level model of WPL guidance (adapted from Billett 2001; 2002b)

Source: Author

	Mean	
	Graduate (N = 41)	Guide (N = 32)
LEVEL 1 - PARTICIPATION IN WORK ACTIVITIES		
Workplace experiences:		
Organising workplace experiences ⁺	2.8	3.1
Sequencing of tasks from low to highly accountability:		
Increasing difficulty ⁺	3.4	4.1
Increasing diversity ⁺	3.4	3.6
Increasing responsibility ⁺	3.6	4.3
Learning through undertaking everyday work activities ⁺	3.1	3.7
Monitoring learners' readiness to progress on the pathways of activities of increasing accountability and complexity ⁺	3.2	3.9
Providing access to goals and sub-goals required for expert performance and associated with the work practice ⁺	3.2	4.1
Learning opportunities available to observe and listen [#]	3.0	N/A
LEVEL 2 - GUIDED LEARNING AT WORK		
Close guidance by experienced workers:		
Modelling / demonstrating of tasks to be performed [#]	3.6	3.1
Coaching with procedures associated with the activity [#]	2.9	3.2
Scaffolding [#]	3.4	3.5
Assisting with joint problem solving [#]	3.6	4.2
Use of techniques to engage workers in learning for themselves:		
Exploration [#]	3.4	3.1
Practice and repetition [#]	3.0	3.2
Use of learning materials and resources [#]	2.3	2.4
Use of techniques to develop understanding / access to goals to be learnt:		
Awareness of goals ⁺	3.2	4.1
Understanding of goals and requirements ⁺	4.1 3.5	4.3
Monitoring learners' progress ⁺	2.9	3.7
Making accessible knowledge that is hidden (the result is inverted) ⁺	2.2	2.6
Avoidance of learning inappropriate knowledge (the result is inverted) ⁺	3.0	N/A
LEVEL 3 - GUIDED LEARNING FOR TRANSFER		
Strategy use to extend learner's knowledge to novel situations:		
Questioning [#]	2.8	3.3
Problem solving [#]	3.6	4.2
Scenario building / Analogies [#]	2.7	3.0
Engaging learners in opportunities to reflect on what they have learnt	2.9 [#] 2.8 ⁺	2.3 [#] 3.3 ⁺
Encouraging the comparison of individuals' progress with that of others ⁺	2.2	2.5
Assisting learners to understand the breadth of the applicability of what they have learnt ⁺	2.9	3.6
Facilitating the abstraction of learning from one situation to another ⁺	3.6	4.2

Frequency key:

1: Never

3: Average

4: Often

2: Occasionally

3: Neutral

5: Very often

+ Extent key:

1: Not at all

3: Neutral

4: Certain extent

2: Limited extent

5: Large extent

Table 5-60 Summary of Billett's (2001; 2002b) three level model of WPL guidance

Source: Author

LEVEL 1 - PARTICIPATION IN WORK ACTIVITIES	Graduate (N = 41)	Guide (N = 32)
Overall mean	3.2	3.8
Percentage of measures scoring the mean of 3.0 or above	88% (7 items)	100% (7 items)
Percentage of measures scoring below the mean of 3.0	12% (1 item)	0% (0 items)
LEVEL 2 - GUIDED LEARNING AT WORK		
Overall mean	3.2	3.4
Percentage of measures scoring the mean of 3.0 or above	69% (9 items)	82% (9 items)
Percentage of measures scoring below the mean of 3.0	31% (4 items)	18% (2 items)
LEVEL 3 - GUIDED LEARNING FOR TRANSFER		
Overall mean	2.9	3.3
Percentage of measures scoring the mean of 3.0 or above	25% (2 items)	75% (6 items)
Percentage of measures scoring below the mean of 3.0	75% (6 items)	25% (2 items)

Declining



In relation to specific direct guidance strategies, Table 5-61 presents the graduates' and guides' perspective on how often they use these strategies. Some of these strategies appear in Table 5-59 but are repeated so that a complete picture of direct guidance strategy use can be obtained.

Table 5-61 Direct guidance strategies – frequency of use

Source: Author

	Mean frequency of use	
	Graduate (N = 41)	Guide (N = 32)
Instructional Model of Learning (Collins <i>et al</i> 1987)		
Modelling (Instruction / Demonstration)	3.6	3.1
Analogies	2.7	3.0
Diagrams	3.2	3.5
Coaching	2.9	3.2
Scaffolding	3.4	3.5
and fading	4.0	3.7
Articulation	3.0	3.3
Questioning	2.8	3.3
Other Inter-Collegial Strategies		
Feedback	2.8	3.2
Performance appraisal system	3.2	N/A
Intra-Organisational Strategies		
Individualised career development plans	2.1	N/A

Key: 1: Never 3: Average 4: Often
 2: Occasionally 5: Very often

This table shows that graduates commonly used six of the eleven strategies. Guides commonly used all of the nine applicable strategies. Both graduates and guides

ranked scaffolding and fading in their top three direct guidance strategies as well as one modelling strategy.

5.3.5.7 Indirect guidance of the physical and social environment

The workplace environment provides indirect rich guidance to novice workers through observing and listening to other workers and through the physical work environment using tools and artefacts. The findings relating to the frequency of use of indirect guidance strategies are presented in Table 5-62.

This table shows that graduates did not use twenty seven of the thirty eight strategies (74%) strategies to any appreciable extent. They most commonly used, in order of decreasing popularity, were:

- Internet
- Learning from mistakes
- Exploration

The guides did not use twenty two of the thirty one applicable strategies (71%) to any appreciable extent. They most commonly used, in order of decreasing popularity, were:

- Internet
- Team meeting discussions
- Learning from mistakes

Table 5-62 Indirect guidance strategies – frequency of use

Source: Author

	Mean frequency of use	
	Graduate (N = 41)	Guide (N = 32)
Instructional Model of Learning (Collins <i>et al</i> 1987)		
Learning through teaching others	2.7	N/A
Discussion (informal chats)	3.1	3.1
Discussion (team meetings)	3.2	3.8
Reflection	2.9	2.3
Learning from mistakes	3.6	3.4
Exploration	3.4	3.1
Other Inter-Collegial Strategies		
Observation	3.0	N/A
Shadowing	2.4	1.6
Maintaining learning logs	2.3	1.8
Self-Directed Strategies		
Practice and repetition	3.0	3.2
Access to learning materials and resources (Books)	2.6	3.2
Access to learning materials and resources (Manuals)	2.5	3.3
Access to learning materials and resources (Internet)	4.0	4.3
Access to learning materials and resources (Professional Journals)	2.1	1.9
Access to learning materials and resources (Third level libraries)	1.5	1.4
Access to learning materials and resources (CDs)	1.3	1.2
Access to learning materials and resources (DVDs)	1.3	1.4
Access to learning materials and resources (CBT)	2.6	2.9
Intra-Organisational Strategies		
Rewards for proficiency and achievement (Promotion)	1.6	1.9
Rewards for proficiency and achievement (Wage increases)	2.1	1.7
Rewards for proficiency and achievement (Awards for accomplishment)	1.6	1.9
Rewards for proficiency and achievement (Allocation of more responsible tasks)	3.3	2.7
Mechanisms for integrated exchange (Company suggestion boxes)	1.1	1.5
Mechanisms for integrated exchange (Company newsletters)	1.4	1.8
Mechanisms for integrated exchange (Company information sessions)	1.8	2.3
Mechanisms for integrated exchange (Company bulletins/memos)	1.4	1.9
Knowledge bases of problem solutions	3.2	3.3
Stretching activities (Working above grade)	2.9	N/A
Stretching activities (Engaging in demanding work)	3.1	N/A
Stretching activities (Thrown in deep end)	3.3	N/A
Perspective switching (Deliberate role transfer)	2.1	N/A
Perspective switching (Working abroad)	1.5	N/A
Extra-Organisational Strategies		
Networking (External professional or occupational networks)	1.7	1.9
Networking (Trade fairs)	1.3	1.3
Networking (Specialised research centres)	1.4	1.4
Networking (Conferences/Seminars)	1.7	1.8
Contact with customers / suppliers (Discussions)	2.1	2.2
Contact with customers / suppliers (Technical support)	2.1	2.2

Key: 1: Never 3: Average 4: Often
 2: Occasionally 5: Very often

5.3.5.8 Additional identified strategies

This section details any additional strategies that graduates and guides felt were not identified in their surveys.

Nine graduates made comments and three of these were ‘no’ (Company 1, Graduate B; Company 12, Graduate B, and Company 13, Graduate K), which indicated that the survey had covered all the strategies they could think of. This sentiment was corroborated by another respondent:

Already include everything i can think of so far.

(Company 1, Graduate D)

Twenty two guides made comments and one of these was ‘no’ (Company 13, Guide B), which indicated that the survey had covered all the strategies this particular guide could think of.

Numerous practitioners used this area to provide insight into and background for certain WPL strategies that were already covered in the surveys. Table 5-63 cross-references these guide and graduate comments with specific Instructional Model of Learning and Other Inter-collegial Strategies. Table 5-64 cross-references the guides’ insight into specific Intra-organisational Strategies.

The remaining comments were classified in Table 5-65 into three general themes: collaborative learning, social media, and the identification of specific projects / tasks. The quotes associated with each theme are displayed in Appendix Table I - 1. Note that this table contains comments relating to the individual observable heterogeneity of graduates, and, even though they were interesting, they were not include in Table 5-65 as they were outside the scope of the research questions.

Table 5-63 Graduate and guide insight into certain WPL strategies

Source: Author

Strategy		Insight	Comment	Respondent
Instructional Model of Learning	Modelling (Diagrams and models)	This approach is a variation of the diagrams and models approach.	<i>Draw up notes on how to complete specific tasks and ask them to try it without supervision</i>	<i>Company 36, Guide A</i>
	Articulation (Questioning)	This approach transfers the responsibility for asking questions from the guide to the graduate.	<i>Get them to ask questions no matter how big or small. Get them to ask other teams members for best practice solutions.</i>	<i>Company 27, Guide A</i>
		This guide re-iterated the importance of repeatedly asking questions.	<i>Ask questions. If the answer is unclear ask again in a different. If you have 'forgotten something' ask again. "There are no dumb questions."</i>	<i>Company 21, Guide A</i>
	Reflection (Learning from mistakes)	The following graduate comment provides an insight into the learning from mistakes strategy.	<i>Gave me the room to attempt to do things myself. Without shadowing me and correct my every mistake. And merely giving advice when asked and on my finished work.</i>	<i>Company 5, Graduate C</i>
		The development test environment was suggested as an area where graduates could learn from their mistakes.	<i>Trial and error in the test environment</i>	<i>Company 21, Guide B</i>
Other Inter-collegial Strategies	Observation (Shadowing)	This guide often lets the graduate drive the shadowing process and rotates them.	<i>Shadowing is less effective than trying to solve problems themselves. Often use shadowing but with the graduate driving. Also rotating the shadower to learn from multiple people.</i>	<i>Company 32, Guide A</i>

Table 5-64 Guide insight into certain WPL Intra-organisational Strategies

Source: Author

Strategy	Insight	Comment	Respondent
Knowledge bases of previous problem solutions	The graduate should maintain the knowledge database with problems they encountered and then inform their colleagues of the entry.	<i>Make them document procedures and document fixes to problems and encourage them to communicate these findings to the rest of the team"</i>	<i>Company 11, Guide B</i>
	Two guides drew attention to the fact that the resultant problem solutions may not be the best solution and that graduates should be aware of that.	<i>No two projects are the same in the particular area of work I do here in [company name omitted] Java backend programming, so graduates need to learn to be aware that things can be done better next time and that technology and ideas/solutions change per project.</i>	<i>Company 34, Guide A</i>
		<i>Brainstorming to suggest solutions that may be superior to the way they are done in the company. Don't assume the company is doing things optimally.</i>	<i>Company 21, Guide C</i>
Stretching activities (thrown in the deep end)	Ultimately, if the graduate does not succeed when thrown in the deep-end, the guide stated that they would evaluate whether the graduate is worth the time and effort that goes into their WPL guidance.	<i>Essentially you can help them so far but unless they make/show some effort it is pointless and a total waste of your time as a senior engineer - you typically have a lot of demands on your time - so you need to determine quickly if the graduate is "worth" the effort. A sink or swim test after a while is the ultimate in this decision making - you must encourage and promote engineers that can be self-sufficient - anything else results in too big a demand on time and resources</i>	<i>Company 1, Guide A</i>
Perspective switching (deliberate role transfer)	This guide elaborated on the areas where graduates would be transferred to.	<i>I would move them around different areas of IT development / support / test / analysis etc.</i>	<i>Company 22, Guide A</i>

Table 5-65 Additional identified strategies and projects

Source: Author

Additional learning strategies, projects, and activities
Collaborative learning: <ul style="list-style-type: none">• Importance of supportive teams in the learning process.• Importance of working with different people with different perspectives and specialities.• Pair-programming.• eXtreme Programming (XP) practices.
Social Media: <ul style="list-style-type: none">• Wiki exchanges to share information.
Projects / Tasks: <ul style="list-style-type: none">• Specifically designed projects for graduate WPL e.g. personal / sample projects.• Substantial SE project from start to finish, supported by a senior developer.• In-house projects prior to working on client sites.• Challenging learning projects, requiring research.• Open-source projects.• Programming tasks with realistic deadlines.• Code review.• Learn business knowledge relating to the software under development.

Previously, Table 5-40 categorised the available learning opportunities as immersion in real projects, working on projects specifically designed for WPL, use of problem solving techniques, and engagement in collaborative learning. Several of these learning opportunities were very similar to some of the additional learning strategies and projects identified in Table 5-65. To illustrate the overlap between these two areas, Table 5-66 merges these strategies and opportunities.

Table 5-66 Merging learning opportunities and additional strategies identified by the respondents

Source: Author

Opp / Strategy	Description of Learning Opportunity	Description of Learning Strategy
Immersion in real projects / tasks	Observing the functional specification process.	Learning business knowledge relating to software under development.
	Fixing defects prior to implementing features.	<i>No similar strategies identified</i>
	Developing minor features.	
	Developing prototypes.	
	Involved in complete work requests.	
	Using documentation as a support.	
	Work with support and testing teams.	
	Managing non-critical tasks.	
	<i>No similar learning opportunities identified</i>	Involved in a substantial SE project from start to finish, supported by a senior developer.
		Working on in-house projects prior to working on client sites.
		Working on challenging learning projects, requiring research.
		Developing open-source projects.
		Working on programming tasks with realistic deadlines.
Projects designed specifically for WPL	Case study projects specifically developed as learning opportunities.	Code review.
Problem solving techniques	Basic problem analysis.	Working on specifically designed projects for graduate WPL e.g. personal / sample projects.
Collaborative learning	Pair programming.	<i>No similar strategies identified</i>
	Working with other teams.	Pair programming and XP practices.
	Peer teaching.	Importance of supportive teams in the learning process.
Social Media	<i>No similar learning opportunities identified</i>	Importance of working with different people with different perspectives and specialities.
		<i>No similar strategies identified</i>
		Wiki exchanges to share information.

5.3.5.9 Summarising the findings for the frequency of learning strategy use

Both graduates and guides reported that the majority of the Instructional Model of Learning Strategies were commonly used whereas the majority of Other Inter-collegial, Self-directed, Intra-organisational and Extra-organisational Strategies were not used to any appreciable extent.

Independent of category, graduates and guides reported that:

- The most commonly used strategy is the Internet, with scaffolding and fading also appearing in the top five strategies (Table 5-67).
- The least commonly used strategies include company suggestion boxes, DVDs, CDs, trade fairs, and specialised research centres. All these appeared in both groups' top six least used strategies (Table 5-68).

Graduates commonly used six of the eleven direct guidance strategies. Guides commonly used all of the nine applicable strategies. Both graduates and guides agreed on the most commonly used direct guidance strategies by ranking scaffolding and fading in their top three as well as one modelling strategy.

Graduates did not use twenty seven of the thirty eight indirect strategies to any appreciable extent. Guides did not use twenty two of the thirty one applicable indirect strategies to any appreciable extent. Both graduates and guides ranked using the Internet and learning from mistakes in their top three most frequently used indirect strategies.

Guides commonly used all three levels of Billett's (2001; 2002b) model of expert guidance, whereas graduates commonly used levels one and two. The guides used each of the three levels of guidance more than graduates did. For both graduates and guides, level 1 was used most.

Table 5-67 Frequently used WPL strategies (graduate and guide perspective)

Source: Author

Graduate perspective (N = 41)		Guide perspective (N = 32)	
Learning strategy	Mean (≥ 3.0)	Learning strategy	Mean (≥ 3.0)
Internet	4.0	Internet	4.3
Fading	4.0	Discussion (team meetings)	3.8
Modelling (Instruction/ Demonstration)	3.6	Fading	3.7
Learning from mistakes	3.6	Diagrams	3.5
Scaffolding	3.4	Scaffolding	3.5
Exploration	3.4	Learning from mistakes	3.4
Allocation of more responsible tasks	3.3	Articulation	3.3
Thrown in deep end	3.3	Questioning	3.3
Discussion (team meetings)	3.2	Knowledge bases of previous problem solutions	3.3
Knowledge bases of previous problem solutions	3.2	Manuals	3.3
Diagrams	3.2	Practice and repetition	3.2
Performance appraisal system	3.2	Books	3.2
Engaging in demanding work	3.1	Feedback	3.2
Discussion (informal chats)	3.1	Coaching	3.2
Articulation	3.0	Exploration	3.1
Practice and repetition	3.0	Discussion (informal chats)	3.1
Observation	3.0	Modelling (Instruction/ Demonstration)	3.1
		Analogies	3.0

Key: 1: Never 3: Average 4: Often
 2: Occasionally 5: Very often


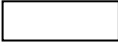


Legend: Direct strategies 
 Indirect strategies 

Table 5-68 Infrequently used WPL strategies (graduate and guide perspective)

Source: Author

Graduate perspective (N = 41)		Guide perspective (N = 32)	
Learning strategy	Mean (< 3.0)	Learning strategy	Mean (< 3.0)
Company suggestion boxes	1.1	CDs	1.2
DVDs	1.3	Trade fairs	1.3
CDs	1.3	Specialised research centres	1.4
Trade fairs	1.3	DVDs	1.4
Company newsletters	1.4	Third level libraries	1.4
Specialised research centres	1.4	Company suggestion boxes	1.5
Company bulletins/memos	1.4	Observation (Shadowing)	1.6
Working abroad	1.5	Wage increase	1.7
Third level libraries	1.5	Company newsletters	1.8
Promotion	1.6	Maintaining learning logs	1.8
Awards for accomplishment	1.6	Conferences/Seminars	1.8
Conferences/Seminars	1.7	Professional journals	1.9
External professional or occupational networks	1.7	Company bulletins/memos	1.9
Company information sessions	1.8	Promotion	1.9
Discussions with customers /clients /suppliers	2.1	Awards for accomplishment	1.9
Technical support from customers/clients/suppliers	2.1	External professional or occupational networks	1.9
Individualised career development plans	2.1	Discussions with customers /clients /suppliers	2.2
Deliberate role transfer	2.1	Technical support from customers/clients/suppliers	2.2
Wage increases	2.1	Reflection	2.3
Professional journals	2.1	Company information sessions	2.3
Maintaining learning logs	2.3	Allocation of more responsible tasks	2.7
Shadowing	2.4	CBT	2.9
Manuals	2.5		
CBT	2.6		
Books	2.6		
Learning through teaching others	2.7		
Analogies	2.7		
Questioning	2.8		
Feedback	2.8		
Coaching	2.9		
Reflection	2.9		
Working above grade	2.9		

Key: 1: Never 3: Average 4: Often
 2: Occasionally 5: Very often

Legend: Direct strategies 
 Indirect strategies 

5.3.6 Summary of the WPL supports for SE graduates

Research Question 1: What are the WPL supports and strategies that a SE graduate encounters while participating in everyday work practice and activities in an entry-level SE position?

In the context of this research question, key findings relating to guides, learners, organisational supports, learning opportunities, and frequency of learning strategy use are briefly summarised in the following sections.

5.3.6.1 Guides

There was little agreement amongst respondents as to whether the majority of guides were selected by the organisation or the graduate. However, when selecting a guide, organisations strongly considered the guides' ability to effectively support graduates, their willingness to participate in WPL initiatives, and their knowledge of and years of experience in the area they would be supporting.

Guides selected by the organisation were more likely to (Table 5-17) be available to support SE graduates, be experienced at supervising SE graduates, be the best choice for WPL support, be adequately prepared for their WPL role, be encouraged to participate, organise graduate WPL, monitor graduate performance, and encourage graduates to engage in problem solving activities with colleagues.

Guides selected by the graduate were more likely to (Table 5-17) be available to the SE graduate, be the best choice for WPL role, be encouraged to participate, monitor graduate performance, and encourage graduates to engage in problem solving activities with colleagues. However, they were less likely to be experienced at supervising SE graduates, be adequately prepared for their WPL role, and organise graduate WPL.

Regardless of how the guide was selected, guides were more likely to (Table 5-17) be considered skilled at sharing knowledge, encourage graduate transferability of learning, encourage graduates to reflect on their learning, be very willing to provide guidance, not at all fear displacement in their role by the graduate they supported,

encourage graduate self-correction based on reflections on their learning, and have a very good relationship with their learner. However, they were less likely to be rewarded for their WPL role and encourage graduates to compare task performance with that of experienced colleagues.

Guides also listed their motivations for engaging in WPL. These include a sense of satisfaction from helping graduates, improving their own existing knowledge, maintaining organisational health, maintaining project/team health and developing standalone employees (Table 5-14).

5.3.6.2 Learners

Graduates, when their guide was selected by the organisation, were more likely to attend training courses to prepare them for WPL, be adequately prepared for their WPL role, and be encouraged to engage in WPL. Graduates, when they selected their own guide, were more likely to be encouraged to engage in WPL. However, they were less likely to attend training courses to prepare them for their WPL role and be adequately prepared for their WPL role. Regardless of how the guide was selected, graduates were more likely to be very willing to engage in WPL and have a very good relationship with their guide (Table 5-23).

Graduates listed their motivations for engaging in WPL which include the opportunity to learn new skills/knowledge, job security and mobility, a sense of satisfaction, and an interest in their job. Table 5-24 cross referenced these motivations with the guides' motivations for participating in WPL. This resulted in an overlap of two criteria: opportunity to learn new skills/knowledge and a sense of satisfaction.

5.3.6.3 Organisational supports

In general, organisations felt that the WPL of SE graduates was very important to them. Half of the organisations developed formal WPL policies and learning resources to support their WPL. All organisations developed these policies and resources with experienced staff / WPL guides. Formal WPL policies specified the learning strategies to be used for new hires, detailed performance milestones, provided approaches for developing syllabi, and used training matrices to bridge skills shortfalls (Table 5-37). Learning resources were based on tasks and activities found in the

workplace, contained learning objectives, were grouped into distinct categories, contained details of how an expert would perform the tasks, outlined strategies for learning the material, and contained conceptual theory that is difficult to learn through on-the-job learning alone (Table 5-37).

All organisational supports and strategies pertaining to the preparation of graduates and guides for their WPL role, and for influencing graduates and guides to engage in WPL were commonly used. The workplaces in this study were perceived as invitational in nature and conducive for learning. However, organisations did not support remote learning and allowed production demands to take precedence over WPL (Table 5-38).

5.3.6.4 Learning opportunities

The learning opportunities available in the workplace were classified as immersion in real projects, working on projects specifically designed for WPL, use of problem solving techniques, and engagement in collaborative learning (Table 5-40). Learning opportunities emerged as structured, with sufficient and equal access provided for them, and they were sequenced in learning pathways. However, graduates were not safeguarded against accessing inappropriate knowledge, but they appeared to have sufficient access to hidden, conceptual knowledge (Table 5-47).

5.3.6.5 Learning strategy use

The general trend indicates that the majority of the Instructional Model of Learning strategies were commonly used but the majority of Other Inter-collegial, Self-directed, Intra-organisational, and Extra-organisational Strategies were not used to any appreciable extent. Independent of category, the Internet, scaffolding, and fading appeared in the top five commonly used strategies (Table 5-67). Company suggestion boxes, DVDs, CDs, trade fairs, and specialised research centres appeared in the top six least used strategies (Table 5-68). The additional strategies suggested by the respondents include collaborative learning, social media, and suggestions for projects / tasks (Table 5-65). When these additional strategies were merged with the learning opportunities identified by respondents, five categories emerged: immersion in real projects/tasks, projects specifically designed for WPL, problem solving techniques, collaborative learning, and social media (Table 5-66).

Guides commonly used all three levels of Billett's (2001; 2002b) model of expert guidance, whereas graduates commonly used levels one and two. The guides used each of the three levels of guidance more than graduates did. For both graduates and guides, level 1 was used most.

Direct strategies were commonly used in the workplace. The most commonly used direct guidance strategies were scaffolding, fading and a modelling strategy. Conversely, indirect strategies were not commonly used. However, the most frequently used indirect strategies were using the Internet and learning from mistakes.

The next section organises the findings according to research question 2.

5.4 Perceived effectiveness of WPL supports and strategies

This section presents the gathered data pertaining to the second research question:

How effective are the WPL supports and strategies for enabling SE entry-level graduates to become competent in their SE role?

As this research question is divided into five sub-questions, the findings pertinent for each sub-question are presented in the following five sections: Perceived effectiveness of guides, Perceived effectiveness of learners, Perceived effectiveness of organisational supports, Perceived effectiveness of learning opportunities and their sequencing, and Perceived effectiveness of learning strategies.

5.4.1 Perceived effectiveness of guides

Research question 2(a): How effective are guides for enabling SE entry-level graduates to become competent in their SE role?

Following the structure of Research Question 2(a), the findings are presented in four distinct categories:

- Guide selection
- Guide preparation
- Influences on guide participation in WPL
- Overall perceived effectiveness of guide support

Where applicable, the findings in this section are presented depending on the selection of the guide i.e. guide appointed by the organisation, guide selected by the graduate, and ignoring guide selection method. Taking this approach provided additional insight into the findings.

5.4.1.1 Guide selection

This section presents the findings according to the guides' skill at sharing knowledge and whether they were the best choice for supporting learning on-the-job.

Skilled at sharing knowledge

Previously, in Table 5-5, graduates and guides reported that guides were skilled at sharing knowledge. Table 5-69 displays graduates' perceived effectiveness of their guide's skill at sharing knowledge. It also displays the guides' perspective on the effect they believe their skill for sharing knowledge has on the development of graduates SE competencies. Regardless of how the guide was selected, both graduates and guides reported that guides were skilled at sharing knowledge which they felt was effective for developing SE graduate competency.

Table 5-69 Perceived effectiveness of guides skill for sharing knowledge

Source: Author

Perspective	Guide selection	Perceived effectiveness (%)					Mean	SD
		1	2	3	4	5		
Graduate (N = 41)	By organisation	0	0	13	52	35	4.2	0.671
	By graduate	0	0	25	58	17	3.9	0.669
Guide (N = 32)	By organisation	0	10	10	50	30	4.0	0.943
	By graduate	0	00	12	59	29	4.2	0.636

Key: 1: Very ineffective 2: Ineffective 3: Neither effective or ineffective 4: Effective 5: Very effective

Best choice for supporting WPL

Previously, in Table 5-6, graduates and guides reported that the guides in their organisations were the best choice for supporting WPL, particularly when the guides were selected by the organisation. Table 5-70 displays the perceived effectiveness of the guide being the best choice to support WPL. These tables show that the guide being the best choice was perceived as effective for developing SE graduate competences, particularly when guides were selected by the organisation.

Table 5-70 Perceived effectiveness of the guide being the best choice for WPL support

Source: Author

Perspective	Guide selection	Perceived effectiveness (%)					Mean	SD
		1	2	3	4	5		
Graduate (N = 41)	By organisation	0	4	17	35	44	4.2	0.887
	By graduate	0	8	8	59	25	4.0	0.853
Guide (N = 32)	By organisation	0	0	0	100	0	4.0	0.000
	By graduate	0	0	31	50	19	3.9	0.719

Key: 1: Very ineffective 2: Ineffective 3: Neither effective or ineffective 4: Effective 5: Very effective

felt their strong learner-guide relationship was effective for developing SE graduate competency. Also, the organisational nurturing of learner-guide relationships was perceived as effective.

Table 5-72 Perceived effectiveness of good learner-guide relationships

Source: Author

Perspective	Guide selection	Perceived effectiveness (%)					Mean	SD
		1	2	3	4	5		
Graduate (N = 41)	By organisation	0	0	13	26	61	4.5	0.730
	By graduate	0	0	11	61	28	4.3	0.778
Guide (N = 32)	By organisation	0	0	10	30	60	4.5	0.707
	By graduate	0	0	0	31	69	4.7	0.479
Organisation (N = 10)	N/A - nurture learner-guide relationships	0	0	0	40	60	4.6	0.516

Key: 1: Very ineffective 2: Ineffective 3: Neither effective or ineffective 4: Effective 5: Very effective

Reluctance to participate

Previously, in Table 5-11, guides, regardless of whether they were selected by the organisation or the graduate, were not at all reluctant to provide guidance to SE graduates in the workplace. Table 5-73 displays the perceived effectiveness of guides' reluctance to engage in WPL. Overall, guides willingness to participate was perceived as effective for developing SE graduate competences.

Table 5-73 Perceived effectiveness of guide reluctance to participate in WPL (guide perspective)

Source: Author

N = 32

Guide selection	Perceived effectiveness (%)					Mean	SD
	1	2	3	4	5		
By organisation	0	0	11	56	33	4.2	0.667
By graduate	0	0	18	18	64	4.5	0.820
Ignoring guide selection method	0	0	15	35	50	4.4	0.745

Key: 1: Very ineffective 2: Ineffective 3: Neither effective or ineffective 4: Effective 5: Very effective

Fear of displacement

Previously, in Table 5-12, guides reported that, regardless of whether they were selected by the organisation or the graduate, they were not at all afraid of being displaced in their role by the graduate they were supporting. Table 5-74 displays the perceived effectiveness of guides fearing displacement by the graduates they

supported. The security guides felt was effective for developing SE graduate competence regardless of whether the guide was allocated by the organisation or selected by the graduate.

Table 5-74 Perceived effectiveness of guides fearing displacement by the graduates they supported (guide perspective)

Source: Author

N = 32

Guide selection	Perceived effectiveness (%)					Mean	SD
	1	2	3	4	5		
By organisation	0	0	37	38	25	3.9	0.835
By graduate	0	0	33	11	56	4.2	0.972
Ignoring guide selection method	0	0	35	24	41	4.1	0.899

Key: 1: Very ineffective 2: Ineffective 3: Neither effective or ineffective 4: Effective 5: Very effective

Availability of expert guidance

Previously, in Table 5-13, graduates and guides reported that expert guidance was commonly available. Guides were more available when appointed by the organisation, compared with guides selected by the graduate. Table 5-75 displays the perceived effect that the availability of expert guidance had on the development of SE graduate competencies. These tables show that, regardless of how the guide was selected, the availability of the guide was perceived as effective for developing SE graduate competences.

Table 5-75 Perceived effectiveness of the availability of guides to support WPL

Source: Author

Perspective	Guide selection	Perceived effectiveness (%)					Mean	SD
		1	2	3	4	5		
Graduate (N = 41)	By organisation	0	0	13	35	52	4.4	0.722
	By graduate	0	0	27	37	36	4.1	0.831
Guide (N = 32)	By organisation	0	0	10	70	20	4.1	0.568
	By graduate	0	0	19	56	25	4.1	0.680

Key: 1: Very ineffective 2: Ineffective 3: Neither effective or ineffective 4: Effective 5: Very effective

Guide motivations for participation in WPL

Previously, in Table 5-16, guides were encouraged by the organisation to participate in WPL. Guides selected by the organisation were encouraged more than those

selected by the graduate. Table 5-76 displays the guides' perceived effectiveness of their organisation's encouragement to participate in WPL. These tables show that guides perceived their encouragement to participate to be effective for developing SE graduate competences. Those guides selected by the organisation felt a great deal more positive about the perceived effectiveness of their encouragement than those selected by the graduate.

Table 5-76 Perceived effectiveness of organisational encouragement of guides to participate (guide perspective)

Source: Author

N = 32

Guide selection	Perceived effectiveness (%)					Mean	SD
	1	2	3	4	5		
By organisation	0	0	30	30	40	4.1	0.876
By graduate	11	22	28	28	11	3.1	1.211
Ignoring guide selection method	7	14	29	29	21	3.4	1.200

Key: 1: Very ineffective 2: Ineffective 3: Neither effective or ineffective 4: Effective 5: Very effective

5.4.1.4 Overall perceived effectiveness of guide support

Table 5-77 displays the graduates' perceived effectiveness of guides to support their WPL. This table shows that graduates perceived guides to be effective, but they perceived company-appointed guides to be more effective than guides the graduates self-selected.

Table 5-77 Overall extent of the perceived effectiveness of guide to support WPL (graduate perspective)

Source: Author

N = 41

Guide selection	Extent (%)					Mean	SD
	1	2	3	4	5		
By organisation	0	8	4	46	42	4.2	0.884
By graduate	9	0	27	46	18	3.6	1.120
Ignoring guide selection method	0	18	9	55	18	3.7	0.977

Key: 1: Not at all 2: Limited extent 3: Neutral 4: Certain extent 5: Large extent

Graduates were asked to provide some insight into their overall rating of their guide's perceived effectiveness. When graduates rated their guide as Very effective (5 on the Likert-type scale), the underlying sentiment in their comments was the constant

availability of their guide. At the opposite end of the Likert-type scale (1 meaning Ineffective), one graduate stated that they had little interaction with their guide. Another graduate who rated their guide as Effective (4 on the Likert-type scale), drew attention to the guides' workload and how they sought advice from other colleagues. The quotes relating to these sentiments can be seen in Appendix Table I - 12.

5.4.1.5 Summarising the findings for the perceived effectiveness of guides

The opinions of guides, graduates, and the organisation in relation to the perceived effectiveness of WPL guide supports and strategies were merged with Table 5-17 and displayed in Table 5-78. This table is divided into three sections:

- The first section details what guides were more likely to do and less likely to do, irrespective of how they were allocated as a guide and the perceived effect this had on SE graduate competence.
- The second section details the guides' opinions, when they were selected by the organisation, of the behaviours they were more likely to engage in and the perceived effectiveness on developing SE graduate competence.
- The third section details what guides were more likely and less likely to do when selected by the graduate and the perceived effectiveness on SE graduate competence.

Overall, graduates perceived guides to be effective; however, they perceived company-appointed guides to be more effective than guides the graduate selected themselves.

Table 5-78 Merging graduate, guide, and organisational perspectives of the frequency of use and perceived effectiveness of guide supports and strategies

Source: Author

Guide selection	Guides were more likely to:	Perceived effectiveness (Effective, Ineffective or N/A)	Guides were less likely to:	Perceived effectiveness (Effective, Ineffective or N/A)
Ignoring guide selection criteria	Be considered skilled at sharing knowledge	Effective	Be rewarded for their WPL role	N/A
	Encourage graduate transferability of learning	N/A	Encourage graduates to compare task performance with that of experienced colleagues	N/A
	Encourage graduates to reflect on their learning	N/A		
	Be very willing to provide guidance	Effective		
	Not at all fear displacement in their role by the graduate they supported.	Effective		
	Encourage graduate self-correction based on reflections on their learning	N/A		
	Have a very good relationship with their learner	Effective		
By the organisation	Be available to support SE graduates	Effective		
	Be experienced at supervising SE graduates	N/A		
	Be the best choice for WPL support	Effective		
	Be adequately prepared for their WPL role	Effective		
	Be encouraged to participate	Effective		
	Organise graduate WPL	N/A		
	Monitor graduate performance	N/A		
	Encourage graduates to engage in problem solving activities with colleagues	N/A		
By the graduate	Be available to the SE graduate	Effective	Be experienced at supervising SE graduates	N/A
	Be the best choice for WPL role	Effective	Be adequately prepared for their WPL role	Effective
	Be encouraged to participate	Effective	Organise graduate WPL	N/A
	Monitor graduate performance	N/A		
	Encourage graduates to engage in problem solving activities with colleagues	N/A		

5.4.2 Perceived effectiveness of learners

Research question 2(b): How effective are learners for enabling themselves to become competent in their SE role?

Following the structure of Research Question 2(b), the findings are presented in two distinct categories:

- Learner preparation
- Influences on learner participation.

Where applicable, the findings in this section are presented depending on the selection of the guide i.e. guide appointed by the organisation, guide selected by the graduate, and ignoring guide selection method. Taking this approach provided additional insight into the findings.

5.4.2.1 Learner preparation

Table 5-79 displays the perceived effectiveness of graduate preparation for developing SE graduate competency.

Table 5-79 Perceived effectiveness of graduate preparation on for their WPL role

Source: Author

Perspective	Guide selection	Perceived effectiveness (%)					Mean	SD
		1	2	3	4	5		
Graduate (N = 41)	By organisation	4	0	37	55	4	3.6	0.800
	By graduate	0	37	38	25	0	2.9	0.835
	Ignoring guide selection method	3	10	37	47	3	3.4	0.850
Organisation (N = 10)	Organisation	0	0	30	40	30	4.0	0.816

Key: 1: Very ineffective 3: Neither effective or 4: Effective
2: Ineffective ineffective 5: Very effective

This table shows the perceived effectiveness of the preparation for developing SE graduate competences:

- Graduates, whose guide was allocated by the organisation felt they were more prepared than not (Table 5-18) and that this preparation was effective.
- Graduates, who selected their own guide felt they were inadequately prepared (Table 5-18) and that this preparation was ineffective.
- Organisations reported that they prepared graduates more so than not for their WPL role (Table 5-18) which they believed was effective.

5.4.2.2 Influences on learner participation

This section presents the findings pertaining to the learner-guide relationship, the reluctance of learners to participate, and their motivations to participate in WPL.

Learner-guide relationship

Table 5-10 shows that, regardless of how the guide was selected, graduates had a very good relationship with their guide, and vice versa. Table 5-72 shows that, regardless of how the guide was selected, graduates felt the strong learner-guide relationship was effective for developing their competency.

Reluctance to participate

Previously, in Table 5-20, graduates, regardless of whether their guide was selected by the organisation or the graduate, were not at all reluctant to engage in WPL. Table 5-80 displays the perceived effectiveness of graduates' willingness to engage in WPL. Overall, graduates willingness to participate was perceived as effective for developing their competences.

Table 5-80 Perceived effectiveness of graduates' willingness to participate in WPL (graduate perspective)

Source: Author

N = 41

Guide selection	Perceived effectiveness (%)					Mean	SD
	1	2	3	4	5		
By organisation	0	6	35	35	24	3.8	0.903
By graduate	0	17	33	33	17	3.5	1.049
Ignoring guide selection method	0	8	35	35	22	3.7	0.926

Key: 1: Very ineffective
2: Ineffective

3: Neither effective or
ineffective

4: Effective
5: Very effective

Learner motivations for participation in WPL

Previously, in Table 5-21, graduates were encouraged by their organisation to participate in WPL. Table 5-81 displays the perceived effectiveness of the organisational encouragement of graduates to participate in WPL. These tables show that graduates perceived their encouragement to participate to be effective for developing their competences. Those graduates selected by the organisation felt a

great deal more positive about the perceived effectiveness of their encouragement than those graduates that selected their own guide.

Table 5-81 Perceived effectiveness of organisational encouragement of graduates to participate (graduate perspective)

Source: Author

N = 41

Guide selection	Perceived effectiveness (%)					Mean	SD
	1	2	3	4	5		
By organisation	0	0	17	65	18	4.0	0.603
By graduate	9	18	27	37	9	3.2	1.168
Ignoring guide selection method	3	6	20	56	15	3.7	0.898

Key: 1: Very ineffective
2: Ineffective

3: Neither effective or ineffective

4: Effective
5: Very effective

5.4.2.3 Summarising the findings for the perceived effectiveness of learners

The opinions of graduates and organisations in relation to the perceived effectiveness of learner supports were merged with Table 5-23 and displayed in Table 5-82. This table is divided into three sections:

- The first section details what learners were more likely to do and less likely to do, irrespective of how they were allocated a guide and the perceived effectiveness on developing their competence.
- The second section details the graduates' opinions, when their guide was selected by the organisation, of the behaviours they were more likely to engage in and the perceived effectiveness on developing their competence.
- The third section details what graduates were more likely and less likely to do, when they selected their own guide and the perceived effectiveness on developing their competence.

Table 5-82 Merging graduate and organisational perspectives on the frequency of use and perceived effectiveness of learner supports

Source: Author

Guide selection	Graduates were more likely to:	Perceived effectiveness (Effective, Ineffective or N/A)	Graduates were less likely to:	Perceived effectiveness (Effective, Ineffective or N/A)
Ignoring guide selection criteria	Be very willing to engage in WPL	Effective		
	Have a very good relationship with their guide	Effective		
By the organisation	Attend training courses to prepare them for WPL	N/A		
	Be adequately prepared for their WPL role	Effective		
	Encouraged to engage in WPL	Effective		
By the graduate	Encouraged to engage in WPL	Effective	Attend training courses to prepare them for their WPL role.	N/A
			Be adequately prepared for their WPL role	Ineffective

5.4.3 Perceived effectiveness of organisational supports

Research question 2(c): How effective are organisational supports for enabling SE entry-level graduates to become competent in their SE role?

Following the structure of Research Question 2(c), the findings are presented in five distinct categories:

- Guide and learner preparation
- Influences on guide and learner participation
- Provide support for remote learning
- Cater for production demands overshadowing learning
- Invitational nature of the workplace

Any additional strategies supplied by the graduates and guides are presented prior to summarising the findings for the perceived effectiveness of organisational supports.

5.4.3.1 Guide and learner preparation

Organisations reported that they prepared guides for their role in WPL (section 5.3.1.3) and they perceived this preparation as effective for developing SE graduate competences (section 5.4.1.2). Likewise, organisations stated that they prepared graduates for their role in WPL (section 5.3.2.1) and they perceived this preparation as effective for developing SE graduate competences (section 5.4.2.1).

Previously, in Table 5-34, organisations felt strongly that they made their SE graduates aware of their WPL role. Table 5-83 displays the perceived effectiveness of organisations explicitly making graduates aware of their WPL role. These tables show that this awareness was effective for developing SE graduate competencies.

Table 5-83 Perceived effectiveness of instilling awareness of WPL role in graduates (organisational perspective)

Source: Author

N = 10

Criteria	Perceived effectiveness (%)					Mean	SD
	1	2	3	4	5		
Instilling awareness in SE graduates of their WPL role	0	0	20	40	40	4.2	0.789

Key: 1: Very ineffective 3: Neither effective or ineffective 4: Effective
2: Ineffective 5: Very effective

5.4.3.2 Influences on guide and learner participation

Previously, in section 5.3.3.4, organisations reported that they encouraged their staff to engage in WPL. Two of the five encouragement measures were particularly used which were encourage reluctant workers and monitor the performance of graduates. Table 5-84 shows the perceived effectiveness that five organisational encouragement measures had on the development of SE graduate competencies. These tables show that the organisations perceived all five measures as effective for developing SE graduate competencies. Two measures were considered particularly effective which were draw attention to the professional development benefits through WPL engagement and monitor performance of graduates.

Table 5-84 Perceived effectiveness of encouraging guides and graduates to engage in WPL (organisational perspective)

Source: Author

N = 10

Encouragement Criteria	Perceived effectiveness (%)					Mean	SD
	1	2	3	4	5		
Encourage reluctant workers to engage in WPL	0	0	25	63	12	3.9	0.641
Draw attention to the professional development benefits through WPL engagement	0	0	20	40	40	4.2	0.789
Monitor performance of WPL guides	0	11	11	56	22	3.9	0.928
Provide feedback to WPL guides on their performance in their WPL role	0	11	34	33	22	3.7	1.000
Monitor performance of graduates	0	0	0	50	50	4.5	0.527

Key: 1: Very ineffective 2: Ineffective 3: Neither effective or ineffective 4: Effective 5: Very effective

Figure 5-13 displays the mean values for the frequency of use and the perceived effectiveness of each of the five organisational encouragement measures.

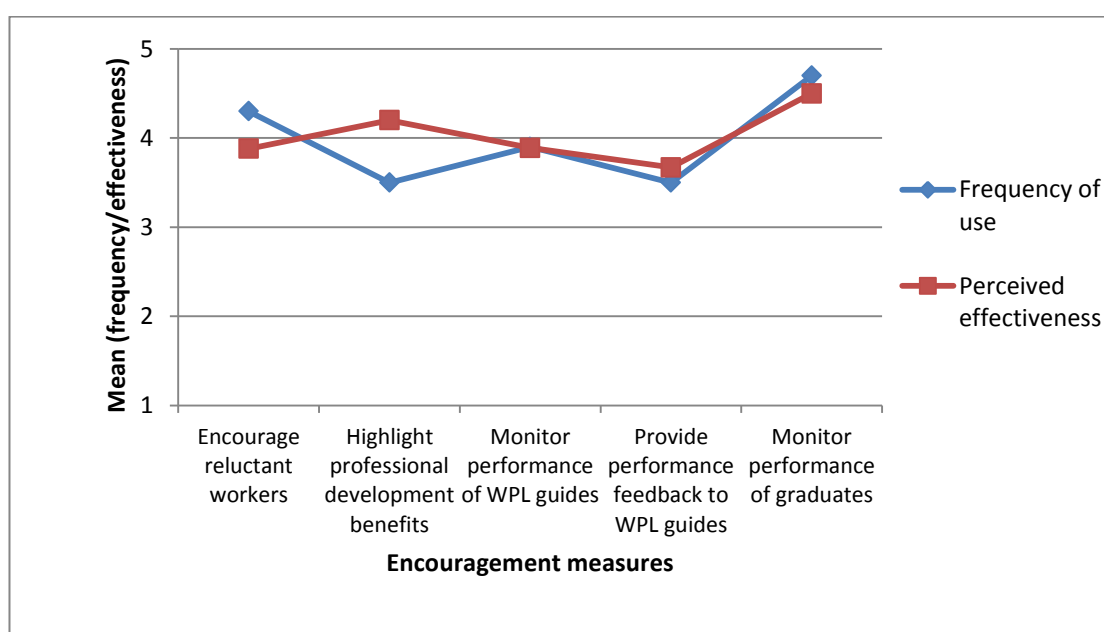


Figure 5-13 Frequency of use and perceived effectiveness of encouraging WPL guides and graduates to engage in WPL (organisational perspective)

Source: Author

Frequency key: 1: Never 2: Occasionally 3: Average 4: Often 5: Very often
Effectiveness key: 1: Very ineffective 2: Ineffective 3: Neither effective or ineffective 4: Effective 5: Very effective

This figure shows that three measures, monitor performance of WPL guides, provide performance feedback to WPL guides, and monitor performance of graduates were each rated virtually equal with regard to frequency of use and perceived effectiveness.

Table 5-86 Perceived effectiveness of production demands overshadowing learning on the development of SE graduate competencies

Source: Author

Perspective	Perceived effectiveness (%)					Mean	SD	Overall mean
	1	2	3	4	5			
Graduate (N = 41)	3	13	57	27	0	3.1	0.740	3.0
Guide (N = 32)	4	38	50	8	0	2.6	0.697	
Organisation (N = 10)	0	10	40	50	0	3.4	0.699	

Key: 1: Very ineffective 2: Ineffective 3: Neither effective or ineffective 4: Effective 5: Very effective

5.4.3.5 Invitational nature of the workplace

Previously, in Table 5-31, both graduates and the guides rated their workplaces as invitational in nature. Table 5-87 displays the perceived effectiveness of the invitational nature of the workplace. These tables show that graduates and guides perceived the invitational nature of their workplace was effective for developing SE graduate competencies. However, no effectiveness measure achieved a mean of 4.0 or above.

Table 5-87 Perceived effectiveness of the invitational nature of the workplace

Source: Author

Source: Author								
Organisation Measures	Perceived effectiveness (%)					Mean	SD	Overall mean
	1	2	3	4	5			
<i>Graduate perspective (N = 41)</i>								
Encouraged graduate participation in WPL	3	6	20	56	15	3.7	0.898	3.5
Supported graduate role in WPL	3	3	33	43	18	3.7	0.918	
Inhibited graduate WPL	4	19	38	31	8	3.2	0.981	
<i>Guide perspective (N = 32)</i>								
Encouraged guides to support WPL	7	14	29	29	21	3.4	1.200	3.3
Supported guide role in WPL	4	21	29	39	7	3.3	1.005	
Inhibited guides when supporting WPL	0	9	57	30	4	3.3	0.703	

Key: 1: Very ineffective 2: Ineffective 3: Neither effective or ineffective 4: Effective 5: Very effective

Note that no effectiveness data was gathered on Skule's (2004) model of a learning conducive workplace as this model, by its very nature, measures the effectiveness of the workplace (discussed in section 2.9).

Team approach to work

Previously, in Table 5-35, both graduates and guides felt that team structures capable of providing opportunities for collaborative learning were prevalent. Table 5-88 displays the perceived effectiveness that team approaches to work has on developing SE graduate competencies. These tables show that both graduates and guides felt the collaborative learning achieved through team approaches was effective on the development of SE graduate competencies. However, no effectiveness measure achieved a mean of 4.0 or above.

Table 5-88 Perceived effectiveness of team approaches to work

Source: Author

Perspective	Perceived effectiveness (%)					Mean	SD
	1	2	3	4	5		
Graduate (N = 41)	0	6	33	43	18	3.7	0.839
Guide (N = 32)	0	11	21	54	14	3.7	0.854

Key: 1: Very ineffective 3: Neither effective or 4: Effective
2: Ineffective ineffective 5: Very effective

Adequate time to participate

Previously, in Table 5-36, organisations and graduates felt that adequate time was allocated to participate however guides felt that they were not allocated sufficient time. Table 5-89 displays the perceived effect that adequate time allocation to participate in WPL had on the development of SE graduate competencies. These tables show that graduates, guides, and organisations all felt that the time allocated to participate was effective for developing SE graduate competencies. In particular, organisations were the most positive about the effectiveness of the time allocation.

Table 5-89 Perceived effectiveness of adequate time being allocated to participate in WPL

Source: Author

Perspective	Perceived effectiveness (%)					Mean	SD	Overall Mean
	1	2	3	4	5			
Graduate (N = 41)	3	4	32	43	18	3.7	0.945	3.9
Guide (N = 32)	23	39	12	15	11	3.7	1.573	
Organisation (N = 10)	0	0	11	56	33	4.2	0.667	

Key: 1: Very ineffective 3: Neither effective or 4: Effective
2: Ineffective ineffective 5: Very effective

Another aspect of time allocation is allowing adequate time for workers (both graduates and guides) to settle into their WPL role. Previously, in Table 5-34,

organisations reported that they allocated sufficient time for their employees to settle into their WPL role. Table 5-90 displays the perceived effectiveness of organisations allocating sufficient time for their employees to settle into their WPL role. These tables show that the time allocation was effective for developing SE graduate competency.

Table 5-90 Perceived effectiveness of organisations allocating adequate time to settle into WPL role (organisational perspective)

Source: Author

N = 10

Criteria	Perceived effectiveness (%)					Mean	SD
	1	2	3	4	5		
Organisation allocated sufficient time to settle into WPL role	0	0	10	50	40	4.3	0.675

Key: 1: Very ineffective
2: Ineffective

3: Neither effective or ineffective

4: Effective
5: Very effective

5.4.3.6 Additional supports

When the organisations were asked if they could think of any other way they supported WPL, one company provided a very comprehensive response which included strategies such as providing sandboxes⁵ to try out software (which would support the learning by mistakes strategy), holding regular meetings with graduates, team leads and HR to plan learning, adhering to prescribed training plans, and self-study. Another company drew attention to the work environment ethics as an additional support. When the organisations were asked if they could think of any ways they inhibited WPL, both cost and sufficient time allocation were issues. Remote learning was also mentioned as an inhibitor for WPL, however the recommendations to overcome this include the use of communication technology such as Skype and email as well as frequent travelling to the remote site. Table 5-91 displays these factors suggested as supporting or inhibiting WPL. The quotes associated with these sentiments can be found in Appendix Table I - 13.

⁵ An experimental environment where new code or content can be tested in isolation from the live system.

Source: Author

Factors organisations suggested as:	
Supporting WPL	Inhibiting WPL
Sandboxes to try out software	Financial constraints
Adhering to prescribed training plans	
Holding regular meetings with graduates, team leaders and HR to plan learning	Sufficient time allocation
Self-study	Remote learning
Immersion in a work environment with sound ethics	

5.4.3.7 Overall organisational support

Table 5-92 presents the perceived effectiveness of the overall support organisations provided for WPL. This table shows that the organisations felt their support was effective for developing SE graduate competencies.

Table 5-92 Overall support sufficient for developing SE graduate competency (organisational perspective)

Source: Author

N = 10							
Perspective	Perceived effectiveness (%)					Mean	SD
	1	2	3	4	5		
Organisation	0	0	0	20	80	4.8	0.422

Key: 1: Very ineffective 3: Neither effective or 4: Effective
2: Ineffective ineffective 5: Very effective

5.4.3.8 Summarising the findings for the perceived effectiveness of organisational supports

The organisations reported that the overall support they provided was effective for the development of SE graduate competencies. When the organisations were asked if they could think of any other ways they supported WPL, many strategies were suggested such as providing sand pits to try out software (which would support the learning by mistakes strategy), holding regular meetings with graduates, team leads and HR to plan learning, adhering to prescribed training plans and self-study and immersion in a work environment with sound ethics. When the organisations were asked if they could think of ways they inhibited WPL, cost, time allocation, and remote learning were mooted.

The opinions of guides, graduates, and the organisation in relation to the perceived effectiveness of organisational supports were merged with Table 5-38 and displayed in Table 5-93. This table shows that, where responses were sought, all organisational supports were perceived as effective.

Table 5-93 Merging graduate, guide, and organisational perspectives of the frequency of use and perceived effectiveness of organisational supports

Source: Author

Classification of supports	Organisational supports	Frequency of use	Perceived effectiveness
WPL Participant Preparation	Instilling awareness in graduates of their WPL role ⁺	4.4	4.2
	Learner preparation*	3.4	3.7
	Guide preparation*	3.2	3.6
WPL Participant Influences on Participation	Encourage reluctant workers to engage in WPL ⁺	4.3	3.9
	Draw attention to the professional development benefits through WPL engagement ⁺	3.5	4.2
	Monitor performance of WPL guides ⁺	3.9	3.9
	Provide feedback to WPL guides on their performance in their WPL role ⁺	3.5	3.7
	Monitor performance of graduates ⁺	4.7	4.5
WPL Participant Support	Support remote learning ⁺	2.9	3.6
	Production demands taking precedence over WPL*	3.7	3.0
Invitational nature	Invitational nature of the workplace: Encouraged participation in WPL*	3.7	3.6
	Supported WPL role*	3.5	3.5
	Inhibited WPL*	1.9	3.3
	Skule (2004) seven conditions of a learning conducive workplace*	3.1	N/A
	Team approach to work*	3.9	3.7
	Allocating adequate time to participate*	3.4	3.9
	Allowing adequate time for graduates to settle into their role ⁺	4.6	4.3

Frequency Key: 1: Not at all 3: Neutral 4: Certain extent
2: Limited extent 5: Large extent
Effectiveness key: 1: Very ineffective 3: Neither effective or 4: Effective
2: Ineffective ineffective 5: Very effective

+ Key: 1: The associated figures were taken directly from the preceding tables in this section.
* Key: 1: The associated figures were calculated directly from the preceding tables in this section. The calculation involved averaging the perspectives of the guide, graduate, and organisation means. This approach provides a rough idea of the organisational supports and is not totally statistically defensible.

5.4.4 Perceived effectiveness of learning opportunities and their sequencing

Research question 2(d): How effective are learning opportunities (and their sequencing) for enabling SE entry-level graduates to become competent in their SE role?

Following the structure of Research Question 2(d), the findings are presented in three distinct categories:

- Access to learning opportunities
- Safeguard against learning inappropriate knowledge
- Sequencing of pathways of learning opportunities

5.4.4.1 Access to learning opportunities

Previously, in section 5.3.4.3, graduates and guides reported being provided with sufficient access to learning opportunities. Table 5-94 displays the perceived effect that sufficient access to learning opportunities had on the development of SE graduate competencies. These tables show that both graduates and guides felt this sufficient access was effective for developing SE graduate competencies.

Table 5-94 Perceived effectiveness of sufficient access to learning opportunities

Source: Author

Perspective	Perceived effectiveness (%)					Mean	SD
	1	2	3	4	5		
Graduate (N = 41)	3	3	33	43	18	3.7	0.918
Guide (N = 32)	0	7	39	39	15	3.6	0.832

Key: 1: Very ineffective 3: Neither effective or 4: Effective
2: Ineffective ineffective 5: Very effective

Previously, in section 5.3.4.3, eighty percent of organisations ensured, to a large extent, that each graduate had equal access to learning opportunities in their workplace. Table 5-95 presents the effect equal access to learning opportunities had on the development of SE graduate competencies. These tables show that organisations felt this access was effective for developing SE graduate competencies.

Table 5-95 Perceived effectiveness of organisations ensuring graduates have equal access to learning opportunities (organisational perspective)

Source: Author

N = 10

Perspective	Perceived effectiveness (%)					Mean	SD
	1	2	3	4	5		
Organisation	0	0	10	40	50	4.4	0.699

Key: 1: Very ineffective 2: Ineffective 3: Neither effective or ineffective 4: Effective 5: Very effective

5.4.4.2 Safeguard against learning inappropriate knowledge

Previously, organisations reported that they safeguarded graduates from learning inappropriate knowledge (section 5.3.4.4). Table 5-96 displays the perceived effectiveness that protecting graduates from learning incorrect or inappropriate information through WPL had on SE graduate competence development. These tables show that organisations felt this safeguarding was effective for developing SE graduate competency.

Table 5-96 Perceived effectiveness of safeguarding against learning inappropriate knowledge (organisational perspective)

Source: Author

N = 10

Perspective	Perceived effectiveness (%)					Mean	SD
	1	2	3	4	5		
Organisation	0	0	30	40	30	4.0	0.816

Key: 1: Very ineffective 2: Ineffective 3: Neither effective or ineffective 4: Effective 5: Very effective

5.4.4.3 Sequencing of pathways of learning opportunities

Previously, in section 5.3.4.6, both graduates and guides reported that all four strategies for sequencing learning opportunities were commonly used in the workplace. Both graduates and guides reported that the most popular sequencing of learning opportunities was by increasing responsibility. Table 5-97 displays the perceived effect that the sequencing of learning opportunities had on the development of SE graduate competencies. These tables show that all sequencing strategies were perceived as effective. Graduates reported the sequencing of learning opportunities by increasing difficulty as the most effective sequencing strategy. Guides reported the

sequencing learning opportunities by increasing responsibility as the most effective sequencing strategy followed very closely by increasing difficulty.

Table 5-97 Perceived effectiveness of the sequencing of learning opportunities

Source: Author

Perspective	Sequencing strategies	Perceived effectiveness (%)					Mean	SD
		1	2	3	4	5		
Graduate (N = 41)	Increasing difficulty	0	4	18	56	22	4.0	0.759
	Increasing diversity	0	0	31	54	15	3.9	0.675
	Increasing responsibility	0	0	33	52	15	3.8	0.681
	Work area	0	0	48	48	4	3.6	0.590
Guide (N = 32)	Increasing difficulty	0	0	8	64	28	4.2	0.577
	Increasing diversity	0	4	16	60	20	4.0	0.735
	Increasing responsibility	0	0	4	50	46	4.4	0.584
	Work area	0	0	36	41	23	3.9	0.774

Key: 1: Very ineffective 3: Neither effective or 4: Effective
2: Ineffective ineffective 5: Very effective

5.4.4.4 Summarising the perceived effectiveness of learning opportunities and their sequencing

The opinions of guides, graduates, and the organisation in relation to the perceived effectiveness of learning opportunities were merged with Table 5-47 and displayed in Table 5-98. This table shows that, where responses were sought, all learning opportunities and their sequencing were perceived as effective.

Table 5-98 Merging graduate, guide and organisational perspectives on the frequency of use and perceived effectiveness of learning opportunities and their sequencing

Source: Author

Category	Learning Opportunity	Frequency of use	Perceived effectiveness
Structure of learning opportunities	Help graduates understand work practices and procedures*	4.2	N/A
	Make graduates aware of learning outcomes*	3.6	N/A
	Make graduates aware of goals and requirements for expert performance*	3.7	N/A
Access to learning opportunities	Access to appropriate learning opportunities*	3.4	N/A
	Sufficient access to learning opportunities*	3.7	3.7
	Equal access to learning opportunities ⁺	4.7	4.4
Access to knowledge	Safeguard against learning inappropriate knowledge	2.9 [*]	4.0 ⁺
	Difficulty accessing hidden knowledge [#]	2.7	N/A
Sequencing of learning opportunities	Increasing difficulty*	3.8	4.1
	Increasing diversity*	3.5	4.0
	Increasing responsibility*	4.0	4.1
	Work area*	3.3	3.8
	Monitor learner progression prior to introducing learning opportunities of increased responsibility*	3.6	N/A

Frequency Key: 1: Not at all 3: Neutral 4: Certain extent
 2: Limited extent 5: Large extent
 Effectiveness key: 1: Very ineffective 3: Neither effective or 4: Effective
 2: Ineffective ineffective 5: Very effective

+ Key: 1: The associated figures were taken directly from the preceding tables in this section.
 * Key: 1: The associated figures were calculated directly from the preceding tables in this section. The calculation involved averaging the perspectives of the guide, graduate, and organisation means. This approach provides a rough idea of the organisational supports and is not totally statistically defensible.

5.4.5 Perceived effectiveness of learning strategies

Research question 2(a): How effective are WPL strategies for enabling SE entry-level graduates to become competent in their SE role?

Following the structure of Research Question 2(e), the findings are presented in five distinct categories:

- Instructional Model of Learning
- Other Inter-collegial Strategies
- Self-directed Strategies

- Intra-organisational Strategies
- Extra-organisational Strategies

In the perceived effectiveness tables in this section, the results are presented using percentage frequency distribution and summative statistics including mean and standard deviation. The figures in this section summarise each of the five categories of WPL strategy by displaying the overall frequency of use and the perceived effectiveness from both the graduate and guide perspective.

5.4.5.1 Instructional Model of Learning

This category comprises the cognitive apprenticeship (which includes modelling, coaching and scaffolding), articulation, reflection and exploration.

Table 5-99 Perceived effectiveness of Instructional Model of Learning strategies (graduate perspective)

Source: Author

N = 41

Learning strategy	Perceived effectiveness (%)					Mean	SD
	1	2	3	4	5		
Modelling (Instruction/ Demonstration)	3	0	6	29	62	4.5	0.861
Analogies	0	3	19	55	23	4.0	0.752
Diagrams	0	0	9	53	38	4.3	0.629
Coaching	0	0	18	55	27	4.1	0.678
Scaffolding and fading	0	3	6	49	42	4.3	0.728
Articulation	0	0	20	62	18	4.0	0.627
Questioning	0	0	32	56	12	3.8	0.641
Learning through teaching others	0	3	16	65	16	3.9	0.680
Discussion (informal chats)	0	3	21	52	24	4.0	0.770
Discussion (team meetings)	3	3	23	60	11	3.7	0.817
Reflection	0	6	22	44	28	3.9	0.878
Learning from mistakes	0	0	8	50	42	4.3	0.632
Exploration	0	3	11	50	36	4.2	0.749

Key: 1: Very ineffective
2: Ineffective

3: Neither effective
or ineffective

4: Effective
5: Very effective

Table 5-99 displays the graduates' perspective on the perceived effectiveness of these learning strategies in the workplace for developing their SE competence. This table shows that graduates perceived all the Instructional Model of Learning strategies as effective for developing graduates' SE competence. The most effective of these strategies in order of decreasing popularity were:

- Modelling

- Learning from mistakes
- Scaffolding and fading
- Diagrams
- Exploration
- Coaching

Table 5-100 displays the guides' perspective on the perceived effectiveness of these learning strategies in the workplace for developing SE graduate competence.

Table 5-100 Perceived effectiveness of Instructional Model of Learning (guide perspective)

Source: Author

N = 32

Learning strategy	Perceived effectiveness (%)					Mean	SD
	1	2	3	4	5		
Modelling (Instruction/ Demonstration)	6	3	19	59	13	3.7	0.965
Analogies	0	7	21	52	20	3.9	0.833
Diagrams	3	0	7	57	33	4.2	0.834
Coaching	0	0	30	43	27	4.0	0.765
Scaffolding and fading	0	0	3	60	37	4.3	0.547
Articulation	0	0	28	31	41	4.1	0.833
Questioning	0	0	23	50	27	4.0	0.718
Discussion (informal chats)	7	0	18	43	32	3.9	1.086
Discussion (team meetings)	0	9	13	47	31	4.0	0.916
Reflection	0	4	61	27	8	3.4	0.697
Learning from mistakes	0	7	3	77	13	4.0	0.657
Exploration	3	13	30	34	20	3.5	1.074

Key: 1: Very ineffective
2: Ineffective

3: Neither effective
or ineffective

4: Effective
5: Very effective

This table shows that guides perceived all the Instructional Model of Learning strategies as effective for developing graduates' SE competence. The most effective of these strategies in order of decreasing popularity were:

- Scaffolding and fading
- Diagrams
- Articulation
- Questioning
- Discussion at team meetings

Figure 5-14 displays the mean frequency of use and the perceived effectiveness of the Instructional Model of Learning strategies from both the graduates' and guides' perspectives. This figure shows that both graduates and guides ranked each strategy as effective and virtually on par with each other. The perceived effectiveness of these strategies was typically ranked higher than their frequency of use in the workplace.

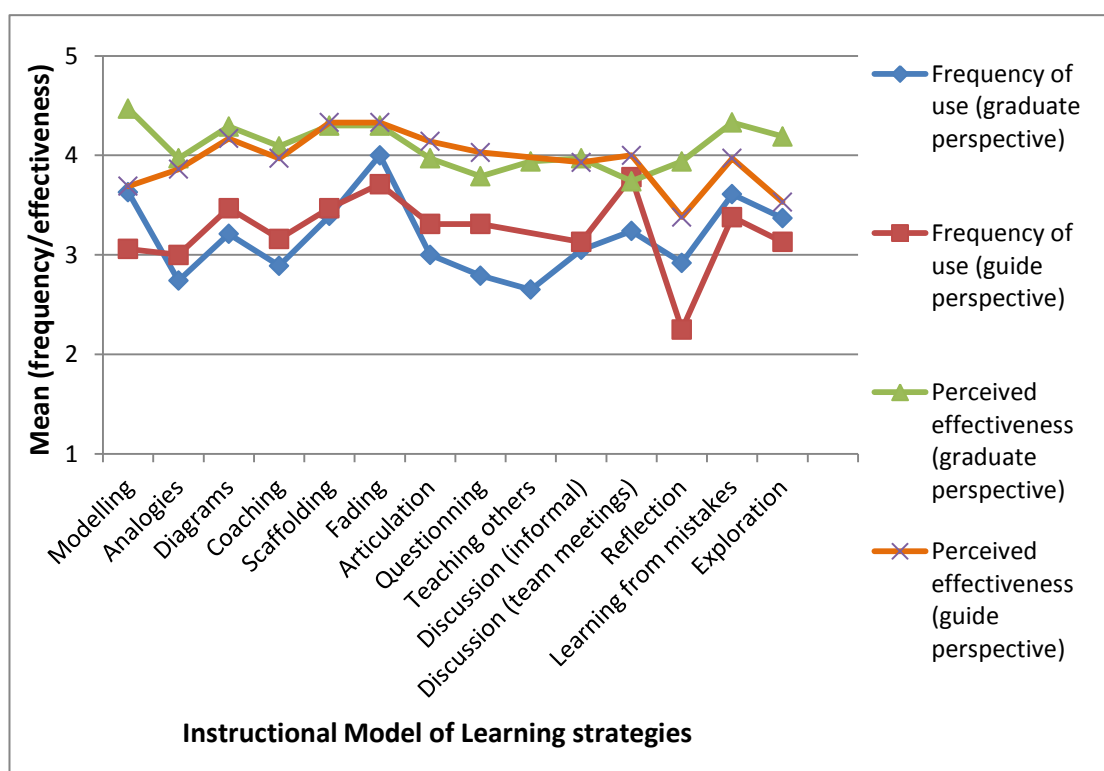


Figure 5-14 Instructional Model of Learning (summary of graduate and guide perspectives)

Source: Author

Frequency key:	1: Never	3: Average	4: Often
	2: Occasionally		5: Very often
Effectiveness key:	1: Very ineffective	3: Neither effective or ineffective	4: Effective
	2: Ineffective		5: Very effective

5.4.5.2 Other Inter-collegial Strategies

This category comprises observation and feedback. Table 5-101 displays the graduates' perspective on the perceived effectiveness of these learning strategies in the workplace for developing their SE competence.

Table 5-101 Perceived effectiveness of Other Inter-collegial Strategies (graduate perspective)

Source: Author

N = 41

Learning strategy	Perceived effectiveness (%)					Mean	SD
	1	2	3	4	5		
Observation	0	9	19	59	13	3.8	0.803
Shadowing	0	8	27	38	27	3.9	0.925
Feedback	0	0	11	64	25	4.1	0.591
Performance appraisal system	3	12	25	47	13	3.5	0.983
Maintaining learning logs	0	16	44	24	16	3.4	0.957

Key: 1: Very ineffective
2: Ineffective

3: Neither effective
or ineffective

4: Effective
5: Very effective

This table shows that graduates perceived all the Other Inter-collegial Strategies as effective for developing their SE competence. The most effective of these strategies was feedback. All SE graduates that used this strategy stated that their feedback was mostly positive.

Table 5-102 displays the guides' perspective on the perceived effectiveness of these learning strategies in the workplace for developing graduate SE competence.

Table 5-102 Perceived effectiveness of Other Inter-collegial Strategies (guide perspective)

Source: Author

N = 32

Learning strategy	Perceived effectiveness (%)					Mean	SD
	1	2	3	4	5		
Shadowing (Observation)	0	10	42	32	16	3.5	0.905
Feedback	0	3	21	48	28	4.0	0.802
Maintaining learning logs	6	7	40	27	20	3.5	1.125

Key: 1: Very ineffective
2: Ineffective

3: Neither effective
or ineffective

4: Effective
5: Very effective

This table shows that guides perceived all the Other Inter-collegial Strategies as effective for developing graduates' SE competence. The most effective of these strategies was feedback. This was also the most effective strategy from the graduates' perspective.

Figure 5-15 displays the mean frequency of use and the perceived effectiveness of the Other Inter-collegial Strategies from both the graduate and guide perspectives. This figure shows that both graduates and guides ranked each strategy as effective and virtually on par with each other. The perceived effectiveness of these strategies was

typically ranked higher than their frequency of use in the workplace. Even though most strategies were not frequently used, they were still considered effective.

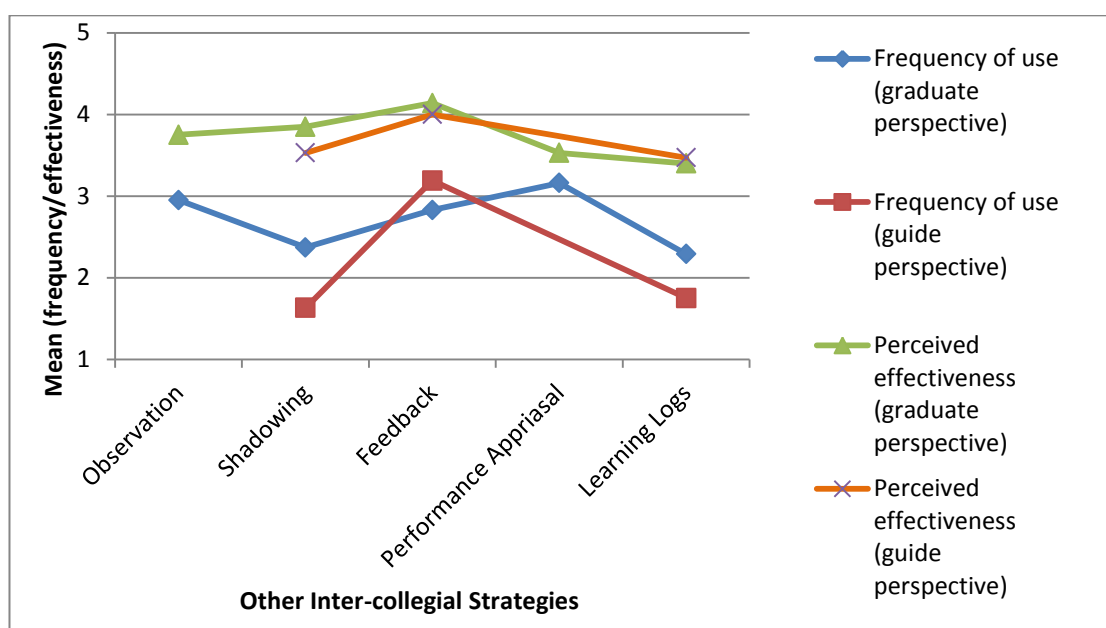


Figure 5-15 Other Inter-collegial Strategies (summary of graduate and guide perspectives)

Source: Author

Frequency key:	1: Never	3: Average	4: Often
	2: Occasionally		5: Very often
Effectiveness key:	1: Very ineffective	3: Neither effective or ineffective	4: Effective
	2: Ineffective		5: Very effective

5.4.5.3 Self-directed Strategies

This category comprises practice and repetition along with access to learning materials and resources. Table 5-103 displays the graduates' perspective on the perceived effectiveness of these learning strategies in the workplace for developing their SE competence. This table shows that graduates perceived all the Self-directed Strategies as effective for developing their SE competence. The most effective of these strategies in order of decreasing popularity were:

- Internet
- Manuals

Table 5-103 Perceived effectiveness of Self-directed Strategies (graduate perspective)

Source: Author

N = 41

Learning strategy	Perceived effectiveness (%)					Mean	SD
	1	2	3	4	5		
Practice and repetition	0	9	12	52	27	4.0	0.883
Access to learning materials & resources							
Books	0	0	20	63	17	4.0	0.615
Manuals	0	0	14	72	14	4.0	0.544
Internet	0	0	6	44	50	4.4	0.613
Professional journals	0	0	31	52	17	3.9	0.694
Third level libraries	7	7	47	33	6	3.3	0.961
CDs	0	0	55	45	0	3.5	0.522
DVDs	0	0	70	30	0	3.3	0.483
CBT	8	8	16	56	12	3.6	1.083

Key: 1: Very ineffective
2: Ineffective

3: Neither effective
or ineffective

4: Effective
5: Very effective

Table 5-104 displays the guides' perspective on the perceived effectiveness of these learning strategies in the workplace for developing graduate SE competence.

Table 5-104 Perceived effectiveness of Self-directed Strategies (guide perspective)

Source: Author

N = 32

Learning strategy	Perceived effectiveness (%)					Mean	SD
	1	2	3	4	5		
Practice and repetition	0	6	16	62	16	3.9	0.751
Access to learning materials & resources							
Books	3	4	24	52	17	3.8	0.912
Manuals	3	6	27	47	17	3.7	0.959
Internet	3	0	6	39	52	4.4	0.877
Professional journals	0	0	52	44	4	3.5	0.593
Third level libraries	0	12	69	13	6	3.1	0.719
CDs	0	23	39	38	0	3.2	0.801
DVDs	0	21	43	29	7	3.2	0.893
CBT	0	4	16	64	16	3.9	0.702

Key: 1: Very ineffective
2: Ineffective

3: Neither effective
or ineffective

4: Effective
5: Very effective

This table shows that guides perceived all the Self-directed Strategies as effective for developing SE graduate competence. The most effective of these strategies was the Internet, which was also the most effective strategy from the graduates' perspective.

Figure 5-16 displays the mean frequency of use and the perceived effectiveness of the Self-directed Strategies from both the graduate and guide perspectives. This figure shows that both graduates and guides ranked each strategy as effective and virtually on par with each other. The perceived effectiveness of these strategies was typically ranked significantly higher than their frequency of use in the workplace.

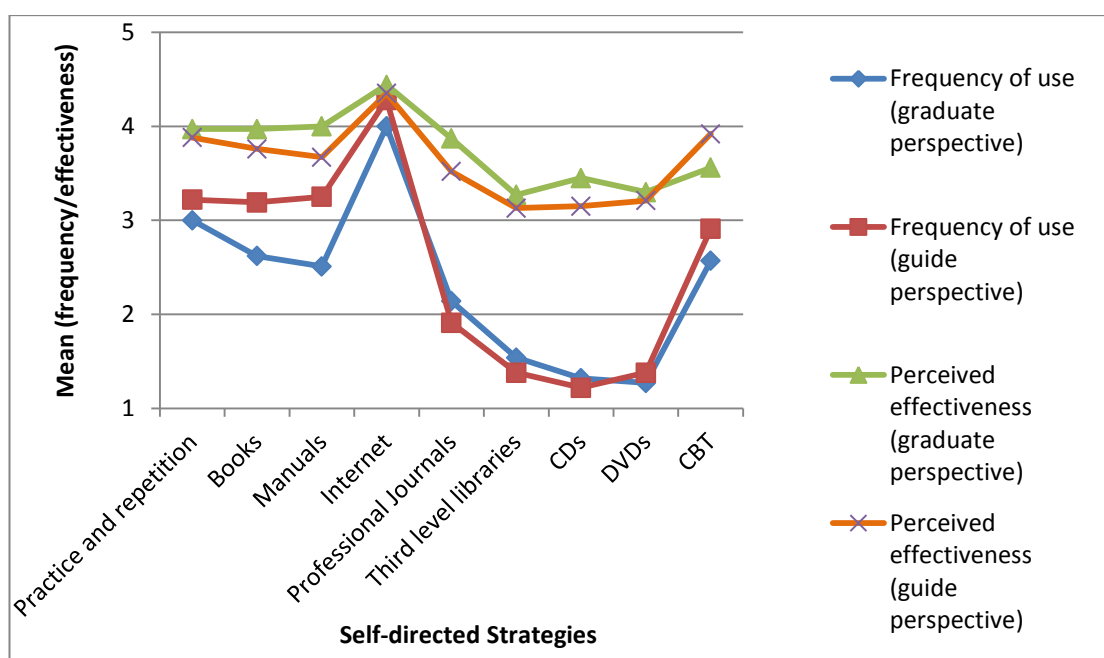


Figure 5-16 Self-directed learning strategies (summary of graduate and guide perspectives)

Source: Author

Frequency key:	1: Never	3: Average	4: Often
	2: Occasionally		5: Very often
Effectiveness key:	1: Very ineffective	3: Neither effective or ineffective	4: Effective
	2: Ineffective		5: Very effective

5.4.5.4 Intra-organisational Strategies

This category comprises individual career development plans, rewards for proficiency and achievement, mechanisms for integrated exchange, knowledge bases of previous problem solutions, stretching activities, and perspective switching. Table 5-105 displays the graduates' perspective on the perceived effectiveness of these learning strategies in the workplace for developing their SE competence. This table shows that graduates perceived all the Intra-organisational Strategies as effective for developing their SE competence. The most effective of these strategies in order of decreasing popularity were:

- Use of knowledge bases of previous problem solutions
- Working above their grade

- Engaging in demanding work
- Being thrown in the deep end
- Allocation of more responsible tasks

Table 5-105 Perceived effectiveness of Intra-organisational Strategies (graduate perspective)

Source: Author

N = 41

Learning strategy	Perceived effectiveness (%)					Mean	SD
	1	2	3	4	5		
Individualised career development plans	0	4	46	41	9	3.6	0.739
Rewards for proficiency and achievement							
Promotion	19	5	28	43	5	3.1	1.221
Wage increases	14	4	14	39	29	3.6	1.339
Awards for accomplishment	21	5	16	47	11	3.2	1.357
Allocation of more responsible tasks	3	0	13	54	30	4.1	0.868
Mechanisms for integrated exchange							
Company suggestion boxes	0	0	86	14	0	3.1	0.378
Company newsletters	0	14	72	7	7	3.1	0.730
Company information sessions	0	13	50	29	8	3.3	0.816
Company bulletins/memos	0	23	54	23	0	3.0	0.707
Knowledge bases of previous problem solutions	0	0	6	60	34	4.3	0.581
Stretching activities							
Working above grade	0	0	17	38	45	4.3	0.751
Engaging in demanding work	3	0	10	48	39	4.2	0.873
Thrown in deep end	0	6	11	43	40	4.2	0.857
Perspective switching							
Deliberate role transfer	0	9	26	56	9	3.7	0.775
Working abroad	0	6	40	47	7	3.5	0.743

Key: 1: Very ineffective
2: Ineffective

3: Neither effective
or ineffective

4: Effective
5: Very effective

Table 5-106 displays the guides' perspective on the perceived effectiveness of these learning strategies in the workplace for developing graduate SE competence. This table shows that guides perceived the majority of the Intra-organisational Strategies as effective for developing SE graduate competence. The most effective of these strategies was knowledge bases of previous problem solutions. The least effective was company suggestion boxes.

Table 5-106 Perceived effectiveness of Intra-organisational Strategies (guide perspective)

Source: Author

N = 32

Learning strategy	Perceived effectiveness (%)					Mean	SD
	1	2	3	4	5		
Mechanisms for integrated exchange							
Company suggestion boxes	15	15	54	8	8	2.8	1.092
Company newsletters	6	19	44	31	0	3.0	0.894
Company information sessions	0	18	13	65	4	3.6	0.843
Company bulletins/memos	5	16	42	37	0	3.1	0.875
Knowledge bases of previous problem solutions	4	0	11	46	39	4.2	0.905

Key: 1: Very ineffective
2: Ineffective

3: Neither effective
or ineffective

4: Effective
5: Very effective

Figure 5-17 displays the mean frequency of use and the perceived effectiveness of the Intra-organisational Strategies from both the graduate and guide perspectives.

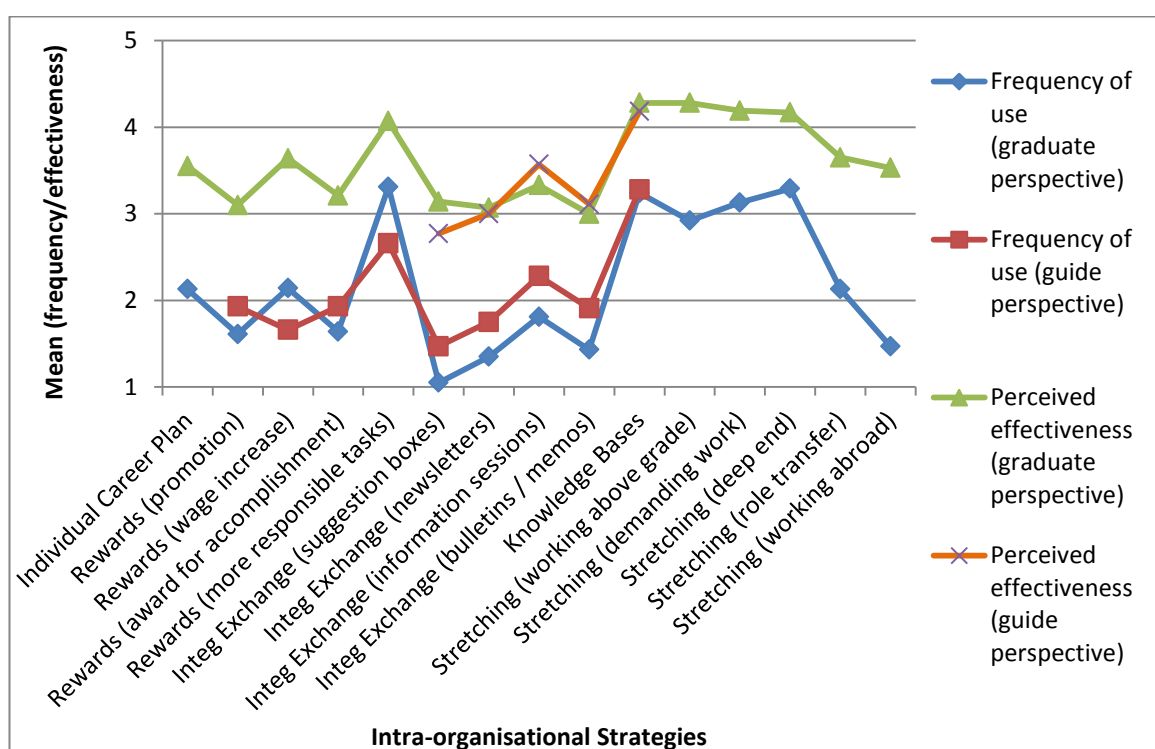


Figure 5-17 Intra-organisational Strategies (summary of graduate and guide perspectives)

Source: Author

Frequency key:

1: Never

3: Average

4: Often

2: Occasionally

5: Very often

5: Very often

Effectiveness key:

1: Very ineffective

3: Neither effective

4: Effective

2: Ineffective

or ineffective

5: Very effective

This figure shows that, both graduates and guides perceived the majority of these strategies as effective, however, guides perceived the use of company suggestion boxes as ineffective. Both graduates and guides agreed that the use of knowledge bases of previous problem solutions was the most effective strategy. They also ranked the perceived effectiveness of all these strategies higher, often significantly, than they ranked their frequency of use in the workplace.

5.4.5.5 Extra-organisational Strategies

This category comprises networking and contact with customers and suppliers. Table 5-107 displays the graduates' perspective on the perceived effectiveness of these learning strategies in the workplace for developing their SE competence.

Table 5-107 Perceived effectiveness of Extra-organisational Strategies (graduate perspective)

Source: Author

N = 41

Learning strategy	Perceived effectiveness (%)					Mean	SD
	1	2	3	4	5		
Networking							
External professional or occupational networks	0	0	41	47	12	3.7	0.686
Trade fairs	0	8	50	34	8	3.4	0.793
Specialised research centres	0	0	58	34	8	3.5	0.674
Conferences/Seminars	0	10	50	40	0	3.3	0.657
Contact with customers/suppliers							
Discussions with customers /clients /suppliers	0	4	44	52	0	3.5	0.593
Technical support from customers/clients/suppliers	0	0	41	55	4	3.6	0.581

Key: 1: Very ineffective
2: Ineffective

3: Neither effective
or ineffective

4: Effective
5: Very effective

This table shows that graduates perceived all the Intra-organisational Strategies as effective for developing their SE competence. The most effective of these strategies in order of decreasing popularity were:

- External professional or occupational networks
- Technical support from customers/clients/suppliers

Table 5-108 displays the guides' perspective on the perceived effectiveness of these learning strategies for developing graduate SE competence. This table shows that guides perceived the majority of the Intra-organisational Strategies as effective for developing their SE competence. The most effective of these strategies were technical

support from customers/clients/suppliers and discussions with customers/clients/suppliers. The least effective strategies were the use of trade fairs and specialised research centres.

Table 5-108 Perceived effectiveness of Extra-organisational Strategies (guide perspective)

Source: Author

N = 32

Learning strategy	Perceived effectiveness (%)					Mean	SD
	1	2	3	4	5		
Networking							
External professional or occupational networks	0	10	48	32	10	3.4	0.838
Trade fairs	23	23	38	8	8	2.5	1.198
Specialised research centres	15	8	54	23	0	2.9	0.987
Conferences/Seminars	10	15	20	40	15	3.4	1.226
Contact with customers/suppliers							
Discussions with customers /clients /suppliers	4	4	18	61	13	3.7	0.915
Technical support from customers/clients/suppliers	4	0	25	54	17	3.8	0.884

Key: 1: Never 2: Occasionally 3: Average 4: Often 5: Very often

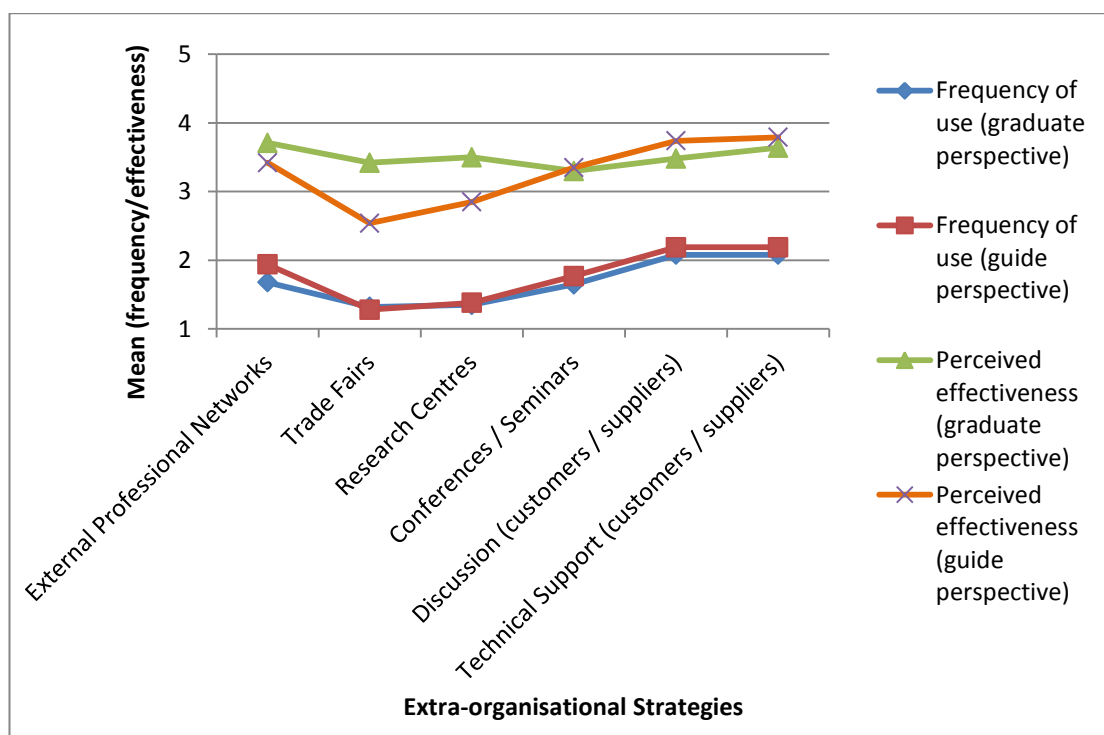


Figure 5-18 Extra-organisational Strategies (summary of graduate and guide perspectives)

Source: Author

Frequency key: 1: Never 2: Occasionally 3: Average 4: Often 5: Very often
 Effectiveness key: 1: Very ineffective 2: Ineffective 3: Neither effective or ineffective 4: Effective 5: Very effective

Figure 5-18 displays the mean frequency of use and the perceived effectiveness of the Extra-organisational Strategies from both the graduate and guide perspectives. This figure shows that both graduates and guides perceived the effectiveness of these strategies on par with only two strategies, trade fairs and research centres considered ineffective by the guides. Both graduates and guides ranked the perceived effectiveness of all these strategies significantly higher than they ranked their frequency of use in the workplace.

5.4.5.6 Summarising the findings for the perceived effectiveness of learning strategies

Overall, the majority of strategies were perceived as effective. Both graduates and guides perceived all the Instructional Model of Learning Strategies, Other Inter-collegial Strategies, and Self-directed Strategies as effective for developing SE graduate competences. Both graduates and guides ranked the perceived effectiveness of all these strategies higher than they ranked their frequency of use in the workplace. For the Intra-organisational Strategies, both graduates and guides ranked the perceived effectiveness of these strategies on par with only one strategy, company suggestion boxes, perceived as not effective. For the Extra-organisational Strategies, both graduates and guides ranked the perceived effectiveness of these strategies on par with only two strategies, trade fairs and research centres, perceived as not effective.

The perceived effectiveness of each individual strategy, along with its classification as either direct or indirect, is displayed in the following three tables:

- Table 5-109 displays the effective to very effective strategies (mean is 4.0 or above). This table shows that:
 - Both graduates and guides perceived the Internet, diagrams, scaffolding and fading to be in the top five most effective strategies.
 - Graduates rated seven direct guidance strategies as effective to very effective and guides rated six.
- Table 5-110 displays the effective strategies (mean is between 3.0 and 3.9 inclusive). This table shows that both graduates and guides perceived the vast majority of strategies to be within this effectiveness category.
- Table 5-111 displays the ineffective strategies (mean is below 3.0). This table shows that graduates perceived no WPL strategy as ineffective. Guides

perceived only three WPL strategies as ineffective for developing SE graduate competences. No direct strategies were perceived as ineffective.

Table 5-109 Effective to Very effective WPL strategies (mean ≥ 4.0)

Source: Author

Graduate perspective (N = 41)		Guide perspective (N = 32)	
Learning strategy	Mean	Learning Strategy	Mean
Modelling (Instruction/ Demonstration)	4.5	Internet	4.4
Internet	4.4	Scaffolding and fading	4.3
Learning from mistakes	4.3	Knowledge bases	4.2
Scaffolding and fading	4.3	Diagrams	4.2
Diagrams	4.3	Articulation	4.1
Knowledge bases	4.3	Questioning	4.0
Working above grade	4.3	Discussion (team meetings)	4.0
Engaging in demanding work	4.2	Feedback	4.0
Exploration	4.2	Coaching	4.0
Thrown in deep end	4.2	Learning from mistakes	4.0
Feedback	4.1		
Coaching	4.1		
Allocation of more responsible tasks	4.1		
Manuals	4.0		
Analogies	4.0		
Articulation	4.0		
Discussion (informal chats)	4.0		
Practice and repetition	4.0		
Books	4.0		

Key: 1: Very ineffective 3: Neither effective or 4: Effective
2: Ineffective ineffective 5: Very effective



Legend: Direct strategies 
Indirect strategies 

Table 5-110 Effective WPL strategies (mean ≥ 3.0 and ≤ 3.9)

Source: Author

Graduate perspective (N = 41)		Guide perspective (N = 32)	
Learning strategy	Mean	Learning Strategy	Mean
Learning through teaching others	3.9	Discussion (informal chats)	3.9
Reflection	3.9	CBT	3.9
Professional journals	3.9	Practice and repetition	3.9
Shadowing	3.9	Analogies	3.9
Questioning	3.8	Technical support from customers/clients/suppliers	3.8
Observation	3.8	Books	3.8
Discussion (team meetings)	3.7	Discussions with customers /clients /suppliers	3.7
External professional networks	3.7	Modelling (Instruction/ Demonstration)	3.7
Deliberate role transfer	3.7	Manuals	3.7
Wage increases	3.6	Company information sessions	3.6
Technical support from customers/clients/suppliers	3.6	Exploration	3.5
CBT	3.6	Observation (Shadowing)	3.5
Individualised career development plans	3.6	Professional journals	3.5
Performance appraisal system	3.5	Maintaining learning logs	3.5
Working abroad	3.5	External professional networks	3.4
Specialised research centres	3.5	Reflection	3.4
Discussions with customers /clients /suppliers	3.5	Conferences/Seminars	3.4
CDs	3.5	DVDs	3.2
Trade fairs	3.4	CDs	3.2
Maintaining learning logs	3.4	Third level libraries	3.1
Company information sessions	3.3	Company bulletins/memos	3.1
DVDs	3.3	Company newsletters	3.0
Conferences/Seminars	3.3		
Third level libraries	3.3		
Awards for accomplishment	3.2		
Company suggestion boxes	3.1		
Promotion	3.1		
Company newsletters	3.1		
Company bulletins/memos	3.0		

Key: 1: Very ineffective 3: Neither effective or ineffective 4: Effective
 2: Ineffective 5: Very effective




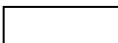
Legend: Direct strategies 
 Indirect strategies 

Table 5-111 Ineffective WPL strategies (mean < 3.0)

Source: Author

Graduate perspective (N = 41)	Guide perspective (N = 32)	
No strategies were considered ineffective	Learning strategy	Mean
	Trade fairs	2.5
	Company suggestion boxes	2.8
	Specialised research centres	2.9

Key: 1: Very ineffective 3: Neither effective or 4: Effective
2: Ineffective ineffective 5: Very effective

Legend: Direct strategies 
Indirect strategies 

5.4.6 Summary of the perceived effectiveness of WPL supports and strategies

Research Question 2: How effective are the WPL supports and strategies for enabling SE entry-level graduates to become competent in their SE role?

In the context of this research question, key findings relating to the perceived effectiveness of guides, learners, organisational supports provided for WPL, learning opportunities, and learning strategy use were presented. The following sections briefly summarise the key findings.

5.4.6.1 Perceived effectiveness of guides

Overall, company-appointed guides were rated as more effective than graduate-selected guides (Table 5-77). This finding is corroborated in Table 5-78, where the perceived effectiveness of all measures ranked higher when guides were selected by the organisation, rather than the graduate e.g. availability to support SE graduates, best choice for WPL support, adequately prepared for their WPL role, and be encouraged to participate. Regardless of how the guide was selected, all the associated measures emerged as effective (Table 5-78). In particular, the guides were considered skilled at sharing knowledge, were very willing to provide guidance, had a very good relationship with their graduates, and did not fear displacement in their role by the graduate they supported and monitored graduate performance.

5.4.6.2 Perceived effectiveness of learners

Table 5-82 displayed the frequency of use and perceived effectiveness of learner supports and strategies. Graduates, when their guides were selected by the organisation were more likely to be encouraged to engage in WPL and more likely to be adequately prepared for their WPL role both of which were perceived as effective. Graduates, when they selected their own guides, were less likely to be adequately prepared for their WPL role which they felt was ineffective. Ignoring guide selection criteria, graduates were willing participants in WPL which was perceived as effective. They also had a good relationship with their guide which was effective for developing their competencies.

5.4.6.3 Perceived effectiveness of organisational supports

Organisations reported their overall support as very effective (Table 5-92) and felt they were effective when encouraging graduates to engage in WPL (Table 5-84). Organisations maintained they also supported WPL by providing sandboxes to try out software (which would support the learning by mistakes strategy), holding regular meetings with graduates, team leads and HR to plan learning, adhering to prescribed training plans and self-study, and immersion in a work environment with sound ethics. However, they felt cost, time allocation, and remote learning inhibited WPL (Table 5-91).

Table 5-93 displayed the frequency of use and perceived effectiveness of organisational supports. No organisational supports were considered ineffective. Organisation supports scoring an effectiveness mean ≥ 4.0 include allocating adequate time for graduates to settle into their role, drawing attention to the professional development benefits through WPL engagement, instilling an awareness in graduates of their WPL role, and monitoring graduates WPL performance. Organisation supports scoring a mean between ≥ 3.0 and ≤ 3.9 inclusive are the invitational nature of the workplace, allocating adequate time to participate in WPL, monitoring performance of WPL guides, providing feedback to WPL guides on their performance in their WPL role, preparing graduates and guides for their WPL role, supporting remote learning, providing team structures capable of providing opportunities for

collaborative learning, catering for production demands taking precedence over WPL, and encouraging reluctant workers to engage in WPL.

5.4.6.4 Perceived effectiveness of learning opportunities and their sequencing

All applicable learning opportunities and their sequencing were perceived as effective (Table 5-98). Graduates were effectively safeguarded against learning inappropriate knowledge whilst also having equal access and sufficient access to learning opportunities. Learning opportunities were sequenced in pathways of learning which were also perceived as effective. Sequencing learning opportunities by increasing responsibility and difficulty were the most effective sequencing approaches.

5.4.6.5 Perceived effectiveness of learning strategies

The general trend indicates that the majority of the Instructional Model of Learning strategies were commonly used and were perceived as effective. The trend also indicates that the majority of Other Inter-collegial, Self-directed, Intra-organisational, and Extra-organisational Strategies were not used to any appreciable extent but, for the majority of strategies, were perceived as effective.

Table 5-109 showed that the Internet, diagrams, scaffolding and fading were placed in the top five most effective strategies. The majority of direct guidance strategies were perceived as effective to very effective (mean of 4.0 or above). Table 5-110 showed that the vast majority of strategies identified in this study were perceived to have a mean value between 3.0 and 3.9 inclusive. Table 5-111 showed that graduates perceived no WPL strategy as ineffective whereas guides perceived only three WPL strategies as ineffective for developing SE graduate competences. No direct strategies were perceived as ineffective.

5.5 Undergraduate use and perceived effectiveness of WPL strategies

This section presents the gathered data pertaining to the third research question:

Having evaluated the research findings, what are the implications for entry-level SE professionals regarding their role in WPL, organisational WPL practices, and higher education teaching approaches?

This research question is mainly addressed in the Discussion chapter when reflecting the findings into WPL, organisational WPL practices, and higher education teaching approaches. The findings are presented in the following five categories (note: only those strategies applicable for undergraduate education are included):

- Instructional Model of Learning
- Other Inter-collegial Strategies
- Self-directed Strategies
- Intra-organisational Strategies
- Extra-organisational Strategies

Any additional strategies supplied by the undergraduates are presented prior to summarising the findings. In the frequency of use tables in this section, the results are presented using percentage frequency distribution and summative statistics using mean and standard deviation.

5.5.1 Instructional Model of Learning

This category comprises the cognitive apprenticeship (which includes modelling, coaching and scaffolding), articulation, reflection, and exploration. Table 5-112 displays the undergraduates' perspective on how often they encounter these learning strategies in the classroom.

Table 5-112 Frequency of use of Instructional Model of Learning strategies (undergraduate perspective)

Source: Author

N = 69

Strategy	Frequency of use (%)					Mean	SD
	1	2	3	4	5		
Modelling (Instruction/ Demonstration)	0	16	26	43	15	3.6	0.937
Analogies	7	24	16	49	4	3.2	1.083
Diagrams	7	18	30	36	9	3.2	1.081
Coaching	10	39	24	24	3	2.7	1.045
Scaffolding	10	30	19	30	11	3.0	1.204
and fading	5	24	25	32	14	3.3	1.123
Articulation	31	31	20	12	6	2.3	1.213
Questioning	19	40	17	18	6	2.5	1.174
Learning through teaching others	23	35	15	18	9	2.6	1.279
Discussion (informal chats)	11	24	24	28	13	3.1	1.222
Discussion (team meetings)	74	19	7	0	0	1.3	0.594
Reflection	17	42	23	14	4	2.5	1.070
Learning from mistakes	1	14	14	36	35	3.9	1.083
Exploration	3	33	20	30	14	3.2	1.136

Key: 1: Never

2: Occasionally

3: Average

4: Often

5: Very often

This table shows in order of decreasing popularity that the most commonly used Instructional Model of Learning strategies in the higher education classroom were:

- Learning from mistakes
- Modelling
- Fading
- Diagrams
- Analogies
- Exploration
- Discussion (informal chats)
- Scaffolding

Table 5-113 displays the undergraduates' perspective on how effective they found these strategies for learning.

Table 5-113 Perceived effectiveness of Instructional Model of Learning strategies (undergraduate perspective)

Source: Author

N = 69

Strategy	Perceived effectiveness (%)					Mean	SD
	1	2	3	4	5		
Modelling (Instruction/ Demonstration)	1	0	6	54	39	4.3	0.718
Analogies	5	3	14	58	20	3.9	0.933
Diagrams	3	0	6	54	37	4.2	0.826
Coaching	5	3	17	43	32	3.9	1.048
Scaffolding and fading	0	0	19	50	31	4.1	0.703
Articulation	6	12	35	33	14	3.4	1.074
Questioning	5	4	34	41	16	3.6	0.987
Learning through teaching others	6	4	9	54	27	3.9	1.026
Discussion (informal chats)	0	0	21	46	33	4.1	0.727
Discussion (team meetings)	9	4	55	32	0	3.1	0.868
Reflection	4	0	51	28	17	3.6	0.911
Learning from mistakes	0	0	10	38	52	4.4	0.665
Exploration	2	8	17	46	27	3.9	0.952

Key: 1: Very ineffective
2: Ineffective

3: Neither effective or
ineffective

4: Effective
5: Very effective

This table shows that all of the Instructional Model of Learning strategies were perceived as effective for learning. The most effective strategies in order of decreasing popularity were:

- Learning from mistakes
- Modelling
- Diagrams
- Discussion (informal chats)
- Scaffolding and fading

Figure 5-19 displays the overall frequency of use and the perceived effectiveness of the Instructional Model of Learning strategies from the undergraduate perspective. For all strategies, the undergraduates ranked the perceived effectiveness of these strategies higher than they ranked their frequency of use in the classroom. All the strategies that were used infrequently emerged as effective.

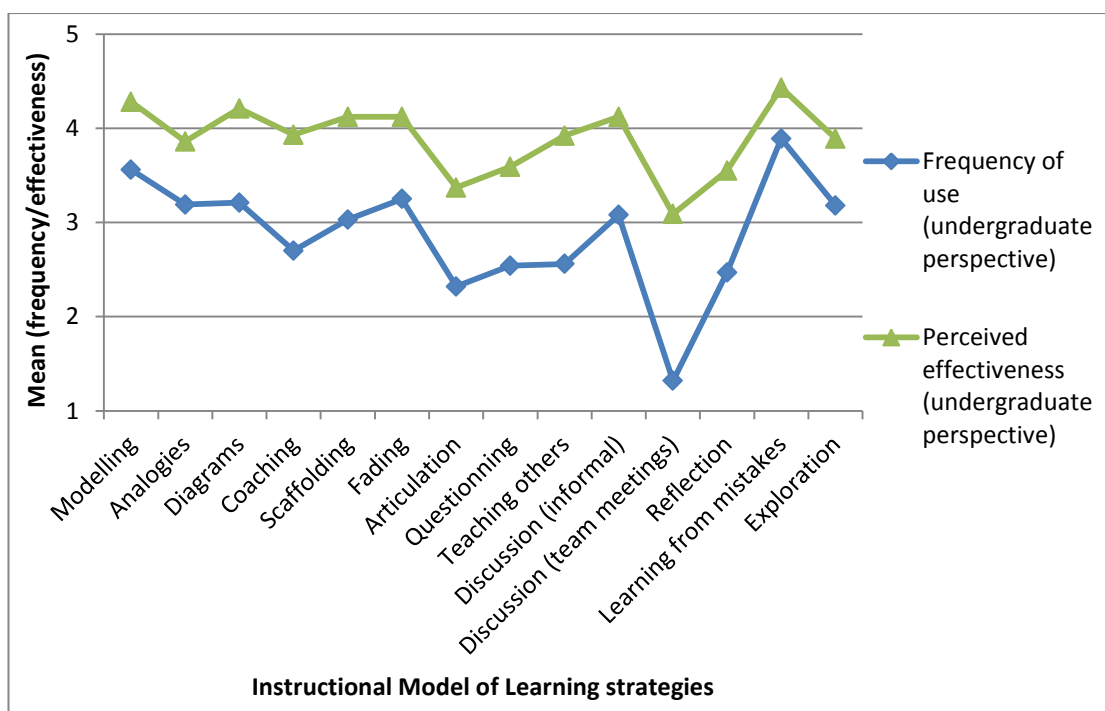


Figure 5-19 Frequency of use of Instructional Model of Learning strategies (undergraduate perspective)

Source: Author

Frequency key: 1: Never 3: Average 4: Often
 2: Occasionally 5: Very often
 Effectiveness key: 1: Very ineffective 3: Neither effective or ineffective 4: Effective
 2: Ineffective 5: Very effective

5.5.2 Other Inter-collegial Strategies

This category comprises observation and feedback. Table 5-114 displays the undergraduates' perspective on how often they encounter these learning strategies in the classroom.

Table 5-114 Frequency of use of Other Inter-collegial Strategies (undergraduate perspective)

Source: Author

N = 69

Strategy	Frequency of use (%)					Mean	SD
	1	2	3	4	5		
Observation	18	40	25	16	1	2.4	1.013
Shadowing	55	26	12	6	1	1.7	0.997
Feedback	9	37	14	30	10	2.9	1.203
Maintaining learning logs	83	11	2	4	0	1.3	0.714

Key: 1: Never 3: Average 4: Often
 2: Occasionally 5: Very often

This table shows that no strategy in this category was used to any appreciable extent. Table 5-115 displays the undergraduates' perspective on how effective they found these strategies for learning.

Table 5-115 Perceived effectiveness of Other Inter-collegial Strategies (undergraduate perspective)

Source: Author

N = 69

Strategy	Perceived effectiveness (%)					Mean	SD
	1	2	3	4	5		
Observation	7	8	25	48	12	3.5	1.033
Shadowing	6	12	40	33	9	3.3	1.008
Feedback	2	2	21	44	31	4.0	0.876
Maintaining learning logs	33	13	33	13	8	2.5	1.319

Key: 1: Very ineffective 3: Neither effective or 4: Effective
2: Ineffective ineffective 5: Very effective

This table shows that the undergraduates perceived the most effective strategies, in order of decreasing popularity, to be:

- Feedback
- Observation
- Shadowing

Eighty two percent of undergraduates that encountered the feedback strategy in the classroom stated that their feedback was mostly positive.

Figure 5-20 displays the overall frequency of use and the perceived effectiveness of Other Inter-collegial Strategies from the undergraduate perspective. For all strategies, the undergraduates ranked the perceived effectiveness of these strategies higher than they ranked their frequency of use in the classroom. Even though these strategies were not used to any appreciable extent, the majority emerged as effective.

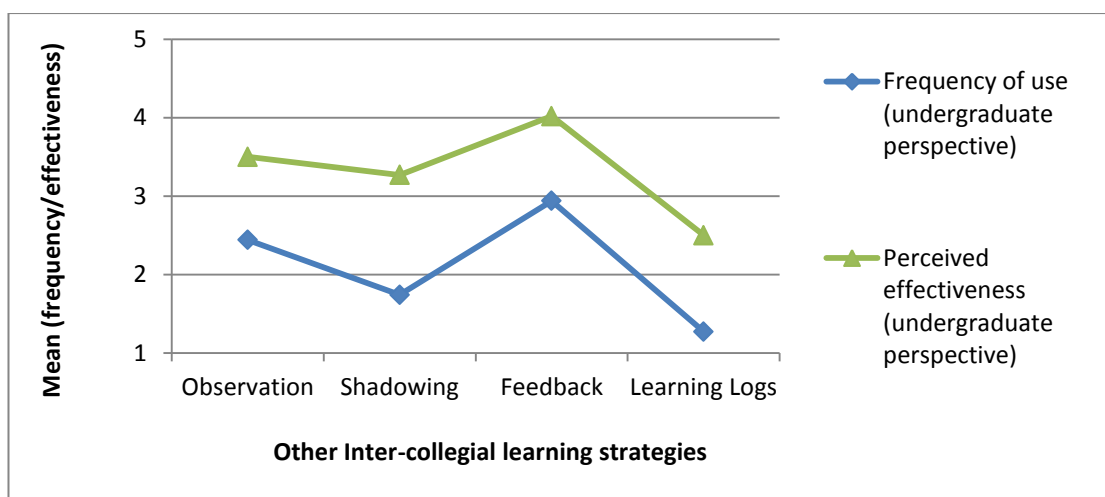


Figure 5-20 Other Inter-collegial learning strategies (undergraduate perspective)

Source: Author

Frequency key: 1: Never 3: Average 4: Often
 2: Occasionally 5: Very often
 Effectiveness key: 1: Very ineffective 3: Neither effective or ineffective 4: Effective
 2: Ineffective 5: Very effective

5.5.3 Self-directed Strategies

This category comprises practice and repetition and access to learning materials and resources. Table 5-116 displays the undergraduates' perspective on how often they encounter these learning strategies in the classroom.

Table 5-116 Frequency of use of Self-directed Strategies (undergraduate perspective)

Source: Author

N = 69

Strategy	Frequency of use (%)					Mean	SD
	1	2	3	4	5		
Practice and repetition	8	43	25	20	4	2.7	1.027
Access to learning materials & resources							
Books	8	36	18	24	14	3.0	1.231
Manuals	40	34	11	13	2	2.0	1.094
Internet	0	5	3	29	63	4.5	0.780
Professional journals	66	23	6	5	0	1.5	0.829
Third level libraries	21	44	17	16	2	2.3	1.032
CDs	88	8	2	2	0	1.2	0.522
DVDs	87	7	5	1	0	1.2	0.609
CBT	30	26	20	13	11	2.5	1.349

Key: 1: Never 3: Average 4: Often
 2: Occasionally 5: Very often

This table shows that only two Self-directed Strategies were commonly used in the higher education classroom:

- Internet
- Books

Resources containing static information, such as CDs, DVDs, professional journals, and manuals were not used to any appreciable extent. Table 5-117 displays the undergraduates' perspective on how effective they found these strategies for learning.

Table 5-117 Perceived effectiveness of Self-directed Strategies (undergraduate perspective)

Source: Author

N = 69

Strategy	Perceived effectiveness (%)					Mean	SD
	1	2	3	4	5		
Practice and repetition	3	0	23	50	24	3.9	0.884
Access to learning materials & resources							
Books	3	4	15	56	22	3.9	0.904
Manuals	0	7	25	55	13	3.7	0.784
Internet	0	2	8	26	64	4.5	0.718
Professional journals	14	10	35	38	3	3.1	1.100
Third level libraries	2	13	26	51	8	3.5	0.891
CDs	13	20	47	13	7	2.8	1.082
DVDs	19	13	44	12	12	2.9	1.258
CBT	0	5	27	41	27	3.9	0.858

Key: 1: Very ineffective
2: Ineffective

3: Neither effective or
ineffective

4: Effective
5: Very effective

This table shows that the undergraduates perceived the most effective strategies, in order of decreasing popularity, to be:

- Internet
- Practice and repetition
- CBT
- Books
- Manuals
- Third level libraries
- Professional journals

Figure 5-21 displays the overall frequency of use and the perceived effectiveness of Self-directed Strategies from the undergraduate perspective.

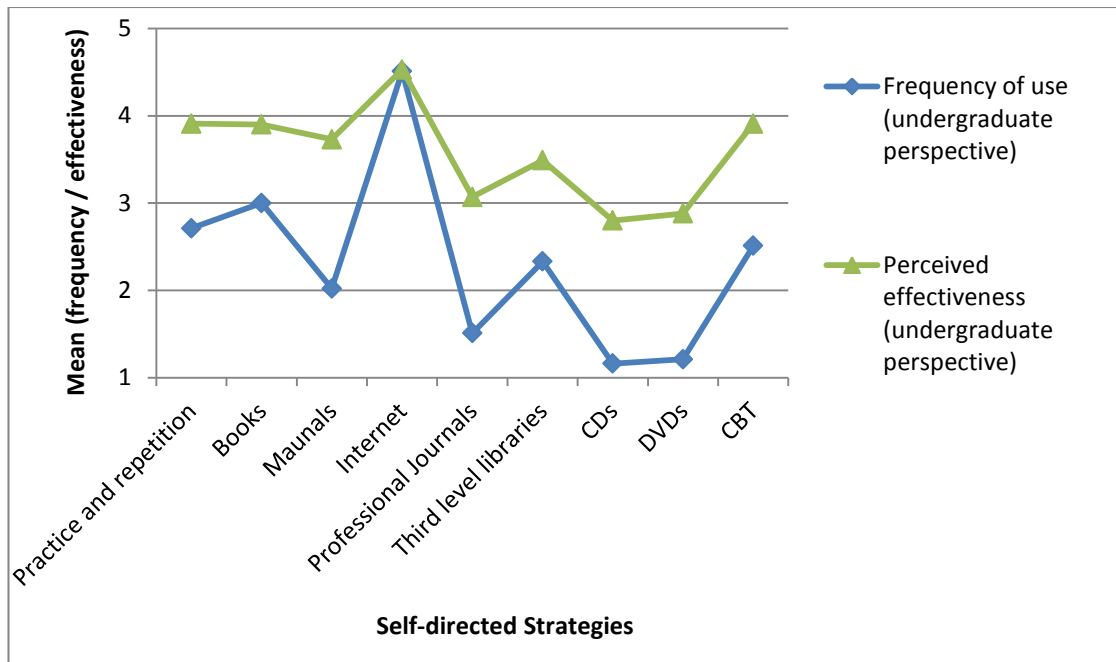


Figure 5-21 Self-directed learning strategies (undergraduate perspective)

Source: Author

Frequency key:	1: Never	3: Average	4: Often
	2: Occasionally		5: Very often
Effectiveness key:	1: Very ineffective	3: Neither effective or ineffective	4: Effective
	2: Ineffective		5: Very effective

For all strategies, the undergraduates ranked the perceived effectiveness of these strategies higher than they ranked their frequency of use in the classroom. Even though the majority of these strategies were not used to any appreciable extent, they typically emerged as effective.

5.5.4 Intra-organisational Strategies

This category comprises mechanisms for integrated exchange, knowledge bases of previous problem solutions, and stretching activities. Table 5-118 displays the undergraduates' perspective on how often they encounter these learning strategies in the classroom. This table shows that no strategy in this category was used to any appreciable extent. Overall, the mechanisms for integrated exchange strategies were never used.

Table 5-118 Frequency of use of Intra-organisational Strategies (undergraduate perspective)

Source: Author

N = 69

Strategy	Frequency of use (%)					Mean	SD
	1	2	3	4	5		
Mechanisms for integrated exchange							
College suggestion boxes	92	5	0	2	1	1.2	0.663
College newsletters	82	15	3	0	0	1.2	0.484
College information sessions	74	18	7	1	0	1.4	0.684
College bulletins/memos	76	24	0	0	0	1.2	0.432
Knowledge bases of previous problem solutions	18	25	22	27	8	2.8	1.238
Stretching activities							
Engaging in demanding work	36	20	20	17	7	2.4	1.334
Thrown in deep end	44	24	12	12	8	2.2	1.315

Key: 1: Never 2: Occasionally 3: Average 4: Often 5: Very often

Table 5-119 displays the undergraduates' perspective on how effective they found these strategies for learning.

Table 5-119 Perceived effectiveness of Intra-organisational Strategies (undergraduate perspective)

Source: Author

N = 69

Strategy	Perceived effectiveness (%)					Mean	SD
	1	2	3	4	5		
Mechanisms for integrated exchange							
College suggestion boxes	25	9	50	8	8	2.7	1.231
College newsletters	22	11	45	22	0	2.7	1.085
College information sessions	9	9	55	27	0	3.0	0.873
College bulletins/memos	10	19	57	14	0	2.8	0.831
Knowledge bases of previous problem solutions	4	4	10	53	29	4.0	0.959
Stretching activities							
Engaging in demanding work	2	7	18	52	21	3.8	0.922
Thrown in deep end	31	25	10	17	17	2.7	1.507

Key: 1: Very ineffective 2: Ineffective 3: Neither effective or ineffective 4: Effective 5: Very effective

This table shows that undergraduates perceived the most effective strategies, in order of decreasing popularity, to be:

- Knowledge bases of previous problem solutions
- Engaging in demanding work

- College information sessions

Figure 5-22 displays the overall frequency of use and the perceived effectiveness of Intra-organisational Strategies from the undergraduate perspective. For all strategies, the undergraduates ranked the perceived effectiveness of these strategies higher than they ranked their frequency of use in the classroom. These strategies were not used to any appreciable extent and they typically emerged as ineffective.

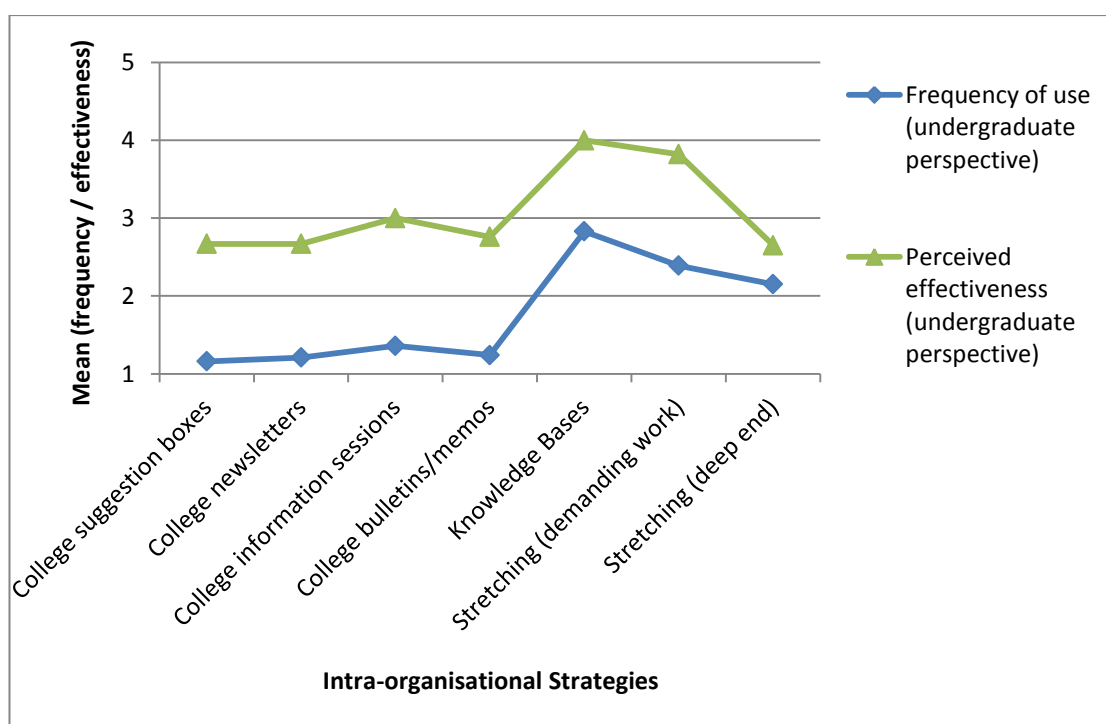


Figure 5-22 Intra-organisational learning strategies (undergraduate perspective)

Source: Author

Frequency key:	1: Never	3: Average	4: Often
	2: Occasionally		5: Very often
Effectiveness key:	1: Very ineffective	3: Neither effective or ineffective	4: Effective
	2: Ineffective		5: Very effective

5.5.5 Extra-organisational Strategies

This category comprises networking strategies. Table 5-120 displays the undergraduates' perspective on how often they encounter these learning strategies in the classroom. This table shows that no strategy in this category was used to any appreciable extent with the mode response for each strategy being Never (bold and italicised in the table).

Table 5-120 Frequency of use of Extra-organisational Strategies (undergraduate perspective)

Source: Author

N = 69

Strategy	Frequency of use (%)					Mean	SD
	1	2	3	4	5		
Networking							
External professional or occupational networks	69	18	7	6	0	1.5	0.882
Trade fairs	93	5	2	0	0	1.1	0.331
Specialised research centres	91	3	3	3	0	1.2	0.654
Conferences/Seminars	80	17	3	0	0	1.2	0.500

Key: 1: Never 3: Average 4: Often
2: Occasionally 5: Very often

Table 5-121 displays the undergraduates' perspective on how effective they found these strategies for learning.

Table 5-121 Perceived effectiveness of Extra-organisational Strategies (undergraduate perspective)

Source: Author

N = 69

Strategy	Perceived effectiveness (%)					Mean	SD
	1	2	3	4	5		
Networking							
External professional or occupational networks	4	4	35	44	13	3.6	0.945
Trade fairs	20	10	60	10	0	2.6	0.966
Specialised research centres	15	0	46	39	0	3.1	1.038
Conferences/Seminars	5	22	39	28	6	3.1	0.988

Key: 1: Very ineffective 3: Neither effective or ineffective 4: Effective
2: Ineffective 5: Very effective

This table shows that undergraduates perceived the most effective strategies, in order of decreasing popularity, to be:

- External professional or occupational networks
- Specialised research centres
- Conferences / seminars

Figure 5-23 displays the overall frequency of use and the perceived effectiveness of Extra-organisational Strategies from the undergraduate perspective.

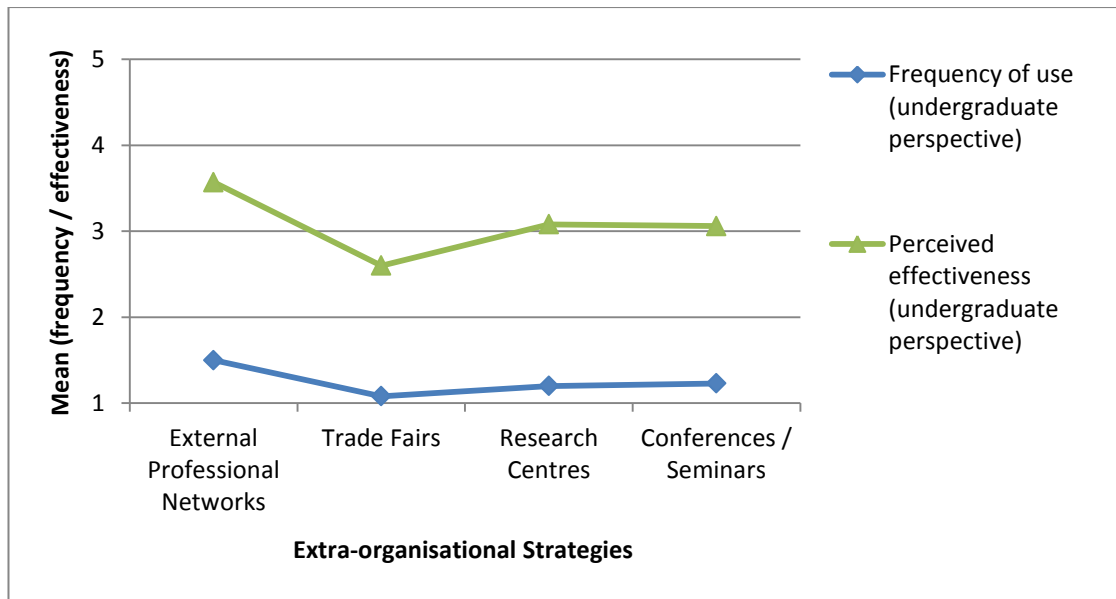


Figure 5-23 Extra-organisational learning strategies (undergraduate perspective)

Source: Author

Frequency key: 1: Never 3: Average 4: Often
 2: Occasionally 5: Very often
 Effectiveness key: 1: Very ineffective 3: Neither effective or ineffective 4: Effective
 2: Ineffective 5: Very effective

For all strategies, the undergraduates ranked the perceived effectiveness of these strategies significantly higher than they ranked their frequency of use in the workplace. Even though all of these strategies were virtually never used, they typically emerged as effective.

5.5.6 Additional learning strategies

Table 5-122 displays additional strategies that undergraduates reported as helping them learn. The quotes associated with each dimension are displayed in Appendix Table I - 14.

Table 5-122 Additional learning strategies identified by undergraduates

Source: Author

Dimension
Extra classes and tuition
Video tutorials
Frequent in class quizzes
Group study
Use of incremental projects
Explicit insight into teaching approaches adopted

5.5.7 Summary of undergraduate strategy use and perceived effectiveness

For all strategies in all five categories, the undergraduates ranked the perceived effectiveness of these strategies higher than they ranked their frequency of use in the classroom. The key findings for each category of strategy are:

- The undergraduates reported that eight of the fourteen Instructional Model of Learning strategies were commonly used. However, all strategies in this category were perceived as effective.
- The four Other Inter-collegial Strategies were used infrequently. Three of these strategies were perceived as effective with the maintenance of learning logs being considered ineffective.
- Seven out of the nine Self-directed Strategies were used infrequently. The Internet was used frequently in undergraduate higher education. However, resources containing static information, such as CDs, DVDs, professional journals, and manuals were not used much by the undergraduates. All strategies except CDs and DVDs were perceived as effective.
- All the Intra-organisational Strategies were used infrequently. Three of the seven strategies were perceived as effective with college suggestion boxes, college newsletters, college bulletins/memos, and being thrown in the deep end considered ineffective.
- The Extra-organisational Strategies were virtually never used. Three of four strategies were perceived as effective with trade fairs being considered ineffective.

Table 5-123 displays, independent of category, the frequently and infrequently used strategies. The most commonly used strategies are the Internet, learning from mistakes, and modelling. The least used strategies are trade fairs, CDs, and college suggestion boxes. Five direct guidance strategies were commonly used and four were used infrequently.

Table 5-123 Frequently and infrequently used WPL strategies (undergraduate perspective)

Source: Author

N = 69

Frequently used strategies (mean ≥ 3.0)		Infrequently used strategies (mean < 3.0)	
Learning strategy	Mean	Learning strategy	Mean
Internet	4.5	Trade fairs	1.1
Learning from mistakes	3.9	CDs	1.2
Modelling (Instruction/ Demonstration)	3.6	College suggestion boxes	1.2
Fading	3.3	Specialised research centres	1.2
Diagrams	3.2	College newsletters	1.2
Analogies	3.2	DVDs	1.2
Exploration	3.2	Conferences/Seminars	1.2
Discussion (informal chats)	3.1	College bulletins/memos	1.2
Scaffolding	3.0	Maintaining learning logs	1.3
Books	3.0	Discussion (team meetings)	1.3
		College information sessions	1.4
		External professional or occupational networks	1.5
		Professional journals	1.5
		Shadowing	1.7
		Manuals	2.0
		Thrown in deep end	2.2
		Articulation	2.3
		Third level libraries	2.3
		Engaging in demanding work	2.4
		Observation	2.4
		Reflection	2.5
		CBT	2.5
		Questioning	2.5
		Learning through teaching others	2.6
		Coaching	2.7
		Practice and repetition	2.7
		Knowledge bases	2.8
		Feedback	2.9

Key: 1: Never 3: Average 4: Often
 2: Occasionally 5: Very often



Legend: Direct strategies 
 Indirect strategies 

Table 5-124 displays, independent of category, the most effective and least effective strategies. The Internet, learning from mistakes, and modelling were perceived as the most effective strategies. Maintaining learning logs, trade fairs, and being thrown in the deep end were perceived as the least effective strategies. All the direct guidance strategies were perceived as effective.



Table 5-124 Perceived effective and ineffective WPL strategies (undergraduate perspective)

Source: Author

N = 69

Perceived as effective (mean ≥ 3.0)		Perceived as ineffective (mean < 3.0)	
Learning strategy	Mean	Learning strategy	Mean
Internet	4.5	Maintaining learning logs	2.5
Learning from mistakes	4.4	Trade fairs	2.6
Modelling (Instruction/ Demonstration)	4.3	Thrown in deep end	2.7
Diagrams	4.2	College newsletters	2.7
Scaffolding and fading	4.1	College suggestion boxes	2.7
Discussion (informal chats)	4.1	College bulletins/memos	2.8
Feedback	4.0	CDs	2.8
Knowledge bases	4.0	DVDs	2.9
Coaching	3.9		
Learning through teaching others	3.9		
CBT	3.9		
Practice and repetition	3.9		
Books	3.9		
Exploration	3.9		
Analogies	3.9		
Engaging in demanding work	3.8		
Manuals	3.7		
Questioning	3.6		
External professional networks	3.6		
Reflection	3.6		
Observation	3.5		
Third level libraries	3.5		
Articulation	3.4		
Shadowing	3.3		
Discussion (team meetings)	3.1		
Specialised research centres	3.1		
Professional journals	3.1		
Conferences/Seminars	3.1		
College information sessions	3.0		

Key: 1: Very ineffective 3: Neither effective or 4: Effective
 2: Ineffective ineffective 5: Very effective

Legend: Direct strategies 
 Indirect strategies 

Undergraduates detailed additional learning strategies such as the supports provided through the provision of extra classes, workshops, and tuition. Some undergraduates re-iterated modelling strategies such as demonstrations, analogies, and diagrams as helpful for their learning. Others mentioned techniques such as using video tutorials,

having frequent in class quizzes, group study, the use of incremental projects, and putting learning into context as helpful for their learning.

5.6 Summary of WPL supports and perceived effectiveness

Table 5-125 details the frequently used WPL strategies from the graduate, guide and the undergraduate perspective with Table 5-126 detailing the infrequently used strategies. For all three respondent groups, the Internet was ranked as the most frequently used strategy, with fading appearing in the top four, and learning from mistakes in the top six. At least four of the top six most frequently used strategies for each respondent group were from the Instructional Model of Learning category. In relation to the most infrequently used strategies, CDs, DVDs, trade fairs, and company/college suggestion boxes appeared in the top six for each category of respondent.

Table 5-127 lists effective (mean ≥ 4.0) WPL strategies from the graduate, guide, and the undergraduate perspective. Graduates reported more WPL strategies as effective compared with guides and undergraduates. Using the Internet, scaffolding and fading, diagrams, feedback, and using knowledge bases of previous problem solutions were all reported by graduates, guides, and undergraduates as effective. Undergraduates reported five Instructional Model of Learning strategies as effective with graduates reporting nine of these strategies and guides reporting seven. Overall the Internet emerged as one of the most effective WPL strategy from all three groups. Table 5-128 lists the remaining effective WPL strategies (mean between 3.0 and 3.9 inclusive). The majority of strategies fell into this category.

Table 5-129 identifies the ineffective strategies (< 3.0). There was little agreement on the strategies perceived as ineffective. Graduates considered no WPL strategy as ineffective. Guides rated only three strategies as ineffective, with undergraduates rating eight strategies as ineffective. The strategies that guides believed were ineffective belonged to the mechanisms for integrated exchange and networking categories. The undergraduates rated three mechanisms for integrated exchange as ineffective.

Table 5-125 to Table 5-129 highlighted each strategy as either direct or indirect. Table 5-130 summarised the frequency of use of direct and indirect strategies according to the graduates, guides, and undergraduates. All three categories of respondent reported that direct strategies were used frequently and indirect strategies tended to be used infrequently.

In a similar vein, Table 5-131 summarised the perceived effectiveness of direct and indirect strategies according to graduates, guides, and undergraduates. All three categories of respondent were very positive about the effect of both direct and indirect strategies. All three categories of respondent reported no direct strategy as ineffective. The graduates also reported no indirect strategy as ineffective. Guides and undergraduates reported minimal indirect strategies as ineffective.

Table 5-132 to Table 5-136 summarised each of the five categories of strategy use according to the graduates, guides and undergraduates perceptions of their use and perceived effectiveness. Each table highlights those strategies that were frequently used (≥ 3.0) and also those strategies that were perceived as effective (≥ 3.5). The perceived effectiveness cut-off of 3.5 was chosen, rather than 3.0, as the majority of strategies scored above 3.0 and the cut-off of 3.5 would be more reflective of effective strategies.

Table 5-125 Frequently used WPL strategies

Source: Author

Frequently used WPL strategies (mean ≥ 3.0)					
Graduate perspective (N = 41)		Guide perspective (N = 32)		Undergraduate perspective (N = 69)	
Learning strategy	Mean	Learning Strategy	Mean	Learning Strategy	Mean
Internet	4.0	Internet	4.3	Internet	4.5
Fading	4.0	Discussion (team meetings)	3.8	Learning from mistakes	3.9
Modelling (Instruction/ Demonstration)	3.6	Fading	3.7	Modelling (Instruction/ Demonstration)	3.6
Learning from mistakes	3.6	Diagrams	3.5	Fading	3.3
Scaffolding	3.4	Scaffolding	3.5	Diagrams	3.2
Exploration	3.4	Learning from mistakes	3.4	Analogies	3.2
Allocation of more responsible tasks	3.3	Articulation	3.3	Exploration	3.2
Thrown in deep end	3.3	Questioning	3.3	Discussion (informal chats)	3.1
Discussion (team meetings)	3.2	Knowledge bases	3.3	Scaffolding	3.0
Knowledge bases	3.2	Manuals	3.3	Books	3.0
Diagrams	3.2	Practice and repetition	3.2		
Performance appraisal system	3.2	Books	3.2		
Engaging in demanding work	3.1	Feedback	3.2		
Discussion (informal chats)	3.1	Coaching	3.2		
Articulation	3.0	Exploration	3.1		
Practice and repetition	3.0	Discussion (informal chats)	3.1		
Observation	3.0	Modelling (Instruction/ Demonstration)	3.1		
		Analogies	3.0		

Key: 1: Never 3: Average 4: Often
2: Occasionally 5: Very often



Legend: Direct strategies 
Indirect strategies 

Table 5-126 Infrequently used WPL strategies

Source: Author

Infrequently used WPL strategies (mean < 3.0)					
Graduate perspective (N = 41)		Guide perspective (N = 32)		Undergraduate perspective (N = 69)	
Learning strategy	Mean	Learning strategy	Mean	Learning Strategy	Mean
Company suggestion boxes	1.1	CDs	1.2	Trade fairs	1.1
DVDs	1.3	Trade fairs	1.3	CDs	1.2
CDs	1.3	Specialised research centres	1.4	College suggestion boxes	1.2
Trade fairs	1.3	DVDs	1.4	Specialised research centres	1.2
Company newsletters	1.4	Third level libraries	1.4	College newsletters	1.2
Specialised research centres	1.4	Company suggestion boxes	1.5	DVDs	1.2
Company bulletins/memos	1.4	Observation (Shadowing)	1.6	Conferences/Seminars	1.2
Working abroad	1.5	Wage Increases	1.7	College bulletins/memos	1.2
Third level libraries	1.5	Company newsletters	1.8	Maintaining learning logs	1.3
Promotion	1.6	Maintaining learning logs	1.8	Discussion (team meetings)	1.3
Awards for accomplishment	1.6	Conferences/Seminars	1.8	College information sessions	1.4
Conferences/Seminars	1.7	Professional journals	1.9	External professional or occupational networks	1.5
External professional or occupational networks	1.7	Company bulletins/memos	1.9	Professional journals	1.5
Company information sessions	1.8	Promotion	1.9	Shadowing	1.7
Discussions with customers /clients /suppliers	2.1	Awards for Accomplishment	1.9	Manuals	2.0
Technical support from customers/clients/suppliers	2.1	External professional or occupational networks	1.9	Thrown in deep end	2.2
Individualised career development plans	2.1	Discussions with customers /clients /suppliers	2.2	Articulation	2.3
Deliberate role transfer	2.1	Technical support from customers/clients/suppliers	2.2	Third level libraries	2.3
Wage increases	2.1	Reflection	2.3	Engaging in demanding work	2.4
Professional journals	2.1	Company information sessions	2.3	Observation	2.4
Maintaining learning logs	2.3	Allocation of more responsible tasks	2.7	Reflection	2.5
Shadowing	2.4	CBT	2.9	CBT	2.5
Manuals	2.5			Questioning	2.5
CBT	2.6			Learning through teaching others	2.6
Books	2.6			Coaching	2.7
Learning through teaching others	2.7			Practice and repetition	2.7
Analogies	2.7			Knowledge bases	2.8
Questioning	2.8			Feedback	2.9
Feedback	2.8				
Coaching	2.9				
Reflection	2.9				
Working above grade	2.9				

Legend: Direct strategies

Indirect strategies

Key: 1: Never 3: Average 4: Often
2: Occasionally 5: Very often

Table 5-127 Effective to Very effective WPL strategies

Source: Author

Effective – Very effective WPL strategies (mean ≥ 4.0)					
Graduate perspective (N = 41)		Guide perspective (N = 32)		Undergraduate perspective (N = 69)	
Learning strategy	Mean	Learning Strategy	Mean	Learning Strategy	Mean
Modelling (Instruction/ Demonstration)	4.5	Internet	4.4	Internet	4.5
Internet	4.4	Scaffolding and fading	4.3	Learning from mistakes	4.4
Learning from mistakes	4.3	Knowledge bases	4.2	Modelling (Instruction/ Demonstration)	4.3
Scaffolding and fading	4.3	Diagrams	4.2	Diagrams	4.2
Diagrams	4.3	Articulation	4.1	Scaffolding and fading	4.1
Knowledge bases	4.3	Questioning	4.0	Discussion (informal chats)	4.1
Working above grade	4.3	Discussion (team meetings)	4.0	Feedback	4.0
Engaging in demanding work	4.2	Feedback	4.0	Knowledge bases	4.0
Exploration	4.2	Coaching	4.0		
Thrown in deep end	4.2	Learning from mistakes	4.0		
Feedback	4.1				
Coaching	4.1				
Allocation of more responsible tasks	4.1				
Manuals	4.0				
Analogies	4.0				
Articulation	4.0				
Discussion (informal chats)	4.0				
Practice and repetition	4.0				
Books	4.0				

Key: 1: Very ineffective 3: Neither effective or 4: Effective
2: Ineffective ineffective 5: Very effective



Legend: Direct strategies 
Indirect strategies 

Table 5-128 Effective WPL strategies
Source: Author

Effective WPL strategies (mean is ranked between 3.0 and 3.9 inclusive)					
Graduate perspective (N = 41)		Guide perspective (N = 32)		Undergraduate perspective (N = 69)	
Learning strategy	Mean	Learning Strategy	Mean	Learning Strategy	Mean
Learning through teaching others	3.9	Discussion (informal chats)	3.9	Coaching	3.9
Reflection	3.9	CBT	3.9	Learning through teaching others	3.9
Professional journals	3.9	Practice and repetition	3.9	CBT	3.9
Shadowing	3.9	Analogies	3.9	Practice and repetition	3.9
Questioning	3.8	Technical support from customers/clients/suppliers	3.8	Books	3.9
Observation	3.8	Books	3.8	Exploration	3.9
Discussion (team meetings)	3.7	Discussions with customers /clients /suppliers	3.7	Analogies	3.9
External professional networks	3.7	Modelling (Instruction/ Demonstration)	3.7	Engaging in demanding work	3.8
Deliberate role transfer	3.7	Manuals	3.7	Manuals	3.7
Wage increases	3.6	Company information sessions	3.6	Questioning	3.6
Technical support from customers/clients/suppliers	3.6	Exploration	3.5	External professional networks	3.6
CBT	3.6	Observation (Shadowing)	3.5	Reflection	3.6
Individualised career development plans	3.6	Professional journals	3.5	Observation	3.5
Performance appraisal system	3.5	Maintaining learning logs	3.5	Third level libraries	3.5
Working abroad	3.5	External professional networks	3.4	Articulation	3.4
Specialised research centres	3.5	Reflection	3.4	Shadowing	3.3
Discussions with customers /clients /suppliers	3.5	Conferences/Seminars	3.4	Discussion (team meetings)	3.1
CDs	3.5	DVDs	3.2	Specialised research centres	3.1
Trade fairs	3.4	CDs	3.2	Professional journals	3.1
Maintaining learning logs	3.4	Third level libraries	3.1	Conferences/Seminars	3.1
Company information sessions	3.3	Company bulletins/memos	3.1	College information sessions	3.0
DVDs	3.3	Company newsletters	3.0		
Conferences/Seminars	3.3				
Third level libraries	3.3				
Awards for accomplishment	3.2				
Company suggestion boxes	3.1				
Promotion	3.1				
Company newsletters	3.1				
Company bulletins/memos	3.0				

Key: 1: Very ineffective 3: Neither effective or 4: Effective
2: Ineffective ineffective 5: Very effective



Legend: Direct strategies 
Indirect strategies 

Table 5-129 Ineffective WPL strategies

Source: Author

Ineffective WPL strategies (mean < 3.0)				
Graduate perspective (N = 41)	Guide perspective (N = 32)		Undergraduate perspective (N = 69)	
No strategies were considered ineffective	Learning strategy	Mean	Learning Strategy	Mean
	Trade fairs	2.5	Maintaining learning logs	2.5
	Company suggestion boxes	2.8	Trade fairs	2.6
	Specialised research centres	2.9	Thrown in deep end	2.7
			College newsletters	2.7
			College suggestion boxes	2.7
			College bulletins/memos	2.8
			CDs	2.8
			DVDs	2.9

Key: 1: Very ineffective
2: Ineffective

3: Neither effective or
ineffective

4: Effective
5: Very effective

Legend: Direct strategies
Indirect strategies

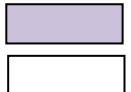


Table 5-130 Frequency of use of direct and indirect WPL strategies

Source: Author

Frequency of use of WPL Strategies	Graduate Perspective (N = 41)		Guide Perspective (N = 32)		Undergraduate Perspective (N = 69)	
	Direct	Indirect	Direct	Indirect	Direct	Indirect
Frequently used (≥ 3.0)	55% (6/11)	29% (11/38)	100% (9/9)	29% (9/31)	56% (5/9)	17% (5/29)
Infrequently used (< 3.0)	45% (5/11)	71% (27/38)	0% (0/9)	71% (22/31)	44% (4/9)	83% (24/29)
TOTAL	100%	100%	100%	100%	100%	100%

Key: 1: Never 2: Occasionally 3: Average 4: Often 5: Very often

Table 5-131 Perceived effectiveness of direct and indirect WPL strategies

Source: Author

Perceived effectiveness of WPL Strategies	Graduate Perspective (N = 41)		Guide Perspective (N = 32)		Undergraduate Perspective (N = 69)	
	Direct	Indirect	Direct	Indirect	Direct	Indirect
Effective → Very effective (≥ 4.0)	70% (7/10)	32% (12/38)	75% (6/8)	15% (4/27)	50% (4/8)	14% (4/29)
Effective (≥ 3.0 and < 4.0)	30% (3/10)	68% (26/38)	25% (2/8)	74% (20/27)	50% (4/8)	59% (17/29)
Ineffective (< 3.0)	0% (0/10)	0% (0/38)	0% (0/8)	11% (3/27)	0% (0/8)	27% (8/29)
TOTAL	100%	100%	100%	100%	100%	100%

Key: 1: Very ineffective 2: Ineffective 3: Neither effective or ineffective 4: Effective 5: Very effective

Table 5-132 Instructional Model of Learning - frequency and perceived effectiveness (graduate, guide and undergraduate perspective)

Source: Author

Instructional Model of Learning WPL Strategy	Graduate (N = 41)		Guide (N = 32)		Undergraduate (N = 69)	
	Frequency of use	Perceived effectiveness	Frequency of use	Perceived effectiveness	Frequency of use	Perceived effectiveness
Modelling	3.6	4.5	3.1	3.7	3.6	4.3
Analogies	2.7	4.0	3.0	3.9	3.2	3.9
Diagrams	3.2	4.3	3.5	4.2	3.2	4.2
Coaching	2.9	4.1	3.2	4.0	2.7	3.9
Scaffolding	3.4	4.3	3.5	4.3	3.0	4.1
Fading	4.0	4.3	3.7	4.3	3.3	4.1
Articulation	3.0	4.0	3.3	4.1	2.3	3.4
Questioning	2.8	3.8	3.3	4.0	2.5	3.6
Teaching others	2.7	3.9	N/A	N/A	2.6	3.9
Discussion (informal)	3.0	4.0	3.1	3.9	3.1	4.1
Discussion (team meetings)	3.2	3.7	3.8	4.0	1.3	3.1
Reflection	2.9	3.9	2.3	3.4	2.5	3.6
Learning from mistakes	3.6	4.3	3.4	4.0	3.9	4.4
Exploration	3.4	4.2	3.1	3.5	3.2	3.9

Legend: Frequency of use ≥ 3.0 **OR** Perceived effectiveness ≥ 3.5



Frequency of use < 3.0 **OR** Perceived effectiveness < 3.5

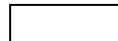


Table 5-133 Other Inter-collegial Strategies - frequency and perceived effectiveness (graduate, guide and undergraduate perspective)

Source: Author

Other Inter-collegial WPL Strategy	Graduate (N = 41)		Guide (N = 32)		Undergraduate (N = 69)	
	Frequency of use	Perceived effectiveness	Frequency of use	Perceived effectiveness	Frequency of use	Perceived effectiveness
Observation	3.0	3.8	N/A	N/A	2.4	3.5
Shadowing	2.4	3.9	1.6	3.5	1.7	3.3
Feedback	2.8	4.1	3.2	4.0	2.9	4.0
Performance Appraisal	3.2	3.5	N/A	N/A	N/A	N/A
Learning Logs	2.3	3.4	1.8	3.5	1.3	2.5

Table 5-134 Self-directed Strategies - frequency and perceived effectiveness (graduate, guide and undergraduate perspective)

Source: Author

Self-directed WPL Strategy	Graduate (N = 41)		Guide (N = 32)		Undergraduate (N = 69)	
	Frequency of use	Perceived effectiveness	Frequency of use	Perceived effectiveness	Frequency of use	Perceived effectiveness
Practice and repetition	3.0	4.0	3.2	3.9	2.7	3.9
Books	2.6	4.0	3.2	3.8	3.0	3.9
Manuals	2.5	4.0	3.3	3.7	2.0	3.7
Internet	4.0	4.4	4.3	4.4	4.5	4.5
Professional Journals	2.1	3.9	1.9	3.5	1.5	3.1
Third level libraries	1.5	3.3	1.4	3.1	2.3	3.5
CDs	1.3	3.5	1.2	3.2	1.2	2.8
DVDs	1.3	3.3	1.4	3.2	1.2	2.9
CBT	2.6	3.6	2.9	3.9	2.5	3.9

Legend: Frequency of use ≥ 3.0 **OR** Perceived effectiveness ≥ 3.5

Frequency of use < 3.0 **OR** Perceived effectiveness < 3.5

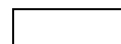
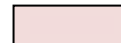


Table 5-135 Intra-organisational Strategies - frequency and perceived effectiveness (graduate, guide and undergraduate perspective)

Source: Author

Intra-organisational WPL Strategy	Graduate (N = 41)		Guide (N = 32)		Undergraduate (N = 69)	
	Frequency of use	Perceived effectiveness	Frequency of use	Perceived effectiveness	Frequency of use	Perceived effectiveness
Individual Career Plan	2.1	3.6	N/A	N/A	N/A	N/A
Rewards (promotion)	1.6	3.1	1.9	N/A	N/A	N/A
Rewards (wage increase)	2.1	3.6	1.7	N/A	N/A	N/A
Rewards (award for accomplishment)	1.6	3.2	1.9	N/A	N/A	N/A
Rewards (more responsible tasks)	3.3	4.1	2.7	N/A	N/A	N/A
Integrated Exchange (suggestion boxes)	1.1	3.1	1.5	2.8	1.2	2.7
Integrated Exchange (newsletters)	1.4	3.1	1.8	3.0	1.2	2.7
Integrated Exchange (information sessions)	1.8	3.3	2.3	3.6	1.4	3.0
Integrated Exchange (bulletins / memos)	1.4	3.0	1.9	3.1	1.2	2.8
Knowledge Bases	3.2	4.3	3.3	4.2	2.8	4.0
Stretching (working above grade)	2.9	4.3	N/A	N/A	N/A	N/A
Stretching (demanding work)	3.1	4.2	N/A	N/A	2.4	3.8
Stretching (deep end)	3.3	4.2	N/A	N/A	2.2	2.7
Stretching (role transfer)	2.1	3.7	N/A	N/A	N/A	N/A
Stretching (working abroad)	1.5	3.5	N/A	N/A	N/A	N/A

Legend: Frequency of use ≥ 3.0 **OR** Perceived effectiveness ≥ 3.5



Frequency of use < 3.0 **OR** Perceived effectiveness < 3.5



Table 5-136 Extra-organisational Strategies - frequency and perceived effectiveness (graduate, guide and undergraduate perspective)

Source: Author

Extra-organisational WPL Strategy	Graduate (N = 41)		Guide (N = 32)		Undergraduate (N = 69)	
	Frequency of use	Perceived effectiveness	Frequency of use	Perceived effectiveness	Frequency of use	Perceived effectiveness
External Professional Networks	1.7	3.7	1.9	3.4	1.5	3.6
Trade Fairs	1.3	3.4	1.3	2.5	1.1	2.6
Research Centres	1.4	3.5	1.4	2.9	1.2	3.1
Conferences / Seminars	1.7	3.3	1.8	3.4	1.2	3.1
Discussion (customers / suppliers)	2.1	3.5	2.2	3.7	N/A	N/A
Technical Support (customers / suppliers)	2.1	3.6	2.2	3.8	N/A	N/A

Legend:

Frequency of use ≥ 3.0 **OR** Perceived effectiveness ≥ 3.5



Frequency of use < 3.0 **OR** Perceived effectiveness < 3.5



5.7 Conclusion

This chapter presented the findings relating to each research question. No synthesis was carried out and no conclusions were drawn; this takes place in the following two chapters.

CHAPTER 6

ANALYSIS

6.1 Introduction

Chapter five organised the findings according to the three research questions identified in section 2.10. This chapter synthesises these findings in the context of the literature for research question one and two. Research question 3 is answered in Chapter 7.

This chapter is organised as follows:

- Guide Factors : answering research question 1(a) and 2(a)
- Learner Factors : answering research question 1(b) and 2(b)
- Organisational Supports : answering research question 1(c) and 2(c)
- Learning Opportunities : answering research question 1(d) and 2(d)
- Strategy: answering research question 1(e) and 2(e)

In order to best answer research question 1 and 2, the opinions of guides, graduates, and the organisation in relation to each factor was merged with its perceived effectiveness and discussed as a unit. In relation to the organisational findings, the low response rate for their survey was taken into consideration. The following sections discuss the key findings in the context of the literature and the research questions for Guides, Learners, Organisational Supports, Learning Opportunities, and Strategy.

6.2 Guide factors

Research Question 1(a): Who are the guides and how were they selected? Are they prepared for their role? What support do they provide? What influences/motivates them to participate?

Research Question 2(a): How effective are guides for enabling SE entry-level graduates to become competent in their SE role?

6.2.1 Who are the guides and how were they selected?

There was little agreement amongst respondents as to whether the majority of guides were selected by the organisation or the graduate (section 5.3.1.1). This disparity could be attributed to the unit of analysis being the individual and not the organisation; some guides and graduates that answered the questionnaire did not belong to any company that answered the organisation questionnaire.

Direct managers and senior colleagues of the graduate emerged as the most popular guides. When guides were selected by the organisation, senior colleagues of the graduate that were not their managers were selected two thirds of the time. This finding is in line with (Boud and Middleton 2003) but contradicts Billett (2001) who stated that organisations typically select the supervisor. When no guides were allocated by the organisation, the majority of graduates turned to their managers and senior colleagues that were not their managers for guidance (Table 5-2).

All organisations stated that they selected guides for their graduates. When selecting a guide, organisations strongly considered the guides' ability to effectively support graduates, their willingness to participate in WPL initiatives, and their knowledge of and years of experience in the area they would be supporting (Table 5-4). These findings are in line with the literature which states that guides should have experience of working in the area (Sherman *et al* 2000), be willing to participate (Clutterbuck 1991) and have the ability to effectively support graduates (Billett 2001).

From the perceived effectiveness stance, company-appointed guides emerged overall as more effective and the better choice for developing graduate SE competencies

when compared with graduate-selected guides (section 5.4.1.1). However, this finding appears to contradict the literature which states that, where feasible, learners should choose their guide (Chivers 2006) and given a choice, learners would prefer to hand pick their guide (Okurame 2008).

6.2.2 What supports do they provide?

Regardless of how the guide was selected, guides encouraged graduates to transfer their learning to other situations, which Nabi and Bagley (1998) reported as crucial to career progression in contemporary organisations. Overall, graduates were encouraged to reflect on their learning which is in line with the literature (Tikkanen 2002) and guides typically encouraged graduates to self-correct based these reflections (section 5.3.1.2).

6.2.3 Are they prepared for their role?

Guides selected by the organisation were adequately prepared for their WPL whereas guides selected by the graduate felt they were not adequately prepared (Table 5-8). However, the level of preparation appeared to have no negative impact on its perceived effectiveness for developing SE graduate competencies (Table 5-71). Organisations reported that they did prepare their guides for their WPL role which they found was effective for developing SE graduate competencies. This finding concurred with Chivers (2006) view that organisations should prepare guides for their role in order to fully reap the benefits of WPL. Even though the guides were asked to comment on the ways in which they were prepared for their WPL role, very little insight was provided. Very few undertook formal training courses to teach them how to support on-the-job learning (Table 5-9).

6.2.4 What influences/motivates them to participate?

In general, guides that were selected by the organisation were encouraged to engage in WPL more and were more effective compared with those guides selected by the graduate (Table 5-78). The qualitative data indicates that guide availability is possibly related to the graduates' view of their guides' overall perceived effectiveness (section 5.4.1.4 and Appendix Table I - 12). However, this would require further research to determine a correlation, if any.

Guides reported that they were motivated to participate in WPL to maintain project/team and organisational health, develop standalone employees, gain a sense of satisfaction from helping graduates, and improve guides existing knowledge (Table 5-14). Sense of satisfaction was the most common motivation cited by guides in the Volkoff (1996) study. Improving guides existing knowledge was also reported in the Volkoff (1996) study.

Regardless of whether the guide was selected by the organisation or the graduate, the guides did not fear displacement in their role by their learner (Table 5-12). This appears to contradict Ashton (2004) who stated that experienced co-workers can limit novices' access to knowledge and learning as they may fear future displacement by the graduate they supported.

Guides, regardless of how they were selected were unlikely to be rewarded for performing their WPL role (Table 5-15). They were only occasionally rewarded for their efforts through promotion, wage increase, allocation of more responsible tasks, and awards for accomplishment. This contradicts Billett (2003) who states that guides' efforts should be duly rewarded as it is crucial for continued guide engagement in WPL.

Table 6-1 summarises the key findings relating to guide selection and Table 6-2 summarises the key findings relating to guide preparation and participation. The revision of the theoretical framework (section 7.2) is based on these tables.

Table 6-1 Guide factors – key findings relating to guide selection

Source: Author

Factor	Key findings relating to the factor
Guide Selection	<p>Organisations selected guides based on:</p> <ul style="list-style-type: none"> • their willingness to participate • the guides' knowledge and years of expertise in the area they would be providing support • ability of the guide to effectively support graduates WPL
	<p>Guides selected by the organisation, when compared with graduate-selected guides:</p> <ul style="list-style-type: none"> • were more effective • an overall better choice • more available to support learners • more experienced • were encouraged more to participate • organised graduate WPL more • monitored graduate performance more • encouraged graduates more to engage in problem solving
	<p>Guides selected by the graduate, when compared with company-selected guides:</p> <ul style="list-style-type: none"> • monitored graduate performance, albeit to a lesser degree • encouraged graduates to engage in problem solving activities, albeit to a lesser degree • less likely to organise graduate WPL
	<p>Guides, regardless of how they were selected:</p> <ul style="list-style-type: none"> • encouraged graduates to transfer their learning to other situations • encouraged graduates to reflect on their learning • encouraged graduates to self-correct based on their reflections • were unlikely to encourage graduates to compare task performance with that of experienced colleagues

Table 6-2 Guide factors – key findings relating to guide preparation and participation

Source: Author

Factor	Key findings relating to the factor
Guide Preparation	The preparation of guides for their role could receive more attention from the organisation, particularly for graduate-selected guides. However, the level of preparation appeared to have no negative impact on the perceived effectiveness for developing SE graduate competencies.
Guide Participation (WPL Participant Preparation)	<p>Guides, regardless of how they were selected,:</p> <ul style="list-style-type: none"> • appeared comfortable with their WPL role • were skilled at sharing knowledge • were very willing to participate • did not fear displacement in their role by the learner <p>all of which were perceived as effective for developing SE graduate competencies.</p>
	<p>Guides, regardless of how they were selected were unlikely to be rewarded for performing their WPL role.</p> <p>Guides were motivated to participate in WPL so that they could:</p> <ul style="list-style-type: none"> • maintain project/team health • develop standalone employees • feel a sense of satisfaction from helping graduates • improve their own knowledge • maintain organisational health
	<p>Regarding the learner-guide relationship:</p> <ul style="list-style-type: none"> • Direct managers and senior colleagues of the graduate were the most prevalent guides • Regardless of how the guide was selected, guides had very good relationships with their learners which was perceived as quite effective for developing SE graduate competencies • Organisations encouraged guides to engage in WPL even though they rarely rewarded them for engaging in WPL

6.3 Learner factors

Research Question 1(b) Are the learners prepared for their learning role and what influences/motivates them to participate?

Research Question 2(b): How effective are learners for enabling SE entry-level graduates to become competent in their SE role?

6.3.1 Are learners prepared for their learning role?

Organisations reported that they prepared graduates to be a learner in the workplace more so than not which was perceived as effective for developing SE graduate competencies. This finding is in line with Billett (2003) who maintained that learners should be prepared for their WPL role. Graduates that were allocated a guide by the organisation felt they were more prepared than not and that this preparation was more effective than not. However, those graduates that selected their own guide reported they were less likely to be adequately prepared for their WPL role which they felt was ineffective for developing their competencies (Table 5-18 and Table 5-79).

When graduates were allocated a guide, the majority attended formal training courses to prepare them for WPL, whereas, graduates that selected their own guides rarely attended such formal training courses (Table 5-19). Some graduates attended workshops and were given learning and development packs when starting in their SE role. Other graduates reported that they were prepared by attending formal training courses however little or no qualitative details were provided on the syllabi or contents. No universal approach for preparing graduates emerged and little or no strategies specifically geared towards preparing a SE graduate to be a learner in the workplace were provided (section 5.3.2.1), even though literature in the area offers detailed suggestions for preparing learners (see Billett 2001; Cheetham and Chivers 2001).

6.3.2 What influences / motivates them to participate?

The organisations encouraged graduates to engage in WPL more so than not (Table 5-26). When a graduate selected their own guide, they were encouraged to engage in

WPL which was effective for developing their competence (Table 5-76). Graduates that were allocated guides by the organisation were encouraged more to participate in WPL than those graduates who chose their own guides (Table 5-21). Regardless of how a guide was selected, graduates were not reluctant to engage in WPL which had a positive effect on developing their ability to perform their SE role (Table 5-20 and Table 5-73). This somewhat contravenes Billett's (2001; 2002a; 2004) view that learners can exhibit varying degrees of participation in WPL by choosing to engage in some tasks and decline to participate in others.

Graduates had a very good relationship with their guide and regardless of how their guide was selected this relationship was quite effective for developing their competency. Guides and the organisation reported a positive relationship existing between learners and guides, independent of guide selection (Table 5-10 and Table 5-72). This finding is in line with Billett (2001) who stated that better learning is achieved when a good learner-guide relationship exists.

Learners were motivated to engage in WPL as they felt it provided them with job security, mobility and demonstrated an interest in their job. Billett (2002a) reported a higher-level, but similar learner motivation: career progression aspirations. Both learners and guides also saw participation in WPL as an opportunity to learn new skills and they also felt a sense of satisfaction from engaging in WPL (Table 5-24).

In summary, learners were more prepared to get the most out of WPL and were encouraged more to engage in WPL when their guide was selected by the organisation rather than the graduate themselves. Both of these were perceived as effective for developing their competence. They also attended significantly more formal training courses to prepare them to be a learner in the WPL. Independent of guide allocation, graduates were very willing to engage in WPL and had a very good relationship with their guides both of which were effective for developing their SE competencies. These sentiments can be seen in Table 6-3 which summarises the key findings relating to learner preparation and participation. The revision of the theoretical framework (section 7.2) is based on this table.

Table 6-3 Learner factors – key findings

Source: Author

Factor	Key findings relating to the factor
Learner Preparation	Graduates that were allocated guides by the organisation were prepared for their WPL role and typically attended formal training courses to prepare them for WPL.
	Graduates who selected their own guides were not adequately prepared for their WPL role and rarely attended formal training courses to prepare them for WPL.
	No universal approach for preparing graduates emerged and little or no strategies specifically geared towards preparing a SE graduate to be a learner in the workplace were provided.
Learner Participation (WPL Participant Preparation)	Graduates were willing learners in the workplace.
	Organisations encouraged graduates to engage in WPL more so than not particularly when they allocated a guide for the graduate. This was effective for developing SE graduate competency.
	Graduate motivations to participate in WPL include: <ul style="list-style-type: none"> • the opportunity to learn new skills • job security and mobility • a sense of satisfaction • an interest in the job
	Good learner-guide relationships were very prevalent which was quite effective for developing SE graduate competencies.

6.4 Organisational supports

Research Question 1(c): What supports does the organisation provide for WPL? Have organisations developed formal WPL policies and learning resources?

Research Question 2(c): How effective are organisational supports for enabling SE entry-level graduates to become competent in their SE role?

6.4.1 What supports does the organisation provide for WPL?

Organisations perceived the overall support they provided as very effective for the development of SE graduate competencies (Table 5-92). Overall, organisations excelled at instilling awareness in graduates of their WPL role, allowing adequate time for graduates to settle into their WPL role, and monitoring the graduates' WPL performance (Table 5-93). Cheetham and Chivers (2001) stated that graduates should

be allowed adequate time to settle into their WPL role; the findings in this study concurred with the literature.

The respondent organisations in this study encouraged their graduates and guides to engage in WPL (Table 5-26). This finding is in line with Skule's (2004) thinking when he stated that organisations should encourage their workers to engage in WPL practices. However, organisations could focus more on encouraging reluctant workers to engage in WPL, whilst also monitoring and providing feedback to guides on their WPL performance (Table 5-84).

Allen *et al* (1997), Dale and Bell (1999), Billett (2002a), and Skule (2004) stated that those engaging in WPL should be afforded adequate time to engage in WPL. Overall, the respondents in this study felt they were allocated adequate time to participate, but this support could be improved upon. However, the respondents felt the organisation excelled at allowing adequate time for graduates to settle into their WPL role (Table 5-93).

Support for remote learning was lacking even though it emerged as effective (Table 5-93). Billett (2001) suggests that organisations should strive to support remote learning in order to improve WPL. Consequently, the organisations in this study could improve upon this support.

Production demands did overshadow learning and restricted opportunities for participation in WPL opportunities (Table 5-93). This finding is in line with Harris *et al* (2001) who stated that the pressures and demands of a production environment can inhibit learning. This finding also echoes both Tikkanen (2002) and Moore (2004) who state that the primary focus of contemporary organisations is production rather than the education and CPD of their workforce. It appears that this support would require some attention from organisations in order to improve the effectiveness of WPL.

The SE workplaces in this study were only just conducive for learning, according to Skule's (2004) model, even though graduates, guides, and the organisation reported four of the fourteen combined measures as below average conduciveness (Figure 5-7).

These four measures are extensive professional contact (LC4, both graduate and guide perspectives) and rewarding of proficiency (LC7, both graduate and guide perspectives). The graduates, guides, and the organisation all rated superior feedback (LC5) and management support for learning (LC6) as above average.

Doyle *et al* (2008) and Lehesvirta (2004) both reported an encouraging learning environment as one of the strongest facilitators of WPL. However, the findings here suggest that organisations could focus more on developing the invitational nature of the workplace i.e. encourage participation in WPL more, better support graduates and guides in their WPL role, and ensure the organisation does not inhibit WPL (Table 5-31). As is evident in Table 5-91, organisations reported other ways they supported WPL which included providing sand pits to try out software (i.e. learning by making mistakes), adhering to prescribed training plans, self-study, immersion in a work environment with sound ethics, and holding regular meetings with graduates, team leads and HR to plan learning. Organisations reported that factors such as cost, time allocation, and remote learning can inhibit WPL.

Team structures capable of providing opportunities for collaborative learning were prevalent (Table 5-35). These should, according to Allen *et al* (1997), Cheetham and Chivers (2001), and Nordman and Hayward (2006) increase the chances of engagement in WPL.

Guide preparation was found to be effective (Table 5-71), however, it did not take place frequently (Table 5-8). Chivers (2006) recommends that guides should be prepared for their WPL in order to fully reap the benefits of WPL. On the other hand, the graduates in the study were prepared, but there was room for improving the preparation. Billett (2003) ascertains that preparing learners would enable them to fully understand all facets of the process. For these reasons, organisations should focus more on preparing their learners and guides.

Table 6-4 summarises and ranks the key findings relating to WPL participant preparation, WPL participant influences on participation, WPL participant support, and invitational nature. The revision of the theoretical framework (section 7.2) is based on this table.

Table 6-4 Organisational supports – classification of key findings

Source: Author

Factor	Specific supports	Classification			
		1	2	3	4
WPL Participant Preparation	instilling awareness in graduates of their WPL role *	✓			
	preparing graduates for their WPL role *		✓		
	preparing guides for their WPL role *		✓		
WPL Participant Influences on Participation	encouraging reluctant workers to engage in WPL *		✓		
	drawing attention to the professional development benefits through WPL engagement *	✓			
	monitoring performance of WPL guides in their WPL role *		✓		
	providing feedback to WPL guides on their WPL performance *		✓		
	monitoring the graduates' performance *		✓		
WPL Participant Support	support for remote WPL *			✓	
	production demands restricting graduates opportunities to participation in WPL *		✓		
Invitational nature	The SE workplaces in this study were conducive for learning (according to Skule's (2004) model) #			✓	
	The invitational nature of the workplace: Encouraged participation in WPL * Supported WPL role * Inhibited WPL *		✓ ✓ ✓		
	providing team structures capable of providing opportunities for collaborative learning *		✓		
	allocating adequate time to participate in WPL *		✓		
	allowing adequate time for graduates to settle into their role *	✓			

Classification key *:

- 1: Excellent WPL supports (frequency ≥ 3.5 and perceived effectiveness ≥ 4.0)
- 2: Good WPL supports, with potential room for improvement ((frequency ≥ 3.0) and (perceived effectiveness ≥ 3.0 and < 4.0))
- 3: Fair WPL supports, consider using more frequently (frequency < 3.0 and perceived effectiveness ≥ 3.0)
- 4: Poor WPL supports (perceived effectiveness < 3.0)

Classification key # (where no perceived effectiveness data was applicable / gathered):

- 1: Excellent WPL supports (frequency ≥ 4.0)
- 2: Good WPL supports (frequency ≥ 3.5 and < 4.0)
- 3: Fair WPL supports (frequency ≥ 3.0 and < 3.5)
- 4: Poor WPL supports (frequency < 3.0)

6.4.2 Have organisations developed formal WPL policies and learning resources?

As anticipated, eighty percent of organisations considered the WPL of SE graduates important or very important to them (Figure 5-6). With regard to the organisations' WPL philosophy, half preferred to gradually train their SE graduates over a long period of time whereas half preferred to intensively train their SE graduates over a short period of time. There was no correlation between the organisations WPL philosophy and the existence of formal WPL policies in the organisation (Table 5-25).

Half of the organisations developed formal WPL policies and learning resources. They were developed largely in conjunction with experienced staff / WPL guides. Graduates / WPL learners were less likely to be included in the development of these policies and resources (5.3.3.5). Organisations that developed formal WPL policies did not necessarily develop learning resources and vice versa (Table 5-27).

The formal WPL policies ranged from specifying the learning strategies to be used for new hires to specifically detailing performance milestones, approaches for developing new syllabi, and the use of training matrices to bridge skills shortfalls (Table 5-37). The contents of learning resources were based largely on tasks and activities found in the workplace and contained learning objectives. These learning resources were generally grouped into distinct categories, with strategies outlined for learning the material. They also detailed how an expert would perform the tasks. On average, they contained conceptual theory that is difficult to learn through WPL alone (Table 5-28 and Table 5-37). These learning resources are in line with Billett (2001) who states that knowledge that is inaccessible through discovery learning alone should be made explicit to novice learners.

6.5 Learning opportunities

*Research Question 1(d): What learning opportunities are available in the workplace?
How are they structured? What access is provided to these learning opportunities?
How are pathways of learning opportunities sequenced?*

*Research Question 2(d): How effective are learning opportunities for enabling SE
entry-level graduates to become competent in their SE role?*

6.5.1 Categories of learning opportunities available in the workplace

Half of the guides reported that graduates work on routine problems the majority of the time. Conversely, graduates reported they encountered slightly more non-routine tasks than routine tasks (Table 5-39). Potentially, the disparity in these figures could be attributed to graduates considering routine tasks as non-routine, due to their inexperience, and vice versa for guides. The graduate findings particularly resonate with the literature. Billett (2004) suggests a mix of both routine and non-routine tasks is required for successful WPL. Tikkanen (2002) and Chivers (2006) both report that novices' learning potential is increased when faced with non-routine tasks.

Four broad categories of learning opportunity were reported by graduates which are immersion in real projects/tasks, working on projects specifically designed for WPL, use of problem solving techniques, and engagement in collaborative learning. Merging these learning opportunities with the additional learning strategies identified by the respondents (Table 5-66) gives rise to a direct overlap between most categories. The resultant five categories include the four listed above in conjunction with a new category called social media. The real world learning opportunities and additional strategies that emerged in this study reflect the literature which states that workplaces routinely provide learners with authentic experiences for the development of required competencies (Billett 2001; 2004).

6.5.2 Structuring of learning opportunities

Learning opportunities were structured in the workplace (Table 5-41). In particular, the respondents felt the workplace excelled at helping graduates to understand work practices and procedures, which was in line with the second level on Billett's (2001) three level model of WPL guidance. The findings suggest that graduates were made aware of the goals and requirements for expert performance of the task. This concurs with Billett's (2001) sentiment that the goals and requirements should be made explicit. However, more attention could be focused on this support in the future. Graduates were also made aware of the learning outcomes for tasks; however, the workplace could potentially improve upon this support.

6.5.3 Access to learning opportunities and knowledge

Graduates emerged as having sufficient access to learning opportunities in the workplace (Table 5-42), however the level of access could be improved upon, particularly as Ashton (2004) reports that regular access to learning opportunities develops vocational expertise. The findings here also show that the workplace should focus on increasing learner access to appropriate learning opportunities, as the respondents demonstrated some concern in this area. Task democracy was thriving in the workplace and the respondents strongly felt graduates had equal access to learning opportunities. This finding contradicts Keep (2000) and Bryson *et al* (2006) who view the workplace as a contested terrain, often deliberately restricting learning opportunities.

The findings suggest organisations should strive to safeguard graduates from learning inappropriate knowledge more (Table 5-43), particularly as Turner and Jackson-Cox (2002) maintain that learning inappropriate knowledge can have a negative effect on organisational performance. Delving deeper into this finding, organisations stated that they safeguarded graduates from learning inappropriate knowledge through WPL whereas some graduates did report that they learned something through WPL that they later found to be incorrect. This apparent contradiction would require further research to determine the extent that organisations protect graduates from learning incorrect knowledge.

Prawat (1993) stated that situated learning (i.e. WPL) can favour procedural learning over conceptual learning. The respondents in this study reported they could access hidden, conceptual knowledge relating to tasks (Table 5-44). This is reassuring as Berryman (1993) maintains that conceptual knowledge is very important for technology-driven enterprises. However, the organisations in this study could focus on providing more access to conceptual knowledge. Future research could also establish the depth of learning achieved by SE graduates when learning on-the-job.

6.5.4 Sequencing pathways of learning opportunities

Learning opportunities were sequenced in the workplace, particularly by increasing difficulty and responsibility. However, the workplace could potentially improve upon giving access to increasingly diverse tasks in multiple work areas (Table 5-45). The sequencing of learning opportunities in these workplaces is consistent with the approach outlined in the numerous WPL models discussed earlier in the literature (Collins *et al* 1991, Billett 2001; Ashton 2004, Moore 2004).

Graduates progression was monitored prior to introducing learning opportunities requiring increasing responsibility (Table 5-46). This is in line with the first level on Billett's (2001) three level model of WPL guidance. However, more attention could be afforded to this strategy in the workplace.

Table 6-5 summarises and ranks the key findings relating to the structure of learning opportunities, access to learning opportunities, access to knowledge, and sequencing of learning opportunities. The revision of the theoretical framework (section 7.2) is based on this table.

Table 6-5 Learning opportunities – classification of key findings

Source: Author

Factor	Specific supports	Classification			
		1	2	3	4
Structure of learning opportunities	Help graduates understand work practices and procedures [#]	✓			
	Make graduates aware of learning outcomes [#]		✓		
	Make graduates aware of goals and requirements for expert performance [#]		✓		
Access to learning opportunities	Access to appropriate learning opportunities [#]			✓	
	Sufficient access to learning opportunities [*]		✓		
	Equal access to learning opportunities [*]	✓			
Access to knowledge	Safeguarding graduates learning inappropriate knowledge [*]			✓	
	Difficulty accessing hidden knowledge [#]				✓
Sequencing of learning opportunities	Increasing difficulty [*]	✓			
	Increasing diversity [*]	✓			
	Increasing responsibility [*]	✓			
	Work area [*]		✓		
	Monitor learner progression prior to introducing learning opportunities of increased responsibility [#]		✓		

Classification key *:

- 1: Excellent WPL supports (frequency ≥ 3.5 and perceived effectiveness ≥ 4.0)
- 2: Good WPL supports, with potential room for improvement ((frequency ≥ 3.0) and (perceived effectiveness ≥ 3.0 and < 4.0))
- 3: Fair WPL supports, consider using more frequently (frequency < 3.0 and perceived effectiveness ≥ 3.0)
- 4: Poor WPL supports (perceived effectiveness < 3.0)

Classification key # (where no perceived effectiveness data was applicable / gathered):

- 1: Excellent WPL supports (frequency ≥ 4.0)
- 2: Good WPL supports (frequency ≥ 3.5 and < 4.0)
- 3: Fair WPL supports (frequency ≥ 3.0 and < 3.5)
- 4: Poor WPL supports (frequency < 3.0)

6.6 Strategy (direct & indirect guidance)

Research Question 1(e): What learning strategies are used when entry-level SE graduates engage in WPL? What level of direct guidance do guides provide to entry-level SE graduates? What indirect guidance does the physical and social environment provide to entry-level SE graduates?

Research Question 2(e): How effective are WPL strategies for enabling SE entry-level graduates to become competent in their SE role?

6.6.1 Learning strategy use

The literature review chapter categorised WPL strategy use into five distinct categories - Instructional Model of Learning strategies, Other Inter-collegial Strategies, Self-directed Strategies, Intra-organisational Strategies, and Extra-organisational Strategies (Table 2-3). For each category, the findings chapter presented the graduates', guides', and undergraduates' perspectives on the frequency of use and perceived effectiveness of each strategy (for a summary, see Table 5-132 up to Table 5-136). These tables highlighted those strategies that were used frequently (≥ 3.0) or were considered effective (≥ 3.5). This chapter takes these findings one step further and classifies each learning strategy in Table 5-132 to Table 5-136 as either primary, secondary, tertiary or periphery according to the rules in Table 6-6.

Table 6-6 Classification rules for WPL strategies

Source: Author

	Frequency	Perceived Effectiveness
Primary Strategies	≥ 3.0 for both graduates and, where applicable, guides	≥ 3.5 for both graduates and, where applicable, guides
Secondary Strategies	≤ 3.0 for either graduate or, where applicable, guides	≥ 3.5 for both graduates and, where applicable, for guides
Tertiary Strategies	≤ 3.0 for both graduate and, where applicable, guides	≥ 3.5 for either graduates or, where applicable, for guides
Periphery Strategies	≤ 3.0 for both graduate and, where applicable, guides	≤ 3.5 for both graduates and, where applicable, for guides

The results of this classification can be seen in Table 6-7. This table represents a WPL strategy spectrum where at one end, the primary strategies are considered the most frequently used and most effective learning strategies in the current SE workplace and at the other end of the spectrum lies the periphery strategies which are virtually never used nor considered effective. This table also colour codes the direct strategies in purple and the indirect strategies in white.

The general trend indicates that the majority of the Instructional Model of Learning strategies were used more often than the majority of Other Inter-collegial, Self-directed, Intra-organisational, and Extra-organisational Strategies. Respondents agreed that the Internet was the most frequently used strategy (Table 5-67). This finding is in line with the Lohman (2005a) study where IT practitioners cited the Internet as the foremost informal learning strategy. Scaffolding and fading also appeared in the top five most frequently used strategies (Table 5-67).

In general, graduates and guides were very positive about the perceived effectiveness of the learning strategies, perceiving all strategies in the Instructional Model of Learning, Other Inter-collegial, and Self-directed categories as effective. Overall, the Internet, scaffolding and fading, knowledge bases of previous problem solutions, and diagrams appeared in their top six most effective strategies (Table 5-127). Graduates considered no WPL strategy as ineffective whereas guides only considered three as ineffective, namely, specialised research centres, company suggestion boxes, and trade fairs (Table 5-129). The ranking of so many strategies as effective strengthens Gerber *et al* (1995) view that there is no limit to the amount of strategies pertinent for learning in the workplace.

When graduates and guides were asked to identify any additional learning strategies they used, three themes emerged which are the importance of collaborative learning, the use of social media tactics, and the identification of tasks and projects suitable for SE graduate WPL (Table 5-65).

Each category of WPL strategy (i.e. Instructional Model of Learning, Other Inter-collegial, Self-directed, Intra-organisational, and Extra-organisational strategies) is now discussed in the context of the findings, Table 6-7, and the literature.

Table 6-7 WPL strategy spectrum (current use and perceived effectiveness in the SE industry)

Source: Author

	Primary strategies	Secondary strategies	Tertiary strategies	Periphery strategies
Instructional Model of Learning	Modelling	Analogies	Reflection	None
	Diagrams			
	Scaffolding	Coaching		
	Fading			
	Articulation	Questioning		
	Discussion (informal)			
	Discussion (team meetings)	Teaching others		
	Learning from mistakes			
	Exploration			
Other Inter-collegial	Performance Appraisal	Feedback	Shadowing	None
	Observation		Learning Logs	
Self-directed	Practice and Repetition	Books	Professional Journals	Third Level Libraries
			CDs	
	Internet	Manuals	CBT	DVDs
Intra-organisational	Knowledge Bases	Individual career plan	Integrated exchange (information sessions)	Rewards (promotion)
		Rewards (more responsible tasks)		Rewards (award for accomplishment)
	Stretching (demanding work)	Stretching (working above grade)	Rewards (wage increase)	Integrated exchange (suggestion boxes)
	Stretching (deep end)	Stretching (role transfer)		Integrated exchange (newsletters)
		Stretching (working abroad)		Integrated exchange (bulletins / memos)
Extra-organisational	None	None	Technical Support (customers / suppliers)	Networking (Trade fairs)
			Networking (External Professional Networks)	
			Networking (Research Centres)	Networking (Conferences / seminars)
			Discussion (customers/ suppliers)	

Legend: Direct strategies  Indirect strategies 

6.6.1.1 Instructional Model of Learning strategies

Table 6-7 shows that the cognitive apprenticeship strategies (modelling, coaching, and scaffolding) emerged as either Primary or Secondary strategies which adds some merit to Prawat's (1992) ascertain that the cognitive apprenticeship is hailed as the best method for fostering WPL. Modelling emerged as a Primary strategy which concurs with Billett (2001) where the guides stated that they would use modelling regularly when engaging in future WPL practices. Coaching emerged as a Secondary strategy whereas the guides in Billett's (2001) study widely reported its use and that they would regularly use it in the future.

In relation to the Instructional Model of Learning strategies, Billett (1998) ranked them according to frequency of use, highest first: questioning, coaching, modelling, analogies, and diagrams. The findings for both the graduate and guide contradict this order, as can be seen in Table 5-67 and Table 5-68. However, the majority of Instructional Model of Learning strategies were classified as Primary strategies. Articulation emerged as a Primary strategy which is in line with Cheetham and Chivers (2001) and a more recent study (Chivers 2011) where articulation was reported as an important strategy for learning. Discussion, both informal and team meetings are Primary strategies. This finding is in line with the Lohman (2005a) study where discussion emerged as the second most popular WPL strategy, after using the Internet. Learning from mistakes was also a Primary strategy. Cheetham and Chivers (2001) also found that this reflection technique is a valuable WPL strategy.

Questioning and analogies were considered equally as effective and as a Secondary strategy. However guides in Billett's (2001) study stated that they did not use analogies as much as they used questioning nor did they widely state their intentions to use questioning in the future. Learning through teaching others was categorised as a Secondary strategy. This somewhat resonates with the Crouse *et al* (2011) study in which this strategy strongly emerged as a WPL strategy.

Reflection emerged in this study as a Tertiary strategy. This contradicts with Dale and Bell's (1999) study where everyone was encouraged to reflect on their learning. Also,

in Cheetham and Chivers (2001) study, reflection was identified as a valuable learning approach.

6.6.1.2 Other Inter-collegial Strategies

These strategies were dispersed across the spectrum from Primary to Periphery. Performance appraisal emerged as a Primary strategy which concurs with Gerber *et al* (1995) who emphasised the crucial role of performance appraisal systems in WPL. Observation also emerged as a Primary strategy which is in line with the importance Cheetham and Chivers (2001) place on the strategy.

Feedback was rated as a Secondary strategy in this study. Shadowing emerged as a Tertiary strategy. Skule (2004) stated that feedback was conducive to learning; however, the Cheetham and Chivers (2001) study reported stronger sentiments for shadowing and found it to be extremely valuable.

Learning logs were classified as a Tertiary strategy. As learning logs are a documented account of the learning experience, conclusions reached, and plans for altering future behaviours (Honey 1994), it is possible that this strategy did not feature strongly in the workplaces due to time constraints. However, this would require more detailed research to establish correlation and causation, if any.

6.6.1.3 Self-directed Strategies

Respondents did not use the majority of Self-directed Strategies frequently (i.e. professional journals, third level libraries, CDs, DVDs, CBT). This low usage appears to conflict with the organisations strong encouragement of SE graduates to become self-directed learners. This organisational encouragement is in line with Cheetham and Chivers (2001) who stated that organisations should encourage novices to become self-directed learners. However, it must be borne in mind that the respondents for this study were highly computer literate and, when engaging in self-directed learning, appeared to favour the Internet over print and disk based media.

The Internet and practice and repetition emerged as Primary strategies. As established above, the Internet's popularity concurs with Lohman (2005a) who cited it as the

foremost informal learning strategy. The finding relating to practice and repetition strongly echoes Harris *et al.*'s (2001) sentiment that novices value learning opportunities where they can repeatedly practice new skills.

6.6.1.4 Intra-organisational Strategies

Three of the four Integrated Exchange strategies (suggestion boxes, newsletters, bulletins / memos) emerged as Periphery strategies. This finding was expected as the respondents were highly technical, computer savvy individuals and these three strategies were typically paper based. The fourth Integrated Exchange strategy, information sessions was classified as a Tertiary strategy.

Rewards appeared dispersed throughout the strategy spectrum. The allocation of more responsible tasks was classified as a Secondary strategy, wage increases as a Tertiary strategy, whereas promotion and award for accomplishment appeared on the Periphery strategy list. Lohman (2005a) found that monetary rewards did not significantly influence engagement in WPL and this study agrees with this sentiment by placing wage increases as a Tertiary strategy. The low categorisation of awards for accomplishment contradicts Gerber *et al* (1995) and Dale and Bell (1999) who both maintained that this reward maximised WPL.

All stretching activities (engaging in demanding work, being thrown in the deep end, working above the current grade, role transfer, and working abroad) were categorised as either Primary or Secondary strategies. These results resonate with the Cheetham and Chivers (2001) and Skule (2004) studies where such strategies resulted in respondents learning a considerable amount.

Individualised career development plans emerged as a Secondary strategy which somewhat concurs with Houldsworth *et al* (1997) who found that effective leaning can be achieved when such plans are devised.

6.6.1.5 Extra-organisational Strategies

No Extra-organisational strategies appeared in the Primary or Secondary strategy list. Even though Cheetham and Chivers (2001) found that networking was an important

strategy for WPL, all these strategies emerged as either Tertiary (external professional networks and research centres) or Periphery (trade fairs and conferences / seminars). With regard to contact with customers / suppliers, both technical support and discussions with them were classified as Tertiary strategies.

6.6.2 Direct guidance

Table 6-7 colour coded the direct strategies with a purple background. Overall, the majority of direct guidance strategies were used frequently (Table 5-130) and no direct strategy was perceived as ineffective (Table 5-131). This is also evident in Table 6-7 where direct strategies were classified as either Primary or Secondary strategies, with none being classified as Tertiary or Periphery. This is a valuable finding, particularly as literature states that the greater the quality and contribution of the direct guidance, the stronger the learning outcomes will be (Billett 2001, Nordman and Hayward 2006).

Overall, all three levels of Billett's (2001) model of expert guidance were used frequently (Table 5-60), indicating that the model is a close fit with the guidance structure existing in the SE workplace. Level 1 (participation in work activities) appeared to be used more, then level 2 (guided learning at work), followed by level 3 (guided learning for transfer) which was used the least. The findings from this study concur with Billett's (2002b) study which showed that his three level model of expert guidance "demonstrated some potential" (p.100) for supporting guided learning in the workplace.

6.6.3 Indirect guidance

Table 6-7 colour coded the indirect strategies with a white background. The majority of indirect guidance strategies were not used frequently (Table 5-130) with many indirect guidance strategies not being used at all (Table 5-126). Regardless, the strategies were typically perceived as effective, with minimal indirect strategies reported as ineffective (Table 5-131). A future research avenue could determine, if strategies are considered effective, why they are not being used more.

Hodkinson and Bloomer (2002 cited in Billett 2004) stated that the learner ultimately decides on their indirect guidance engagement and practices. In this study, the Internet, learning from mistakes, the use of knowledge bases, and discussion (team meetings) were selected by respondents as some of the most valuable indirect strategies (all classified in Table 6-7 as Primary strategies). As discussed in section 6.6.1, the importance of these indirect strategies concurs with the Cheetham and Chivers (2001), Lohman (2005a), and Chivers (2011) studies.

6.7 Conclusion

This chapter synthesised the findings presented in Chapter 5 in the context of the literature. In doing so, answers to research questions 1 and 2 were furnished by specifically addressing each of their sub-questions.

The following chapter revises the theoretical framework based on the findings. This revised framework is then used to answer research question 3 by reflecting it into the SE workplace and higher education.

CHAPTER 7

REVISED THEORETICAL FRAMEWORK

7.1 Introduction

This chapter revises the theoretical framework based on the findings from the study. This revised framework is then used to answer research question 3 by reflecting it into the SE workplace and higher education.

7.2 Revising the theoretical framework

This section compares the rhetoric to the reality in relation to the WPL supports and strategies that exist for SE graduates. The theoretical framework that emerged in the literature review is the rhetoric (Figure 2-9) and the findings from this study are the reality. *Organisational Supports*, *Learning Opportunities*, *Guide Factors*, *Learner Factors*, and *Strategy (Direct & Indirect Guidance)* will be re-evaluated, resulting in a revised theoretical framework that is more representative of the reality of the WPL supports and structures for SE graduates.

7.2.1 Organisational supports

Table 6-4 classified the key findings relating to the organisational supports as:

- WPL Participant Preparation.
Graduate-selected guides felt they were not prepared for their role and organisations prepared the guides they appointed (section 6.2.3). As there appeared to be little learner involvement in guide preparation, the theoretical framework now shows *Guide Preparation* in the intersection between just the *Guide Factors* and *Organisation Supports*. Likewise, as graduates who selected their own guide felt they were not prepared for their role and organisations prepared the learners for whom they appointed guides for (section 6.3.1), there also appeared to be little guide involvement with learner preparation. The theoretical framework now shows *Learner Preparation* in the intersection between just the *Learner Factors* and *Organisation Supports*.

- WPL Participant Influences on Participation.

This support originally appeared in the intersection between *Guide Factors*, *Learner Factors*, and *Organisational Supports* in the theoretical framework (Figure 2-9). The findings show that the organisation encouraged both learners and guides to engage in WPL (Table 5-17, Table 5-23, and Table 5-93). As the reality suggests that guides and learners have different influences, the support should be split into two, namely, *Guide Influences on Participation* and *Learner Influences on Participation*. The measures associated with guide influences can be seen in Table 5-17 and Table 5-93. As learner support for guides was not evident, *Guide Influences on Participation* is moved into the intersection between *Guide Factors* and *Organisational Supports*. The measures associated with learner influences can be seen in Table 5-7, Table 5-23, and Table 5-93. Guides supported graduates by encouraging them to transfer their learning to other situations, reflect on their learning, and self-correct based on these reflections (Table 5-7). As guides can influence learner participation, *Learner Influences on Participation* remains in the intersection between *Guide Factors*, *Learner Factors*, and *Organisational Supports*.

- WPL Participant Support.

In the theoretical framework that emerged from the literature (Figure 2-9), *Provide Support for Remote Learning* and *Cater for Production Demands Overshadowing Learning* appear in the *Organisational Supports* section. As the reality suggests that these measures are indeed supports provided by the organisation (Table 6-4), these measures remain in place. However, they are now encompassed under the *WPL Participant Support* heading.

- Invitational Nature.

As the reality suggests that the organisations studied are invitational in nature and that this is a good WPL support (Table 6-4), this measure remains in place.

Formal policies and learning resources were typically developed with experienced staff and WPL guides as opposed to graduates and WPL learners (section 6.4.2). As the reality suggests guide involvement and little learner contribution when developing *Formal Policies*, this factor was moved from *Organisational Supports* into the intersection between *Guide Factors* and *Organisational Supports*. Continuing in the

same vein, the *Learning Resources* factor also falls into the intersection between *Guide Factors* and *Organisational Supports*. However, it also has *Learning Opportunity* involvement; the findings suggest learning resources are largely based on tasks and activities found in the workplace, detail learning objectives, and also contain conceptual knowledge (section 6.4.2). Consequently, *Learning Resources* was moved into the intersection between *Guide Factors*, *Organisational Supports*, and *Learning Opportunities*.

The reported WPL supports and inhibitors (Table 5-91) should also feature in the revised theoretical framework. This would provide a starting point for organisations when considering their WPL strengths and weaknesses. These factors did not appear as explicit supports in the theoretical framework that emerged from the literature (Figure 2-9); they were implicit in the other measures. *Promote WPL Supporting Factors* and *Overcome WPL Inhibiting Factors* were placed in the *Organisational Supports* area.

7.2.2 Learning opportunities

Table 6-5 classifies the key findings relating to learning opportunities as:

- Structure of learning opportunities.
Goals and Requirements for Expert Performance appeared in the intersection between *Learning Opportunities* and *Learner Factors* in Figure 2-9. This study found that guides provided this support, along with helping graduates understand work practices, procedures, and learning outcomes (section 6.5.2). As these support structures are provided by guides with little input from learners, this factor should move into the intersection between *Guide Factors* and *Learning Opportunities*.
- Access to learning opportunities.
This factor was placed in the intersection between *Learning Opportunities* and *Organisational Supports* in Figure 2-9. As the guides can influence graduates' access to learning opportunities (Table 5-42), this factor should cross another boundary to include *Guide Factors*.
- Access to knowledge.
Figure 2-9 placed both *Safeguarding Against Learning Inappropriate Knowledge* and *Difficulty Learning Opaque Knowledge* in the intersection

between Learning Opportunities and Organisational Supports. Table 6-5 grouped these together under the heading of *Access to Knowledge*. As the guide has a direct impact on making hidden knowledge accessible through WPL (Table 5-44), Access to Knowledge should cross the boundary and include Guide Factors.

- Sequencing of learning opportunities.

This factor was placed in Figure 2-9 in the intersection between *Learning Opportunities* and *Organisational Supports*. Guides did sequence learning opportunities in the workplace (Table 6-5). As little organisational support was evident in such sequencing, this factor was moved into the intersection between *Guide Factors* and *Learning Opportunities*.

Figure 2-9 identified *Engagement in Routine and Non-Routine Tasks* as a measure under the *Learning Factors* umbrella. This study classified the SE learning opportunities reported by guides and learners into four broad categories (immersion in real projects/tasks, working on projects specifically designed for WPL, use of problem solving techniques, and engagement in collaborative learning – see Table 5-40). Designing projects specifically for WPL would require support from the organisation. As the four categories of learning opportunity appear to have guide, learner, and organisational input, this would imply a universal measure and so should be placed in the area surrounding all these factors in Figure 7-1. *Learning Opportunity Categories Available* encompasses the four new categories listed above and *Engagement in Routine and Non-Routine Tasks*.

Knowledge and Content appeared in Figure 2-9 in the intersection between *Organisational Supports* and *Learning Opportunities*. This was absorbed in Figure 7-1 into the *Learning Opportunity Categories Available* and *Structure of Learning Opportunity* measures (see Appendix Table H-16 for details).

7.2.3 Guide factors

Table 6-1 classified the key findings relating to the guide factors as:

- Guide Selection.

Guide Selection appeared in Figure 2-9 in the intersection between *Guide*

Factors, Learner Factors, and Organisational Supports. Accepting that company-appointed guides appeared more effective and an overall better choice when compared with graduate-selected guides coupled with the care organisations took when selecting guides, the learners' input into guide selection appeared to be unnecessary. The theoretical framework was altered to reflect this and *Guide Selection* now appears in the intersection between *Guide Factors* and *Organisational Supports* only.

- Guide Preparation (previously discussed in section 7.2.1).
- Influences on Guide Participation (previously discussed in section 7.2.1).

Figure 2-9 identified *Levels of Expert Guidance and the Transferability of Knowledge* as a measure under the *Guide Factors* umbrella. As Billett's model of expert guidance emerged as a close fit with the guidance structure in existence in the SE workplace (section 6.6.2), this measure remains in place. As the third level of this model comprises guided learning for transfer, this measure will be renamed as *Levels of Expert Guidance*.

7.2.4 Learner factors

Each of the learner supports identified in the theoretical framework (Figure 2-9) was discussed in the preceding sections. The following list identifies each support followed by the section it was previously discussed in:

- Guide selection (section 7.2.3)
- Learner preparation (section 7.2.1)
- Influences on learner participation (section 7.2.1)
- Engagement in routine and non-routine tasks (section 7.2.2)
- Goals and requirements for expert performance (section 7.2.2)

7.2.5 Strategies

Initially, as literature review progressed, a natural grouping for the WPL strategies emerged (Table 2-3). These categories were called the Instructional Model of Learning, Other Inter-collegial, Self-directed, Intra-organisational, and Extra-

organisational strategies. In this rhetoric, however, no measure of frequency of use or perceived effectiveness of each strategy was available.

Section 6.6.1 cross-tabulated the strategies in each of the above five categories against a spectrum of new categories, *Primary strategies*, *Secondary strategies*, *Tertiary Strategies*, and *Periphery strategies*. These new categories represent both the frequency of use and perceived effectiveness of each strategy in the SE workplace. As this new spectrum provides depth to the original five categories, these will now be used in the theoretical framework instead.

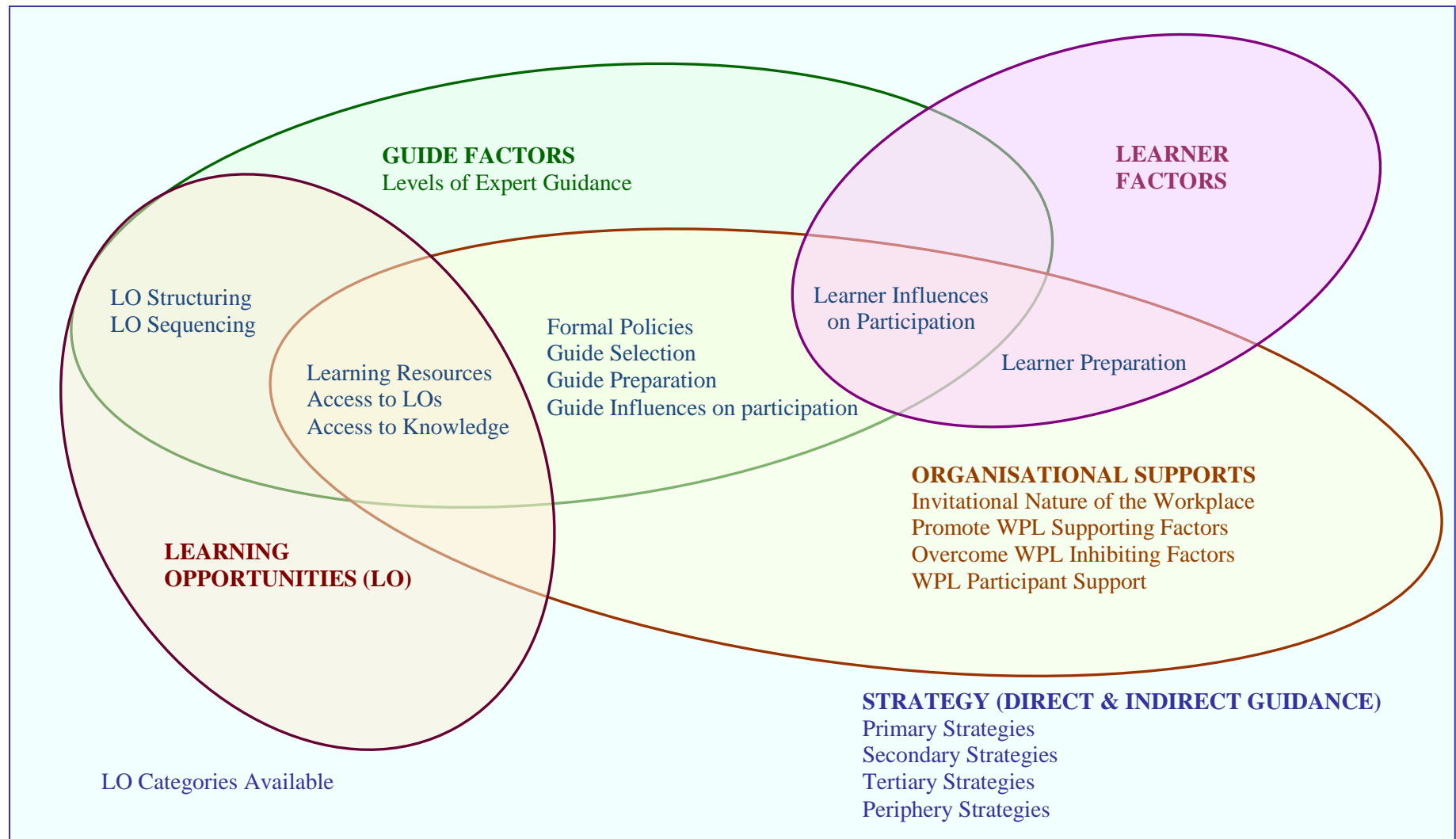


Figure 7-1 The revised theoretical framework based on the reality of the SE WPL

Source: Author

7.3 Applying the revised framework into different contexts

The final research question reflects the revised theoretical framework (Figure 7-1) into both the SE workplace and also into higher education and provides recommendations and suggestions based on this reflection.

Research question 3: Having evaluated the research findings, what are the implications for entry-level SE professionals regarding their role in WPL, organisational WPL practices, and higher education teaching approaches?

The application of the revised theoretical framework into industry is discussed first, followed by the reflection of the framework into higher education.

7.3.1 Application of the revised framework in industry

Billett (2001) suggests that the WCM should be used when novice workers engage in everyday tasks. As a WCM contains WPL strategies, learning opportunities, and their sequencing, it is a subset of the revised theoretical framework. Therefore, the revised theoretical framework could be used by industry to gain insight into their WPL practices and also as a check list for supporting and evaluating current WPL approaches. It could also provide inspiration for future WPL approaches and consequently act as a planning tool. Each of the five categories listed in the revised theoretical framework are taken in turn and shown how and where they could be applicable for industry.

7.3.1.1 Strategy (direct & indirect guidance)

Table 6-7 categorised each WPL strategy as Primary, Secondary, Tertiary, or Periphery based on their current usage and effectiveness in the SE workplace. Primary strategies were the most frequently used and most effective learning strategies in the SE workplace. Secondary strategies were effective strategies but not used as frequently as Primary strategies. Tertiary strategies were used less frequently and not considered that effective. Periphery strategies were virtually never used nor were they considered effective.

Chivers (2011) showed that learning strategies were used by guides without much knowledge of the strategies that existed and which ones best suited the learner's needs. Table 6-7 could possibly help bridge this gap. Initially, industry could focus on using the Primary strategies in the workplace, supported by the Secondary strategies. Following a period of usage, they could reassess the frequency and perceived effectiveness of each of the strategies in use and redesign this table according to their specific organisational needs, learner needs, and strategy successes.

However, it is worth noting that Table 6-7 does not show best practice; it only shows the current popularity and perceived effectiveness of each strategy. For example, reflection worryingly emerged as a Tertiary strategy. This is in line with the study conducted by Drohan (2005) where SE workers cited the lack of time as a reason for not reflecting regularly. WPL strategy best practice could be an area for future study; in particular the impact of workers' reflections on their learning within the SE industry could be looked into.

In Billett's (2001) three level model of expert guidance, the most frequently used level was level one. Industry could review this and focus on developing level two to be the most frequently used, with the ultimate aim of achieving level three guidance.

7.3.1.2 Guide factors

Table 6-1 presented the key finding relating to guide selection and Table 6-2 presented the key findings relating to preparation and participation. These tables could be used by both the organisation and the guide to develop a pertinent checklist for supporting and evaluating their specific WPL needs. This table also highlights that more attention needs to be paid to the preparation of guides, particularly those selected by the graduate. It also shows that guides selected by the organisation emerged as more effective than those selected by the graduate.

7.3.1.3 Learner factors

Table 6-3 presented the key findings relevant for WPL learner preparation and participation. This table could be used by all stakeholders in WPL to develop a

pertinent checklist for supporting and evaluating their specific WPL needs. It is evident from this table that learner preparation is an issue that requires attention.

7.3.1.4 Organisational supports

The key findings relating to WPL organisational supports were classified in Table 6-4 according to WPL Participant Preparation, WPL Participant Influences on Participation, WPL Participant Support, and Invitational Nature. This table could be used by the organisation to develop a pertinent checklist for supporting and evaluating their specific WPL needs. This table clearly shows that remote learning needs more support. The invitational nature of work, according to Skule's (2004) model also needs attention in order to provide a more conducive WPL environment.

Table 5-37 identified typical contents of formal learning policies and learning resources. Table 5-28 detailed the extent that organisations considered identified criteria when developing learning resources. The organisation and other WPL stakeholders could use these tables as pointers when developing or reworking these resources. Table 5-91 also listed some additional pointers that organisations could use to provide more support for WPL and ensure they don't inadvertently inhibit WPL.

7.3.1.5 Learning opportunities

Table 5-66 listed five categories of learning opportunity that could provide ideas or inspiration for choosing or developing learning opportunities suitable for SE graduates. Table 6-5 classified the key findings according to learning opportunity structure, access, and sequencing. It also included access to knowledge. It is evident from this table that organisations should focus on improving access to appropriate learning opportunities, safeguarding graduates from learning inappropriate knowledge, and making hidden, conceptual knowledge more accessible. This table could also be used by the organisation as a checklist for supporting and evaluating WPL, and to support the sequencing of learning opportunities so that learners can follow a learning pathway leading from peripheral to full participation.

7.3.2 Application of the revised framework in higher education

Prior to reflecting the revised theoretical framework (Figure 7-1) into higher education and providing recommendations for teaching practices, it was necessary to obtain a snap shot of the current use and perceived effectiveness of WPL strategies in the higher education classroom (section 7.3.2.1). This snapshot enabled effective reflection by providing a benchmark of current practice in higher education (section 7.3.2.2). However, the snapshot was only of one site, WIT, and future research would need to be conducted across a number of sites to substantiate these recommendations.

7.3.2.1 Current undergraduate WPL strategy use

Table 5-132 to Table 5-136 listed the undergraduates' perspective on the frequency of use and perceived effectiveness for each of the five categories of strategy (Instructional Model of Learning, Other Inter-collegial, Self-directed, Intra-organisational, and Extra-organisational Strategies) in the higher education classroom. Using the data in these five tables, this section classified each learning strategy as Primary, Secondary, or Periphery according to the rules listed in Table 7-1. Note that there is no Tertiary strategy category for undergraduates as there is only one group of respondents, the undergraduates.

Table 7-1 Classification rules for WPL strategies (undergraduates only)

Source: Author


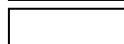
	Frequency	Perceived Effectiveness
Primary Strategies	≥ 3.0	≥ 3.5
Secondary Strategies	< 3.0	≥ 3.5
Periphery Strategies	< 3.0	< 3.5

The results of this classification can be seen in Table 7-2. This table represents a WPL strategy spectrum where at one end, the Primary strategies are the most frequently used and perceived as the most effective WPL strategies in higher education and at the other end of the spectrum lies the Periphery strategies which are virtually never used nor considered effective. This table also colour coded the direct strategies in purple and the indirect strategies in white. No direct strategy appeared in the Periphery category.

Table 7-2 WPL strategy spectrum (current use and perceived effectiveness in SE undergraduate education)

Source: Author

Source: Author	Primary strategies	Secondary strategies	Periphery strategies
Instructional Model of Learning	Modelling	Coaching	Articulation
	Analogies		
	Diagrams	Questioning	Discussion (team meetings)
	Scaffolding		
	Fading	Teaching others	
	Discussion (informal)		
	Learning from mistakes	Reflection	
	Exploration		
Other Inter-collegial	None	Observation	Shadowing
		Feedback	Learning Logs
Self-directed	Books	Practice and Repetition	Professional Journals
		Manuals	Third Level Libraries
	Internet	CBT	CDs
			DVDs
Intra-organisational	None	Knowledge bases	Integrated exchange (suggestion boxes)
			Integrated exchange (newsletters)
		Stretching (demanding work)	Integrated exchange (information sessions)
			Integrated exchange (bulletins/memos)
			Stretching (deep end)
Extra-organisational	None	External Professional Networks	Trade Fairs
			Research Centres
			Conferences / Seminars

Legend: Direct strategies 
Indirect strategies 

7.3.2.2 Applying the framework to higher education

When comparing the WPL strategy spectrum from industry (Table 6-7) with the current strategy use in undergraduate higher education (Table 7-2), a total of fifteen strategies appeared in different category brackets, which can be seen in Table 7-3.

Table 7-3 Comparing WPL strategy spectra (SE Workplace versus SE Higher Education)

Source: Author

Strategy	SE Industry Category	SE Higher Education Category	Change
Articulation	Primary	Periphery	Demoted 2 categories
Discussion (team meetings)	Primary	Periphery	Demoted 2 categories
Stretching (deep end)	Primary	Periphery	Demoted 2 categories
Practice and repetition	Primary	Secondary	Demoted 1 category
Knowledge bases	Primary	Secondary	Demoted 1 category
Stretching (demanding work)	Primary	Secondary	Demoted 1 category
Shadowing	Tertiary	Periphery	Demoted 1 category
Professional journals	Tertiary	Periphery	Demoted 1 category
Networking (research centres)	Tertiary	Periphery	Demoted 1 category
Integrated exchange (information sessions)	Tertiary	Periphery	Demoted 1 category
Analogies	Secondary	Primary	Promoted 1 category
Books	Secondary	Primary	Promoted 1 category
Reflection	Tertiary	Secondary	Promoted 1 category
External professional networks	Tertiary	Secondary	Promoted 1 category
CBT	Tertiary	Secondary	Promoted 1 category

When compared with the strategy use in the workplace, a total of ten strategies were demoted one or more categories in higher education (see Table 7-3). Articulation, discussion (team meetings), and stretching (deep end) are primary strategies in the workplace but appear as periphery strategies in higher education. Practice and repetition, knowledge bases, and stretching (demanding work) are primary strategies in the workplace but appear as secondary strategies in higher education. Shadowing, professional journals, research centres, and information sessions were tertiary

strategies in the workplace, but appeared as periphery strategies in higher education. Higher education should focus more on including these strategies in the undergraduate classroom in order to prepare the graduates for the current WPL landscape and expectations.

When compared with the strategy use in the workplace, a total of five strategies were promoted one category in higher education (see Table 7-3). Analogies and books appeared as secondary strategies in the workplace but were primary strategies in higher education. Reflection, external professional networks, and CBT appeared as tertiary strategies in the workplace, but appeared as secondary strategies in higher education. Based on this, these strategies would require little or no attention in higher education.

From the strategy use perspective, higher education should focus more on ensuring that the primary strategies used in the workplace are more prevalent in the classroom. Particular attention should be drawn to the six primary strategies in the workplace that were demoted in higher education (articulation, team meetings / discussion, being thrown in the deep end, practice and repetition, use of knowledge bases / previous problem solutions and engaging in demanding work). These strategies, excluding practice and repetition, are typical characteristics of the Problem-based learning (PBL) approach. In addition, other primary strategies such as informal discussion, learning from mistakes, and exploration and secondary strategies such as questioning, teaching others, and reflection are also characteristics of the PBL approach (Drohan 2005). Previous research suggests that the SE problems encountered in the workplace share very similar characteristics to PBL problems (Drohan 2005). For these reasons, SE higher education should consider using PBL as a curriculum delivery mechanism, if not already doing so.

From the guide factor perspective, the guide selection criteria will have little applicability in higher education as lecturers are resourced by management and much of the criteria are already used when selecting lecturers for specific modules. However, the remaining criteria such as preparation, participation, and the relationship with the learner could be used by lecturers as pointers when preparing and delivering their modules (see Table 6-1 and Table 6-2). From the learner factor perspective,

preparation, participation, and the relationship with the guide could be used to inform students of an acceptable ethos while also providing motivations for engaging in learning (see Table 6-3).

The organisational supports area would also provide some valuable pointers for structuring content delivery and approaches e.g. providing team structures capable of providing opportunities for collaborative learning, allowing graduates adequate time to settle into their role, and so on (see Table 6-4).

The learning opportunities category could be one of the most valuable areas for higher education in that it provides many suggestions for designing project work and course content for SE modules (see Table 5-66 and Table 6-5). It also advocates collaborative learning and problem solving techniques as learning opportunities in the workplace, which further strengthens the case for using PBL in SE classrooms.

7.4 Conclusion

In this chapter, the rhetoric was compared to the reality in relation to the WPL supports and strategies that exist for SE graduates. Arising from this comparison, the theoretical framework was revised (Figure 7-1). This revised framework was reflected into the workplace and also into higher education and recommendations were provided. This reflection answered research question 3.

The following chapter, Chapter 8, revisits the overall research aim and objectives, presents the key findings and recommendations, details the contribution of the study to WPL and higher education, addresses the limitations of the research, provides future research directions, and concludes this research study.

CHAPTER 8

CONCLUSION

8.1 Introduction

This chapter concludes the research study by revisiting the aim and objectives of the study and detailing how each was achieved. The key findings and recommendations of the study are then documented followed by the contribution of the study to both WPL theory and practice. The contribution of the study to higher education is also identified. The chapter concludes with the limitations of the research and the future research directions that could be explored.

8.2 Revisiting the aim and objectives of the study

The overall aim of this research was to investigate the organisation of the workplace to support the WPL that entry-level SE graduates encountered whilst engaged in everyday work practices and activities and use this information to inform WPL practices and higher education teaching practices. Five objectives contributed to the overall aim:

1. To review the relevant literature relating to WPL strategies and supports to obtain a comprehensive understanding of the research topic.
2. To investigate the WPL strategies and supports that a SE graduate encounters while participating in everyday work practice and activities in an entry-level SE position.
3. To investigate the perceived effectiveness of these WPL strategies and supports for enabling SE entry-level graduates to become competent in their SE role.
4. To illustrate how the WPL strategies and supports identified above interconnect, thereby gaining insights into the perceived structure of WPL environments for entry-level SE graduates.
5. To explore the application of the structured WPL environment in:
 - a. industry for improving WPL practices and SE graduates' competency.

- b. higher education for improving the readiness of SE graduates for the expectations of WPL practices.

The first objective was met by conducting an extensive trawl of the WPL supports and strategies literature, and using this knowledge to formulate an extensive literature review chapter and frame the research questions.

The second and third objectives were met by investigating five factors that structure WPL, namely, Guide Factors, Learner Factors, Organisational Supports, Learning Opportunities, and WPL Strategies. Guide selection, preparation, supports, motivations, and their relationship with the learner were studied along with the perceived effectiveness of each measure. Learner preparation, motivations, and relationship with their guide and the perceived effectiveness of these measures were also looked at. Organisational supports such as preparing, encouraging, supporting, and facilitating the participation of WPL learners and guides were studied along with the invitational nature of the workplace. The perceived effectiveness of each of these organisational supports was also appraised. The organisations' policies and learning resources were researched to identify typical contents. The types of learning opportunities available in the workplace were identified, their structure was investigated, learner access to them was established, and their sequencing was determined. Finally, WPL strategy use and perceived effectiveness was investigated and the strategies were categorised according to Primary, Secondary, Tertiary, and Periphery use.

The fourth objective was met by initially developing the theoretical framework based on the rhetoric available in the literature, prior to conducting the field research (Figure 2-9) and revising it based on the synthesis of the findings from the study (Figure 7-1). This revision illustrated the perceived realities of SE WPL and the interconnectedness of the WPL supports and strategies for entry-level SE graduates.

In relation to the fifth objective, the first part was met by reflecting the revised theoretical framework (Figure 7-1) into current WPL practices. In particular, the framework was reflected into each of the five categories (Strategy, Guide, Learner, Organisational Supports, and Learning Opportunities) and suggestions were made for

supporting and evaluating WPL. The second part of the fifth objective was met by first comparing the strategy use in the revised theoretical framework (Figure 7-1) with the current strategy use in higher education (Table 7-2). Following this, proposals were made for including the most popular and effective WPL strategies in the classroom. The remaining four categories, Guide, Learner, Organisational Supports, and Learning Opportunities were reflected into higher education and recommendations were provided for teaching practices that could potentially improve the readiness of SE graduates for the expectations of WPL practices.

The overall aim of this study was successfully achieved by evolving the WPL supports and strategies rhetoric (theoretical framework Figure 2-9) to include the perceived reality (revised theoretical framework Figure 7-1) and reflecting it into WPL practice and higher education. Based on this reflection, recommendations were made for both WPL and higher education practices.

8.3 Key findings and recommendations

The key findings emerging from this study are itemised below in accordance with each of the five factors on the revised theoretical framework (Figure 7-1). These key findings are important as they provide an enhanced understanding of the WPL terrain for SE graduates. Overall, the WPL environment, namely the revised theoretical framework, was perceived as effective for developing SE graduate competencies. It is recommended that participants and stakeholders in SE graduate WPL review these key findings in conjunction with the revised theoretical framework when either planning or evaluating SE graduate WPL.

Guides (see Table 6-1 and Table 6-2 for more key findings)

- Guides emerged as an effective support for WPL, particularly guides selected by the organisation.

Learners (see Table 6-3)

- Learners that selected their own guide were not adequately prepared for WPL and this was considered ineffective.

Both learners and guides (see Table 6-1, Table 6-2, and Table 6-3 for more key findings)

- Learners and guides were very willing to engage in WPL.
- Learners had a very good relationship with their guide and vice versa.
- WPL emerged as more effective when graduates were allocated a guide by the organisation as opposed to the graduate selecting their own guide.

Organisational Supports (see Table 6-4)

- Organisations were an effective support for WPL.
- Organisations could support remote learning better.
- Production demands took precedence over WPL more so than not.
- The invitational nature of the SE workplace was above average.

Learning opportunities and their sequencing (see Table 6-5)

- Learning opportunities were structured more so than not.
- Learning opportunities were sequenced in pathways of learning more so than not, particularly by increasing responsibility and difficulty.

Direct and indirect strategies (see Table 6-7)

- The Instructional Model of Learning (Collins *et al* 1987), which has been in existence for many years, was considered effective for SE graduate WPL.
- Direct guidance strategies were used more so than not whereas the majority of indirect guidance strategies were ranked below average use, with many not being used at all.
- There was a trend to use dynamic resources more so than static resources for WPL. An example of a dynamic resource includes the use of knowledge bases which would be maintained on a regular basis in the organisation. Static resources would include CDs, and DVDs.
- The most effective strategies were using the Internet, scaffolding, diagrams, feedback, and using knowledge bases of previous problem solutions.

8.4 Contribution to WPL

The contribution to the field of WPL knowledge is covered from both a theoretical and a practical perspective. From the theoretical perspective, research into WPL is sparse (Livingstone 2001), limited, and largely anecdotal (Noe *et al* 2013), with few studies investigating the WPL of entry-level professionals commencing their career (Metso and Kianto 2014). There is also a paucity of WPL research conducted specifically in the SE discipline (Lohman 2005a). The findings and recommendations from this study have contributed to bridging this gap by providing a revised theoretical framework and supporting tables detailing the SE graduate WPL terrain.

This study also details the methodology and supporting research instruments for exploring the structure of WPL in the SE discipline from multiple stakeholder perspectives. These research instruments could be easily tailored for other disciplines and deployed to produce WPL structures specific to the discipline.

From a practical perspective, the SE industry depends on the competency of its professionals (Reed and Kelly 2002). Engagement in lifelong learning is a key to worker success (OECD 2007) and organisational success is fostered when WPL is a core strategic element (O' Connor 2004; Rowden 2007; Noe *et al* 2010). In order to structure, guide, and evaluate WPL, the SE industry could use the revised theoretical framework. Also, a suite of checklists to plan, structure, and evaluate WPL endeavours could be developed by organisations from the tables supporting the revised theoretical framework. Chapter 6 provides multiple suggestions for incorporating the research findings into WPL practice (see section 7.3.1).

8.5 Contribution to higher education

This study could improve teaching and learning practices in higher education. Chapter 6 provides multiple suggestions for incorporating the research findings into third level classrooms (see section 7.3.2.2). As a case in point, the findings from this study are currently used in SE undergraduate education by a WIT colleague of the author. In many level 8 SE courses in WIT, there is a module called *Preparation for Flexible Semester* whose aim is to “prepare and encourage students to capitalise on the learning potential of their internship experience...focus on developing students’

transferrable skills while also introducing them to reflective practice, WPL strategies, ethics and awareness” (WIT, 2012, p.1). The findings from this study are currently used to familiarise students, embarking on their industrial placement, with the types of learning strategies that they could use in the workplace so that they can maximise their placement experience. The findings from this study also make the undergraduates more aware of the active role they must take when learning in the workplace. This approach promotes the concept of lifelong learning, a necessary skill in the constantly evolving and innovative SE workplace.

The author also uses the findings to inform her delivery of programming modules in undergraduate SE courses. Programming labs are designed to include as many Primary strategies as is practical. Assignments, where applicable, use the PBL approach and incorporate many Primary strategies. The guide preparation, participation, and relationship factors reflect the andragogical approach adopted. The categories of learning opportunity are used for inspiration when developing both lab work and assignments. Other suggestions such as pair-programming are used in both labs and PBL problems.

8.6 *Limitations of the research*

The method limitations were discussed in section 4.4 and covered limitations relating to the survey method, the target population, and the sampling approach. The limitations associated with the survey method included the absence of a time dimension in the study, the use of only one site when deploying the undergraduate survey, and the bias related to self-reporting. The limitations associated with the population included organisations declining to participate in the study due to heavy workload and the possibility that graduate respondents were of a higher calibre as they were selected from a larger recruitment pool due to the recent global economic downturn. The sampling approach also had its own limitations. As non-probability sampling was used, strictly speaking, it was not possible to generalise the results to the overall population. However, based on the background data gathered, the respondents in this study could be said to be typical of the target population, and therefore generalisable to the extent that they are representative. However, this sampling limitation should be borne in mind when critiquing this study. In addition, when the

organisations used snowball sampling to secure respondents, there was potential they were selecting individuals with similar views and characteristics, which could lead to a sampling bias.

The reliance on one research method (survey) could also have limited the study. The study would have benefited from follow up interviews with the respondents to get a more in-depth picture of WPL. However, time was a factor and the allowable timeframe for completing a Ph.D. did not lend itself to follow up interviews. This could be a future avenue of research.

Ashton (2004) suggests one methodological limitation in current WPL research is the tendency of researchers to focus on one particular discipline or workers holding positions of similar responsibility. Amongst others, he cites examples of how Fuller and Unwin focused on apprentices and Billett focused on hairdressers and small business proprietors. Adopting such a localised approach, Ashton (2004) argues can result in the wider organisational structures and influences taking a back seat in the study, resulting in the relationship between the organisational structures and localised learning processes being poorly understood. This study focused solely on SE graduates in their first year of employment in the industry. However, being aware of the above limitation, this research endeavoured to understand the relationship between the organisational structure and the learning process by soliciting responses from all WPL stakeholders, namely, the learner, the guide, and the organisation. However the low response rate from organisations (10 respondents in total) would indicate that this limitation could exist to a degree, however, it must also be borne in mind that this study was also only interested in determining the guided learning supports for a narrow group of workers.

8.7 Future research directions

In addition to using the research approach adopted in this study to investigate various disciplines, several other important future research directions emerged as a result of conducting this study. Future directions related to the WPL discipline include:

- Testing the revised theoretical framework.
- Determining the readiness of WPL learners for their learning role.

- Evaluating the use of the Internet and social media in WPL.
- Examining why indirect strategies are not used more frequently, as findings show they are perceived as effective.
- Extension of the revised theoretical framework to include strategies that are considered best practice, rather than those WPL participants perceive as effective.

Each of these is now discussed in turn.

The most apparent avenue for future research arising from this study would be to test the revised theoretical framework in the SE industry. This could further evolve the framework and develop a series of field tested check lists and supporting documentation. In addition, the application of the revised theoretical framework into SE higher education could also be field tested and advanced more through future study. Such efforts would prepare the SE graduates more for the expectations of WPL upon graduation. This revised theoretical framework could also be tested with SE internship students and the modules preparing the students for SE work placement could evolve based on that research.

The readiness of SE graduates for their WPL role could be explored. Particular areas that could be looked at include graduates' entry-level familiarity with the most popular and effective WPL strategies followed by their learning curve and length of time it takes to become proficient in their role, through the use of these WPL strategies.

The use of the Internet and social media for WPL could be a significant novel research area. This study showed that the Internet was the most frequently used strategy and, in general, the most effective. Social media also emerged as a strategy that was used in WPL. Insight into the use and perceived effectiveness of the Internet and social media for WPL would be a considerably large area of study. Lohman (2005a) also recommended future research in this area. Such a study could take place in the SE workplace, or could be discipline independent.

The findings showed that the majority of indirect guidance strategies were not used frequently (Table 5-130) with many indirect guidance strategies not being used at all (Table 5-126). However, they were typically perceived as effective, with minimal indirect strategies reported as ineffective (Table 5-131). Future research could examine why these strategies are not being used more, particularly as they are considered effective.

Table 6-7, categorised the WPL strategies according to current popularity and perceived effectiveness, but does not show best practice. For example, reflection emerged as a Tertiary strategy even though many authors recognise reflection as an essential component in the learning process (Kolb 1984; Collins *et al* 1987; Houldsworth *et al* 1997; Clifford 2007). Future research could add another dimension to this table by determining which strategies would result in superior WPL.

From a methodological perspective, a single research instrument could be developed, containing formative scales that could be given to both graduates and guides. This would allow sophisticated inferential statistics to be used freely. Such a scale should be tested for reliability and validity. Opportunities also exist for more in-depth study involving case studies or grounded research. This current study recognised learning as an individual and personal process, where the unit of analysis was delimited to the individual and the focus was on processes and practices rather than relationships. However this study merely scratched the surface of the relationship dynamic topic and uncovered its importance. The learner-guide relationship emerged as one of the most effective WPL supports. Also, the guides and learners identified the importance of collaborative learning as an additional learning strategy along with engagement in collaborative learning as an additional learning opportunity. Team structures capable of providing opportunities for collaborative learning were also prevalent. The dynamics associated with the learner-guide relationship and collaborative learning is an extensive, complex topic that could be explored further. Future research could focus more on gaining personal insights into this area, through the use of narrative case studies and grounded research.

8.8 Conclusion

This study provided insight into WPL structures and supports that entry-level SE graduates encountered whilst engaged in everyday work practices and activities resulting in a revised theoretical framework. This revised framework mapped the reality of SE WPL.

From a practical perspective, the framework and its supporting tables (i.e. Table 6-1 to Table 6-7) have many implications for industry. The tables could be used as a checklist for supporting and evaluating current WPL approaches. Combining the tables with the framework could enable stakeholders to gain an insight into their own WPL practices and indicate where improvements could be made in their organisations. The framework and tables could also provide inspiration for future WPL approaches and act as a planning tool. The framework and its supporting tables also have implications for tertiary education, for example, providing recommendations for teaching practices, providing a check list for supporting and evaluating current tertiary education approaches, and furnishing inspiration for future teaching approaches.

From a theoretical perspective, this study contributes to WPL theory and research methodology. Research into WPL is sparse, limited, and largely anecdotal, with few studies investigating the WPL of entry-level professionals. There is also a paucity of WPL research conducted specifically in the SE discipline. The findings and recommendations from this study have contributed to bridging this gap by providing a revised theoretical framework based on the reality of the SE graduate WPL terrain, along with supporting tables. The study details a methodology and supporting research instruments for exploring the structure of WPL in the SE discipline from multiple stakeholder perspectives. This approach could be easily tailored for other disciplines and future research conducted in those areas.

Future research, continuing on from this study, could perform an in-depth longitudinal study, using the revised framework as a starting point. This approach could be used to ascertain how entry-level SE graduates develop over a given period of time (potentially measured using the Dreyfus (2004) model of skill acquisition). It could also be used to determine the impact that personal characteristics and beliefs have on

WPL and its perceived effectiveness (the time dimension could be studied here). Finally, using a longitudinal approach could yield a more in-depth picture of the WPL supports and strategies, with a particular focus on specific strategies.

Many avenues for future, standalone research emerged during this study. One finding showed that indirect strategies were considered effective, but were not being used frequently. Future research could determine why these effective strategies are not being used more. Another extensive, complex topic that could be investigated is the dynamics associated with the learner-guide relationship and collaborative learning. Such a study could focus more on gaining personal insights through the use of narrative case studies and grounded research.

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APPENDIX A –
Cold-call email for target organisations

Subject: Research study: Investigating entry-level software engineering graduates on-the-job learning.

Message body:

Dear <name, if available>,

My name is Siobhan Drohan and I am a Lecturer in Computing in Waterford Institute of Technology.

I am conducting a research study that I hope would improve software engineering graduates ability to learn on-the-job and I am hoping that <insert organisation name> would be in a position to participate in the study. If you have hired software engineering graduates in the past few years, you would be perfect for the study and I would be delighted if you could participate.

The objective of this study is to provide valuable information regarding on-the-job learning that software engineering graduates' receive in their first year of employment. The results will provide a unique insight into how on-the-job learning is structured for entry-level software engineering graduates as well as more in-depth information on the frequency and perceived effectiveness of the on-the-job strategies currently being used. By reflecting the findings into third-level curricula and teaching practices, it is envisaged that entry-level software engineering graduates' ability to learn on-the-job will be improved.

All information supplied in the surveys will be kept strictly confidential. The organisation name will never be published and findings from this study will be disseminated as summative statistics and anonymous quotes from participants.

If you are happy to participate in this study, please follow the instructions laid out below. If you have any questions, please don't hesitate to contact me on 087-2959755 or sdrohan@wit.ie.

Instructions

In order to obtain a transparent and balanced representation of entry-level on-the-job learning, three groups need to be surveyed. Please distribute the relevant survey link to each group (I have attached PDF files of each survey for information purposes):

- Graduates: A 30 minute survey for software engineering graduates having recently completed (i.e. in the past year / few years) their first year of work following graduation. It would be great if multiple graduates completed this survey. Please distribute this link to graduates: <http://www.surveymonkey.com/s/7HQNG6C>
- Experienced colleagues: A 25 minute survey for experienced colleagues that support entry-level software engineering graduates on-the-job learning. It would be great if multiple experienced colleagues completed this survey.

Please distribute this link to experienced colleagues: <http://www.surveymonkey.com/s/7HTKFFM>

- The organisation: A 15 minute survey for the person responsible for the professional development or training of all software engineering graduates in the organisation. The link to the organisation survey is: <http://www.surveymonkey.com/s/7HMZJW2>

Looking forward to hearing from you and kind regards,
Siobhan Drohan.

Attachments: A PDF file containing each survey was attached to this email. This allowed potential respondents to view the surveys prior to committing to the research. It also encouraged the face validation of the field research instruments by the respondents.

APPENDIX B –

Follow up email for target organisations

Subject: Research study: Investigating entry-level software engineering graduates on-the-job learning.

Message body:

Dear <name, if available>,

I'm just following up on this study. I wonder if you have had a chance to review this study and if <insert organisation name> are in a position to participate, please?

Your participation would be very much appreciated as it would help us to improve our graduates' ability to learn on-the-job. If you have any questions, please don't hesitate to contact me.

All the best and thanks again for any support you can give me with this study, Siobhan.

Attachments: The original email that was sent a few weeks previously.

APPENDIX C –
Email for WIT SE lecturing staff

Subject: Research study: Investigating entry-level software engineering graduates on-the-job learning.

Message body:

Dear colleagues,

I am currently coming to the end of my PhD field research that is investigating entry-level software engineering graduates' workplace learning in their first year of employment following graduation.

However, in order to reflect my findings into third level curricula, I need to survey undergraduate software engineering students to determine the prevalence and frequency of use of workplace learning strategies currently used in undergraduate courses. I have ethics committee approval for this survey and I have attached it in PDF format. No personal information is requested at all and the information supplied in the surveys will be kept strictly confidential and only disseminated in summative format.

The survey takes 10 minutes to complete and generally comprises of a series of drop-down boxes. If you teach on any of the computing degrees in WIT and you are happy for your students to participate in this study, I would be delighted if you could post the information below in your module(s) News Forum in Moodle and draw your students' attention to it in practical class. This survey is applicable to full-time and part-time (ACCS) students studying at undergraduate or masters level.

If you have any questions, please don't hesitate to contact me.

All the best,
Siobhan.

Instructions for the students:

Dear student,

My colleague, Siobhan Drohan is currently conducting research that investigates entry-level software engineering graduates' workplace learning in their first year of employment following graduation.

However, in order to reflect the findings into third level curricula, she needs to survey undergraduate software engineering students to determine the prevalence and frequency of use of workplace learning strategies currently used in undergraduate courses.

Siobhan would be delighted if you would participate in this study by completing the following survey: <http://www.surveymonkey.com/s/UndergraduateSurveyWIT>

It takes 10 minutes, no personal information is gathered and all the information supplied will be kept strictly confidential and only disseminated in summative format.

All the best,
<insert name here>

Attachments: A PDF file containing the undergraduate survey was attached to this email. This allowed the computing lecturers to view the surveys prior to committing to the research and sending the details to their students.

**APPENDIX D –
Graduate survey**

Graduate Survey

1. Introduction

DESCRIPTION: The purpose of this study is to obtain valuable information regarding the on-the-job learning that software engineering graduates receive in their first year of employment. On-the-job learning refers to any workplace learning that takes place OUTSIDE of formal classes and workshops.

PARTICIPATION: Your participation in this study is critical (and very much appreciated) to ensure that the results are an accurate representation of the on-the-job learning that software engineering graduates experience.

RESULTS: The results of this survey will provide a unique insight into the structure of the workplace learning environment for software engineering graduates as well as more in-depth information on the effectiveness of the on-the-job strategies currently being used. These results will be reflected back into third-level courses to better prepare graduates for on-the-job learning.

CONFIDENTIALITY: All information supplied in this survey will be kept strictly confidential and individual responses will NOT be made available to your employer.

DURATION: There are between 31 and 34 questions in this survey (depending on your responses) and it should take approximately 30 minutes to complete. The majority of questions comprise drop-down boxes and scales for measuring effectiveness and frequency.

Graduate Survey

2. Section A - Background and Employment Information

1. Name:

2. Age:

3. Gender:

☐

Male

☐

Female

* 4. What year did you graduate from college?

Options: 2006 - 2010

* 5. What is the name of the organisation you work for?

* 6. When did you start working for this organisation?

Start Date:

Month Options: Jan – Dec
Year Options: 2006 - 2010

* 7. What is your employment status with this organisation?

and what is your job title?

Options:
Permanent Full-time
Permanent Part-time
Non-permanent Full-time
Non-permanent Part-time

8. To what extent do you agree or disagree with the following statements:

	Strongly Disagree(1)	Disagree(2)	Neither agree or disagree(3)	Agree(4)	Strongly Agree(5)
a) My customers are very demanding	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
b) My company is very demanding	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
c) My managers are very demanding	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
d) My colleagues are very demanding	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
e) My job requires that I engage in decision making	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
f) My job requires that I engage in project management tasks	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
g) My job exposes me to frequent changes in technology, products and processes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

* 9. Before you started working for this organisation, did you have any prior experience working in a software engineering role (e.g. work experience, internships, summer job, etc)?

Options: Yes/No
Logic: Yes → Q10
No: → Q12

Graduate Survey

3. Section A.2 - Details of Work Experience

Please provide details of your prior work experience.

10. When did this prior work experience take place?

	Month	Year
Start Date:	<input type="text"/>	<input type="text"/>
End Date:	<input type="text"/>	<input type="text"/>

Month Options: Jan – Dec
Year Options: 2006 - 2010

11. What were your typical duties?

Graduate Survey

4. Section B - On-the-job Learning Strategies (1 of 4)

REMINDER: Please answer these questions in relation to your on-the-job learning in your first year of employment following graduation.

12. When learning on-the-job:

	How often did you learn in this manner?	How effective was this strategy in developing your ability to perform your role as a software engineer?
a) Did an experienced colleague demonstrate to you how to perform a particular task?	<input type="text"/>	<input type="text"/>
b) Did you learn by eavesdropping, observing or listening to experienced colleagues while they undertook work or discussed tasks with other workers?	<input type="text"/>	<input type="text"/>
c) Did experienced colleagues use analogies with you (i.e. to draw similarities and/or highlight differences between selected concepts)?	<input type="text"/>	<input type="text"/>
d) Did experienced colleagues use diagrams / models with you to represent concepts that are difficult to explain?	<input type="text"/>	<input type="text"/>
e) Did you perform work tasks while experienced colleagues closely monitored your performance and provided feedback on it?	<input type="text"/>	<input type="text"/>
f) Did you articulate your thought process and problem solving approaches, either orally or written, in an effort to justify your approach to a particular work task?	<input type="text"/>	<input type="text"/>
g) Did experienced colleagues ask you questions so that you could justify and rationalise your reasoning behind a particular work task?	<input type="text"/>	<input type="text"/>
h) Did you teach any of your colleagues in the workplace?	<input type="text"/>	<input type="text"/>
i) Did you regularly take stock of what you learned by reflecting on your own learning and how it can improve your performance?	<input type="text"/>	<input type="text"/>
j) Did you keep a reflective journal / learning log?	<input type="text"/>	<input type="text"/>
k) Did you learn from mistakes you made when trying things out in the workplace?	<input type="text"/>	<input type="text"/>
l) Did you learn by finding your own way when solving problems, without support from your colleagues?	<input type="text"/>	<input type="text"/>
m) Did you learn about your role by consciously shadowing an experienced worker for a period of time?	<input type="text"/>	<input type="text"/>
n) Did you repeatedly practise new skills/tasks?	<input type="text"/>	<input type="text"/>
o) Did you learn by working above your grade?	<input type="text"/>	<input type="text"/>
p) Did you learn by voluntarily engaging in demanding work?	<input type="text"/>	<input type="text"/>
q) Did you learn by being thrown in the deep end?	<input type="text"/>	<input type="text"/>
r) Did you learn through deliberate role transfer i.e. working for any period of time in more than one role in the organisation?	<input type="text"/>	<input type="text"/>
s) Did you learn by working abroad for the organisation?	<input type="text"/>	<input type="text"/>
t) Was a training plan developed specifically for you?	<input type="text"/>	<input type="text"/>
u) Did you have formal performance appraisals?	<input type="text"/>	<input type="text"/>

Never(1)
Occasionally(2)
Average(3)
Often(4)
Very Often(5)

Very Ineffective(1)
Ineffective(2)
Neither Effective or Ineffective(3)
Effective(4)
Very Effective(5)
N/A (didn't use this strategy)

Graduate Survey

5. Section B - On-the-job Learning Strategies (2 of 4)

REMINDER: Please answer these questions in relation to your on-the-job learning in your first year of employment following graduation.

13. Did you learn by engaging with peers or experts through:

	How often did you learn in this manner?	How effective was this strategy in developing your ability to perform your role as a software engineer?
a) Informal chats with colleagues (e.g. over coffee breaks)	<input type="text"/>	<input type="text"/>
b) Discussions with customers / clients / suppliers	<input type="text"/>	<input type="text"/>
c) Technical support from customers /clients / suppliers	<input type="text"/>	<input type="text"/>
d) Team meetings	<input type="text"/>	<input type="text"/>
e) External professional or occupational networks (e.g. IEEE, ACM, etc)	<input type="text"/>	<input type="text"/>
f) Trade fairs	<input type="text"/>	<input type="text"/>
g) Specialised research centres	<input type="text"/>	<input type="text"/>
h) Conferences / seminars	<input type="text"/>	<input type="text"/>

Never(1)
Occasionally(2)
Average(3)
Often(4)
Very Often(5)

Very Ineffective(1)
Ineffective(2)
Neither Effective or Ineffective(3)
Effective(4)
Very Effective(5)
N/A (didn't use this strategy)

Graduate Survey

6. Section B - On-the-job Learning Strategies (3 of 4)

REMINDER: Please answer these questions in relation to your on-the-job learning in your first year of employment following graduation.

14. Did you learn using any of the following resources:

	How often did you learn in this manner?	How effective was this resource in developing your ability to perform your role as a software engineer?
a) Books	<input type="text"/>	<input type="text"/>
b) Manuals	<input type="text"/>	<input type="text"/>
c) Internet	<input type="text"/>	<input type="text"/>
d) Professional journals	<input type="text"/>	<input type="text"/>
e) College / university libraries	<input type="text"/>	<input type="text"/>
f) CDs	<input type="text"/>	<input type="text"/>
g) DVDs	<input type="text"/>	<input type="text"/>
h) Computer based training	<input type="text"/>	<input type="text"/>
i) Company suggestion boxes	<input type="text"/>	<input type="text"/>
j) Company newsletters	<input type="text"/>	<input type="text"/>
k) Company information sessions	<input type="text"/>	<input type="text"/>
l) Company bulletins/memos	<input type="text"/>	<input type="text"/>
m) Knowledge bases of previous problem solutions	<input type="text"/>	<input type="text"/>

Never(1)
Occasionally(2)
Average(3)
Often(4)
Very Often(5)

Very Ineffective(1)
Ineffective(2)
Neither Effective or Ineffective(3)
Effective(4)
Very Effective(5)
N/A (didn't use this strategy)

Graduate Survey

7. Section B - On-the-job Learning Strategies (4 of 4)

REMINDER: Please answer these questions in relation to your on-the-job learning in your first year of employment following graduation.

15. When learning on-the-job, did you:

	How often did you learn in this manner?	As you repeatedly performed such tasks, did the expert provide less and less support until you could complete the task on your own?	How effective was this strategy in developing your ability to perform your role as a software engineer?
Practise tasks that you did not have the knowledge to finish on your own, but had guidance and advice from an expert to help you complete it?	<input type="text"/>	<input type="text"/>	<input type="text"/>
<div>Never(1)</div> <div>Occasionally(2)</div> <div>Average(3)</div> <div>Often(4)</div> <div>Very Often(5)</div>	<div>Never(1)</div> <div>Occasionally(2)</div> <div>Average(3)</div> <div>Often(4)</div> <div>Very Often(5)</div> <div>N/A (didn't use this strategy)</div>	<div>Very Ineffective(1)</div> <div>Ineffective(2)</div> <div>Neither Effective or Ineffective(3)</div> <div>Effective(4)</div> <div>Very Effective(5)</div> <div>N/A (didn't use this strategy)</div>	

16. When learning on-the-job, did you:

	How often did you learn in this manner?	Did you receive mostly negative or positive feedback?	How effective was this strategy in developing your ability to perform your role as a software engineer?
Get feedback from individuals or teams relating to your performance?	<input type="text"/>	<input type="text"/>	<input type="text"/>
<div>Never(1)</div> <div>Occasionally(2)</div> <div>Average(3)</div> <div>Often(4)</div> <div>Very Often(5)</div>	<div>Mostly negative</div> <div>Mostly positive</div> <div>N/A (didn't use this strategy)</div>	<div>Very Ineffective(1)</div> <div>Ineffective(2)</div> <div>Neither Effective or Ineffective(3)</div> <div>Effective(4)</div> <div>Very Effective(5)</div> <div>N/A (didn't use this strategy)</div>	

17. Were your learning achievements recognised by your organisation through:

	How often were your learning achievements recognised?	How effective was this recognition in developing your ability to perform your role as a software engineer?
a) Promotion	<input type="text"/>	<input type="text"/>
b) Wage increases	<input type="text"/>	<input type="text"/>
c) Awards for accomplishment	<input type="text"/>	<input type="text"/>
d) Allocation of more responsible tasks	<input type="text"/>	<input type="text"/>

Never(1)
Occasionally(2)
Average(3)
Often(4)
Very Often(5)

Very Ineffective(1)
Ineffective(2)
Neither Effective or Ineffective(3)
Effective(4)
Very Effective(5)
N/A (didn't use this strategy)

18. Can you think of anything else that you or your colleagues did that helped you learn to do the kind of work you are doing now?

Graduate Survey

8. Section C - Your Colleagues' Role in On-the-job Learning

19. When you joined the organisation, were you appointed an experienced colleague (e.g. a mentor, buddy, etc) to support your on-the-job learning?

☐ Yes

☐ No

Logic: Yes → Q20
No: → Q21

Graduate Survey

9. Section C.1 - Your Colleagues' Role in On-the-job Learning

20. Was the experienced person your:

☐ Supervisor / manager

☐ Colleague - junior

☐ Colleague - peer

☐ Colleague - senior, but not your manager

☐ Customer / client / supplier

Other (please specify)

Graduate Survey

10. Section C.2 - Your Colleagues' Role in On-the-job Learning

21. When learning on-the-job, who did you turn to MOST for support (please select just one):

☐ Supervisor / manager

☐ Colleague - junior

☐ Colleague - peer

☐ Colleague - senior, but not your manager

☐ Customer / client / supplier

☐ None of the above

Other (please specify)

Graduate Survey

11. Section C.3 - Your Colleagues' Role in On-the-job Learning

The questions in this section refer to the individual identified by you (on the previous page of this survey) as the person who supported your on-the-job learning in your first year of employment following graduation.

22. To what extent did this person:

a) Organise your on-the-job learning?	<input type="text"/>
b) Monitor your performance when learning on-the-job?	<input type="text"/>
c) Provide access to appropriate on-the-job learning opportunities?	<input type="text"/>
d) Introduce on-the-job learning opportunities requiring more and more responsibility as your learning progressed?	<input type="text"/>
e) Help you understand work practices and procedures?	<input type="text"/>
f) Encourage you to engage in problem-solving activities with your colleagues/peers?	<input type="text"/>
g) Encourage you to apply your learning obtained in one task to another task?	<input type="text"/>
h) Encourage you to reflect on your own learning?	<input type="text"/>
i) Encourage you to self-correct based on your reflections?	<input type="text"/>
j) Encourage you to compare your performance on a task with that of an experienced colleague?	<input type="text"/>
k) Help you understand the breadth of the applicability of what you have learnt?	<input type="text"/>

Not at all(1)
Limited Extent(2)
Neutral (3)
Certain Extent(4)
Large Extent(5)

23. To what extent:

	How effective was this in developing your ability to perform your role as a software engineer?	
a) Was this person the best choice for helping you learn on-the-job?	<input type="text"/>	<input type="text"/>
b) Was this person skilled at sharing knowledge through on-the-job learning?	<input type="text"/>	<input type="text"/>
c) Did you have a good relationship with this person?	<input type="text"/>	<input type="text"/>
d) Was this person available to help you learn on-the-job?	<input type="text"/>	<input type="text"/>

Not at all(1)
Limited Extent(2)
Neutral (3)
Certain Extent(4)
Large Extent(5)

Very Ineffective(1)
Ineffective(2)
Neither Effective or Ineffective(3)
Effective(4)
Very Effective(5)
N/A (didn't use this strategy)

24. Overall, to what extent did you find this person an effective support for developing your ability to perform your role as a software engineer?

- ☐ Not at all(1) ☐ Limited extent(2) ☐ Neutral(3) ☐ Certain extent(4) ☐ Large extent(5)

Why?

Graduate Survey

12. Section D - Your Role in On-the-job learning

25. What motivates you to participate in on-the-job learning?

26. How did your organisation prepare you for your learning role in on-the-job learning?

27. Did your organisation provide any training courses/activities that taught you how to learn on-the-job?

- ☐ Yes ☐ No

If Yes, what did it involve?

Graduate Survey

13. Section E - Your Organisation's Role in On-the-job Learning

28. In your first year of employment, to what extent was:

the amount of time allocated for your on-the-job learning sufficient for the demands of your software engineering role?		How effective was this in developing your ability to perform your role as a software engineer?
<div> Not at all(1) Limited Extent(2) Neutral (3) Certain Extent(4) Large Extent(5) </div>	<input type="text"/>	<input type="text"/>

Very Ineffective(1)
 Ineffective(2)
 Neither Effective or Ineffective(3)
 Effective(4)
 Very Effective(5)
 N/A (no on-the-job learning was required)
 N/A (no time was allocated)

29. In your first year of your employment, to what extent:

		How effective was this in developing your ability to perform your role as a software engineer?
a) Did your organisation/management encourage you to participate in on-the-job learning?	<input type="text"/>	<input type="text"/>
b) Did your organisation/management support your on-the-job learning?	<input type="text"/>	<input type="text"/>
c) Did your organisation / management inhibit your on-the-job learning?	<input type="text"/>	<input type="text"/>
d) Did the team structures in your organisation promote collaborative learning?	<input type="text"/>	<input type="text"/>
e) Did your organisation adequately prepare you to get the most out of your on-the-job learning?	<input type="text"/>	<input type="text"/>
f) Were you ever reluctant to engage in on-the-job learning?	<input type="text"/>	<input type="text"/>
g) Did you feel you had sufficient access to on-the-job learning opportunities?	<input type="text"/>	<input type="text"/>
h) Did workload restrict your opportunities to engage in on-the-job learning?	<input type="text"/>	<input type="text"/>

Not at all(1)
 Limited Extent(2)
 Neutral (3)
 Certain Extent(4)
 Large Extent(5)

Very Ineffective(1)
 Ineffective(2)
 Neither Effective or Ineffective(3)
 Effective(4)
 Very Effective(5)
 N/A

Graduate Survey

14. Section F - Opportunities for Learning On-the-job

REMINDER: Please answer these questions in relation to your on-the-job learning in your first year of employment following graduation.

30. ROUTINE TASKS: well defined, common and familiar tasks.

NON-ROUTINE TASKS: new tasks requiring new knowledge to complete.

In your first year of employment, were your workplace tasks mainly **ROUTINE** or **NON-ROUTINE**? Please indicate the ratio that best describes the typical breakdown:

- ☐ 0% routine : 100% non-routine
- ☐ 20% routine : 80% non-routine
- ☐ 40% routine : 60% non-routine
- ☐ 60% routine : 40% non-routine
- ☐ 80% routine : 20% non-routine
- ☐ 100% routine : 0% non-routine

31. Describe some on-the-job learning opportunities available to you in your role.

32. To what extent:

a) Did you learn something through on-the-job learning that you found to be incorrect or inappropriate at a later date?	<input type="text"/>
b) Did you find it hard to learn sufficient knowledge about a task solely through on-the-job learning?	<input type="text"/>
c) Were you made aware of the outcome of the learning i.e. what you should be able to do once you have mastered the task?	<input type="text"/>
d) Were you explicitly made aware of what is required to perform the task the same way an expert would perform it?	<input type="text"/>
e) Did you find it easy to understand what was required to perform the task the same way an expert would perform it?	<input type="text"/>

Not at all(1)
Limited Extent(2)
Neutral (3)
Certain Extent(4)
Large Extent(5)

Graduate Survey

33. To what extent were the tasks sequenced or planned in accordance with:

How effective was this in developing your ability to perform your role as a software engineer?

a) Increasing difficulty i.e. do you learn easy things first and then progress onto harder, more challenging tasks?	<input type="text"/>	<input type="text"/>
b) Increasing diversity i.e. do you learn tasks requiring more diverse skills and strategies last?	<input type="text"/>	<input type="text"/>
c) Increasing responsibility i.e. do you learn tasks of minimum responsibility first and then progress onto more highly accountable ones?	<input type="text"/>	<input type="text"/>
d) Work area e.g. function, department, system, etc.	<input type="text"/>	<input type="text"/>

Not at all(1)
Limited Extent(2)
Neutral (3)
Certain Extent(4)
Large Extent(5)

Very Ineffective(1)
Ineffective(2)
Neither Effective or Ineffective(3)
Effective(4)
Very Effective(5)
N/A

34. Overall, to what extent do you feel that the opportunities you had for on-the-job learning enabled you to become competent in your software engineering role?

☐ Not at all(1)
 ☐ Limited Extent(2)
 ☐ Neutral(3)
 ☐ Certain Extent(4)
 ☐ Large Extent(5)

Please explain

Graduate Survey

15. Survey Completed

Thank you very much for completing this survey. Your participation is very much appreciated!

APPENDIX E –
On-the-job learning guide survey

On-the-job Learning Guide Survey

1. Introduction

APPLICABILITY: This survey is for experienced personnel that have supported the on-the-job learning of entry-level software engineering graduates.

DESCRIPTION: The purpose of this study is to obtain valuable information regarding the on-the-job learning that software engineering graduates receive in their first year of employment. On-the-job learning refers to any workplace learning that takes place OUTSIDE of formal classes and workshops. When answering this survey, please think about the support you gave to software engineering graduates when learning on-the-job in their first year of employment.

PARTICIPATION: Your participation in this study is critical (and very much appreciated) to ensure that the results are an accurate representation of on-the-job learning that software engineering graduates experience.

RESULTS: The results of this survey will provide a unique insight into the structure of the workplace learning environment for software engineering graduates as well as more in-depth information on the effectiveness of the on-the-job strategies currently being used. These results will be reflected back into third-level courses to better prepare graduates for on-the-job learning.

CONFIDENTIALITY: All information supplied in this survey will be kept strictly confidential and individual responses will NOT be made available to your employer.

DURATION OF SURVEY: There are between 13 and 26 questions in this survey (depending on your responses) and it should take approximately 25 minutes to complete. The majority of questions comprise drop-down boxes and scales for measuring effectiveness and frequency.

On-the-job Learning Guide Survey

2. Section A - Background and Employment Information

1. Name:

* 2. How many years of experience do you have in the software engineering industry?

* 3. What is the name of the organisation you work for?

* 4. When did you start working for this organisation?

	Month	Year
Start Date:	<input type="text"/>	<input type="text"/>

Month Options: Jan – Dec
Year Options: 1960 - 2009

5. What is your current job title?

6. At any point in your career have you supported, in any way, the on-the-job learning of entry-level software engineering graduates?

- ☐ Yes
☐ No

Logic:

Yes → Q7

No: → Survey completed

On-the-job Learning Guide Survey

3. Section B - On-the-job Learning Strategies (1 of 4)

REMINDER: Please answer these questions in the context of the on-the-job learning of software engineering graduates in their first year of employment following graduation.

7. How often:

	How often do you use this strategy?	Is this strategy effective in developing software engineering graduates' ability to perform their role?
a) Do software engineering graduates watch you demonstrating how to perform a particular task?	<input type="text"/>	<input type="text"/>
b) Do you use analogies with software engineering graduates(i.e. to draw similarities and/or highlight differences between selected concepts)?	<input type="text"/>	<input type="text"/>
c) Do you use diagrams / models with software engineering graduates to represent concepts that are difficult to explain?	<input type="text"/>	<input type="text"/>
d) Do you closely monitor software engineering graduates performing work tasks and provide feedback on their performance?	<input type="text"/>	<input type="text"/>
e) Do you encourage software engineering graduates to articulate their thought process and problem solving approaches, either orally or written, in an effort to clarify their approach to a particular work task?	<input type="text"/>	<input type="text"/>
f) Do you ask software engineering graduates questions so that they could clarify and rationalise their reasoning behind a particular work task?	<input type="text"/>	<input type="text"/>
g) Do you encourage software engineering graduates to regularly take stock of what they learned by reflecting on their own learning and how it can improve their performance?	<input type="text"/>	<input type="text"/>
h) Do you encourage software engineering graduates to learn from mistakes they made when trying things out in the workplace?	<input type="text"/>	<input type="text"/>
i) Do you encourage software engineering graduates to learn by finding their own way when solving problems, without support from you or your colleagues?	<input type="text"/>	<input type="text"/>
j) Are you shadowed by a software engineering graduate?	<input type="text"/>	<input type="text"/>
k) Do you give feedback to software engineering graduates relating to their performance?	<input type="text"/>	<input type="text"/>
l) Do you encourage software engineering graduates to repeatedly practise new skills/tasks?	<input type="text"/>	<input type="text"/>
m) Do you encourage software engineering graduates to maintain learning logs?	<input type="text"/>	<input type="text"/>

Never(1)
Occasionally(2)
Average(3)
Often(4)
Very Often(5)

Very Ineffective(1)
Ineffective(2)
Neither Effective or Ineffective(3)
Effective(4)
Very Effective(5)
N/A (didn't use this strategy)

On-the-job Learning Guide Survey

4. Section B - On-the-job Learning Strategies (2 of 4)

REMINDER: Please answer these questions in the context of the on-the-job learning of software engineering graduates in their first year of employment following graduation.

8. Do you encourage the graduates to learn by engaging with peers or experts through:

	How often do you encourage them?	Is this strategy effective in developing software engineering graduates' ability to perform their role?
a) Informal chats with colleagues (e.g. over coffee breaks)	<input type="text"/>	<input type="text"/>
b) Discussions with customers / clients / suppliers	<input type="text"/>	<input type="text"/>
c) Technical support from customers /clients / suppliers	<input type="text"/>	<input type="text"/>
d) Team meetings	<input type="text"/>	<input type="text"/>
e) External professional or occupational networks (e.g. IEEE, ACM, etc)	<input type="text"/>	<input type="text"/>
f) Trade fairs	<input type="text"/>	<input type="text"/>
g) Specialised research centres	<input type="text"/>	<input type="text"/>
h) Conferences / seminars	<input type="text"/>	<input type="text"/>

Never(1)
Occasionally(2)
Average(3)
Often(4)
Very Often(5)

Very Ineffective(1)
Ineffective(2)
Neither Effective or Ineffective(3)
Effective(4)
Very Effective(5)
N/A (didn't use this strategy)

On-the-job Learning Guide Survey

5. Section B - On-the-job Learning Strategies (3 of 4)

REMINDER: Please answer these questions in the context of the on-the-job learning of software engineering graduates in their first year of employment following graduation.

9. Do you encourage these graduates to learn by using any of the following resources:

	How often do you encourage them?	Is this strategy effective in developing software engineering graduates' ability to perform their role?
a) Books	<input type="text"/>	<input type="text"/>
b) Manuals	<input type="text"/>	<input type="text"/>
c) Internet	<input type="text"/>	<input type="text"/>
d) Professional journals	<input type="text"/>	<input type="text"/>
e) College / university libraries	<input type="text"/>	<input type="text"/>
f) CDs	<input type="text"/>	<input type="text"/>
g) DVDs	<input type="text"/>	<input type="text"/>
h) Computer based training	<input type="text"/>	<input type="text"/>
i) Company suggestion boxes	<input type="text"/>	<input type="text"/>
j) Company newsletters	<input type="text"/>	<input type="text"/>
k) Company information sessions	<input type="text"/>	<input type="text"/>
l) Company bulletins/memos	<input type="text"/>	<input type="text"/>
m) Knowledge bases of previous problem solutions	<input type="text"/>	<input type="text"/>

Never(1)
Occasionally(2)
Average(3)
Often(4)
Very Often(5)

Very Ineffective(1)
Ineffective(2)
Neither Effective or Ineffective(3)
Effective(4)
Very Effective(5)
N/A (didn't use this strategy)

On-the-job Learning Guide Survey

6. Section B - On-the-job Learning Strategies (4 of 4)

REMINDER: Please answer these questions in the context of the on-the-job learning of software engineering graduates in their first year of employment following graduation.

10. Do you...

	How often do you encourage this?	As they repeatedly perform such tasks, do you provide less and less support until the software engineering graduate could complete the task on their own?	Is this strategy effective in developing software engineering graduates' ability to perform their role?
...encourage these graduates to practise tasks that they do not have the knowledge to complete on their own, but had help from you to complete it?	<input type="text"/>	<input type="text"/>	<input type="text"/>
<div>Never(1) Occasionally(2) Average(3) Often(4) Very Often(5)</div>	<div>Never(1) Occasionally(2) Average(3) Often(4) Very Often(5) N/A (didn't use this strategy)</div>	<div>Very Ineffective(1) Ineffective(2) Neither Effective or Ineffective(3) Effective(4) Very Effective(5) N/A (didn't use this strategy)</div>	

11. Can you think of anything else that you do that helps these graduates to learn the kind of work they are doing now?

On-the-job Learning Guide Survey

7. Section C - Your Role in On-the-job Learning

REMINDER: Please answer this question in the context of the on-the-job learning of software engineering graduates in their first year of employment following graduation.

12. Did your organisation explicitly appoint you to support the on-the-job learning of these graduates?

- ☐ Yes
☐ No

Logic: Yes → Q13
No: → Q14

On-the-job Learning Guide Survey

8. Section C.1 - Your Role in On-the-job Learning

13. In your career to date, how many of these graduates have you supported?

- ☐ 1-2
☐ 3-5
☐ 6-10
☐ 11-15
☐ 16+

Logic: Skip to Q15

On-the-job Learning Guide Survey

9. Section C.2 - Your Role in On-the-job Learning

14. Have software engineering graduates turned to you for support when they were learning on-the-job in the first year following their graduation?

- ☐ Yes ☐ No

If Yes, how many turned to you for support?

Logic: Yes → Q15
No: → Survey completed

On-the-job Learning Guide Survey

10. Section C.3 - Your Role in On-the-job Learning

REMINDER: Please answer these questions in the context of the on-the-job learning of software engineering graduates in their first year of employment following graduation.

15. When supporting these graduates on-the-job learning, to what extent do you:

a) Organise their on-the-job learning?	<input type="text"/>
b) Monitor their performance when learning on-the-job?	<input type="text"/>
c) Provide access to appropriate on-the-job learning opportunities?	<input type="text"/>
d) As their learning progressed, introduce on-the-job learning opportunities requiring more and more responsibility?	<input type="text"/>
e) Help them understand work practises and procedures?	<input type="text"/>
f) Encourage them to engage in problem-solving activities with their colleagues/peers?	<input type="text"/>
g) Encourage them to apply their learning obtained in one task to another task?	<input type="text"/>
h) Encourage them to reflect on their own learning?	<input type="text"/>
i) Encourage them to self-correct based on their reflections?	<input type="text"/>
j) Encourage them to compare their performance on a task with that of an experienced colleague?	<input type="text"/>
k) Help them understand the breadth of the applicability of what they have learnt?	<input type="text"/>

Not at all(1)
Limited Extent(2)
Neutral (3)
Certain Extent(4)
Large Extent(5)

16. When supporting these graduates on-the-job learning, in general, to what extent:

		What effect does this have in developing software engineering graduates' ability to perform their role?
a) Are you the best choice for helping them learn on-the-job?	<input type="text"/>	<input type="text"/>
b) Are you skilled at sharing knowledge through on-the-job learning?	<input type="text"/>	<input type="text"/>
c) Do you have a good relationship with those whose on-the-job learning you supported?	<input type="text"/>	<input type="text"/>
d) Are you available to help them learn on-the-job?	<input type="text"/>	<input type="text"/>
e) Are you reluctant to support their on-the-job learning?	<input type="text"/>	<input type="text"/>
f) Are you afraid of being displaced in your role by those whose on-the-job learning you supported?	<input type="text"/>	<input type="text"/>

Not at all(1)
Limited Extent(2)
Neutral (3)
Certain Extent(4)
Large Extent(5)

Very Ineffective(1)
Ineffective(2)
Neither Effective or Ineffective(3)
Effective(4)
Very Effective(5)
N/A (didn't use this strategy)

On-the-job Learning Guide Survey

17. To what extent do you:

a) Find it hard to impart sufficient knowledge about a task solely through on-the-job learning?

b) Make these graduates aware of the outcome of the learning i.e. what they should be able to do once they have mastered the task?

c) Explicitly make these graduates aware of what is required to perform the task the same way an expert would perform it?

Not at all(1)
Limited Extent(2)
Neutral (3)
Certain Extent(4)
Large Extent(5)

18. To what extent do you sequence or plan tasks in accordance with:

What effect does this have
in developing software
engineering graduates'
ability to perform their
role?

a) Increasing difficulty i.e. did these graduates learn easy things first and then progress onto harder, more challenging tasks?

b) Increasing diversity i.e. did these graduates learn tasks requiring more diverse skills and strategies last?

c) Increasing responsibility i.e. did these graduates learn tasks of minimum responsibility first and then progress onto more highly accountable ones?

d) Work area e.g. system, function, department, etc.

Not at all(1)
Limited Extent(2)
Neutral (3)
Certain Extent(4)
Large Extent(5)

Very Ineffective(1)
Ineffective(2)
Neither Effective or Ineffective(3)
Effective(4)
Very Effective(5)
N/A (didn't use this strategy)

On-the-job Learning Guide Survey

11. Section C - Your Role in On-the-job learning

REMINDER: Please answer these questions in the context of the on-the-job learning of software engineering graduates in their first year of employment following graduation.

19. What motivates you to support the on-the-job learning of these graduates?

20. How did your organisation prepare you to support the on-the-job learning of these graduates?

21. Did your organisation provide any training courses/activities that taught you how to support on-the-job learning?

☐

Yes

☐

No

If Yes, what did you cover in the course?

On-the-job Learning Guide Survey

12. Section D - Your Organisation's Role in On-the-job Learning

REMINDER: Please answer these questions in the context of the on-the-job learning of software engineering graduates in their first year of employment following graduation.

22. When supporting the on-the-job learning of these graduates, are your efforts recognised by your organisation through:

Please indicate how often your efforts are recognised

a) Promotion	<input type="text"/>
b) Wage increases	<input type="text"/>
c) Awards for accomplishment	<input type="text"/>
d) Allocation of more responsible tasks	<input type="text"/>

Never(1)
Occasionally(2)
Average(3)
Often(4)
Very Often(5)

23. To what extent is:

the amount of time allocated for you to support graduates' on-the-job learning sufficient for the demands of the graduate software engineering role?

What effect did this have in developing software engineering graduates' ability to perform their role?

<input type="text"/>	<input type="text"/>
----------------------	----------------------

Not at all(1)
Limited Extent(2)
Neutral (3)
Certain Extent(4)
Large Extent(5)

Very Ineffective(1)
Ineffective(2)
Neither Effective or Ineffective(3)
Effective(4)
Very Effective(5)
N/A (no on-the-job learning was required)
N/A (no time was allocated)

24. To what extent:

		What effect did this have in developing software engineering graduates' ability to perform their role?
a) Does your organisation/management encourage you to support on-the-job learning?	<input type="text"/>	<input type="text"/>
b) Does your organisation/management support your role in on-the-job learning?	<input type="text"/>	<input type="text"/>
c) Does your organisation / management inhibit you when supporting on-the-job learning?	<input type="text"/>	<input type="text"/>
d) Does the team structures in your organisation promote collaborative learning?	<input type="text"/>	<input type="text"/>
e) Did your organisation adequately prepare you to support on-the-job learning?	<input type="text"/>	<input type="text"/>
f) Do you feel that these graduates had sufficient access to on-the-job learning opportunities?	<input type="text"/>	<input type="text"/>
g) Does your workload restrict your opportunities to support on-the-job learning?	<input type="text"/>	<input type="text"/>

Not at all(1)
Limited Extent(2)
Neutral (3)
Certain Extent(4)
Large Extent(5)

Very Ineffective(1)
Ineffective(2)
Neither Effective or Ineffective(3)
Effective(4)
Very Effective(5)
N/A

On-the-job Learning Guide Survey

13. Section E - Opportunities for Learning On-the-job

REMINDER: Please answer these questions in the context of the on-the-job learning of software engineering graduates in their first year of employment following graduation.

25. ROUTINE TASKS: well defined, common and familiar tasks.

NON-ROUTINE TASKS: new tasks requiring new knowledge to complete.

Are the workplace tasks available for these graduates mainly **ROUTINE** or **NON-ROUTINE**? Please indicate the ratio that best describes the typical breakdown:

- ☐ 0% routine : 100% non-routine
- ☐ 20% routine : 80% non-routine
- ☐ 40% routine : 60% non-routine
- ☐ 60% routine : 40% non-routine
- ☐ 80% routine : 20% non-routine
- ☐ 100% routine : 0% non-routine

26. Describe some on-the-job learning opportunities available to these graduates.

27. Overall, to what extent do you feel that the on-the-job learning opportunities these graduates had enabled them to become competent in their software engineering role?

- ☐ Not at all(1) ☐ Limited Extent(2) ☐ Neutral(3) ☐ Certain Extent(4) ☐ Large Extent(5)

Please explain

On-the-job Learning Guide Survey

14. Survey Completed

Thank you very much for completing this survey. Your participation is very much appreciated!

APPENDIX F – Organisation Survey

Organisation Survey

1. Introduction

DESCRIPTION: The purpose of this study is to obtain valuable information regarding the on-the-job learning that software engineering graduates receive in their first year of employment. On-the-job learning refers to any workplace learning that takes place OUTSIDE of formal classes and workshops. When answering this survey, please think about the support you gave to both software engineering graduates when learning on-the-job in their first year of employment and those employees supporting their learning.

PARTICIPATION: Your participation in this study is critical (and very much appreciated) to ensure that the results are an accurate representation of the on-the-job learning that software engineering graduates experience.

RESULTS: The results of this survey will provide a unique insight into the structure of the workplace learning environment for software engineering graduates as well as more in-depth information on the effectiveness of the on-the-job strategies currently being used. These results will be reflected back into third-level courses to better prepare graduates for on-the-job learning. The results will also provide a comprehensive snapshot of on-the-job learning in your organisation and its effectiveness.

CONFIDENTIALITY: All information supplied in this survey will be kept strictly confidential and only reported upon in summative form.

DURATION OF SURVEY: There are between 19 and 22 questions in this survey (depending on your responses) and it should take approximately 15 minutes to complete. The majority of questions comprise drop-down boxes and scales for measuring effectiveness and frequency.

Organisation Survey

2. Section A - Background Information

1. Organisation Name:

2. Your Name:

3. What is your current job title?

4. Worldwide, approximately how many employees are in your organisation?

☐

1-49

☐

50-99

☐

100-499

☐

500-1999

☐

2000+

5. In Ireland, how many software engineering graduates have you recruited in the past three years?

☐

0

☐

1-4

☐

5-9

☐

10-24

☐

25-49

☐

50-99

☐

100+

Organisation Survey

3. Section B - Policies for On-the-job Learning

REMINDER: Please answer these questions in the context of the on-the-job learning of software engineering graduates in their first year of employment following graduation.

NOTE: On-the-job learning is any workplace learning taking place OUTSIDE OF FORMAL CLASSES or WORKSHOPS.

6. In relation to on-the-job learning, does your organisation:

- ☐ Gradually train these graduates over a long period of time
- ☐ Intensively train these graduates over a short period of time
- ☐ Have no training planned

Other (please specify)

7. What level of importance does your organisation place on the on-the-job learning of these graduates?

- ☐ Very Unimportant(1) ☐ Unimportant(2) ☐ Neutral(3) ☐ Important(4) ☐ Very Important(5)

8. Does your organisation have formal policies developed to structure the on-the-job learning of these graduates?

- ☐ Yes
- ☐ No

Logic: Yes → Q9
No: → Q11

Organisation Survey

4. Section B - Policies for On-the-job Learning

9. People consulted when drawing up the policies (please tick all that apply):

- ☐ Experienced staff / mentors / on-the-job learning guides
- ☐ Graduates / on-the-job learners
- ☐ Training department
- ☐ Human resources
- ☐ None of the above

Other (please specify)

10. What is detailed in these policies?

Organisation Survey

5. Section B - Learning Resources for On-the-job Learning

REMINDER: Please answer this question in the context of the on-the-job learning of software engineering graduates in their first year of employment following graduation.

11. Does your organisation have documents that detail how to learn a particular task to the standard required by the organisation?

- ☐ Yes
- ☐ No

Logic: Yes → Q12
No: → Q14

Organisation Survey

6. Section B - Learning Resources for On-the-job Learning

REMINDER: Please answer these questions in the context of the on-the-job learning of software engineering graduates in their first year of employment following graduation.

12. People consulted when developing these documents (please tick all that apply):

- ☐ Experienced staff / mentors / on-the-job learning guides
- ☐ Graduates / on-the-job learners
- ☐ Training department
- ☐ Human resources
- ☐ None of the above

Other (please specify)

13. In relation to these documents, to what extent:

a) Are the contents based on tasks and activities found in the workplace?

b) Are they grouped into distinct categories?

c) Do they have clear strategies detailed for learning content and skills?

d) Do they have specific learning objectives?

e) Do they include details on how an expert would perform the task being learned?

f) Do they contain theory that is difficult to learn through on-the-job learning alone?

Not at all(1)
Limited Extent(2)
Neutral (3)
Certain Extent(4)
Large Extent(5)

Organisation Survey

7. Section C - Supporting On-the-job Learning

Please answer these questions in relation to:

- a) software engineering graduates learning on-the-job in their first year of employment following graduation
- b) experienced employees supporting the on-the-job learning of these graduates

14. As an organisation, to what extent do you:

		What effect does this have in developing software engineering graduates' ability to perform their role?
a) Highlight the professional development benefits gained by engaging in on-the-job learning?	<input type="text"/>	<input type="text"/>
b) Encourage reluctant workers to engage in on-the-job learning?	<input type="text"/>	<input type="text"/>
c) Reward workers when they engage in on-the-job learning?	<input type="text"/>	<input type="text"/>
d) Allow employees specific time to partake in on-the-job learning?	<input type="text"/>	<input type="text"/>
e) Have team structures that provide opportunities for collaborative learning?	<input type="text"/>	<input type="text"/>
f) Take account of production demands taking precedence over on-the-job learning opportunities?	<input type="text"/>	<input type="text"/>

Not at all(1)
Limited Extent(2)
Neutral (3)
Certain Extent(4)
Large Extent(5)

Very Ineffective(1)
Ineffective(2)
Neither Effective or Ineffective(3)
Effective(4)
Very Effective(5)
N/A

15. To what extent do you:

What effect does this have
in developing software
engineering graduates'
ability to perform their
role?

a) Explicitly make these graduates aware of their role in on-the-job learning?	<input type="text"/>	<input type="text"/>
b) Encourage these graduates to become self-directed learners?	<input type="text"/>	<input type="text"/>
c) Allow these graduates adequate time to settle into their role as learners?	<input type="text"/>	<input type="text"/>
d) Monitor these graduates performance when learning on-the-job?	<input type="text"/>	<input type="text"/>
e) Monitor the performance of experienced employees supporting these graduates on-the-job learning?	<input type="text"/>	<input type="text"/>
f) Provide performance feedback to experienced employees supporting these graduates on-the-job learning?	<input type="text"/>	<input type="text"/>
g) Safeguard these graduates from learning inappropriate or incorrect information through on-the-job learning?	<input type="text"/>	<input type="text"/>
h) Ensure that each of these graduates has equal access to the learning opportunities in your organisation?	<input type="text"/>	<input type="text"/>
i) Actively nurture relationships between these graduates and experienced employees supporting their on-the-job learning?	<input type="text"/>	<input type="text"/>
j) Provide supports when either the graduate or the experienced employee supporting their on-the-job learning are not present in the office at the same time e.g. remote working, different shifts, etc?	<input type="text"/>	<input type="text"/>

Not at all(1)
Limited Extent(2)
Neutral (3)
Certain Extent(4)
Large Extent(5)

Very Ineffective(1)
Ineffective(2)
Neither Effective or Ineffective(3)
Effective(4)
Very Effective(5)
N/A

Organisation Survey

16. Can you think of other ways your organisation/management **SUPPORTS** this on-the-job learning?

17. Can you think of any ways in which your organisation/management **INHIBITS** this on-the-job learning?

Organisation Survey

8. Section D - Selecting Employees to Support On-the-job Learning

REMINDER: Please answer this question in the context of the on-the-job learning of software engineering graduates in their first year of employment following graduation.

18. Does your organisation select experienced employees to support these graduates on-the-job learning?

- ☐ Yes
☐ No

Logic: Yes → Q19
No: → Q20

Organisation Survey

9. Section D - Selecting Employees to Support On-the-job Learning

REMINDER: Please answer these questions in the context of the on-the-job learning of software engineering graduates in their first year of employment following graduation.

19. When selecting individuals to support these graduates, to what extent do you consider their:

- a) Knowledge of the area they would be supporting?
b) Years of experience in the area they would be supporting?
c) Effectiveness in supporting graduates' on-the-job learning?
d) Willingness to participate in on-the-job learning initiatives?

Not at all(1)
Limited Extent(2)
Neutral (3)
Certain Extent(4)
Large Extent(5)

Organisation Survey

10. Section E - Preparing Employees for On-the-job Learning

REMINDER: Please answer these questions in the context of the on-the-job learning of software engineering graduates in their first year of employment following graduation.

20. To what extent does your organisation:

What effect does this have in developing software engineering graduates' ability to perform their role?

a) Prepare these graduates for their role in on-the-job learning?

Not at all(1)
Limited Extent(2)
Neutral (3)
Certain Extent(4)
Large Extent(5)

Very Ineffective(1)
Ineffective(2)
Neither Effective or Ineffective(3)
Effective(4)
Very Effective(5)
N/A

If you prepare these graduates, how do you do it?

21. To what extent does your organisation:

What effect does this have in developing software engineering graduates' ability to perform their role?

a) Prepare the experienced employees to support graduates' on-the-job learning?

Not at all(1)
Limited Extent(2)
Neutral (3)
Certain Extent(4)
Large Extent(5)

Very Ineffective(1)
Ineffective(2)
Neither Effective or Ineffective(3)
Effective(4)
Very Effective(5)
N/A

If you prepare experienced employees, how do you do it?

Organisation Survey

11. Section F - Overall Support for On-the-job Learning

REMINDER: Please answer this question in the context of the on-the-job learning of software engineering graduates in their first year of employment following graduation.

22. Overall, to what extent do you feel that the support your organisation provides is sufficient for enabling these graduates to become competent in their software engineering role?

☐ Not at all(1)

☐ Limited Extent(2)

☐ Neutral(3)

☐ Certain Extent(4)

☐ Large Extent(5)

Please explain

Organisation Survey

12. Survey Completed

Thank you very much for completing this survey. Your participation is very much appreciated!

**APPENDIX G –
Undergraduate Survey**

Undergraduate Survey

1. Introduction

DESCRIPTION: The purpose of this study is to obtain valuable information regarding the use of on-the-job learning strategies in third level computing undergraduate education.

THE IDEAL PARTICIPANT: This survey is designed for computing undergraduates in any year of their study.

PARTICIPATION: Your participation in this study is critical (and very much appreciated) to ensure that the results are an accurate representation of the on-the-job learning strategies that computing students experience in third level education.

RESULTS: The survey results will be disseminated in statistical form in a PhD thesis. These results will provide a unique insight into the preparedness of computing graduates for on-the-job learning and will be synthesised with the results of a study conducted in industry to identify frequency and effectiveness of on-the-job learning strategies.

CONFIDENTIALITY: All information supplied in this survey will be kept strictly confidential and individual responses will NOT be made available to anyone.

DURATION: There are 8 questions in this survey and it should take approximately 10 minutes to complete. The majority of questions comprise drop-down boxes and scales for measuring effectiveness and frequency.

Please note, where questions ask for written opinions, any negative personal comments included will be disregarded and not recorded.

Undergraduate Survey

2. Section A - Background Information

***1. What year are you currently studying?**

1st
2nd
3rd
4th
Graduate Diploma Year

Other (please specify)

***2. What age are you?**

Undergraduate Survey

3. Section B - Learning Strategies (1 of 4)

REMINDER: Please answer these questions in relation to any learning that you experienced whilst studying for your computing qualification.

3. During any of your classes:

	How often did you learn in this manner?	How effective was this strategy for your learning?
a) Did lecturers demonstrate to you how to perform a particular task?	<input type="text"/>	<input type="text"/>
b) Did you learn by eavesdropping, observing or listening to someone while they undertook work or discussed tasks with other students or lecturers?	<input type="text"/>	<input type="text"/>
c) Did lecturers use analogies with you (i.e. to draw similarities and/or highlight differences between selected concepts)?	<input type="text"/>	<input type="text"/>
d) Did lecturers use diagrams / models with you to represent concepts that are difficult to explain?	<input type="text"/>	<input type="text"/>
e) Did you perform work tasks while lecturers closely monitored your performance and provided feedback on it?	<input type="text"/>	<input type="text"/>
f) Did you articulate your thought process and problem solving approaches to lecturers, either orally or written, in an effort to justify your approach to a particular body of work?	<input type="text"/>	<input type="text"/>
g) Did lecturers ask you questions so that you could justify and rationalise your reasoning behind a particular concept?	<input type="text"/>	<input type="text"/>
h) Did you (formally or informally) teach any of your classmates in college?	<input type="text"/>	<input type="text"/>
i) Did you regularly take stock of what you learned by reflecting on your own learning and how it can improve your performance?	<input type="text"/>	<input type="text"/>
j) Did you keep a reflective journal / learning log?	<input type="text"/>	<input type="text"/>
k) Did you learn from mistakes you made when trying things out when learning new concepts in college?	<input type="text"/>	<input type="text"/>
l) Did you learn by finding your own way when solving problems, without support from your lecturers?	<input type="text"/>	<input type="text"/>
m) Did you learn about your role by consciously shadowing an knowledgeable student or lecturer for a period of time?	<input type="text"/>	<input type="text"/>
n) Did you repeatedly practise new skills/tasks/concepts?	<input type="text"/>	<input type="text"/>
o) Did you learn by voluntarily engaging in demanding work or study?	<input type="text"/>	<input type="text"/>
p) Did you learn by being thrown in the deep end?	<input type="text"/>	<input type="text"/>

Not at all(1)
Limited Extent(2)
Neutral (3)
Certain Extent(4)
Large Extent(5)

Very Ineffective(1)
Ineffective(2)
Neither Effective or Ineffective(3)
Effective(4)
Very Effective(5)
N/A (didn't use this strategy)

Undergraduate Survey

4. Section B - Learning Strategies (2 of 4)

REMINDER: Please answer these questions in relation to any learning that you experienced whilst studying for your computing qualification.

4. Did you learn by engaging with your peers or experts through:

	How often did you learn in this manner?	How effective was this strategy for your learning?
a) Informal chats with fellow students or experts (e.g. over coffee, during lunch breaks)	<input type="text"/>	<input type="text"/>
b) Technical support (within and external to college)	<input type="text"/>	<input type="text"/>
c) Formal meetings	<input type="text"/>	<input type="text"/>
d) External professional or occupational networks (e.g. IEEE, ACM, etc)	<input type="text"/>	<input type="text"/>
e) Trade fairs	<input type="text"/>	<input type="text"/>
f) Specialised research centres	<input type="text"/>	<input type="text"/>
g) Conferences / seminars	<input type="text"/>	<input type="text"/>

Not at all(1)
Limited Extent(2)
Neutral (3)
Certain Extent(4)
Large Extent(5)

Very Ineffective(1)
Ineffective(2)
Neither Effective or Ineffective(3)
Effective(4)
Very Effective(5)
N/A (didn't use this strategy)

Undergraduate Survey

5. Section B - Learning Strategies (3 of 4)

REMINDER: Please answer these questions in relation to any learning that you experienced whilst studying for your computing qualification.

5. Did you learn using any of the following resources:

	How often did you learn in this manner?	How effective was this strategy for your learning?
a) Books	<input type="text"/>	<input type="text"/>
b) Manuals	<input type="text"/>	<input type="text"/>
c) Internet	<input type="text"/>	<input type="text"/>
d) Professional journals	<input type="text"/>	<input type="text"/>
e) College / university libraries	<input type="text"/>	<input type="text"/>
f) CDs	<input type="text"/>	<input type="text"/>
g) DVDs	<input type="text"/>	<input type="text"/>
h) Computer based training	<input type="text"/>	<input type="text"/>
i) College suggestion boxes	<input type="text"/>	<input type="text"/>
j) College newsletters	<input type="text"/>	<input type="text"/>
k) College information sessions	<input type="text"/>	<input type="text"/>
l) College bulletins/memos	<input type="text"/>	<input type="text"/>
m) Knowledge bases of previous problem solutions	<input type="text"/>	<input type="text"/>

Not at all(1)
Limited Extent(2)
Neutral (3)
Certain Extent(4)
Large Extent(5)

Very Ineffective(1)
Ineffective(2)
Neither Effective or Ineffective(3)
Effective(4)
Very Effective(5)
N/A (didn't use this strategy)

Undergraduate Survey

6. Section B - Learning Strategies (4 of 4)

REMINDER: Please answer these questions in relation to any learning that you experienced whilst studying for your computing qualification.

6. During any of your classes, did you:

	How often did you learn in this manner?	As you repeatedly performed such tasks, did your lecturer provide less and less support until you could complete the task on your own?	How effective was this strategy for your learning?
Practise tasks that you did not have the knowledge to finish on your own, but had guidance and advice from lecturers to help you complete it?	<input type="text"/>	<input type="text"/>	<input type="text"/>
Never(1) Occasionally(2) Average(3) Often(4) Very Often(5)	Yes No N/A (didn't use this strategy)	Very Ineffective(1) Ineffective(2) Neither Effective or Ineffective(3) Effective(4) Very Effective(5) N/A (didn't use this strategy)	

7. During any of your classes, did you:

	How often did you learn in this manner?	Did you receive mostly negative or positive feedback?	How effective was this strategy for your learning?
Get feedback from lecturers relating to your performance?	<input type="text"/>	<input type="text"/>	<input type="text"/>
Never(1) Occasionally(2) Average(3) Often(4) Very Often(5)	Mostly negative Mostly positive N/A (didn't use this strategy)	Very Ineffective(1) Ineffective(2) Neither Effective or Ineffective(3) Effective(4) Very Effective(5) N/A (didn't use this strategy)	

8. Can you think of anything else that you or your lecturers did that helped you learn?

Undergraduate Survey

7. Survey Completed

Thank you very much for completing this survey. Your participation is very much appreciated!

APPENDIX H – Defining main constructs

Appendix Table H - 1 Defining Instructional Model of Learning

Source: Collins *et al* (1987)

	Survey question item		
	Graduate	Guide	Under graduate
Instructional Model of Learning strategies			
Modelling (Instruction / Demonstration)	12a	7a	3a
Analogies	12c	7b	3c
Diagrams	12d	7c	3d
Coaching	12e	7d	3e
Scaffolding and fading	15	10	6
Articulation	12f	7e	3f
Questioning	12g	7f	3g
Learning through teaching others	12h	N/A	3h
Discussion (informal chats)	13a	8a	4a
Discussion (team meetings)	13d	8d	4c
Reflection	12i	7g	3i
Learning from mistakes	12k	7h	3k
Exploration	12l	7i	3l

Appendix Table H - 2 Defining Other Inter-collegial Strategies

Source: Author

	Survey question item		
	Graduate	Guide	Under graduate
Other Inter-collegial Strategies			
Observation	12b	N/A	3b
Shadowing	12m	7j	3m
Feedback	16	7k	7
Performance appraisal system	12u	N/A	N/A
Maintaining learning logs	12j	7m	3j

Appendix Table H - 3 Defining Self-directed Strategies

Source: Author

Source: Author		Survey question item		
		Graduate	Guide	Under graduate
Self-directed Strategies				
Practice and repetition		12n	7l	3n
Access to learning materials and resources	Books	14a	9a	5a
	Manuals	14b	9b	5b
	Internet	14c	9c	5c
	Professional journals	14d	9d	5d
	Third level libraries	14e	9e	5e
	CDs	14f	9f	5f
	DVDs	14g	9g	5g
	CBT	14h	9h	5h

Appendix Table H - 4 Defining Intra-organisational Strategies

Source: Author

		Survey question item		
		Graduate	Guide	Under graduate
Intra-organisational Strategies				
Individualised career development plans		12t	N/A	N/A
Knowledge bases of problem solutions		14m	9m	5m
Rewards for proficiency and achievement	Promotion	17a	22a	N/A
	Wage increases	17b	22b	N/A
	Awards for accomplishment	17c	22c	N/A
	Allocation of more responsible tasks	17d	22d	N/A
Mechanisms for integrated exchange	Company suggestion boxes	14i	9i	5i
	Company newsletters	14j	9j	5j
	Company information sessions	14k	9k	5k
	Company bulletins/memos	14l	9l	5l
Stretching activities	Working above grade	12o	N/A	N/A
	Engaging in demanding work	12p	N/A	3o
	Thrown in deep end	12q	N/A	3p
Perspective switching	Deliberate role transfer	12r	N/A	N/A
	Working abroad	12s	N/A	N/A

Appendix Table H - 5 Defining Extra-organisational Strategies

Source: Author

		Survey question item		
		Graduate	Guide	Under graduate
Extra-organisational Strategies				
Networking	External professional or occupational networks	13e	8e	4d
	Trade fairs	13f	8f	4e
	Specialised research centres	13g	8g	4f
	Conferences/Seminars	13h	8h	4g
Contact with customers / suppliers	Discussions	13b	8b	N/A
	Technical support	13c	8c	4b

Appendix Table H - 6 Defining direct guidance strategies

Source: Author

		Survey question item		
		Graduate	Guide	Under graduate
Instructional Model of Learning (Collins <i>et al</i> 1987)				
Modelling (Instruction / Demonstration)		12a	7a	3a
Analogies		12c	7b	3c
Diagrams		12d	7c	3d
Coaching		12e	7d	3e
Scaffolding		15	10	6
and fading		15	10	6
Articulation		12f	7e	3f
Questioning		12g	7f	3g
Other Inter-Collegial Strategies				
Feedback		16	7k	7
Performance appraisal system		12u	N/A	N/A
Intra-Organisational Strategies				
Individualised career development plans		12t	N/A	N/A

Appendix Table H - 7 Defining indirect guidance strategies

Source: Author

	Survey question item		
	Graduate	Guide	Under graduate
Instructional Model of Learning (Collins <i>et al</i> 1987)			
Learning through teaching others	12h	N/A	3h
Discussion (informal chats)	13a	8a	4a
Discussion (team meetings)	13d	8d	4c
Reflection	12i	7g	3i
Learning from mistakes	12k	7h	3k
Exploration	12l	7i	3l
Other Inter-Collegial Strategies			
Observation	12b	N/A	3b
Shadowing	12m	7j	3m
Maintaining learning logs	12j	7m	3j
Self-Directed Strategies			
Practice and repetition	12n	7l	3n
Access to learning materials and resources (Books)	14a	9a	5a
Access to learning materials and resources (Manuals)	14b	9b	5b
Access to learning materials and resources (Internet)	14c	9c	5c
Access to learning materials and resources (Professional Journals)	14d	9d	5d
Access to learning materials and resources (Third level libraries)	14e	9e	5e
Access to learning materials and resources (CDs)	14f	9f	5f
Access to learning materials and resources (DVDs)	14g	9g	5g
Access to learning materials and resources (CBT)	14h	9h	5h
Intra-Organisational Strategies			
Rewards for proficiency and achievement (Promotion)	17a	22a	N/A
Rewards for proficiency and achievement (Wage increases)	17b	22b	N/A
Rewards for proficiency and achievement (Awards for accomplishment)	17c	22c	N/A
Rewards for proficiency and achievement (Allocation of more responsible tasks)	17d	22d	N/A
Mechanisms for integrated exchange (Company suggestion boxes)	14i	9i	5i
Mechanisms for integrated exchange (Company newsletters)	14j	9j	5j
Mechanisms for integrated exchange (Company information sessions)	14k	9k	5k
Mechanisms for integrated exchange (Company bulletins/memos)	14l	9l	5l
Knowledge bases of problem solutions	14m	9m	5m
Stretching activities (Working above grade)	12o	N/A	N/A
Stretching activities (Engaging in demanding work)	12p	N/A	3o
Stretching activities (Thrown in deep end)	12q	N/A	3p
Perspective switching (Deliberate role transfer)	12r	N/A	N/A
Perspective switching (Working abroad)	12s	N/A	N/A
Extra-Organisational Strategies			
Networking (External professional or occupational networks)	13e	8e	4d
Networking (Trade fairs)	13f	8f	4e
Networking (Specialised research centres)	13g	8g	4f
Networking (Conferences/Seminars)	13h	8h	4g
Contact with customers / suppliers (Discussions)	13b	8b	N/A
Contact with customers / suppliers (Technical support)	13c	8c	4b

Appendix Table H - 8 Defining the three level model of WPL guidance

Source: Adapted from Billett (2001; 2002b)

	Survey question item	
	Graduate	Guide
LEVEL 1 - PARTICIPATION IN WORK ACTIVITIES		
Workplace experiences [†]		
Organising workplace experiences ⁺	22a	15a
Sequencing of tasks from low to highly accountability:		
Increasing difficulty ⁺	33a	18a
Increasing diversity ⁺	33b	18b
Increasing responsibility ⁺	33c	18c
Learning through undertaking everyday work activities ⁺	22c	15c
Monitoring learners' readiness to progress on the pathways of activities of increasing accountability and complexity ⁺	22d	15d
Providing access to goals and sub-goals required for expert performance and associated with the work practice ⁺	32d	17c
Learning opportunities available to observe and listen [#]	12b	N/A
LEVEL 2 - GUIDED LEARNING AT WORK		
Close guidance by experienced workers:		
Modelling / demonstrating of tasks to be performed [#]	12a	7a
Coaching with procedures associated with the activity [#]	12e	7d
Scaffolding [#]	15	10
Assisting with joint problem solving [#]	22f	15f
Use of techniques to engage workers in learning for themselves:		
Exploration [#]	12l	7i
Practice and repetition [#]	12n	7l
Use of learning materials and resources [#]	14a-m	9a-m
Use of techniques to develop understanding / access to goals to be learnt:		
Awareness of goals ⁺	32d	17c
Understanding of goals and requirements ⁺	32e 22e	15e
Monitoring learners' progress ⁺	22b	15b
Making accessible knowledge that is hidden (the result is inverted) ⁺	32b	17a
Avoidance of learning inappropriate knowledge (the result is inverted) ⁺	32a	N/A
LEVEL 3 - GUIDED LEARNING FOR TRANSFER		
Strategy use to extend learner's knowledge to novel situations:		
Questioning [#]	12g	7f
Problem solving [#]	22f	15f
Scenario building / Analogies [#]	12c	7b
Engaging learners in opportunities to reflect on what they have learnt	12i [#] 22h ⁺	7g [#] 15h ⁺
Encouraging the comparison of individuals' progress with that of others ⁺	22j	15j
Assisting learners to understand the breadth of the applicability of what they have learnt ⁺	22k	15k
Facilitating the abstraction of learning from one situation to another ⁺	22g	15g

Frequency key:

1: Never

3: Average

4: Often

2: Occasionally

5: Very often

+ Extent key:

1: Not at all

3: Neutral

4: Certain extent

2: Limited extent

5: Large extent

Appendix Table H - 9 Defining learning conditions conducive to learning at work

Source: Adapted from Skule (2004)

	Survey question item		
	Graduate	Guide	Org
Learning Condition 1 (A high degree of exposure to change) #			
My job exposes me to frequent changes in technology, products and processes	8g	N/A	N/A
Learning condition 2 (A high degree of exposure to demands) #			
My customers are very demanding	8a	N/A	N/A
My company is very demanding	8b	N/A	N/A
My managers are very demanding	8c	N/A	N/A
My colleagues are very demanding	8d	N/A	N/A
Learning condition 3 (Managerial responsibility) #			
My job requires that I engage in decision making concerning certain tasks	8e	N/A	N/A
My job requires that I engage in project management tasks	8f	N/A	N/A
Learning Condition 4 (Extensive professional contact) +			
Informal chats	13a	8a	N/A
Discussions with customers	13b	8b	N/A
Technical support from customers	13c	8c	N/A
Team meetings	13d	8d	N/A
External professional networks	13e	8e	N/A
Trade fairs	13f	8f	N/A
Specialised research centres	13g	8g	N/A
Conferences/seminars	13h	8h	N/A
Learning condition 5 (Superior feedback) +			
Feedback	16	7k	N/A
Performance appraisal system	12u	N/A	N/A
Provide feedback to WPL guides on their performance in their WPL role	N/A	N/A	15f
Learning condition 6 (Management support for learning) +			
Time allocated to participate	28	23	14d
Encouraged graduate participation	29a	N/A	N/A
Supported graduate role in WPL	29b	N/A	N/A
Encouraged guide participation	N/A	24a	N/A
Supported guide role in WPL	N/A	24b	N/A
Graduate preparation	N/A	N/A	20a
Guide preparation	N/A	N/A	21a
Monitor performance of graduates	N/A	N/A	15d
Monitor performance of WPL guides	N/A	N/A	15e
Instilling awareness in SE graduates of their WPL role	N/A	N/A	15a
Encourage reluctant workers to engage in WPL	N/A	N/A	14b
Provide support for remote learning	N/A	N/A	15j
Organisation allocated sufficient time to settle into WPL role	N/A	N/A	15c
Learning condition 7 (Rewarding of proficiency) +			
Promotion	17a	22a	N/A
Wage increases	17b	22b	N/A
Awards for accomplishment	17c	22c	N/A
Allocation of more responsible tasks	17d	22d	N/A
Draw attention to the professional development benefits through WPL engagement	N/A	N/A	14a
Reward workers when they engage in WPL	N/A	N/A	14c

Note: Items with a # beside them are measured on a 5-point Likert-type agreement scale, whereas those items with a + beside them are measured on a 5-point Likert-type extent scale.

Appendix Table H - 10 Defining the general invitational nature of the workplace**Source: Author**

		Survey question item		
		Graduate	Guide	Org
Team approach to work		29d	24d	14e
Adequate time to participate		29e	23	14d
Invitational nature of the workplace	Encouraged participation in WPL	29a	24a	N/A
	Supported WPL role	29b	24b	N/A
	Inhibited WPL	29c	24c	N/A

Appendix Table H - 11 Defining formal WPL policies and learning resources**Source: Author**

		Survey question item
		Org
Formal WPL policies	Organisation developed formal WPL policies	8
	Key people involved in developing formal WPL policies	9
	Contents of the formal WPL policies	10
Learning Resources	Organisation developed learning resources	11
	Key people involved in developing learning resources	12
Learning resource development	Contents based on tasks and activities found in the workplace	13a
	Grouping of learning resources into distinct categories	13b
	Clear strategies detailed for learning the contents and skills relating to each learning resource	13c
	Learning objectives of each learning resource are detailed	13d
	Includes details on how an expert would perform the task being learned	13e
	Contains theory that is difficult to learn through on-the-job learning alone	13f

Appendix Table H - 12 Defining guide selection**Source: Author**

		Survey question item		
		Graduate	Guide	Org
Selected by organisation or by the graduate		19	12, 14	18
Working relationship with the graduate		20, 21	N/A	N/A
Number of graduates guided to date		N/A	13, 14	N/A
Guide skill at sharing knowledge		23b	16b	N/A
Guide is the best choice for learning		23a	16a	N/A
Criteria for selecting guides	Knowledge of the area they would be supporting	N/A	N/A	19a
	Expertise in the area they would be supporting	N/A	N/A	19b
	Ability to effectively support graduates WPL	N/A	N/A	19c
	Willingness to participate in WPL initiatives	N/A	N/A	19d

Appendix Table H - 13 Defining worker preparation**Source: Author**

		Survey question item		
		Graduate	Guide	Org
Learner	Preparation for learning role	29e	N/A	20a
	Training provided by organisation	26, 27	N/A	20b
Guide	Preparation for guide role	N/A	24e	21a
	Training provided by organisation	N/A	20, 21	21b

Appendix Table H - 14 Defining influences on worker participation**Source: Author**

		Survey question item		
		Graduate	Guide	Org
Learner-guide relationship		23c	16c	15i
Reluctance to participate		29f	16e	N/A
Fear of displacement		N/A	16f	N/A
Availability of expert guidance		23d	16d	N/A
Rewards for participation	Reward workers for engaging in WPL	N/A	N/A	14c
	Promotion	17a	22a	N/A
	Wage Increase	17b	22b	N/A
	Allocation of more responsible tasks	17c	22c	N/A
	Awards for accomplishment	17d	22d	N/A
Guide supports	Overall guide supports	24	N/A	N/A
	Organise graduate on-the-job learning	22a	15a	N/A
	Monitor graduate performance when learning on-the-job	22b	15b	15d
	Encourage graduates to engage in problem solving activities with colleagues/peers	22f	15f	N/A
	Encourage transferability of learning	22g	15g	N/A
	Encourage graduates to reflect on their learning	22h	15h	N/A
	Encourage graduate self-correction based on reflections	22i	15i	N/A
	Encourage graduates to compare their task performance with that of experienced colleagues	22j	15j	N/A
Organisational encouragement of guide and learner participation	Encourage reluctant workers to engage in WPL	N/A	N/A	14b
	Draw attention to the professional development benefits through WPL engagement	N/A	N/A	14a
	Monitor performance of WPL guides	N/A	N/A	15e
	Provide feedback to WPL guides on their performance in their WPL role	N/A	N/A	15f
	Monitor performance of graduates	N/A	N/A	15d
General motivations for participating in WPL		25	19	N/A
General ways organisations support learning		N/A	N/A	16
General ways organisations inhibit learning		N/A	N/A	17

Appendix Table H - 15 Defining general organisational supports

Source: Author

	Survey question item		
	Graduate	Guide	Org
The importance of WPL to the organisation	N/A	N/A	7
WPL philosophy for SE graduates WPL	N/A	N/A	6
Provide support for remote learning	N/A	N/A	15j
Cater for production demands overshadowing learning	29h	24g	14f
Overall WPL support	34	27	22

Appendix Table H - 16 Defining learning opportunities

Source: Author

		Survey question item		
		Graduate	Guide	Org
Learning opportunities available in workplace (knowledge and content)	Routine/non-routine ratio	30	25	N/A
	Description of those in the SE workplace	31	26	N/A
Structure of learning opportunities (knowledge and content)	Help graduates understand work practices and procedures	32e	15e	N/A
	Make graduates aware of learning outcomes	32c	17b	N/A
	Make graduates aware of goals and requirements for expert performance	32d	17c	N/A
Access to learning opportunities	Access to appropriate learning opportunities	22c	15c	N/A
	Sufficient access to learning opportunities	29g	24f	N/A
	Equal access to learning opportunities	N/A	N/A	15h
Access to knowledge	Safeguard against learning inappropriate knowledge	32a	N/A	15g
	Difficulty accessing hidden or opaque knowledge	32b	17a	N/A
Sequencing of pathways of learning opportunities	Increasing difficulty	33a	18a	N/A
	Increasing diversity	33b	18b	N/A
	Increasing responsibility	33c	18c	N/A
	Work area	33d	18d	N/A
	Monitor progression prior to introducing tasks of increasing responsibility	N/A	15d	N/A

APPENDIX I –
Respondent quotes

Appendix Table I - 1 Additional identified strategies and projects

Source: Author

Dimension	Insight	Respondent quote
Individual observable heterogeneity	SE graduates' individual observable heterogeneity should be taken into consideration when engaging in WPL.	<i>It entirely depends on the graduate - different approaches work better on differing individuals. You have to tailor the approach to match the personality of the graduate.</i> (Company 1, Guide A)
		<i>The approach taken varies by graduate a lot, and the task they are working on. I really don't believe there is a general "solution."</i> (Company 16, Guide A)
Collaborative Learning	The importance of supportive teams in the learning process and how this facilitated articulation strategies.	<i>A supportive team of colleagues made it an easy environment to integrate into. I always felt that I could come back to a colleague and ask for further explanation, or clarification and when learning, this is key. Also, when faced with difficulty, being able to talk through issue, I would find the solution myself but having a sounding board to confirm that what I was saying sounded correct helped. Code reviews⁶ helped to ensure that was meeting the coding standards.</i> (Company 19, Graduate A)
	Learning through XP practices and pair-programming.	<i>Pair-programming⁷ within teams and other XP practices⁸</i> (Company 31, Guide A)
	Increasing diversity; the importance of working with numerous colleagues, each with their own speciality.	<i>I worked with a number of different colleagues, each with their own area of expertise. This was very effective as I was learning something different from different people</i> (Company 13, Graduate C)
Social media	Two guides mentioned the use of Wiki exchanges for activities such as posting problems, potential solutions, debating, sharing information, and questioning. This new discussion strategy, Wiki exchanges, could be classified under the articulation heading (Instructional Model of Learning) or as a resource (Self-directed Strategies).	<i>Each Project keeps a wiki where partners working on similar tasks post problems and sometimes solution, this encourages debate and often partners working in a different area could pose a possible solution, Graduates are also encouraged to participate.</i> (Company 1, Guide B)
		<i>Wikis to share information, open environment where people are not afraid to ask questions, fostering an environment of understanding rather than just learning tasks by rota</i> (Company 17, Guide A)

⁶ A code review typically takes place between an expert programmer and the novice programmer. The expert programmer reviews each line of code to ensure that it is correct, meets naming standards, is efficient, meets the organisations standards, and so on.

⁷ Pair-programming occurs when two software engineers work at one computer at the same time. One engineer is the driver and the other is the navigator. The driver writes the code and articulates their thought process while the navigator reviews the code as it is written. The two software engineers frequently rotate the role of driver and navigator.

⁸ XP is a form of agile software development that uses the pair-programming technique. Agile uses brief development cycles to complete units that are frequently released to the customer.

Appendix Table I - 1 Additional identified strategies and projects (contd.)

Source: Author

Dimension	Insight	Respondent quote
Projects and tasks used for the WPL of SE graduates	Entry-level graduates in this organisation initially work on a substantial SE project from start to finish, enabling them to learn about company practices while being supported by a senior developer.	<i>When a graduate started they were given a two month graduate project that they developed from all aspects of a software project and life cycle. This was guided by a senior developer. This allowed them to learn about the company & its practices, gain experience, etc. Their performance was not rated.</i> (Company 12, Graduate F)
	Another variation of this approach is reported by a guide where their entry-level graduates typically work on in-house projects, which allows for performance monitoring and correction prior to working on client sites.	<i>Graduates normally work on in-house projects before we would put them on client sites to work. This allows us to monitor their performance and address issues before they go onto doing work in front of clients</i> (Company 28, Guide A)
	Other guides discussed the use of sample projects to develop the required skills.	<i>Independent research and personal projects to practice skills / techniques</i> (Company 33, Guide A)
		<i>Set challenging learning projects that are of value to the company and will encourage the graduate to research one or more technical areas</i> (Company 30, Guide A)
		<i>Vital requirement to have practical application of any learning or training that goes on for graduates. I have found that sample project based training e.g. development of programs based on a specific technical concept rather than specific to the organisation is very effective.</i> (Company 24, Guide A)
	In addition to the technical side of software development, one guide drew attention to the importance for SE graduates to obtain business knowledge relating to the software they are developing.	<i>I would also expose them to the business area they are providing software for.</i> (Company 22, Guide A)
	Another guide iterated the importance of deadlines while working on realistic development tasks.	<i>working on real world programming tasks with real world deadlines</i> (Company 21, Guide B)
	Guides also provided additional strategies specific to the SE discipline only which includes code review and open source projects.	<i>Participation in peer code review sessions</i> (Company 25, Guide A)
		<i>participate in open source software projects</i> (Company 11, Guide C)

Appendix Table I - 2 Guide preparation for their WPL role (when selected by organisation)

Source: Author

Guide preparation when selected by the organisation	Guide quote
Little or no preparation	<i>No training was provided by the organisation. I have a teaching backround as a math teacher.</i> (Company 21, Guide A)
	<i>There was very limited support in place. I was given an amount of time to support this, but there was very limited materials / training etc. involved.</i> (Company 22, Guide A)
	<i>I got no preparation at all; I was just assigned graduates through the 'buddy system'.</i> (Company 29, Guide B)
	<i>Limited preparation, just rely on experience.</i> (Company 32, Guide A)
	<i>Nothing specific.</i> (Company 16, Guide A)
Learning objectives set out to prepare guides for their WPL role	<i>Syllabus was developed along with experts.</i> (Company 28, Guide A)
	<i>External Training and objective setting.</i> (Company 33, Guide A)
Training varies from organisation to organisation	<i>Varies from organisation to organisation.</i> (Company 35, Guide A)
Guide replicating their own WPL experiences as a graduate	<i>As I joined as a graduate and got on-the-job learning, I was able to pass on the skills I had picked up.</i> (Company 29, Guide A)

Appendix Table I - 3 Guide preparation for their WPL role (when selected by graduate)

Source: Author

Guide preparation when selected by the graduate	Guide quote
Little or no preparation	<i>They didn't.</i> (Company 11, Guide B)
	<i>not at all.</i> (Company 11, Guide C)
	<i>Minimal support from the company; it is understood that when one becomes experienced in the field, one should be able to train those who are less experienced.</i> (Company 14, Guide A)
	<i>No support, the on-the-job learning/teaching is not a recognised task within our dept so everything is done on an informal basis and is the responsibility of individuals to help/share with each other.</i> (Company 17, Guide A)
	<i>not at all.</i> (Company 21, Guide B)
	<i>Not at all - depended on my experience and professionalism to do this properly.</i> (Company 24, Guide A)
	<i>No preparation. I just establish a niche to fit them in.</i> (Company 26, Guide A)
	<i>Encouraged me to take up the role but no formal training.</i> (Company 27, Guide A)
	<i>None.</i> (Company 31, Guide A)
	<i>No preparation done at all. Just told to help out graduates.</i> (Company 34, Guide A)
	<i>It didn't really - it was just necessity.</i> (Company 36, Guide A)
	<i>Nothing directly, but the environment is an open, collaborative one where learning and mentoring is part and parcel of the job.</i> (Company 30, Guide A)
Attended training courses	<i>Train the Trainer/coaching courses to those supporting on-the-job learning.</i> (Company 13, Guide A)
	<i>Developed induction training.</i> (Company 23, Guide A)
	<i>Training courses.</i> (Company 5, Guide A)

Appendix Table I - 4 Organisation's perspective on guide preparation for their WPL role

Source: Author

Guide preparation	Organisation quote
Through induction programmes	<i>Induction programme with specific emphasis on our graduate scheme.</i> (Company 5)
By identifying skills gaps	<i>identifying skills gaps and documenting.</i> (Company 10)
Through discussion	<i>Sitting down with them and going through our expectations of them, by outlining the support tools we have for them to utilise, by encouraging open and honest communications between the graduates and team lead/mentor.</i> (Company 2)

Appendix Table I - 5 Curricula items on formal training courses designed to prepare guides for their WPL role

Source: Author

Curricula items	Guide quote
Soft skills	<i>We have internal training programmes which do help with people skills, presentation and communication.</i> (Company 34, Guide A)
Mentoring	<i>Mentoring training.</i> (Company 23, Guide A)
Coaching	<i>Coaching etc.</i> (Company 5, Guide A)
Questioning	<i>Questioning graduate to help them learn.</i> (Company 13, Guide A)
Learning theories	<i>Theories of training and adult learning, coaching techniques.</i> (Company 33, Guide A)
Practical examples	<i>Practical examples and how they support learning</i> (Company 13, Guide A)

Appendix Table I - 6 Guide motivations for participating in WPL

Source: Author

Dimension	Insight	Guide quote
Maintaining project/team health	Project / team health was the most significant motivation for supporting graduate WPL. Guides appeared anxious to get graduates up to speed as early as possible so that they could start effectively contributing to the project / team work.	<i>It's critical to the success of a project that all personell are up to speed on the processes</i> (Company 14, Guide A)
		<i>Need to get graduates up to speed and capable of delivering tasks on a project as soon as possible. Real requirement for the level of support to decline to minimal supervision within 12 - 18 months of starting with a company</i> (Company 24, Guide A)
		<i>Building a good team. Seeing engineer develop</i> (Company 23, Guide A)
		<i>Sharing the knowledge with graduates makes for a better workplace and product for everyone on the team</i> (Company 17, Guide A)
		<i>To get the best job done to the best of the teams ability</i> (Company 27, Guide A)
		<i>You can easily train the graduates for the requirements of the team/company. It makes your working day easier when they are on the same page as everyone else.</i> (Company 29, Guide B)
		<i>The graduates are there to be part of the team. If they know the job there are better to support the team and organization. The graduate then is better able to help others when needed.</i> (Company 21, Guide A)
		<i>these graduates are resources at the end of the day - and at some point will end up being your problem or saviour on a project. So I would have a vested interest in helping to select suitable graduates that will continue past their probation.</i> (Company 1, Guide B)
		<i>Wanting to see different projects/improvements realized</i> (Company 11, Guide B)
Evolving guides' own knowledge	Evolving guide knowledge was reported as motivation for supporting graduate WPL. Two guides reported that supporting graduate WPL helped them to keep up-to-date and fresh.	<i>requires me to be up to date on techniques and technologies.</i> (Company 30, Guide A)
		<i>Keeps my mind fresh and challenged by the questions. Makes me reflect on the depth of my own knowledge</i> (Company 26, Guide A)
Maintaining organisational health	Maintaining organisational productivity and profits motivated guides to support WPL.	<i>from an organisation point of view if it is done badly not only will they as individuals suffer, but so will we as an organisation.</i> (Company 22, Guide A)
		<i>Overall productivity requirements</i> (Company 35, Guide A)
		<i>As a consultancy firm, graduates are expected to become billable resources as soon as possible</i> (Company 28, Guide A)

Appendix Table I - 6 Guide motivations for participating in WPL (contd.)

Source: Author

Dimension	Insight	Guide quote
Developing standalone employees	This was also a significant motivation for supporting graduate WPL with seven guides reporting this sentiment. Guides appeared anxious to get graduates up to speed as early as possible so that they could stand on their own two feet, effectively making the guides' role easier in the long run and producing experienced employees from the graduates.	<i>Helping a person become skillful at thier job and see them grow in the organisation and become experts in their own rights</i> (Company 13, Guide A)
		<i>so that they become net contributors</i> (Company 11, Guide C)
		<i>No graduate will arrive on a job and immediately know what to do - some help and guidance will help everyone involved</i> (Company 1, Guide A)
		<i>Everyone is a graduate at some point, once they are trained in then they are able to help with more complex tasks.</i> (Company 21, Guide B)
		<i>Effective OJL makes my job easier in the long run as there is less support requirement eventually</i> (Company 33, Guide A)
		<i>Any organisation benefits from diversity within the work place from Junior to Senior staff. No piece of work can carry a graduate, otherwise they are just a cost, they must become effective relatively quickly. The more you Invest early the quicker they become effective.</i> (Company 32, Guide A)
		<i>It helps the company to have trained/experience graduates. I appreciate the help/assistance I've received from experience professionals in the past; I'd like to help people improve too.</i> (Company 16, Guide A)
Guides' sense of satisfaction from helping graduates	Another commonly cited motivation was the sense of satisfaction that guides felt when helping graduates develop their competencies. Seven guides cited this sentiment.	<i>Sense of satisfaction in bringing out someones abilities</i> (Company 5, Guide A)
		<i>Wanting to make a difference</i> (Company 11, Guide B)
		<i>I'm an avid learner myself (life-long learning is heavily promoted in [company name removed]) and I really enjoy imparting my knowledge to anyone who might find it beneficial.</i> (Company 21, Guide C)
		<i>I have always enjoyed working with people. I have enjoyed my career in IT and feel I can help these graduates do the same, as well as impart the knowledge for them to be successful</i> (Company 22, Guide A)
		<i>Makes you feel better to help others while also improving their skills</i> (Company 29, Guide A)
		<i>It's good for morale</i> (Company 31, Guide A)
		<i>enjoy seeing graduates develop within their role and into their future career</i> (Company 30, Guide A)

Appendix Table I - 7 Graduate preparation for their WPL role (when selected by the organisation)

Source: Author

Preparation for WPL role	Graduate Quote
No preparation given	<i>Didn't - just took it all in</i> (Company 13, Graduate A)
	<i>Didn't prepare me</i> (Company 13, Graduate B)
	<i>Did not prepare</i> (Company 13, Graduate F)
	<i>No Preparation. The company gave me various task and it was up to me to learn.</i> (Company 13, Graduate H)
	<i>It didn't.</i> (Company 13, Graduate I)
	<i>None, just got on with it</i> (Company 15, Graduate A)
	<i>No formal preparation, just a friendly, approachable team of people</i> (Company 19, Graduate A)
Attended training courses but provided no details of the syllabi	<i>3 month training program</i> (Company 12, Graduate C)
	<i>A basic course was provided externally initially, however after budget cuts and due to large workloads, everything else was picked up as I went along</i> (Company 5, Graduate C)
	<i>By providing training course</i> (Company 13, Graduate L)
Attended training courses and provided some details of the syllabi	<i>I was sent on a a number of different training courses both external (technical courses) and inteernal (related to the workings of the company)</i> (Company 13, Graduate C)
	<i>organised training and had graduate workshops</i> (Company 13, Graduate J)
	<i>The organisation eased us into our roles through a Graduate Program which combined on the job learning, with classroom based sessions, thus preparing us for our imminent start within the team</i> (Company 12, Graduate D)
Provided with graduate learning and development packs	<i>An HR induction was held and a Graduate Learning and Development pack was issued</i> (Company 18, Graduate D)
Allocated time to train in self-selected subject	<i>By giving fore-warning for scheduled training and allowed us to assign time during our work hours during the year to do training on self selected subjects we feel we could use further training on and provide those resources to do it</i> (Company 12, Graduate F)
Used specific WPL strategies to prepare for their role	<i>Assigned me to work alongside an experience colleague</i> (Company 17, Graduate A)
	<i>Basically, I am using search engine to find any interesting topic and visit some technical websites. Also i chat with colleagues</i> (Company 1, Graduate D)
	<i>By allocating the appropriate time and resources (people, books etc)</i> (Company 12, Graduate E)
	<i>With access to books, internent and senior colleges.</i> (Company 5, Graduate A)

Appendix Table I - 8 Training to prepare graduates for their WPL role

Source: Author

Dimension	Graduate Quote
Technical training	<i>Linux OS training course (5 day on-the-job training course) given by Linux expert (Company 1, Graduate B)</i>
	<i>Not specifically on "How" to learn but a course which gave everyone the basics of the technology that is used in the company (Company 12, Graduate C)</i>
	<i>External technical courses in the languages worked with on a daily basis (Company 13, Graduate C)</i>
	<i>A one week course in Java programming. (Company 5, Graduate C)</i>
General comments	<i>Training Academy of lectures and assignments relating to different parts of the business. (Company 18, Graduate D)</i>
	<i>workshops with an external company every few months (Company 13, Graduate J)</i>
	<i>6 weeks IT course in DIT [Dublin Institute of Technology]. (Company 13, Graduate H)</i>
	<i>Computer based training courses and self organised in house learning. (Company 12, Graduate E)</i>
	<i>External liaison with project partners (Company 1, Graduate A)</i>
	<i>Part time Msc study, free workshop and course activities (Company 1, Graduate D)</i>
	<i>job related courses (Company 13, Graduate E)</i>
	<i>Time and task managment. Career planning. (Company 13, Graduate L)</i>
	<i>Online learning - videos etc (Company 5, Graduate A)</i>

Appendix Table I - 9 Graduate motivations for participating in WPL

Source: Author

Dimension	Insight	Respondent quote
Opportunity to learn new skills / knowledge	The most popular motivation for engaging in WPL was the opportunity to learn new skills and knowledge.	<i>Building my knowledge</i> (Company 13, Graduate F)
		<i>Gaining more experience and knowledge</i> (Company 13, Graduate A)
		<i>Learning interesting/new technologies.</i> (Company 12, Graduate C)
		<i>The ability to learn new skills</i> (Company 13, Graduate L)
		<i>to gain new skills to take on more responsibility</i> (Company 13, Graduate J)
		<i>The fact that I will learn a new skill</i> (Company 15, Graduate A)
		<i>Opportunity to learn</i> (Company 14, Graduate A)
		<i>Keep up with technology.</i> (Company 5, Graduate A)
		<i>Learn new things - a change from normal work. Makes day to day tasks easier.</i> (Company 13, Graduate C)
		<i>to learn and work independently</i> (Company 13, Graduate H)
		<i>The gaining of experience</i> (Company 15, Graduate B)
		<i>To understand of concepts and find problems</i> (Company 1, Graduate D)
Job security and mobility	Job security and mobility was a strong driving force for motivating graduates to engage in WPL.	<i>Becoming better at my job so that I can move up the ladder in the company and apply for professional accreditation</i> (Company 18, Graduate D)
		<i>Job security</i> (Company 1, Graduate A)
		<i>New skills, better position, more opportunities</i> (Company 11, Graduate A)
		<i>Responsibilities</i> (Company 13, Graduate K)
		<i>Necessity</i> (Company 1, Graduate C)
		<i>to hopefully ready me for promotion to higher roles</i> (Company 5, Graduate C)
		<i>provides a base from which I can further study if I want and branch out into other areas\projects</i> (Company 12, Graduate F)

Appendix Table I - 9 Graduate motivations for participating in WPL (contd.)

Source: Author

Dimension	Insight	Respondent quote
A sense of satisfaction	Graduates were also motivated to engage in WPL through a sense of satisfaction and self-motivation.	<i>I continually strive for self-improvement and to try do the best I can</i> (Company 1, Graduate B)
		<i>Love solving problems and seeing the final outcome</i> (Company 5, Graduate B)
		<i>The desire to improve</i> (Company 13, Graduate I)
		<i>By seeing an end working product as a result doing 'real' work</i> (Company 19, Graduate A)
		<i>Self motivation</i> (Company 1, Graduate D)
		<i>Keep CV looking good</i> (Company 5, Graduate A)
An interest in their job	An interest in their job and completing their tasks also motivated graduates to engage in WPL.	<i>An interest in the job</i> (Company 12, Graduate E)
		<i>Getting the job done</i> (Company 17, Graduate A)
		<i>understanding of the infrastructure</i> (Company 13, Graduate E)
		<i>To allow me to get my tasks done</i> (Company 5, Graduate C)
		<i>You learn what's practical and applicable to what you are working on</i> (Company 12, Graduate F)

Appendix Table I - 10 Formal WPL policy contents provided by the organisation

Source: Author

Formal WPL policy contents	Organisation quote
Specify learning strategies for new hires	<i>Coaching - by line managers Mentoring of new employees Induction Projects/Secondment - internationally and nationally Internal Training Courses</i> (Company 2)
	<i>We always place our new employees with an experienced staff member</i> (Company 7)
Detail performance milestones	<i>Training plans for performance mgt, milestones for month 1, month 3, month 6, continuous on the job training is encouraged and external vendors are sometimes brought in</i> (Company 8)
Approaches for developing syllabi	<i>Syllabus drawn up for any discipline for which we would be recruiting detailing theoretical and practical training to be delivered as well as a career development plan for the graduates.</i> (Company 9)
Use of training matrices to bridge skills shortfalls	<i>Identifying potential skills gaps - then completing a training matrix to bridge gaps</i> (Company 10)

Appendix Table I - 11 Learning opportunities suggested by guides

Source: Author

Learning opportunity	Insight	Guide quote
Immersion in real projects / tasks	Four graduates detailed the learning opportunities they had when assigned to real tasks and projects.	<i>After about 3 months of training I was put onto active project teams and given tasks like all team members. They were supervised less and less and I was encouraged to think independently.</i> (Company 12, Graduate E)
		<i>The graduate programme we engaged in combined real tasks with training. Also, company based Computer Based Training Modules are a must for all new employees, introducing them to all aspects of the company and their role as they work. In addition, most of the tasks i took on could really be seen as on-the-job learning opportunities, the role was new to me, and the tasks were too, so simply doing my job is a learning curve still.</i> (Company 12, Graduate D)
		<i>Almost all my learning was done as I worked. Anything I didn't understand was explained. There was very little structured learning, due only to workload not allowing time for it.</i> (Company 5, Graduate C)
		<i>New tasks where always accompanied with an explanation, either verbal and supported with documentation, or using existng written resources</i> (Company 19, Graduate A)
	Bug fixing (routine tasks) prior to working on development tasks (non-routine tasks).	<i>Was given bugs to fix before I was given features to implement.</i> Company 17, Graduate A
	Working on bugs or developing minor features are typical learning opportunities. One guide maintained that graduates are supported when engaging in these learning opportunities.	<i>Bug fixing, addition of minor new features</i> (Company 17, Guide A)
		<i>Software bug fixing requires a range of skills. Assigning a wide variety of bugs to the graduate(s) engenders an environment of on-the-job learning, as long as it is coupled with the necessary level of support from experienced engineer(s)</i> (Company 14, Guide A)
		<i>Writing functional specifiacion documents, invovled in complete work request as an observer with limited productive role, some small programming elements may be given to them.</i> (Company 21, Guide B)
		<i>Work with the support team. Work with the testing team. Contribute to a project straightaway.</i> (Company 23, Guide A)
		<i>Managing non-critical tasks on projects</i> (Company 21, Guide C)
		<i>Developing certian small modules for prototype presentation.</i> (Company 26, Guide A)

Appendix Table I - 11 Learning opportunities suggested by guides (contd.)
Source: Author

Learning opportunity	Insight	Guide quote
Working on projects designed specifically for WPL	SE graduates were given case studies or projects specifically developed as learning opportunities.	<i>special pet projects - more an exercise is validating the graduate before you leave them near anything they can break.</i> (Company 1, Guide A)
		<i>completing readymade case studies redoing work already completed by experienced colleagues</i> (Company 35, Guide A)
Problem solving techniques	Problem solving activities can be a learning opportunity.	<i>basic problem analysis</i> (Company 35, Guide A)
Collaborative learning	Graduates reported strategies such as peer teaching, pair-programming, working with other teams, and maintaining existing systems as learning opportunities.	<i>Mentored training project & peer training (self and guided learning with colleagues of the same level).</i> (Company 12, Graduate F)
		<i>Paired programming with more senior developer</i> (Company 5, Graduate A)
		<i>Working with other teams, learning new techniques from different sources</i> (Company 13, Graduate C)
		<i>Writing scripts within the larger framework of a system they've had no input to. This is a real-world situation which they may not have had experience with in education</i> (Company 31, Guide A)

Appendix Table I - 12 Comments relating to the overall effectiveness rating of guides

Source: Author

Likert-type selection	Insight	Graduate Quote
Very effective	Constant availability of the guide	<i>My supervisor was always available (i.e. reply to requests promptly by email or IM) to provide support, advice, and feedback</i> <i>Company 1, Graduate B</i>
		<i>always available for questions if needed.</i> <i>Company 12, Graduate A</i>
		<i>An experienced hand was never too far away. Coming from college my emphasis was on getting the task at hand to work, whereas my mentors concern was to work in the best possible way.</i> <i>Company 12, Graduate E</i>
		<i>I had a lot of questions and as he was sitting right next to me I could get an immediate response.</i> <i>Company 13, Graduate C</i>
		<i>Always available to discuss problems with. Willing to give advice and take time out of his busy schedule to help explain a task or how to solve a particular issue.</i> <i>Company 18, Graduate D</i>
Effective	Guide workload encouraged graduate to look elsewhere for support	<i>They had their own work to be getting on with and was therefore not always available to assist. After a few month I looked to many different colleagues for advice, understanding who had expertise where.</i> <i>Company 5, Graduate C</i>
Ineffective	Little interaction with guide	<i>not much interaction</i> <i>(Company 5, Graduate A)</i>

Appendix Table I - 13 Factors organisations suggested as supporting or inhibiting WPL

Source: Author

Supports for WPL	Company quote
Sandboxes to try out software	<i>Assigning mentors/buddy - Organise specific one-one sessions with business analysts/developers with specific skill sets on a regular basis - Provide a sand pit for graduates to go in and try out software - Putting graduates straight on project roll outs/upgrades with deadlines etc both internationally and in Ireland - Hold regular individual and group meetings between graduates, team leads and HR to identify if there are any gaps and to put a plan in place if there are. - At the beginning of the graduate role, a training plan is developed outlining the areas that graduates should cover over the first 6 months. At the end of the first year they then go on to the Performance and Development Plan where training and performance management is continually monitored and on the job or external identified - Plenty of step action guides available for graduates to study in their own time at work.</i> <i>(Company 2)</i>
Adhering to prescribed training plans	
Holding regular meetings with graduates, team leaders and HR to plan learning	
Self-study	
Immersion in a work environment with sound ethics	<i>Good job environment with good sound job ethics. Thriving sports and social club.</i> <i>(Company 5)</i>
Inhibiting WPL	Company quote
Financial constraints	<i>Costs.</i> <i>(Company 7)</i>
Sufficient time allocation	<i>Sometimes people as so busy with on the job work that they dont have the time to train</i> <i>(Company 8)</i>
	<i>If senior managers/team leads are stretched - to fix this we will assign a mentor at a more junior level to ensure they have support.</i> <i>(Company 2)</i>
Remote learning	<i>mentors can sometimes be in a different office so communication can be via skype/email</i> <i>(Company 3)</i>
	<i>Providing on the job training to graduates in remote locations can [inhibit learning]- we try to organise the graduate to return to HQ or the manager to go to their location as much as possible. In general communication is very open and queries are encouraged</i> <i>(Company 2)</i>

Appendix Table I - 14 Additional undergraduate learning strategies

Source: Author

Dimension	Undergraduate quote
Extra classes and tuition	<i>Put on some extra classes</i> (Undergraduate 13)
	<i>Help Outside of class hours. eg. maths workshop.</i> (Undergraduate 16)
	<i>Offered extra classes</i> (Undergraduate 37)
	<i>Lecturers provided tutorial classes instead of some practicals or lecturers where they would individually help students having issues with projects or reports this was VERY helpful.</i> (Undergraduate 48)
	<i>Giving advice on resources external to class such as maths/computer learning center, also other resources external to wit</i> (Undergraduate 63)
Video tutorials	<i>Videos used in class related to lectures</i> (Undergraduate 12)
	<i>Video tutorials</i> (Undergraduate 65)
Frequent in class quizzes	<i>Regular class quiz's</i> (Undergraduate 28)
Group study	<i>Group study has been the best study tool I've used.</i> (Undergraduate 25)
Use of incremental projects	<i>Stepped or goal based learning, e.g. completing a section of a project, each subsequent part of the project was an add on to the goal of completing an overall project</i> (Undergraduate 45)
Explicit insight into teaching approaches adopted	<i>Discussion of philosophy of why we where doing each step, and of alternative views made it more interesting. Interest in what we are doing and why we are doing if far more valuable than dry repetition of course matter.</i> (Undergraduate 7)

APPENDIX J –
Additional tables of findings

Appendix Table J - 1 Supports guides provide for SE graduates (graduate perspective)

Source: Author

N=41

Frequency of use (%)						Mean	SD
1	2	3	4	5			
Organise graduate on-the-job learning							
Guide selected by the organisation	21	25	12	29	13	2.9	1.393
Guide selected by the graduate	25	34	8	25	8	2.6	1.379
Ignoring guide selection method	22	28	11	28	11	2.8	1.376
Monitor graduate performance when learning on-the-job							
Guide selected by the organisation	17	21	12	42	8	3.0	1.301
Guide selected by the graduate	17	33	17	25	8	2.8	1.288
Ignoring guide selection method	17	25	14	36	8	2.9	1.286
Encourage graduates to engage in problem solving activities with colleagues/peers							
Guide selected by the organisation	8	8	25	25	34	3.7	1.274
Guide selected by the graduate	25	0	17	25	33	3.4	1.621
Ignoring guide selection method	14	6	22	25	33	3.6	1.381
Encourage transferability of learning							
Guide selected by the organisation	8	8	25	34	25	3.6	1.213
Guide selected by the graduate	17	8	8	33	34	3.6	1.505
Ignoring guide selection method	11	8	20	33	28	3.6	1.296
Encourage graduates to reflect on their learning							
Guide selected by the organisation	21	21	21	33	4	2.8	1.250
Guide selected by the graduate	17	25	33	8	17	2.8	1.337
Ignoring guide selection method	20	22	25	25	8	2.8	1.261
Encourage graduate self-correction based on reflections							
Guide selected by the organisation	17	17	29	21	16	3.0	1.334
Guide selected by the graduate	17	33	17	25	8	2.8	1.288
Ignoring guide selection method	17	22	25	22	14	2.9	1.308
Encourage graduates to compare their task performance with that of experienced colleagues							
Guide selected by the organisation	50	8	25	17	0	2.0	1.213
Guide selected by the graduate	42	8	25	17	8	2.4	1.443
Ignoring guide selection method	47	8	25	17	3	2.2	1.283

Key: 1: Not at all 3: Neutral 4: Certain extent
2: Limited extent 5: Large extent

Appendix Table J - 2 Supports guides provide for SE graduates (guide perspective)

Source: Author

N = 32

Source: Author						N = 32	
WPL Guide Supports	Frequency of use (%)					Mean	SD
	1	2	3	4	5		
Organise graduate on-the-job learning							
Guide selected by the organisation	0	30	0	40	30	3.7	1.252
Guide selected by the graduate	21	26	11	32	10	2.8	1.385
Ignoring guide selection method	14	28	7	34	17	3.1	1.382
Monitor graduate performance when learning on-the-job							
Guide selected by the organisation	0	0	30	30	40	4.1	0.876
Guide selected by the graduate	5	21	11	53	10	3.4	1.121
Ignoring guide selection method	3	14	17	45	21	3.7	1.078
Encourage graduates to engage in problem solving activities with colleagues/peers							
Guide selected by the organisation	0	0	0	30	70	4.7	0.483
Guide selected by the graduate	5	5	11	47	32	4.0	1.079
Ignoring guide selection method	3	3	7	42	45	4.2	0.978
Encourage transferability of learning							
Guide selected by the organisation	0	0	10	30	60	4.5	0.707
Guide selected by the graduate	0	5	21	32	42	4.1	0.937
Ignoring guide selection method	0	4	17	31	48	4.2	0.872
Encourage graduates to reflect on their learning							
Guide selected by the organisation	10	10	30	30	20	3.4	1.265
Guide selected by the graduate	16	16	26	21	21	3.2	1.385
Ignoring guide selection method	14	14	27	24	21	3.2	1.327
Encourage graduate self-correction based on reflections							
Guide selected by the organisation	10	10	20	40	20	3.5	1.269
Guide selected by the graduate	21	0	26	32	21	3.3	1.416
Ignoring guide selection method	17	3	24	35	21	3.4	1.347
Encourage graduates to compare their task performance with that of experienced colleagues							
Guide selected by the organisation	40	10	10	20	20	2.7	1.703
Guide selected by the graduate	42	16	16	21	5	2.3	1.376
Ignoring guide selection method	41	14	14	21	10	2.5	1.478

Key: 1: Not at all 3: Neutral 4: Certain extent
2: Limited extent 5: Large extent