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Learning a trade: Becoming a trades person through apprenticeship

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"Ko nga kaihanga whare, ka riro ma te whare ano ratau e hanga."

"Those who build the house are built by it."

Attributed to a Māori Elder and translated by Professor Wharehuia Milroy

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OVERVIEW

In this project, apprentices' perspectives on how they went about learning a trade are collated, studied and appraised. Guidelines for apprentices and their workplace trainers to assist with workplace-based learning are then derived from apprentices' *experienced curriculum*. The framework used to understand how apprentices learn a trade and become trade persons is informed by socio-material learning theories. Apprentices' learning is understood to include individuals' identity formation through embodiment of knowledge as revealed through skilled practice; incorporating learning through inter-relational or co-creation with other learners and experts and through interaction with materials and tools and machines be they hardware or software. In learning a trade, apprentices learn the social and cultural practices of their trade as they become trades persons by learning how to do, think, feel and be.

SUMMARY:

Aims and objectives:

The project aims to improve understanding of apprentices' workplace-based learning and occupational identity formation through a synthesis of data on how apprentices perceive learning at work and contemporary understanding of workplace learning as informed by theories of embodied cognition and knowledge (Marchand, 2010) and grounded cognition (Billett & Choy, 2013).

Literature foundation:

The project uses the framework of 'learning as becoming' (Hodkinson, Biesta & James, 2008) to understand apprentices' ways of doing, thinking, feeling and being. The project is informed by socio-cultural and socio-material learning theories with the following proviso. Billett and Choy (2013) caution on applying educational theories derived from formal education to workplace learning as these theories may not account for the multifarious and contextual nature of workplace-based learning.

Research method:

Interviews with boat building, carpentry, cookery, dairy farming, engineering (fitting, turning or fabrication), hairdressing, glazing and joinery apprentices were conducted. Data analysis, underpinned by phenomenographical approach (i.e. privileging participant perspectives),using frequency and thematic analysis and case studies.

Findings:

The majority of apprentices learnt a trade through watching, practice and being coached. Apprentices also learnt through imitation, critical reflection and thinking, enquiry, problem solving, interaction with others (through feedback and conversations) and teaching or helping others.

Guidelines

Apprentices – to become mindful practitioners who are able to reflectively learn to become effective problem solvers.

Coaches- to assist apprentices through modelling, coaching, scaffolding and fading supported by sound feedback strategies.

Recommendations

Apprentices – Introduce, support and enhance metacognition and learning to learn strategies within trades learning contexts.

Coaches – Maximise direct coaching strategies.

ITOs – Increase opportunities for peer learning connection and recognise workplace-based achievements.

Training of tutors and coaches - Improve vocational pedagogical approaches to encompass multimodalities and multiliteracies of trades-based learning.

INTRODUCTION

Apprentices' workplace learning involves learning occupational practices as recognised and embodied in expert practitioners. Learning trade-based occupational skills goes beyond competency. Learning to become a trades person encompasses aspects of learning by doing, deliberate and reflective practice, and co-construction or co-creation of specialist understandings with peers, co-workers and mentors. This project seeks to better understand, from apprentices' perspectives, how workplace learning opportunities may be improved.

This project is a follow-up from an Ako Aotearoa National project (Chan, 2011a), "*Belonging, becoming and being: First year apprentices' experiences in the workplace*". In the follow-up study reported here, apprentices were interviewed to find out how they progressed in learning the skills, knowledge, i.e., practical, cognitive and tacit and dispositions or attitudes defining their chosen occupation. The findings from interviews were synthesised with contemporary literature on skills learning and refined into practical guidelines for apprentices and their coaches. In this report the term coaches is used to also encompass trainers, assessors, employers and supporters who assist apprentices with learning work skills, knowledge or dispositions. The guidelines presented in this report (see Figures 8 and 9 for summaries) are to assist with improved awareness and build skill development capability with apprentices and their trainers and coaches.

As with the initial project (Chan, 2011a), apprentices from seven Industry Training Organisations (ITOs) participated. The ITOs were:

- Building and Construction ITO (BCITO) - carpentry apprentices participated. Note this cohort is different from the previous project whereby students participating in a Gateway[1] programme were interviewed.
- Competenz – Engineering apprentices in manufacturing (fabrication and fitting, turning and toolmaking) participated.

[1] Gateway is a government initiative to engage young people at school. School students complete work experience for two or three days a week. Workplaces offering Gateway opportunities span a range of trades and industries.

- Hairdressing ITO (HITO) – hairdressing apprentices participated. The apprentices from the original study were Christchurch-based and could not be contacted. Due to the Canterbury earthquakes, many Christchurch residents had moved away from the city after 2011. Hence, the participating apprentices in this current project were randomly selected from a list of apprentices who had recently completed their hairdressing qualifications.
- Joinery ITO (JITO) – apprentices in glazing and joinery participated.
- NZ Marine ITO (NZMITO) – boat building apprentices participated
- Primary ITO (PITO) - This ITO assist training in the agriculture, horticulture, equine, water and sports turf sectors. Agricultural ITO dairy farm trainees participated in this project.
- Service IQ – This ITO represents the aviation, travel, tourism, museums, hospitality, retail and wholesale sectors of New Zealand's (NZ) service industry. Cookery apprentices participated in the project.

EVIDENCE-BASED NEED FOR UNDERTAKING THE PROJECT

In belonging to a workplace, becoming and being (Chan, 2011b), apprentices learn the various ways of doing, thinking, being and feeling that contribute towards recognition and eventual adoption of the identity of a trade worker.

- Learning how to do the tasks of a trade worker includes learning skills, i.e., procedural knowledge, coupled with acquiring and applying practical knowledge to practice.
- The cognitive or thinking, i.e., conceptual knowledge, aspects of learning a trade include making meaning of visual, auditory, and kinaesthetic perspectives, then selecting and directing understanding towards completion of practical tasks.
- Being a trade worker includes adoption of attitudes and dispositions, i.e., dispositional knowledge, coming about through strengthening or transformation of apprentices' extant values, beliefs and emotions. For example, the aspect of craftsmanship is dependent on reinforcing or attaining and sustaining trade-specific value systems regarding work practices and production.

- All of the above include learning, assimilating and sometimes transferring from subconscious to implicit. Additionally, learning requires the deployment of many senses including visual, audio, tactile, spatial sense, taste and smell. In sum, to learn how to feel physically and emotionally.

The list above details some of the many contributions towards attainment of practices, opaque or tacit knowledge components and understandings that are outwardly recognised through occupational identity markers, i.e., behaviours congruent with an occupation, and attained through processes of learning as becoming (Hodkinson, Biesta & James, 2008). See appendix 1 for a visual summary of concepts some of which are presented and discussed in the section 'relevant literature '.

There is recognition that the workplace is sometimes a difficult environment for learners (Billett, 2001b) with apprentices having variable access to expansive participative learning opportunities (Fuller & Unwin, 2003). Additionally, the attainment of practical skills is still poorly understood (Silver & Forrest, 2007). In NZ, completion rates of apprentices have been low (Mahoney, 2009) with marked variability across industry sectors. With the honourable Steven Joyce's, Minister of Parliaments (2012) announcement of an increase in apprentice numbers and support for apprenticeship training, it is timely to ensure support mechanisms provided to assist apprentices are deployed through practice derived from evidence-based studies.

PROJECT AIMS AND OBJECTIVES

The project seeks to improve understanding of apprentices' workplace-based learning and occupational identity formation. This is achieved through a synthesis of data on how apprentices perceive learning at work and contemporary understanding of workplace learning as informed by theories of embodied cognition or knowledge (Marchand, 2010) or through grounded cognition (Billett & Choy, 2013).

RELEVANT LITERATURE

LEARNING A TRADE

The main objective of apprenticeship is to ensure apprentices have access to adequate training and practice-based learning to become competent practitioners, entrusted with trade workers' or crafts persons' work tasks and responsibilities (Chan, 2011b).

At the individual level, apprentices learn skills, consolidate and apply trade-relevant knowledge, and acquire dispositions or attitudes required of their occupation. However, for some time, there has been recognition of trade capabilities being more complex than quantifiable competencies (Billett, 2011; Crawford, 2009; Rose, 2005).

The following sections summarise some contemporary work in associated training and education relevant to this project. A caution needs to be raised with respect to the present literature. A reliance on studies from education may be inappropriate due to the contextual and situational differences between learning in (a) educational institutions, i.e., formalised learning and (b) workplace-based learning in contested, diverse and continually evolving environments (Billett & Choy, 2013). However, emergent literature arising from anthropological and cognitive psychology is beginning to inform the workplace learning process. To provide background, an overview of the relevant contemporary literature on learning skills, knowledge and acquiring dispositions is presented. This is then followed by the approach framing this project. That is, apprenticeship learning includes eventual attainment of grounded or embodied cognition aspects of an occupation overtly expressed in apprentices' becoming and identifying with their trade. The last part of this section, improving learning a trade, brings together various concepts presented and applies these to suggestions on how to improve trade-based learning as summarised by Lucas, Spencer & Claxton's (2012) recent work on vocational pedagogy.

LEARNING HOW TO DO – PRACTICAL SKILLS

Skill acquisition is a primary objective of apprenticeship learning (Vickerstaff, 2003, 2007). Unfortunately, the contemporary literature is sparse on the topic of practical or manual skill acquisition in trades-based occupations. However, the areas of sports psychology, performance arts and medical training provide a rich and partially interrelated source (Lucas

et al., 2012). To provide accessibility, the principles and recommendations from research undertaken in skills training from sports, performance arts and medical training need to be contextualised to the trades' learning context.

Apart from Billett & Choy's caution in the above section, another point to consider is the neurological basis of motor learning being 'innate'; with motor skills learning often implicit (i.e. completed without conscious awareness) (Masters & Poolton, 2012). For example, when was the last time you concentrated on moving your wrist and hand when you write? When we write, our focus is on the words we are writing rather than how our hand holds the pen and moves about. The same may be surmised with motor skills used in the trades. Initial motor skills learning requires effort, followed by repetitive practice which eventually subsumes learnt movements into the subconscious.

LEARNING HOW TO THINK - KNOWLEDGE

Various studies in the past have tried to understand learning 'practical knowledge'. For instance, Jarvis (1994) proposes that learning involves adaption, imitation, practice, instruction, following through, exploration and experimentation. Guzman (2009) defines practical knowledge as being a blend of:

- Explicit - things that can be explained.
- Tacit procedural knowledge - things that are often unrecognised and cannot be easily explained. This is sometimes referred to as opaque knowledge.
- Tacit practice - doing things based on 'intuition'.

There is also a rich body of work in the organisation management literature on 'knowledge management' exists (for instance in Corradi, Gherardi & Verzelloni, (2010)). Again, this literature needs to be contextualised to the trades learning context.

LEARNING HOW TO BE - ACQUIRING DISPOSITIONS AND CONNECTING HEART AND BRAIN

Moon (2008) proposes critical thinking as a way of being. Having skills, being able to complete a diverse range of specialist activities and the capability to solve problems through logical processes can only be expressed through socially developed habits and attitudes

which are sometimes referred to as habits of mind. Some industries regard the learning of dispositional and attitudinal skills as major components of the occupation. For example, hospitality employees need to attain 'service orientation', defined by Cran (1994) as the individual dispositions to provide courteous but not servile responses or assistance to customers and workmates.

In another example, the ability to put into practice, aspects of craftsmanship is also important. Craftsmanship is defined as, "an enduring basic human impulse, the desire to do a job well for its own sake" (Sennett, 2008 p. 9). Associated with the difficult to pin down qualities of service orientation and craftsmanship is the appreciation of aesthetics. Aesthetic knowing (Emerstein & Whyte, 2007; Fine, 2003; Johnson, 2007) requires bringing together messages provided by the senses (overt and covert or tacit) and knowledge networks to make fine nuanced judgements about products, processes and inter-personal relationships. Hence, trades practice relies not only on being competent in skills and knowledge but also on the ability to perform work tasks to industry recognised standards predicated on the deployment of attributes of care, artistry, technique and judgement.

LEARNING HOW TO FEEL – TACIT KNOWLEDGE AND EMBODIED COGNITION, CONNECTING BODY TO BRAIN

Contemporary studies in psychology use the term grounded cognition (Barsalou, 2008) and embodied cognition (Marchand, 2010) to describe how people learn through the interactions between mind and body. Aspects of interest to trades-based learning include the role of haptics brought about by learning through non-verbal communications such as touch and incorporating ways of thinking and feeling into doing things. Other influences include those contributed by "the epistemology of the hand" (Brinkman & Tanggaard, 2010) as in how the practicality of manual actions influences the way we conceptualise practical problems, and the role of embodied knowledge through language use and learning via *the meaning of body* (Johnson 2007).

The brain and hand work synchronously together; one cannot be separated from the other. To learn a trade is to work dynamically both with brain and hand (Crawford, 2009; Rose, 2005). An example from a recent project working with welding tutors to improve teaching practice (Chan & Leijten, 2012) indicates the sound of welding to be an important welders'

skill. However, tutors made the assumption that students would also be attuned to the sound of welding as a defining factor for correct welding processes. Therefore, the skill to listen to the sound of welding had become embodied into the practice of expert welders. The ability to gauge welding efficacy through sound, is therefore a specialised and assumed expert welder skill.

THE CONTRIBUTION OF OTHERS – THE SOCIO-CULTURAL DIMENSION

Socio-culturists advocate the importance of both the individual and the social in how learning occurs (Penuel & Wertsch, 1995). Therefore, in learning how to become, there is the contribution of:

- Learning interactional expertise (Collins & Evans, 2007).
- Attaining inter-subjective understandings (Hutchins & Klausen, 1998) often through subconscious interpretation of non-vocal signals (Burgoon, 1994).
- Circumspection or learning by looking around (Nielsen, 2007).
- Ontological origins, i.e., innate talents or affinities combined with skills, knowledge and dispositions learnt through the life course (Sheets-Johnstone, 2000).

Individuals are premised to be new-comers entering specialised communities of practice through learning, understanding and then using communication conventions and practices (Lave & Wenger, 1991). Workplace learning proceeds through 'guided learning' (Billett, 2001a) to assists novices to become members of a practice community.

THE CONTRIBUTION OF EVEN MORE OTHERS – THE SOCIO-MATERIALITY APPROACH

Recent work on socio-materiality (Fenwick, Edwards & Sawchuk, 2011) challenges current understandings of how people learn. Socio-materiality shifts the historical focuses from the cognitive, individual and social, i.e., socio-cultural, towards including learners' interactions with tools, technologies, bodies (including human and animal), actions and objects. Instead of static relationships, learning and other human activities are to be understood as being fluid, dynamic and complex.

Many aspects of trade work include individuals working with tools, machinery, equipment and materials. Trade workers also work in environments requiring individuals to develop and maintain good spatial relationship sense, e.g., matching building plans to the site and construction of a building, and awareness of temporality, e.g., effects of weather or the seasons on a dairy herd. The way the body adapts to workplace physical environments (Roth & Bowen, 2001) is also important in trades carried out in specialised workplaces, e.g., the heat of a commercial kitchen, the noisy engineering workshop, the cluttered building work site and muddy and wet farm environments. Experts from similar disciplines display material consciousness, they see, feel and sense messages from the materials, machines and tools they work with (Sennett, 2008). Hence, socio-material aspects of work are a rich area for further study as they connect learners, conceptualisations and relationships between material, spatial and temporal.

BRINGING IT TOGETHER: THE CONCEPT OF 'BECOMING' AND IDENTITY FORMATION

To encompass the many influences contributing to the formation of trade workers' occupational identity, as introduced in the above, the concept of 'learning as becoming' (Hodkinson et al., 2008) is used in this project as the underlying foundation. In learning a trade, novices learn how to become trade workers as recognised by others they work with and then by themselves (Chan, 2011b).

Occupational identity (Billett, 2008) may be envisaged as a combination of:

- individuals' history - their ontogeny and lifelong learning experiences
- personal or innate affinities to occupational tasks
- individuals' learning - how to do, think, be and feel
- interpersonal interactions in workplaces - through socio-cultural and material approaches.

The myriad ways and approaches a trade is learnt, contribute towards the holistic outcome of learners becoming trade workers, able to complete work tasks epitomising the trade or craft. Figure 1 provides a summary of the aspects discussed in this section and demonstrates the links between the ways of becoming and the ways of learning.

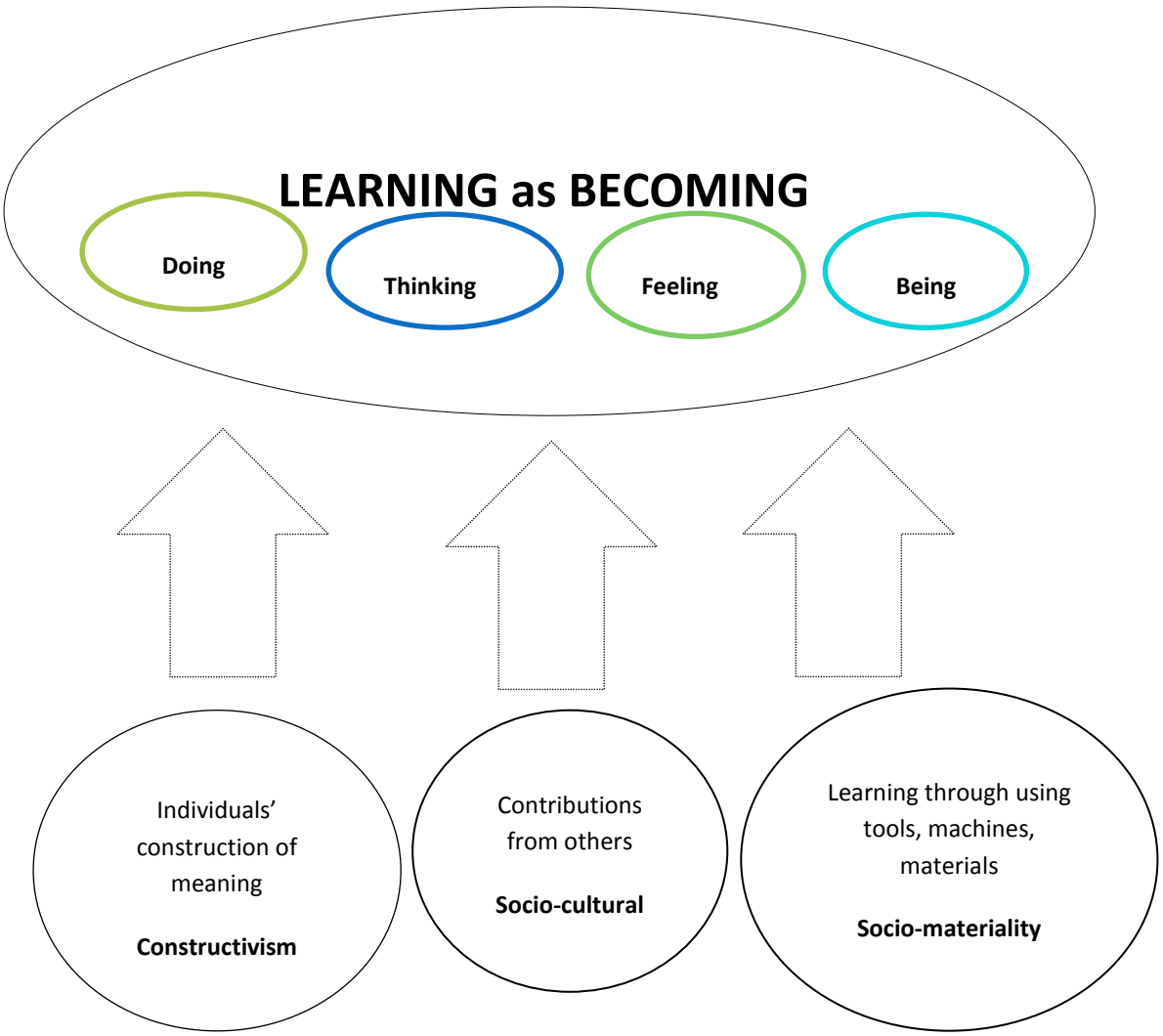


Figure 1: A conceptual framework to understanding apprentice learning

IMPROVING THE LEARNING OF A TRADE

From the above sections we understand that learning to become a trade worker can be recognised as requiring apprentices to acquire and consolidate skills, knowledge and dispositions or attitudes through individual effort and interaction with others (people and materials).

Recent work on vocational pedagogy summarises the ways in which students learn practical skills and knowledge (Lucas et al., 2012). The ways of learning as suggested by Lucas et al.

(2012), are used in this project to categorise apprentices' perceived approaches to learning their trade. Ways of learning include:

- Individual approaches: learning by watching, imitating, practising and learning *on the fly*
- Strategies used by learners to make sense of and improve learning: learning to think critically, listening, transcribing and remembering, drafting and sketching and reflection
- Direct assistance from other workers, trainers, supervisors through: coaching, providing feedback, conversation and real-world problem solving
- Indirect assistance: competing in skills competitions and teaching and helping others.
- Technology enhanced learning and teaching methods assisting learning: virtual environments, simulation, role play and games.

To make the most of the learning approaches summarised above, Lucas et al. (2012) propose the need for learners to acquire generic skills for learning. These include:

- habits of mind – investigation, experimentation, reasoning and imagination along with
- frames of mind – curiosity, determination, resourcefulness, sociability, reflection and wisdom.
- Both habits and frames of mind contribute to the development of presence of mind.

The current NZ school curriculum reflects the learning of many of the habits or frames of mind. Macfarlane et al. (2008) provide an extension through linking the NZ curriculum learning objectives with aspects of Māori pedagogy which are also supported by findings from Cain's (2013) study of Māori in the workplace. Included are aspects of thinking or making meaning – tātaritanga (Grace, 2005), relating to others –manaakitanga; managing self –rangatiratanga and whanaungatanga; participating and contributing – whaiwahitanga; belonging – mana whenua; well-being – mana atua; exploration – mana aotūroa; communication – mana reo, and contribution – mana tangata.

To develop deeper understanding of work tasks, including some of the tacit and socio-material elements, strategies to enhance workplace learning include questioning dialogues,

diagrams and models and analogies (Billett, 2001a). Figure 2 summarises apprentices' ways of learning as synthesised through the literature review section of this report.

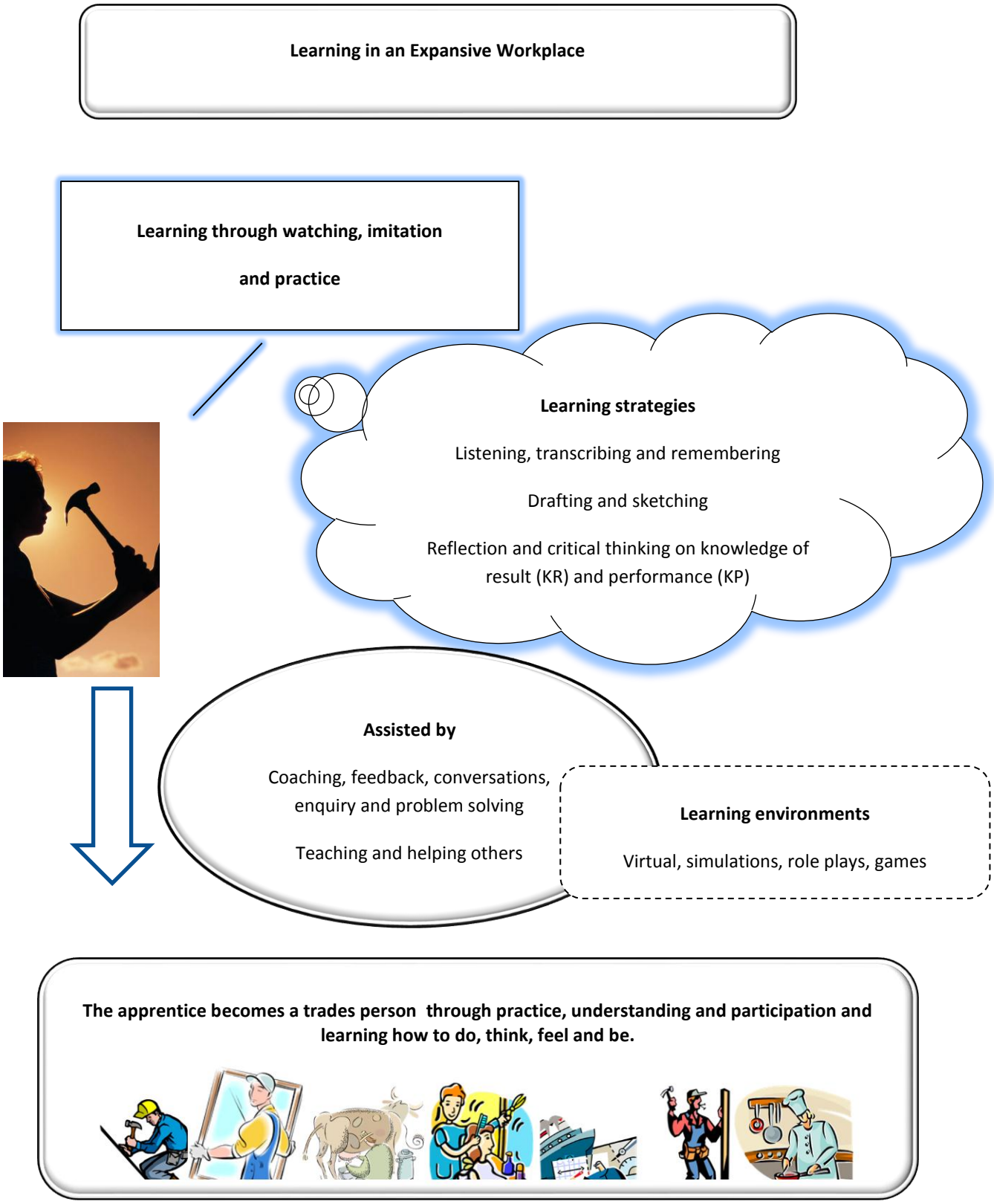


Figure 2: Learning a trade

PROJECT DESIGN, METHOD AND ANALYTICAL APPROACH

PROJECT APPROACH

Apprentices were interviewed by telephone to discuss how they learnt their trade skills. A phenomenographical approach (Marton & Booth, 1997) – see below for discussion - was used to understand how apprentices experience workplace learning.

A literature review, as summarised in the previous section, was conducted of contemporary learning theories with the aim of contextualising the literature to be of relevance to vocational educators. Many of the aspects of learning through becoming are difficult to quantify, therefore, the central analytical approach is to understand how apprentices approach learning a trade and to identify signature pedagogies or the main learning approaches (Gurung, Chick & Haynie, 2009) of specialist trade occupations. The objective is to help make workplace learning processes overt to learners/apprentices and their trainers, allowing both to work towards strategies for improving trade skills learning.

A synthesis of interview data and literature review was then used to develop guidelines (summarised in Figures 8 and 9) for apprentices and coaches, such as, workplace trainers and vocational educators.

THE PHENOMENOGRAPHICAL APPROACH

The research theoretical stance framing this project is learning as both individual and social (Penuel & Wertsch, 1995). It is difficult for individuals to separate aspects of individual and social learning as individuals' learning is enhanced by their interactions with others, the work process, and tools and materials (Fenwick et al., 2011). The phenomenographical approach allows the learning experiences of learners to be expressed as holistic narratives (Marton & Booth, 1997).

Billett (2011) defines three approaches to vocational curriculum structure as intended, enacted and experienced. Within the NZ vocational education context, each of the curriculum structures is now explained.

- The intended curriculum is prescribed by the NZ Qualifications Authority (NZQA) in the form of National Certificates and Diplomas completed through the completion of credit bearing competency-based unit standards.
- The enacted curriculum is how various unit standards are aggregated, integrated or separated to provide apprentices with structured learning as required to complete National Certificates and Diplomas. ITOs play a role in supporting the enacted curriculum through grouping individual unit standards into learning plans. Workplaces will also have enacted curricula based on their organisational manufacturing and production requirements. Additionally, apprentices will learn components of their trade through formalised training, through off-job training either on block courses, day-release courses or through correspondence delivery.
- The experienced curriculum is how learning is perceived to occur through learners' engagement with mainly workplace based learning, supplemented by off-job training.

As such, phenomenography is a qualitative approach incorporating aspects of an interpretive research paradigm. The objective is to try to describe, analyse and understand the learning experiences of research participants. The phenomenographic methodology begins with the researcher forming an approach to the investigation as involving a two-way process. While the researcher seeks to comprehend research participants' experiences, the process is also to assist participants to recognise their own capabilities and practices. Hence, interviews are conversations between researcher and participant. Data analysis may also seek the input of participants, so as to provide participants with some return on their involvement with the project.

SELECTION OF APPRENTICES

Apprentices were sourced through the database of apprentices who were interviewed in the first year apprentice project (Chan, 2011a). Updated contact details were confirmed with each of the seven ITOs participating in this project. The apprentices represent the following trade occupations; boat building, carpentry, cookery, dairy farming, engineering (fitting, turning and fabrication), hairdressing, glazing and joinery. The following activities were undertaken:

- Apprentices interviewed in the original 2011 project were contacted by conference phone by a research assistant to ascertain if they were willing to participate in this project
- The research process information and consent forms were then posted to the apprentices
- The researcher then made contact with and conducted the interviews (see below for details of the interview process)
- Interview transcripts were returned to apprentices for their confirmation.
- Any changes requested were actioned and acknowledged with apprentices.

INTERVIEW PROCESS

As introduced in the introductory section to phenomenographical research, the interview process is conducted as a conversation between researcher and participant.

The guiding questions included:

- how do you learn skills?
- who teaches or who do you learn from?
- what are things you have found difficult to learn?
- how have you gone about learning difficult skills or concepts?

However, the wording used to elicit responses from the participants varied to allow for individual circumstances, industry affiliations, workplace organisation, ITO support and off-job training methods. The guiding questions were used as conversation starters, with participants encouraged to 'tell the story' of how they learnt the trade, what influences had assisted the processes of learning or practising skills and the contributions of others in the workplace to their learning.

DATA ORGANISATION

All interviews were recorded and transcribed. Pseudonyms were used to identify apprentices and any persons and places of work. A generic narrative, comprising composites from interview data of each trade / occupation was then collated (see appendices 3 and 4).

These narratives represented a basis from which comparisons across the research participants' trades and occupations were carried out for thematic analysis.

DATA ANALYSIS PROCESS

The data analysis consisted of three distinct phrases. Frequency analysis was used to identify ways of learning identified by apprentices as instances of 'how I learn'. Thematic analysis was used to trace the contributions of socio-cultural and socio-material aspects mentioned by apprentices as contributing to their learning. A combination of the findings from the frequency and thematic analysis was used to determine the most important ways of learning as experienced by apprentices, to inform the construct of guidelines to help apprentices maximise learning opportunities and for coaches to help apprentices develop the necessary workplace learning approaches and skills.

FREQUENCY ANALYSIS

In this process, each interview was reviewed several times to reveal ways of learning mentioned by apprentices as listed by Lucas et al. 2012. Interview fragments indicating a match with each way of learning were coded and counted.

THEMATIC ANALYSIS

Thematic analysis focused on identifying factors or influences on apprentices learning through workplace and practice-based learning.

Initial inductive coding of individual interview transcripts and each trade's 'composite narrative' was used to sort preliminary themes and identify patterns and processes common to several participants or which were independent. These initial codes were then re-worked to uncover repetitions and produce a general set of themes. Reflection on the themes to match and synthesise with the literature was then carried out.

CASE STUDIES

Case studies were constructed for each participant trade. These case studies collated the common themes arising through the interview data. The case studies summarised apprentices' descriptions of the ways they learnt their trade, in particular, the *signature*

discipline (Donald, 2002; Gurung et al., 2009) defining occupations and the many unquantifiable aspects of trades learning (see appendices 3 and 4).

The case studies were collated through studying in detail, the responses made by apprentices in each of the participating occupations. Distinct 'ways of learning' and industry specific requirements were identified (see appendix 4 for a framework to construct the case studies). Detailed case study narratives are reported in appendix 3.

FINDINGS

APPRENTICE PARTICIPANTS

A total of 27 apprentices participated.

Table 1: Research participants by occupation

Trade	Boat builders	Carpenters	Cooks	Dairy farmers	Engineers	Glaziers	hairdressers	Joiners
Number	3	5	4	2	4	3	4	2

All the boat builders, cooks, dairy farmers, engineers, glaziers , joiners and two of the carpenters participated in the original first year apprentices project (Chan, 2011a). The two carpenters were Gateway students who had obtained an apprenticeship on completing school. The other three carpenters interviewed were randomly selected from a list of carpenters who had recently completed their qualifications. All had recently re-located to Christchurch to work in the Christchurch post –earthquakes rebuild.

One of the hairdressing apprentices from the original project was contacted however declined to be interviewed. One of the effects of the Christchurch earthquakes seems to have been movement of young people working in the service industries to Australia or North Island. As a consequence, the HITO provided a list of hairdressers who had recently completed their qualifications and the four hairdressers interviewed were randomly selected.

All the interviewed apprentices were male except for all the hairdressers and one carpenter. All had completed or were close (by the end of 2013) to completing their apprenticeship. Dairy farmers had completed a shorter traineeship of one to two years. All three of the boat builders were in their fifth year and close to completing their apprenticeship.

HOW APPRENTICES LEARN – FINDINGS FROM FREQUENCY ANALYSIS

This study found the frequency of the various 'ways of learning', with high frequencies of coaching, learning by watching and practice, is similar to other studies (Billett, 2001a; Harris et al. 2001). In particular, the hallmarks of apprenticeship learning – learning by watching, practising, coaching and through enquiry- occur with the highest frequencies through the interview data (see tables 2a and 2b for summary). The following sections provide more detail on various ways of learning.

Table 2a: Frequency of apprentices' responses on individual approaches and strategies

Watching	**Imitation**	**Practice**	**Critical thinking**	**Listening, transcribing remembering**	**Drafting & sketching**	**Reflection**
15	3	21	1	4	1	4

Table 2b: Frequency of apprentices' responses on learning with and from others

Coaching	**Feedback**	**Conversation**	**Problem solving**	**Enquiry**	**Teaching others**
16	1	5	4	14	7

INDIVIDUAL APPROACHES TO LEARNING

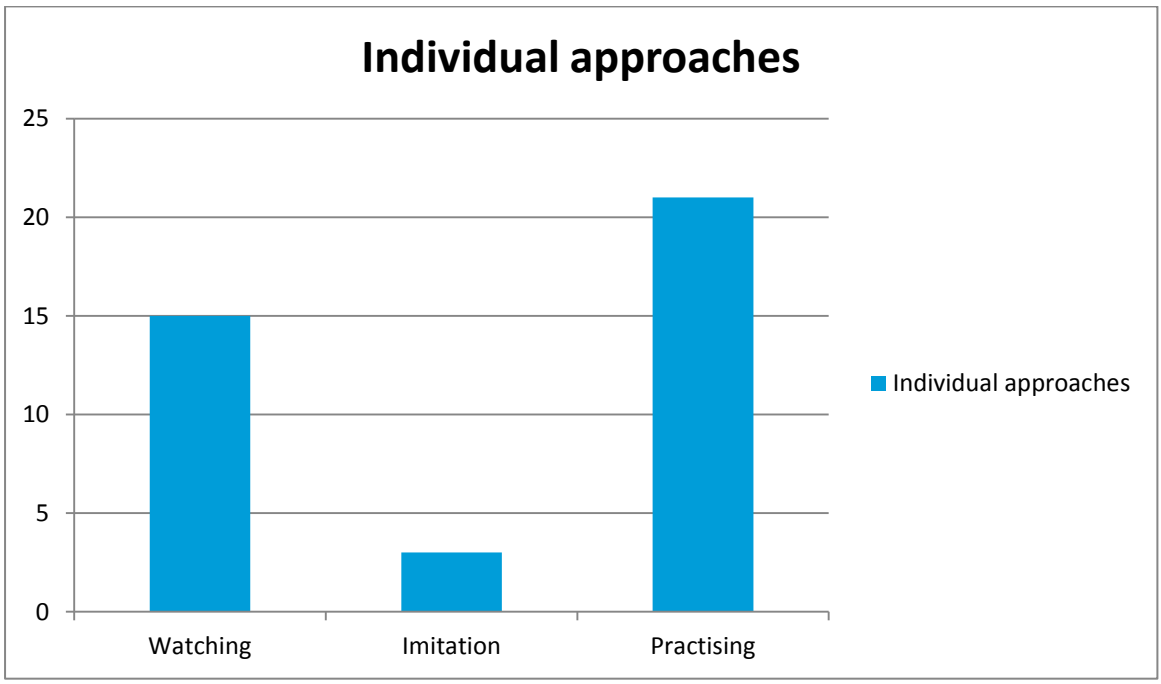


Figure 3: Frequency of apprentices' responses on individual approaches to learning

In this section, the aspects of learning by watching, imitation and practising, and their underlying theoretical frameworks as summarised in sports training and skills learning psychology literature are presented and discussed. The ways of learning used by most apprentices can be summed up in the phrase:

> Watching [and] asking [questions] around a bit [sic] [of] the farmers, [is] basically what [how] you learn. (Dairy farmer 1)

LEARNING BY WATCHING

In the workplace, perhaps two forms of learning by watching occur.

1) There is the formalised show and tell used by skilled trades people to demonstrate tasks while apprentices watch. This form of coaching takes place at the start of an apprenticeship or when apprentices are introduced to a new or unfamiliar work task.
2) The more common form of learning by watching is described as circumspection, as used by Nielsen (2007) to describe how apprentices learn by looking about. Circumspection arises when apprentices are busy completing set duties which also

allows them to observe others working in the same workspace but doing different tasks.

The ability to learn by observing physical tasks modelled is proposed by Billett (2001b), Sheets-Johnstone (2000) and Rogoff (1990) to be a defining characteristic of human learning.

Workplaces' enacted curriculum provides for a situated learning environment whereby work or production is often physically and visually available. Apprentices are often able to view or assist with work as it progresses (Lave, 2011; Chan. 2011b). Visualisation is an important aspect of learning and practice (Sorby, 1999; Moran, Campbell, Holmes & MacIntyre, 2012). Visual access to workplace practice provides rich opportunities for apprentices to construct visual concepts in their mind's eye providing prompts and guidance as new learning is modelled to them. New skills are then learnt through practice, refinement and reflection, leading to embodiment of skill and knowledge. The opportunity to view the practice of others provides models for apprentices to copy, physical actions, processes, machinery and tool use, dispositional approaches and the visualisation of the quality attributes required in the finished product or service. Opportunities to watch practice, directly or indirectly, assist learners to form mental images of movement sequences and goals (Moran et al., 2012).

The interview vignettes coded as learning through watching were further refined by coding them as instances of direct / assisted or coached forms of learning through watching and indirect learning approaches.

Direct forms of learning through watching were evidenced from comments similar to the following comments:

> I am a bit of a hands-on person so, if somebody tells me how to do it, I probably wouldn't get [it]. In fact, if I see someone doing something, I just pick it up really. (Carpenter 1)

> I like to watch and [for the engineer to] tell me how it is to be done. Like we are shown the job and yes…. the visual. (Engineer 3)

Eight of the responses described aspects of learning through indirect observation or circumspection. Here are four examples:

> Yeah, watching then doing it myself. (Carpenter, 4)

> Just by, you know, watching, paying attention…

Picking up little subtle things that they [chefs] did to learn the techniques. (Cook 2)

…being aware of what's going on around the place. (Dairy worker 1)

I taught myself everything, just by watching. (Hairdresser 4)

Hence, learning by watching is an important preliminary backdrop and reinforcing frame to apprentices' on-going situated learning.

IMITATION

Learning by imitation is related to the above - learning by watching- approach. Marchand's work on embodied cognition (2010) explains some of the process of imitation and mimesis or learning through watching, imitation and practice (Roth & Lawless, 2002) through recent findings on the role of mirror neurons. It is proposed that humans have innate tendencies to imitate the actions of others. Imitative action may sometimes be subconscious and learning through imitation often leads to practical knowledge becoming subsumed and tacit. Therefore, much of practice-based learning may be difficult to articulate as the learning occurs at an unconscious level (Marchand, 2010).

Practice becomes embodied into the ways trade skills are performed. Some of the ways embodied practice may be expressed include the use of maxims (Farrer & Trorey, 2008) or as analogies and metaphors (Filliettaz, de Saint George & Duc, 2010) to connect past learning with new learning. Here are two examples of how apprentices describe learning by imitation.

I taught myself everything, just by watching. I just copied. (Hairdresser 4)

Yeah. You gotta observe something for the first time and then you have your own go at doing it. (Cook 3)

PRACTISING

'Just doing it (the work)' is used by people to describe workplace learning (Billett, 2001a). Learning through doing involves engagement in productive work efforts either individually or in teams. Individual and shared work activities contribute to the workplaces' enacted curriculum (Billett, 2011).

Through undertaking a series of cognitive psychological studies on experts in chess, musical performance, the visual arts and sciences, Ericsson (1996, 2006) and others (Ericsson, Krampe & Tesch-Romer, 1993) conceptualise and define deliberate practice. The seven principles of deliberate practice to achieve expertise are:

1. Informative and immediate feedback is fundamental towards assisting learners to define knowledge and skills
2. Measuring and analysing current performance is required to improve on performance
3. Practice activities need to be specifically defined to improve performance aspects requiring improvement
4. Practice activities need to be repetitive to allow for reflection on outcomes and processes
5. Learner motivation to improve performance is a prerequisite to achieving expertise.
6. Time and effort are required to attain expertise
7. Teachers and coaches play a crucial role in guiding individual development (Van de Weil, Van den Bossche & Koopmans, 2011).

Therefore learning by practising is more than just watching, imitation and mindless repetition. It is the purposeful, attentive and thoughtful learning, which includes integration of physical movements and understanding of how theory applies to practice. The integration is often deployed with unaware adherence to dispositional learning to account for context-specific quality requirements (e.g. service orientation, aesthetics and craftsmanship). Deliberate practice implies the learner knowing how to learn. To be proficient at practising a motor skill means:

- Continual appreciation of what the body does, i.e., being attuned to knowledge of result (KR) and performance (KP)
- Commitment to a regime of structured practice
- Diligence to work through repetitive practice
- Reflective cycles to ensure each iteration of motor activity leads to small and sometimes significant improvements.

Optimum deliberate practice also requires the learner to:

- Know when to seek assistance
- Work out whether to accept recommendations from coaches etc.
- Select what strategies to use to implement suggested improvement
- Be attuned to messages, i.e., KP and KR and feedback from tools, machinery, materials, ingredients etc., i.e., the aspects of socio-materiality.

The data from the frequency analysis above provides examples from every apprentice of learning through watching and practising.

> …then you go and do it [the work]… and then once you have done it a few times, you know how to do it anyway. (Boat builder 3)

> Mainly just from trying to learn and by the everyday work and trying to work out why you do the things you do. (Dairy farmer 2)

A summary of the concepts discussed in this section are summarised in Figure 4.

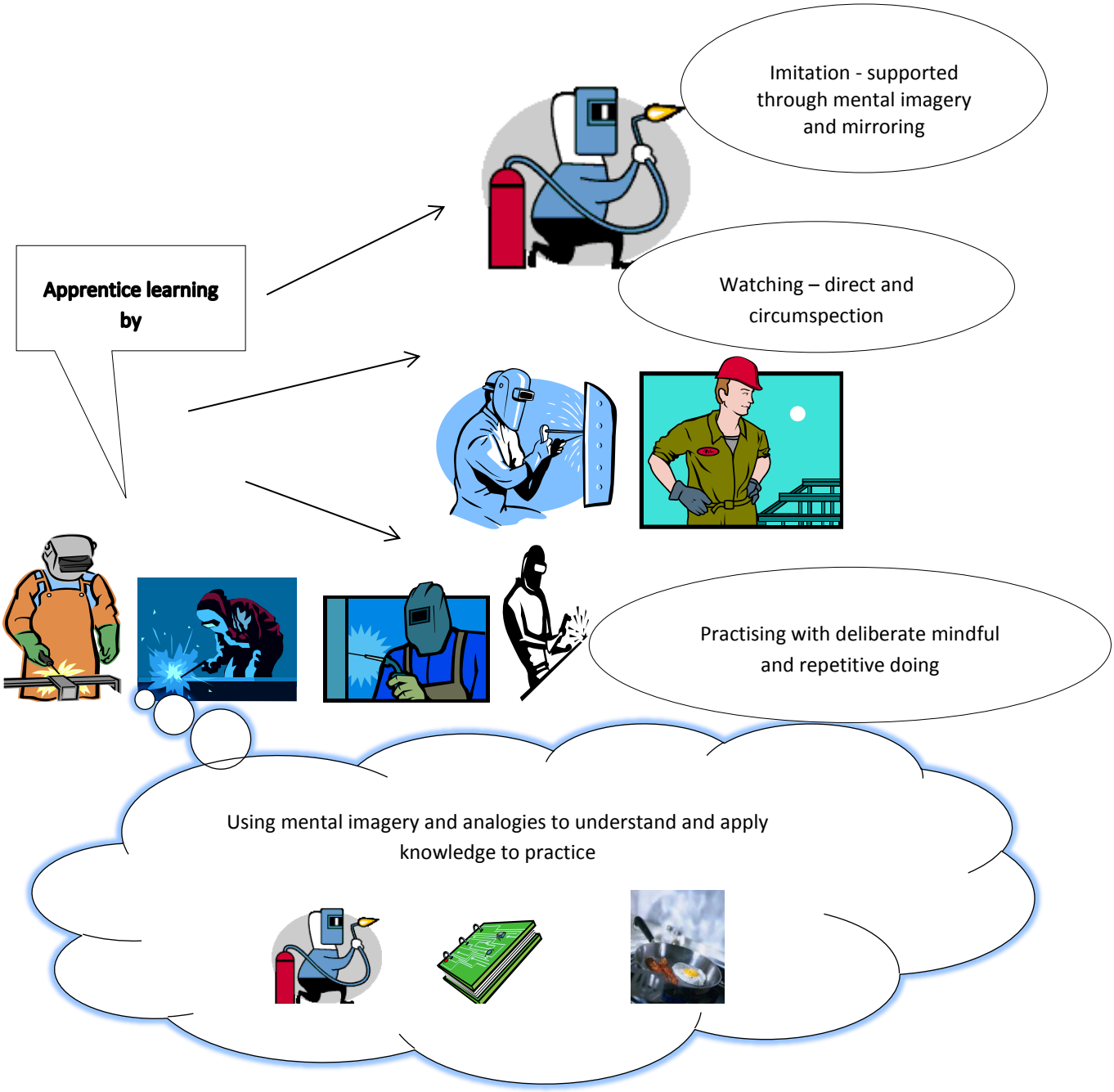


Figure 4: Learning through watching, imitation and practice

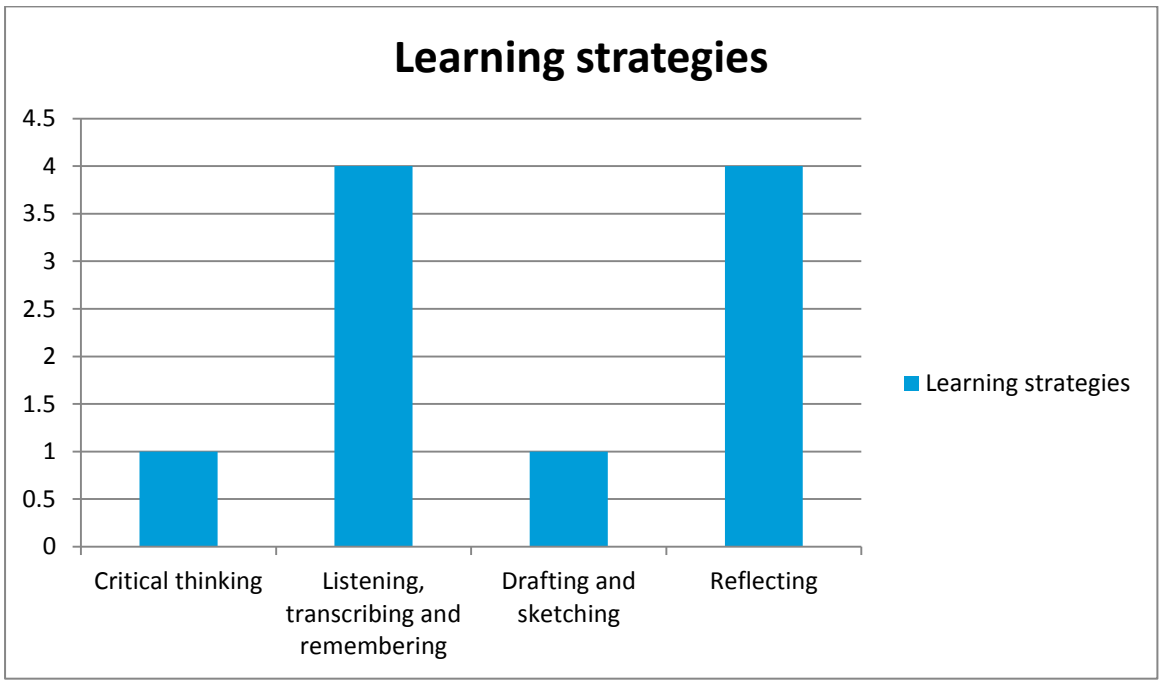


Figure 5: Frequency of apprentices' responses on individual strategies used for workplace learning

In this section, the various relevant literature on conceptual understanding is introduced and synthesised with the information from the above section on learning of practical or motor skills.

CRITICAL THINKING

Moon (2008) defines critical thinking as "a form of learning that is a means of generating new knowledge by processing existing knowledge and ideas" (p.33) through various methods including analysis, understanding and synthesis. Some critical thinking tasks include:

- Review of someone else's argument
- Evaluation of an object
- Development of an argument
- Critical thinking about self
- Review of an incident
- Engagement with others to constructively respond to arguments of others
- On-going tendency to use critical thinking when engaging with the world.

In learning a practical skill, there is need to continually review various sensory and cognitive inputs, make sense of multimodal inputs and deliberately practise to attain confident, sometimes almost effortless physical and/or cognitive performance. Through the learning and repetitive practice processes, practical skills become fluent and cognitively automated with links between practice and theory submerged into the tacit. Therefore, critical thinking, albeit less visible and difficult to define, is also an element in learning trade skills through processes exemplified by the ability to be attuned to the messages provided through the senses (visual, aural, body position and touch) and honed through deliberate practice. Skills and theory are connected and made overt through work and task generated problem solving activities. The result is reflected in changes to learners' muscular, skeletal and neuro-physical structures, leading to the merging of physical and cognitive motor skills learning (Marchand, 2010). In essence, practice becomes embodied and merged into tacit knowledge frameworks. Here, an apprentice articulates his efforts to integrate his mental imagery and conceptualisation of a joinery product from plans, with the actual pieces of wood required to build the product.

> I would try to figure it out, to a point. If somewhere I got stuck, I would try and figure it out a little bit more, and if it didn't work for me, then I would probably work through the materials and lay them out on my bench. And say, like, I have missed out on this line here and what this line must stand for. And even if I get stuck, cos things aren't entirely clear when I take something off the picture on paper, I would more than likely go and see the foreman. (Joiner 2)

Therefore, this apprentice is bringing together and applying cognitive, spatial, kinaesthetic and critical thinking skills to his everyday work. The interview fragment provides an example of the myriad skills, knowledge and dispositions, i.e., persistence and craftsmanship approaches, required for trades practice.

LISTENING, TRANSCRIBING AND REMEMBERING

This learning approach is utilised in the workplace and when apprentices attend off-job training or formalised on-job training sessions. In some trades, apprentices are expected to take notes while on-the-job training proceeds. The notes are then used as a ready reference to ensure work tasks are completed to expected organisational standard operating procedures. An example is provided here:

> Especially when it came to pastry work, there was quite a lot to take in. Everything, just write everything down. Just put it into a book, write everything down. Just keep reading over it. (Cook, 2)

Annotating processes through text-based notes provides apprentices with several learning opportunities. These include:

- Physical record of a procedure in an accessible format
- Need for apprentice to process their observations and record aspects of the procedure which are meaningful to them
- With the advent of mobile technology, still photos have become a common method to record procedures or products as evidence of skills attainment
- Annotation of photos with text and storing and accessing this information through a mobile phone is the modern form of recording learning in a notebook.

DRAFTING AND SKETCHING

The ability to draft or sketch and to make meaning through viewing plans is an important skill set in building, construction, manufacturing and engineering-associated trade industries. Drafting and sketching is also often used in service industries with a 'design' component; examples include hairdressing and cookery. Drafting and sketching provide physical representations of learners' mental models (Sorby 1999). These mental models assist with learners' attempts to replicate practice learnt through watching and to fine tune their initial and on-going imitation of experts' modelled practice. Here are some instances:

> Engineering drawings, yup. Though, you learn it in the first year. Through [the] night school course. You have to do engineering drawings yourself. (Engineer, 1)

> A lot of it was giving me a job sheet and you would get a picture of it, a diagram or a plan or whatever you've got to work to and you've got to figure out your own way of doing it. (Joiner 2)

Drafting and sketching supplement text transcriptions of procedures, providing learning advantages as listed in the above section. Drafting and sketching are also non-text means of communication and represent one of the multiliteracies (New London Group, 1996) in learning trade skills.

REFLECTING

Many models of reflective practice have been recommended with the most recognised being the work of Schon (1983) and Brookfield (1995). Schon advocated the importance of practice but also emphasised the need to supplement practice with reflection. In becoming efficient problem solvers, learners learn:

- How to identify or frame a problem
- Implement appropriate strategies to solve the problem
- Evaluate the effectiveness of strategies and approaches used.

Therefore, deliberate practice of practical or manual skills includes cognitive effort through reflection and critical thinking. Here is an example of how an apprentice connects theory to practice through critical thinking and reflection and applies learning to work-generated problem solving:

> So you would read all about bearings and types of bearings and uses and then when you come to that as you progress through the work, you are getting more technical jobs and you start getting to bearings and bits and pieces like that. You already know the theory side of it so you are kind of more able to understand what you are looking at, so you've already done [sic] the paperwork side of it…. they always wanted me to sort it out by myself. So that's the way I learn kind of system…
>
> I think it all relates back to the first year where I was taught …the basic ways of how to do things. So when you come across a problem on the job, it's almost like a process of elimination back to the basic points of what is actually going on. (Engineer 2)

And another example of working out how to complete work tasks efficiently:

> So then I could make my own decisions without having their input. If my decision didn't work, then I would find a way to fix it. Doing it the old way or if it did work, I would just carry on doing it that way cos I prefer it that way. (Joiner 2)
>
> By thinking on the way that I have been taught, I would be probably making something and I would get to a certain point where I would say, I would be thinking to myself, maybe if I did it this way, it could be faster, or it could be more efficient but it is sort of a little bit risky because I could get it wrong at the same time and if I do get it wrong, I am going to have to find the time, which is quite hard to come by, spare time, every time is precious. So it is like, it is quite a risky thing. (Joiner 2)

The statements above provide salient examples of Schon's (1983) well-known phrase on reflection as "our knowing is in our action" and Pye's (1968) concept of *workmanship of risk* whereby the manufacturing of a craft product is subject to and dependent on decisions made during the production process. Decisions made are in turn based on highly developed practical judgement and tacit knowledge. A poor or incorrect decision would lead to ruination of the product. Hence the workmanship of risk is premised on high degrees of skilled practical work, application of knowledge and underpinned by a disposition to strive for perfection.

LEARNING WITH THE ASSISTANCE OF OTHERS

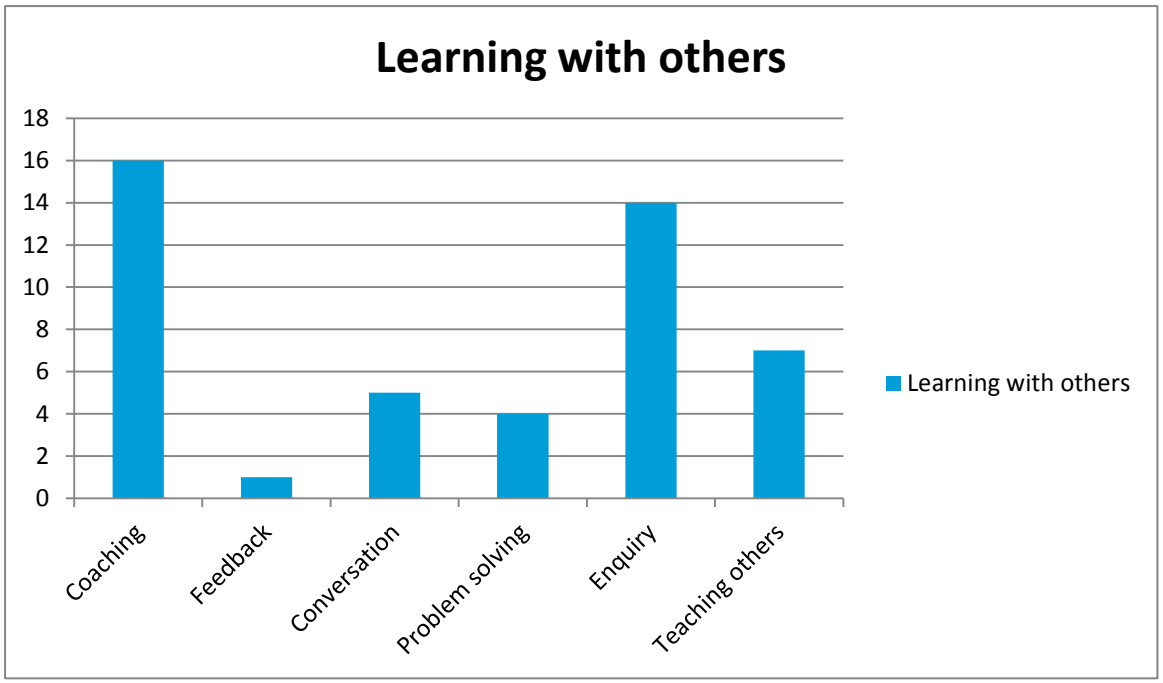


Figure 6: Frequency of apprentices' responses on how they learn with assistance of others

In this section, the contribution from others is discussed. Of note is the small number of responses received for the aspect of feedback. As feedback is essential to individuals' knowledge of how they are progressing, it will be important to provide assistance to workplace trainers / mentors / coaches etc. to incorporate better feedback strategies.

DIRECT INTERACTIONS WITH OTHERS

COACHING

Lucas et al. (2012) states that along with learning by watching, imitation and practice, coaching is the learning approach most associated with apprenticeship. Vygotsky's socio-cultural approach advocates that individuals learn through assistance provided by peers, parents or relatives, teachers and/or co-workers (Wertsch, 1984). Learners are provided with scaffolds to help them bridge the zone of proximal development (zpd). The zpd is the learning gap between what the learner already knows and where they need to get to. Guided learning at work (Billett, 2001a) involves the steps of modelling, coaching, scaffolding and fading.

- Learners learn through watching work tasks as they are modelled by other workers
- Coaching implies a formalised approach to supplement demonstration with articulation of some of the tacit and physically invisible aspects of tasks and includes assisting the learner to learn the task through feedback (aural and physical)
- Scaffolding is then use to assist learners to move beyond beginning to more advanced tasks
- Fading is where coaching is gradually withdrawn to allow the learner to work independently.

Here, three apprentices talk about how all the workers in the workplace provide learning assistance:

> The boss, he will show me the task, tell me what I am doing, show me and then he will watch me do it. (Carpenter 5)
>
> … pretty much everyone that works there, or most people that work there anyway, has [have] helped me in some, [or] one way or another. (Glazier 3)
>
> I have had probably three, I have had four different bosses. And, so, it has been quite a variety of different methods and what not. So it's been quite good. (Carpenter 3)

Billett (2001a) categorises guidance in workplace learning as direct (as in coaching) or indirect (whereby workers learn through peer interaction, observing and listening to others whilst working). To enhance the efficacy of direct guidance, the principles of 'cognitive apprenticeship' (Brown, Collins & Duguid, 1989) include workplace trainers and coaches:

- Modelling the activity to be learnt, e.g. :-

  > You work with them so you [can] do the job without them by the end of it. So, you just learn from them. You learn all the good bits. (Engineer 1)

- Providing assistance while the learner is practising through coaching.

  > [I] just help to do the actual work. So they talk you through the actual job. [I] look at what they are doing and why they are doing it, and then, any little tips and tricks you learn as well. (Engineer 1)
  >
  > That would be my employer, who is J. …. He is very hands on in the workshop so he gets out there with us, when we are new he shows us, especially the way he wants it done. So you pick up the skills through him. (Engineer 2)

- Helping to extend learners' skills acquisition through progressive scaffolding of the task complexity.

You more or less get taught the basic ways of how to fabricate. In the sense of you are told how to do it step by step when you first start out. (Engineer 2)

The first year you are very, like, learning the basic principles of how to do everything. The second year it kind of falls into place and then the third year, you can concentrate more on the design. (Engineer 2)

Yeah, we started off with people that we worked [with], through models and once we got more confident, we would practise on clients that knew we were trainees. (Hairdresser 1)

- Fading (i.e removing guidance for the learner) as the learner attains competence through practice.

…. the first year, you are shown things very closely. The second year you stand on your own feet a little bit more and then like I have signed up to do the Advanced trade which is five hours. So at the beginning of the third year they very much stood back and let me do my own thing, which was leading into the advanced trade side. (Engineer 2)

Probably for the first year, I would say. Most days, after that I started on the little odd bit by myself but I am pretty much by myself now, every day. (Glazier 3)

There is a lot of repetitive work so I would say it would have been just how many times I was assigned a job and I waited until people stopped watching over me. (Joiner 2)

The interaction between coach and apprentice is enhanced by coaches providing clear feedback goals for apprentices to work towards. The next section provides more detail on how to use effective feedback to enhance learning.

FEEDBACK

There are two major streams of feedback to learners during motor skill learning. There is task-intrinsic feedback that learners receive from visual, auditory, proprioceptive (positioning of the body and balance) and tactile and 'augmented feedback' to provide KR and KP (Magill, 2006). Supplementing learners' individual perceptions of KR and KP is the provision of feedback to learners from others. The work of Hattie and Timperley (2007) on the importance of feedback towards enhancing learning was recently applied effectively to assist students learning welding (Chan & Leitjen, 2012). The use of three forms of feedback is advocated. These are:

- Feed up – Are the learning objectives being met?
- Feed back – What is the performance level on learning?
- Feed forward – What does the learner need to do to improve learning or move to the next objective?

Good coaching should include the entire feedback cycle. The coach should assist the learner to:

- Ascertain if they are on the right track (feed up)
- Provide comments on the learners' performance (feedback)
- Assist the learner to assess what needs to be worked on, i.e., through deliberate practice to improve performance (feed forward).

However, the data reveals workplace feedback practices as sometimes unsupportive of learning:

> My chef was quite a hard guy at that time. He would show me once and that was it. If I didn't [get it] and I screwed it up after that, then that was my own fault. He wouldn't show me again. I had to do it all myself, pretty much. He showed me once and then that was it. (Cook 1)

> Oh yeah, you pretty much get a bollocking, you know, if you muck it up. That is one of the first learning curves. You are encouraged to not to repeat it [make the mistake] again. (Boat builder 1)

Apprentices reported on self-directed methods to learn, for instance through the mistakes they had made. Here is one example:

> Usually, if I made a mistake within the second or third time, I will have it pretty well done. If I knew how then I would correct them myself, otherwise I would ask for help. (Carpenter 1)

The example above leads to other ways used by learners to learn from interactions with others through conversation, problem solving and inquiry.

CONVERSATION

As with coaching, conversational learning occurs through informal or planned teaching and learning sessions. Conversational learning may also be involved in learning by watching through the unconscious interpretation of non-vocal signals or body language (Burgoon, 1994). Conversations between learner and trainer or coach reveal the many invisible but taken for granted fine motor skills are required for fluent practice. Therefore conversations aid learners to:

- Pick up tips of the trade or maxims (Farrar & Trorey, 2008)
- Attain and fine-tune motor skills for sustained, fluid performance
- Learn through analogies used by coaches to explain actions (Filliettaz, 2010; Filliettaz, de Saint George & Duc, 2010; Moran et al., 2012)

- Realise the thinking happening in coaches' heads through demonstrations include the elements of cognitive apprenticeship (Brown, Collins & Duguid, 1989) that assist mental learning processes to be made visible and accessible to the learner
- Become familiar with the various ways practice communities communicate. Apprentices attain industry specific inter-subjective understandings (Hutchins & Klausen, 1998) to describe and enact processes and systems
- Understand the 'interactional expertise' (Collins & Evans, 2007) aspects of becoming a trades person to help apprentices learn the communication protocols pertinent to their trade.

The following quotes are some examples of apprentices learning from others:

> I was very lucky that I got some really talented old-school hairdressers. And they just showed me a phenomenal amount. (Hairdresser 2)
>
> You work with them so you [can] do the job without them by the end of it. So you just learn from them you learn all the good bits. (Engineer 1)
>
> I usually get paired up with them [experienced engineers]. And you start, and you help them. You are not going to be doing a lot of the main block [type of motor] when you start. You go in and look at doing and get a good idea of what's involved in all different jobs and stuff like that. You are never really left alone. Yeah, they are always telling me what's going on and you really have to understand what is happening. (Engineer 3)

REAL-WORLD PROBLEM SOLVING

The workplace provides opportunities for authentic problem-based learning (PBL). De Graff and Kolmos (2003) propose PBL cover a wide range of educational practices from problem-oriented lectures to completely open experiential learning environments. Within a workplace environment, problem solving may be taken as a just-in-time opportunity or learning on the fly (Lucas et al., 2012) for apprentices to observe experts model industry specific ways of problem solving and then to learn by doing. Therefore workplace-based PBL occurs through serendipitous opportunities and occasions and being there at the right time and place. The following quote provide a good example of this type of learning

> By the time you got to kitchens, it was a little bit more difficult because there are a few more details on top of hidden lines, boxes and in a plan view, for example you can get the shape of the kitchen but you can't necessarily see all the cupboards. They are overlapping each other. But they can be quite difficult. So the details come from these triangle drawings that I have been explaining of what the stair looks like. (Joiner 2)

The workplace directed nature of apprenticeship learning is summed up by this apprentice:

> Some people might only do certain things and other people might get a wide variety of things. Depending on whether the employer specialises, say. Unless the employee or the apprentice somehow seeks out other experiences, it's sorta out of their hands really. They don't have any say in it. What they learn, is what work there is. (Glazier 2)

Here an apprentice talks about the ways he has been scaffolded through coaching and learning through enquiry:

> I think it all relates back to the first year where I was taught by J. the basic ways of how to do things. So when you come across a problem on the job, it's almost like a process of elimination back to the basic points of what is actually going on.
>
> You know, if something is not square, it can only be a couple of things that causes it. And then normally they are the basics that have either been done wrong or been missed out or something like that. That's the stuff that was taught right at the beginning, the ground work.
>
> Yes, obviously the basics are very important in that first starting up stage. (Engineer 2)

ENQUIRY

This section discusses how problem solving is enriched by opportunities to delve into a process or topic by finding out more from others.

The opportunity for learners to ask questions is an important aspect of guided learning and especially useful when learners are transferring learning from one specialised context into another (Billett, 2001b). Enquiry-based learning (Spronken-Smith et al, 2011) in undergraduate education required teacher motivation and capability, supported by whole institution backing through implementation of relevant strategies and assessment policies. A similar case could apply to workplace learning.

The following quotes are examples of how inquiry occurs through apprenticeship learning:

> Learn on the job and just asking questions, basically. (Carpenter 2)
>
> Yes, yes, definitely. In the last year, my BCITO guy, he was more worried. He just wanted to talk to us, make sure we understood instead of us writing in our books and then him going away and checking the answers. So, I actually quite enjoyed that side of things. You will find out if you don't know it, if you talk about it. It made me go away and learn as to how, you know, building and what not How to build a house and so then I could talk about it. Instead of just, you know, sort of looking through the book for answers and not probably learning as well. (Carpenter 3)
>
> But, if it was something I would struggle with or if it was a job that needs me to look more into bigger detail, I would ask the guys with a little more expertise. (Joiner 2)
>
> [I] ask as many questions as I can, so I can get it in my head. There was that. All the tradesmen would tell you don't be afraid to ask too many questions. Never be scared to ask questions. Especially, [if] you don't understand something it can become quite dangerous. (Engineer 3)

The next section is an example of the reciprocal nature of inquiry-based learning. Not only will apprentices learn from others who know more than they but learning also occurs when they are able to assist others by answering questions or clarifying processes.

INDIRECT INTERACTION WITH OTHERS

TEACHING AND HELPING OTHERS - WHAIWAHITANGA

Learning through conversation, enquiry and coaching also occurs when a learner teaches or helps others to learn. In assisting others, learners have to model actions or articulate learnt concepts (Fuller & Unwin, 2004). The meta-cognitive or self-understanding of how one learns activity, encourages learners to make their articulate their thinking processes, an example of 'cognitive apprenticeship' teaching apprroaches (Brown, Collins & Duguid, 1989). The learner as teacher is a hallmark of Māori pedagogical approaches with the Māori term for learning ako, meaning both to learn and to teach. Here are some examples of how apprentices contribute to the learning in the workplace:

> The senior apprentices are usually who the new guys ask for a bit of help. (Engineer 3)
>
> [There is] the basic outline and then there is the building codes, or guidelines and dissertations and all that. And even looking up on the internet for materials and getting information off the internet.
>
> Interviewer: So do you share this information at work with the others?
>
> Yeah, I am always bringing out different finds. (Carpenter 2)
>
> Yeah, everyone has got ideas on how to do things so I could pick up on their ideas. (Glazier 3)
>
> We have the reps that come through every few months that we do training with. Well, I just sort of learn off other people now. (Hairdresser 1)

Workplace learning is reliant on individuals exercising their agency, i.e. motivation and willingness to learn and to search out learning opportunities. Apprentices' learning and teaching is focused on areas of practice and interactions between more experienced workers or trainers (Chan, 2011b). Hence, skills required to learn in the workplace are different from those used in formalised learning environments like school or polytechnic / pre-trade programmes (Billett, 2001b). Therefore, there is a need to assist apprentices to maximise their workplace learning efficacy.

A summary of the three contributors to apprentices' learning a trade and learning to become is summarised in Figure 7. Contributions from apprentices' individual learning strategies, accompanied by contributions from workplace coaching, all add to apprentices eventually becoming able to assist or teach others.

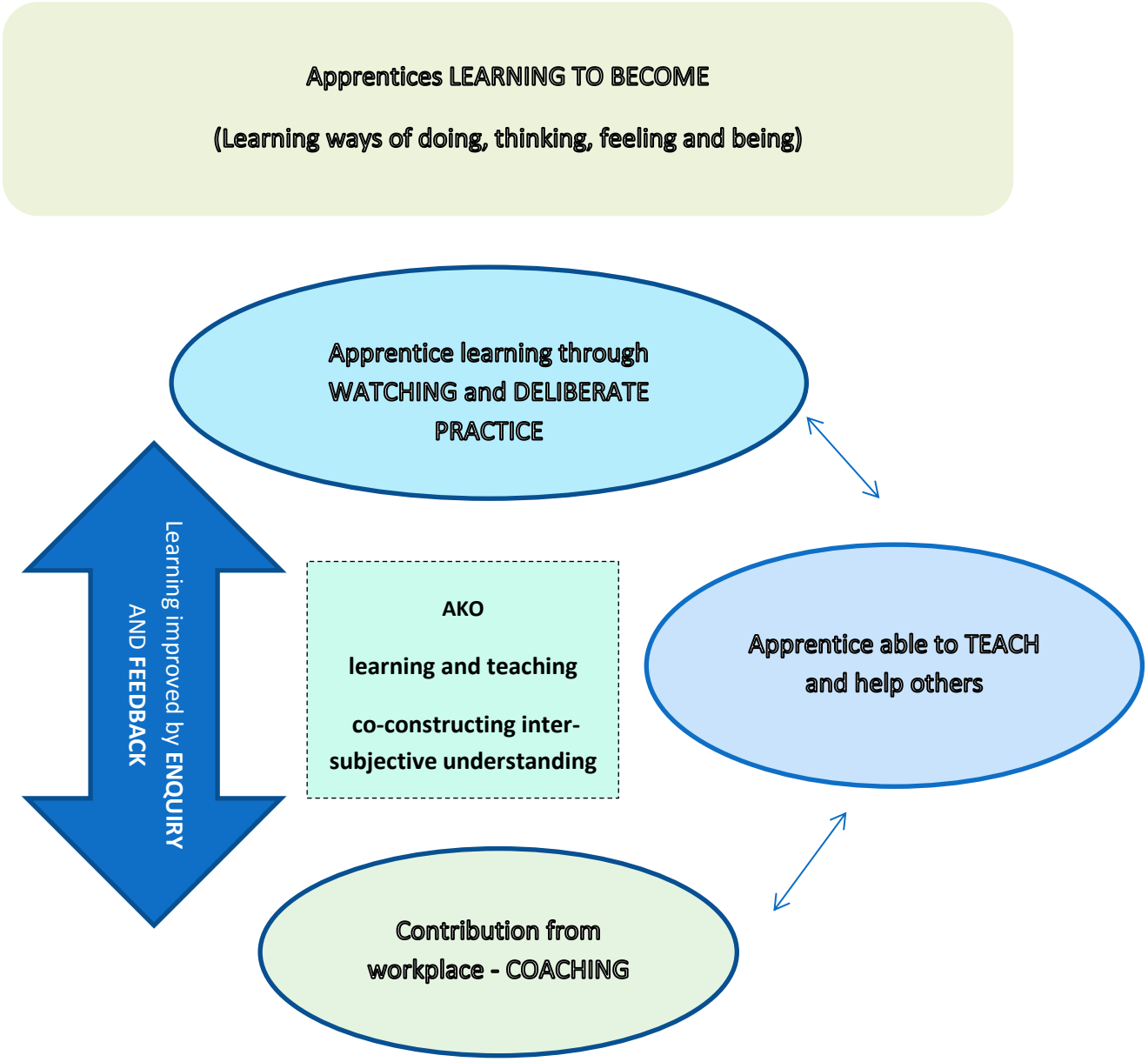


Figure 7: Contributors to apprentices' learning

HOW APPRENTICES LEARN – THEMES

The main themes were derived using nVivo[2] through processes of frequency and recursive thematic analysis. Each of these themes is now discussed.

EFFICACY OF WORKPLACE LEARNING

All the apprentices indicated they had learnt skills and knowledge to become effective trades people. In the main, apprentices' learning was largely workplace-based and driven by workplaces' production or organisational requirements. Apprentices recognised they learnt their trade through opportunities to watch, practise and be coached . The following is an example of workplace learning content:

> Because I am very much a hands on learner… they would always insists that I take charge of it and try to get to the solution, then just check it with them kind of thing. (Engineer, 2)

The workplaces' enacted curriculum led to apprentices attaining skills, knowledge and dispositions too contribute to their workplaces' productivity.

WORKPLACE LEARNING AFFORDANCE STILL VARIABLE

As a proviso to the above section, apprentices' access to workplace learning has always been dependent on organisational requirements (Billett, 2001b). Some apprentices understood that what they learnt over the course of their apprenticeship was dependent on workplace-based learning affordance and support. Here two apprentices describe the ways the enacted curriculum of their workplace shapes their opportunities for workplace learning.

> Like you are expected to work really constantly, you are expected to have a passion for cooking. Like you jump into work every day, you are expected to work a twelve hour shift, you work a twelve hour shift. It's expected of you. And that's what hard, because I don't have that passion and like I am a technical student, does that make sense, like I did well in hospo [hospitality] because I worked well under pressure and I had time management. (Cook 4)

> Well, you don't really get much choice yourself. It really is not up to the apprentice, it is up to the employer. And that is not up to the employer, it is up to the market. Whatever market forces that tell you whatever type of work there is that's what you end up learning. (Glazier 2)

[2] A qualitatitive data analysis software system.

One way to temper the disadvantages of variable workplace learning affordances is to increase apprentices' *tool kit* of learning strategies. The next section discusses some ways to assist apprentices' workplace learning skills.

DISCUSSION

This section discusses some of the ramifications of the findings reported above. Of importance are the contributions of ways of learning prevalent in the literature on formal learning which if critically contextualised, may assist apprentices' learning of a trade.

RECOMMENDATIONS FOR ASSISTING APPRENTICES

METACOGNITION AND ARTICULATION OF LEARNING

Half of the apprentices found it difficult to explain how they had learnt their trade. They had become competent trades people but were unable to describe how they may have gone about learning specific aspects. For many, manual work skills had become innate and part of how they moved, worked and functioned. They were able to perform work tasks to required standards and absorbed the ways things were done in their trade. They had become trades people. Additionally, the embodiment of manual skills learning means learners are often unable to articulate all the nuances of practical skills processes. Some practical skills activities may also not have written or verbal language equivalents to adequately describe actions and tactile and spatial dimensions or qualities (Marchand, 2010). The lack of descriptive language leads to the use of maxims (Farrer & Trorey, 2008) or analogies and metaphors (Filliettaz, de Saint George & Duc, 2010).

Self-efficacy and metacognition, or the ability to work out what one already knows and how to learn what one does not know, have been identified as one of the best predictors of learner success (Hattie, 2009). Adults are held to be self-directed learners, able to plan, organise and utilise learning opportunities to meet learning goals (Knowles, 1984). However, the majority of apprentices are on the cusp of adulthood, with many selecting the apprenticeship route into occupations due to poor experiences or low attainment at school (Leach & Zepke, 2010). Metacognition is a learnt skill requiring focused contextualised learning that either did not occur during apprentices' school experiences or were difficult to

'transfer' between school and work learning contexts (Tanggaard, 2007). Therefore, a focus on metacognitive strategies to aid individual apprentices' learning would be productive.

As a guide, apprentices should be encouraged by both on and off-job trainers to become reflective practitioners who are mindful or reflective as they deliberately practise practical / manual skills, consolidate theory learning with practical tasks and develop problem solving skills. Apprentices can be prepared, before they begin training, to adopt metacognitive skills of checking if they are on task, what their learning goals are and how they might know they have become proficient. During workplace learning, on or off–job opportunities should be provided for apprentices to reflect on deliberate practice (see the next section for more discussion). At regular intervals, or during off-job day-release or block courses, apprentices should be guided to complete a stock-take of their progressing skills learning. This stock-take must not only consist of a check list of competencies completed, but include the introduction of strategies to assist apprentices to unpack the things they can do and understand, to learn what else they need to learn. The goal is to identify how much more they need to hone a skill or understand concepts, and how to further improve practice.

THE NEED OF GREATER 'LEARNING TO LEARN' SKILLS IN WORKPLACE-BASED LEARNING

Related to the above section, of the need for apprentices to not only know what they already know and what they need to know, is the necessity for apprentices to work out how to maximise their workplace- based learning opportunities. In general, we take for granted that we are able to learn through watching and practising as it is a fundamental human skill. We learn by watching and doing from the time we are born (Sheets-Johnstone, 2000). Here is one apprentice's explanation of how she attained the skills to be a good hairdresser:

> I had the creativity and then it was a case of, to be honest, I just watched, practiced and the internet was a huge help. (Hairdresser 2)

Note how this apprentice used her self-recognised ability or aptitude, in this case being creative, to supplement her learning through watching and practising. This apprentice also had the metacognitive skills to unpack her 'learning by doing' to identify the areas whereby she required more practice and information, supplementing her on-job resources with techniques or guides sourced through the internet. Therefore, apprentices require access to,

understanding and deployment of learning to learn skills to enhance their ways of learning through watching and practice and to maximise their learning through coaching. In particular, the deliberate practice cycle should be undertaken to ensure apprentices attain required work skills. The deliberate practice cycle requires apprentices to be cognisant of learning as it progresses and in particular, to be attuned to the various bodily / kinaesthetic, social (from coaches / trainers, other workers and peers) and material (from machinery, tools and environment) tasks feedback, i.e. KP and KR. Some of the complexities of trade work are detailed in the case studies in appendices 3 and 4.

Apprentices need to be self-directed and pro-active learners when most of their skill learning is workplace-situated. Examples from apprentices, of workplace learning, include the following need to make use of the workplace context to further their skill or knowledge acquisition:

> Yes, cos a lot of the work that has been already done on the machine is logged so that they can look back through and see what they do [sic] last time. (Engineer, 1)
>
> … it was mainly through trial and error but again, it was reading, researching and making yourself find information out. (Hairdresser 2)

The life-long learning generic skills required for trades careers are at present, subsumed or assumed within present competency-based qualification structures and systems. Associated with individual apprentices acquiring learning to learn skills to assist with their on-going and further learning, is the need to assist apprentices to navigate workplace politics. The workplace learning literature stresses the importance of the two-way relationship between individual workplace learners and the affordances provided by the workplace for learning (Billett, 2001a, 2001b; Fuller & Unwin, 2003). Establishing 'expansive-participative' workplace learning environments require organisations to set-up and deploy pro-active systems providing rich learning opportunities. Individuals' contribution to understanding how to access workplace learning provisions is important. Apprentices, on the lowest rung of organisational hierarchies, require workplace and industry training organisation support to ensure workplace learning opportunities are maximised (Fuller & Unwin, 2003).

RECOMMENDATION TO IMPROVE COACHING

IMPROVE DIRECT GUIDANCE

Billett (2001a) proposes direct guidance from experts and other experienced workers as important contributors to quality workplace learning. Besides the coaching activities described in the section above on 'being coached', workplace trainers / coaches also need to assist apprentices to:

- Secure access to relevant and worthwhile work tasks to accomplish learning goals
- Ensure learners are not exposed to inappropriate knowledge
- Assist learners to access difficult to learn work practices like problem solving and judgement making
- Provide forms of close guidance as learners progress through competency.

However, as reported in the sections on 'through feedback' and the discussion on the aspect of the quality of workplace learning as being variable, the project's apprentices' access to effective coaching was not always consistent. Therefore, there is a need to provide workplace trainers and/or coaches with guidelines for good practice to enhance workplace learning.

RECOMMENDATIONS FOR ITOS

INCREASE OPPORTUNITIES FOR PEER CONNECTION

As with the '*first year apprentices*' project (Chan. 2011a), there were many instances when apprentices acknowledged they learnt from their peers. Often, this took place during off-job training, when apprentices attended day-release or block courses. The following quote demonstrates this point:

> I found it very good. The courses were very good. You can communicate with people at your level. You can have fun with them, it's great especially when you are in a small kitchen everyday with the same people, going to those block courses and learning new techniques from different people from around NZ. Amazing, it's a great idea. (Cook 1)

Apprentices used social media such as Facebook or texting to maintain contact with their peers and extend their learning opportunities beyond their own workplaces. Such informal

means of learning were initiated by some of the apprentices in this study but are not difficult to develop for all apprentice groups.

RECOGNISE WORKPLACE-BASED LEARNING ACHIEVEMENT

All of the apprentices participating in this project became trades persons as recognised by their employers and workmates. This recognition is expressed through apprentices:

- Independently completing work tasks with minimal or no supervision
- Managing aspects of their work
- Assisting in the training of other new workers and junior apprentices.

An implication of the above is that one way to acknowledge and certify apprentices' work competencies is to validate their workplace roles as trades people. Validation will include ascertaining when apprentices are able to work independently, take responsibility for work tasks and assist in training others. This holistic approach is now possible through the NZQA recognition of graduate profiles and their associated learning outcomes as a means for recording learners' achievements. The caveat will be for workplace trainers, supervisors and assessors to have adequate training to be able to reach reliable and valid judgements of apprentices meeting graduate profiles.

RECOMMENDATION FOR TRAINING OF TRADES TUTORS AND COACHES

NEED TO EXTEND VOCATIONAL PEDAGOGY

The preparation and staff development focus of trades tutors and workplace coaches have, in the main, been framed by adult learning theories (e.g. Knowles, 1984) with an emphasis on teaching in formal education environments using text-based resources to learn conceptual knowledge. Addition of theories of learning relevant to workplace learning, i.e., cognitive apprenticeship, situated learning and communities of practice, have been recommended for inclusion into the enacted curriculum for training NZ tertiary educators in the institutes of technology and polytechnic (ITP) sector (Chan, 2012).

Learning a trade involves multi-modalities and multiliteracies within socio-material learning paradigms. Therefore, recent work on grounded cognition (Barsalou, 2008), knowledge

management (Corradi et al., 2010), expertise (Ericsson, 1996) and sports psychology (Hodges & Williams, 2012) provide productive groundwork for the development of a specific pedagogical framework relevant to trades learning. In particular, to assist trades people to unravel and articulate the many tacit dimensions of their expertise and their embodied practice. In turn, to develop better teaching and coaching strategies so as to assist trades learners to become mindful practitioners.

RECOMMENDATION FOR FURTHER RESEARCH:

INVESTIGATE AND DEFINE THE SIGNATURE PEDAGOGIES OF TRADES LEARNING

The literature on signature pedagogies (Donald, 2002; Gurung et al., 2009) reports on work undertaken in the higher education sector. As cautioned by Billett and Choy (2013), learning principles developed in formal education require careful consideration for application in workplace learning and non-formal learning contexts. In particular, the current literature on signature pedagogies concentrates on the development of conceptualisations and 'ways of thinking'. Apprentice learning, with emphasis on practical and manual skills, application of contextualised knowledge and specific dispositions and reliance on multimodalities and multiliteracies beyond text, require further study to reveal the salient structures of trades learning. Therefore, trades-based signature disciplines, encompassing ways of doing, thinking, feeling and being, provide future direction for study.

Billett and Choy (2013) suggest one approach is to identify workplace activities that have potential to offer rich learning experiences for learners to access the ways experts deploy their practical and tacit knowledge. For example, the hand-over session conducted by nurses as work shifts rotate provides opportunities for nursing teams to share their understandings of patient care. Identification of specific rich learning activities appropriate to each trades context will improve workplace practice. Support for workers to comprehend how specific rich learning activities operate will enhance opportunities to improve workplace practices for all workers and help novices learn 'practices of the community'. The last three rows of the table in appendix 4 summarises data collected through this study and provide a starting point for identifying work tasks that involve the

workmanship of risk (Pye, 1968) and investigating trades signature ways of doing and thinking.

GUIDELINES

BUILDING THE GUIDELINES

The guidelines centre round the two main contributors to apprentices' learning, the agency of the apprentice and the affordances provided by the workplace for effective workplace learning. Both need to be in synchrony for 'expansive learning' (Fuller & Unwin, 2003; Chan, 2011b) to occur.

The implications from the findings as introduced and extended in the above 'discussion' section have been incorporated into the guidelines. Therefore, the guidelines are derived to assist apprentices not only to improve their own learning of practical trade skills through watching and practice, but also to extend metacognitive skills to improve learning strategies. A similar approach is used in the guidelines for workplace trainers. The coaching process needs to help make visible the many nuances of trade skills learning and trainers and coaches need to be more attuned to the learning needs of novice workers. The framework used to align the guidelines to apprentices' 'ways of learning' is detailed and summarised in appendix 2.

The guidelines are summarised in Figure 8 for apprentices and Figure 9 for coaches.

GUIDELINES FOR APPRENTICES

The guidelines for apprentices are focused on learning through watching and practice and these are the two major ways of learning identified from this study.

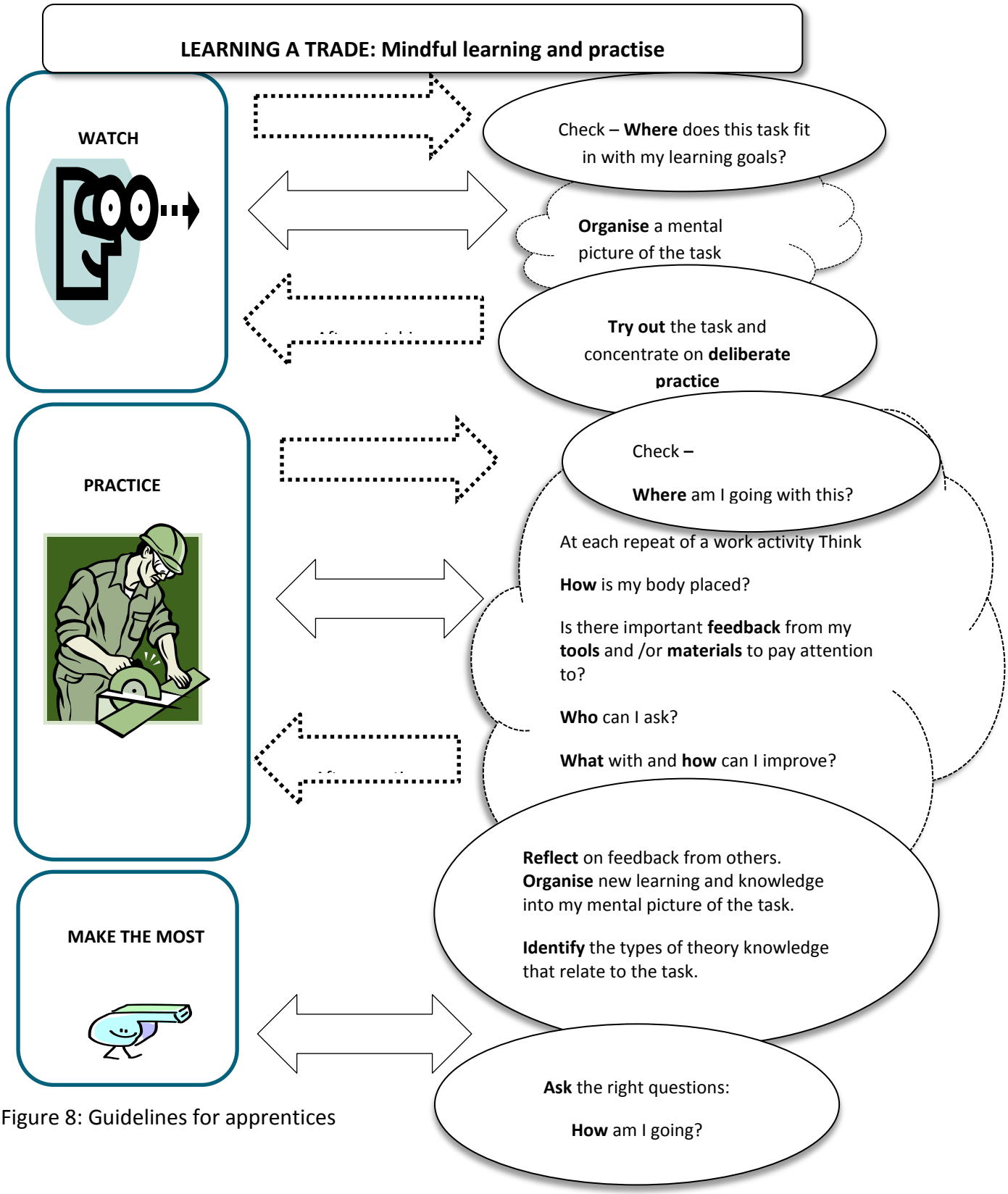


Figure 8: Guidelines for apprentices

GUIDELINES FOR COACHES

The guidelines for workplace trainers, mentors, coaches and supervisors etc. are provided to assist better deployment of the coaching process. Emphasis has been placed on the feedback process as the study reveals this an area as requiring improvement.

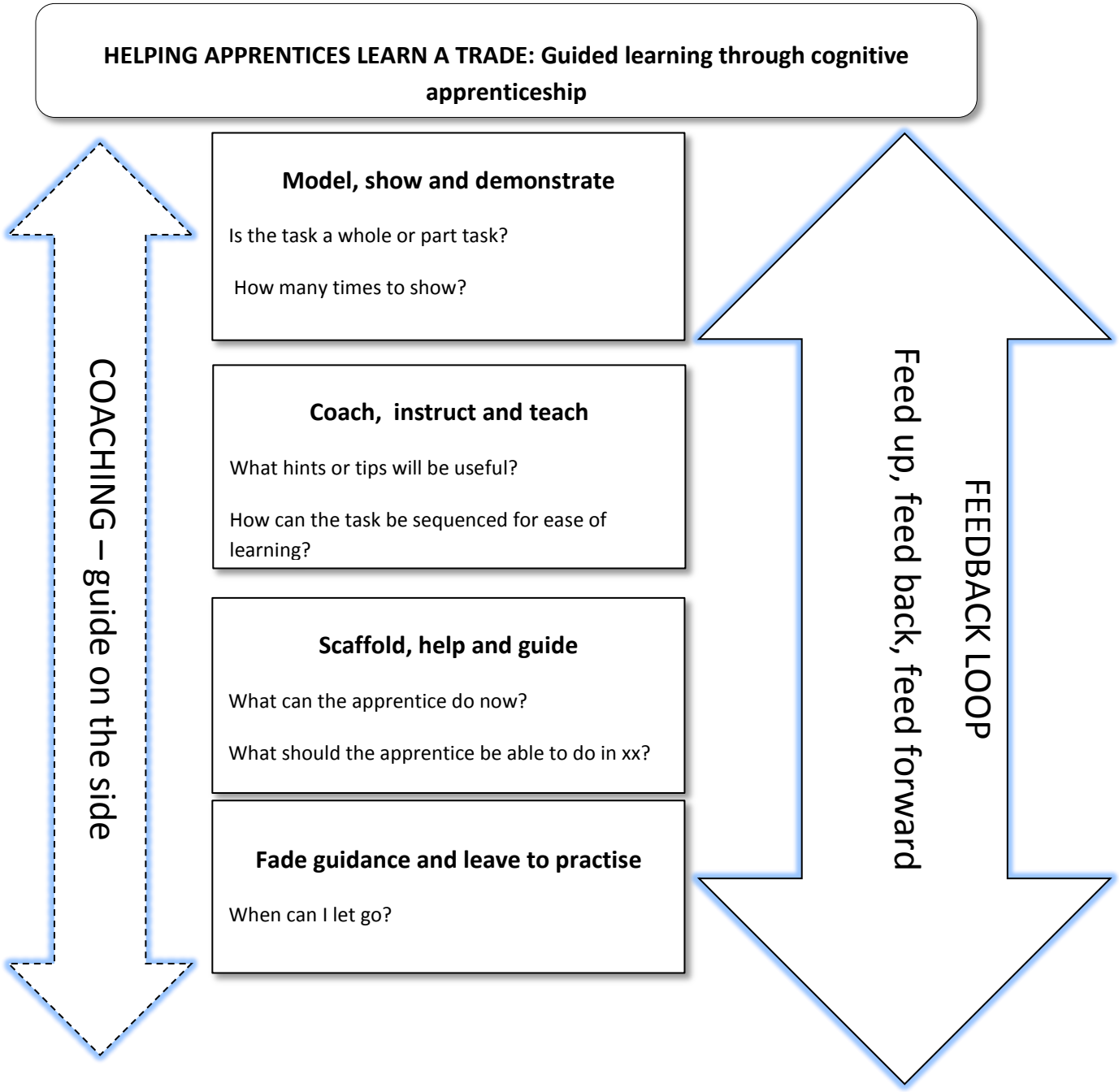


Figure 9: Guidelines for coaches

WHERE TO FROM HERE?

The findings reported here are derived from a small sample of apprentices across a small range of traditional trades and industries. However, the frequency of responses on how apprentices go about learning a trade, especially with regard to learning through watching, practising and being coached, lead to the inference of these ways of learning as being familiar ways used to describe how workplace learning occurs. The ways of learning identified by apprentices, are congruent with previous work, exemplified by Billett (2001a) and Harris et al., (2001), provide support for the reliability of this project's findings.

This project has begun a process of understanding how apprentices learn a trade. The phenomenological approach was used to obtain apprentices' experiences of learning a trade. As nascent trade practitioners, their learning experiences of progressing from novice to competent trades person were relatively fresh. Although experiences were fresh, the project found many apprentices had difficulty articulating their ways of learning due to the complex and sometimes opaque nature of trades' practical skills, knowledge and dispositions. Preparing apprentices to become mindful practitioners, and trainers and coaches to become more effective at helping apprentices learn the trade may be one way to improve trades learning. Future research into apprenticeship learning could be undertaken using the socio-materiality approaches recommended by Fenwick et al. (2011) including complexity theory, cultural-historical activity theory (CHATs), actor-network theory and spatiality theories. These approaches might help illuminate in greater detail and depth the many facets of trades learning trades experts themselves have subsumed into tacit knowledge and find difficult to articulate. The use of videos to gather practice and multi-modal discourse analysis (Chan, 2013), underpinned by socio-materiality approaches, may also assist future studies.

The guidelines produced by the project assist with the improvement of apprentices' workplace learning. There is still much work to be done in establishing an evidence-based approach towards improving apprenticeship learning, for example, how apprentices may be assisted to become much more proactive, self-directed and metacognitive about working around the learning opportunities afforded in their industries and workplaces. This evidence

may then inform ways to improve workplace-based learning and curriculum practices to assist apprentices learning a trade.

CONCLUSION

In this study, apprentices were asked how they went about learning how to become trades people. Data was collected on apprentices' experienced workplace curriculum and ways of learning. The data reveal apprentices learn best through watching, practising and coaching. Guidelines for apprentices to learn by watching and practice were then formulated to help apprentices maximise workplace learning of trade skills. Guidelines for workplace-based trainers, coaches, mentors and supervisors, with an emphasis on feedback strategies, were also proposed to improve the assistance provided to apprentice learners.

REFERENCES

Barsalou, L.W. (2008). Grounded cognition. Annual Review of Psychology, 59 , 617-645.

Billett, S. (2001a). Learning in the workplace: Strategies for effective practice. Crows Nest, New South Wales, Australia: Allen & Unwin.

Billett, S. (2001b). Learning throughout working life: Interdependencies at work. Studies in Continuing Education, 23(1), 19-35.

Billett, S. (2008). Subjectivity, learning and work: Sources and legacies. Vocations and Learning, 1(2), 149-171.

Billett, S. (2011). Vocational education: Purposes, traditions and prospects. Dordrecht, Netherlands: Springer.

Billett, S., & Choy, S. (2013). Learning through work: emerging perspectives and new challenges. Journal of Workplace Learning, 25(4), 264 – 276.

Brinkman, S., & Tanggaard, L. (2010). Toward an epistemology of the hand. Studies in the Philosophy of Education, 29, 243-257.

Brookfield, S. (1995). Becoming a critically reflective teacher. San Francisco. CA: Jossey-Bass.

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. Educational Researcher, 18 (1), 32-42.

Burgoon, J. K. (1994) Non-verbal Signals. In M.L. Knapp & G.R. Miller (Eds.) Handbook on interpersonal communication (pp. 229-285). Thousand Oaks, CA: Sage Publications.

Cain, K., Connor, J., Garrow, L., & Young, C. (2013) Māori learners in workplace settings. Wellington, NZ: Ako Aotearoa. http://akoaotearoa.ac.nz/projects/m%C4%81ori-learners-workplace-setting

Chan, S. (2011a). Belonging to a workplace, becoming and being: First year apprentices' experiences in the workplace. http://akoaotearoa.ac.nz/ako-aotearoa/ako-aotearoa/resources/pages/belonging-becoming-and-being-first-year-apprentices-experiences-workplace

Chan, S. (2011b). Belonging to a workplace, becoming and being a baker: The role and processes of apprenticeship. Unpublished PhD thesis. Griffith University, Brisbane, Australia.

Chan, S. (2012). Perspectives of new trades tutors: Boundary crossing between vocational identities. Asia Pacific Journal of Teacher Education, 40(4), 409-421

Chan, S. (2013). Using videos and multimodal discourse analysis to study how students learn a trade. International Journal of Training Research, 11(1), 69-78. http://jtr.econtentmanagement.com/archives/vol/11/issue/1/

Chan, S. & Leijten, F. (2012). Using feedback strategies to improve peer-learning in welding. International Journal of Training Research, 10 (1), 23-29.

Collins, H., & Evans, R. (2007). Rethinking expertise. Chicago, Ill: University of Chicago Press.

Corradi, G., Gherardi, S., & Verzelloni, L. (2010). Through the practice lens: Where is the bandwagon of practice-based studies heading. Management Learning, 41(3), 265-283.

Cran, D.J. (1994). Towards validation of the service orientation construct. The Services Industries Journal, 14(1), 34-44.

Crawford, M. B., (2009). Shop class as soulcraft: An inquiry into the value of work. USA: Penguin.

De Graff, E., Kolmos, A. (2003). Characteristics of problem-based learning. International Journal of Engineering Education, 19(5), 657-662.

Donald, J. G. (2002). Learning to think: Disciplinary perspectives. San Francisco, CA: Jossey Bass.

Emerstein, B. & Whyte, J. (2007). Beyond words: Aesthetic knowledge and knowing in organisations. Organisational Studies, 28(5), 689-708.

Engestrom, Y. (2001). Expansive learning at work: Toward an activity theoretical reconceptualisation. Journal of Education and Work, 14(1), 133-156.

Ericsson, K. A., Krampe, R. T., Tesch-Romer, C. (1993). The role of deliberate practice in the acquisition of expert performance. Psychological Review, 100(3), 363-406.

Ericsson, K.A. (1996). The acquisition of expert performance: An introduction to some of the issues. In K.A. Ericsson (Ed.) The Road to Excellence: The Acquisition of Expert Performance in the Arts and Sciences, Sports and Games. Mahwah, NJ: Lawrence Erlbaum Associates.

Ericsson, K. A. (2006). The Influence of experience and deliberate practice on the development of superior expert performance. In K. A. Ericsson, N. Charness, P. J. Feltovich & R. R. Hoffman (Eds.), The Cambridge Handbook of Expertise and Expert Performance(pp. 685 – 705). Cambridge, United Kingdom: Cambridge University Press.

Farrar, N., & Trorey, G. (2008). Maxims, tacit knowledge and learning: Developing expertise in dry stone walling. Journal of Vocational Education and Training, 60(1), 35-48.

Fenwick, T., Edwards, R., Sawchuk, P. (2011). Emerging approaches to educational research. London, UK; New York, NY: Routledge.

Filliettaz, L. (2010). Guidance as an interactional accomplishment: Practice-based learning within the Swiss VET system. In S. Billett (Ed.), Learning through practice: Models, traditions, orientations and approaches (pp. 156-179). Netherlands: Springer.

Filliettaz, L., de Saint George, I., & Duc, B. (2010). Skiing, cheese fondue and Swiss watches: Analogical discourse in vocational training interactions. Vocations and Learning, 3(2), 117-140.

Fine, G. A. (2003). Occupational Aesthetics: How trade school students learn to cook. In D. A. Harper & H. M. Lawson (Eds.). The Cultural Study of Work. Oxford, U.K.: Rowman and Littlefield.

Fuller, A., & Unwin, L. (2003). Learning as apprentices in the contemporary UK workplace: Creating and managing expansive and restrictive participation. Journal of Education and Work, 16 (4), 407-426.

Fuller, A. & Unwin, L. (2004). Young People as Teachers and Learners in the Workplace: Challenging the Novice-Expert Dichotomy. International Journal of Training and Development, 8(1), 31-41.

Grace,W. (2005) 'He Māpuna te Tamaiti: Māori Ecologies to Support the Child' (unpublished paper presented to the Commentary Group on the NZCF Key Competencies, November, commissioned by the Ministry of Education, Wellington).

Gurung, R. A., Chick, N. L, & Haynie, A. (2009).Exploring signature pedagogies: Approaches to teaching disciplinary habits of mind. Sterling, VA: Stylus Publishing.

Guzman, G. (2009). What is practical knowledge? Journal of Knowledge Management, 13(4), 86-98.

Harris, R., Willis, P., Simons, M., & Collins, E. (2001). The relative contributions of institutional and workplace learning environments: an analysis of apprenticeship training. Journal of Vocational Education and Training, 53(2), 263-274.

Hattie, J. (2009) Visible learning: A synthesis of over 800 meta-analyses relating to achievement. London, New York: Routledge.

Hattie, J., & Timperley, H. (2007). The power of feedback. Review of Educational Research, 77(1), 81-112.

Hodges, N. J. & Williams, A. M., (2012). Skill acquisition in sports: Research theory and practice (2nd Ed.). London, England; New York, NY: Routledge.

Hodkinson, P., Biesta, G., & James, D. (2008). Understanding learning culturally: Overcoming the dualism between social and individual views of learning. Vocations and Learning, 1(1), 27-47.

Hutchins, E., & Klausen, T. (1998). Distributed cognition in an airline cockpit. In Y. Engestrom & D. Middleton (Eds.). Cognition and communication at work. Cambridge, UK: Cambridge University Press.

Jarvis, P. (1994). Learning practical knowledge. Journal of Further and Higher Education, 18(1), 31-43.

Johnson, M. (2007). The meaning of the body: Aesthetics of human understanding. Chicago: University of Chicago Press.

Joyce, S. (2012). More apprentices, better results from industry training. Retrieved August 2nd 2012 from http://www.beehive.govt.nz/release/more-apprentices-better-results-industry-training

Knowles, M.S. (1984). The adult learner: A neglected species. Houston: Gulf Pub. Co., Book Division.

Lave, J. (2011). Apprenticeship in critical ethnographical practice. Cambridge, UK: Cambridge University Press.

Lave, J., & Wenger, E. (1991). Situated learning: Legitimate peripheral participation. Cambridge, UK. New York: Cambridge University Press.

Leach, L., & Zepke, N. (2010). Making it into the pipeline: Transitions from school to tertiary education. Journal of Adult Learning, 38(1), 5-22.

Lucas, B., Spencer, E. & Claxton, G. (2012). How to teach vocational education: A theory of vocational pedagogy. City and Guilds Centre for Skill Development. London, UK.

Macfarlane, A., Glynn, T., Waiariki G., Penetito, W. & and Bateman S. (2008). Indigenous epistemology in a national curriculum framework? Ethnicities 8(1), 102- 127.

Magill, R. A. (2006). Motor learning and Control: Concepts and Applications (8th Ed.). New York, NY: McGraw Hill.

Mahoney, P. (2009) Modern apprenticeships: completion analysis. Ministry of Education. New Zealand.

Marton, F. & Booth, S. (1997). Learning and awareness. Mahwah, New Jersey: Lawrence Erlbaum Associates.

Marchand, T.H. J. (2010). Embodied cognition and communication: Studies with British fine woodworkers. In T. H. J. Marchand (Ed.). Making Knowledge: Explorations of the indissoluble relation between mind, body and environment (pp. 95-114). Malden, MA: Wiley-Blackwell.

Masters, R.S.W., & Poolton, J.M. (2012). Advances in implicit motor learning. In N.J. Hodges & A.M. Williams (Eds.). Skill acquisition in sports: Research theory and practice (2nd Ed.) (pp. 59-75). London, England; New York, NY: Routledge.

Moon, J. (2008). Critical thinking: An exploration of theory and practice. London, UK: Routledge.

Moran, A., Campbell, M., Holmes, P., & MacIntyre, T. (2012). Mental imagery, action observation and skill learning. In N.J. Hodges & A.M. Williams (Eds.). Skill acquisition in sports: Research theory and practice (2nd Ed.) (pp. 94-111). London, England; New York, NY: Routledge.

New London Group (1996). A pedagogy of multiliteracies: Designing social futures. Harvard Educational Review, 66(1), 60-92.

Nielsen, K. (2007). Aspects of a practical understanding: Heidegger at the workplace. Scandanavian Journal of Educational Research, 51(5). 455-470.

Penuel, W. P., & Wertsch, V. (1995). Vygotsky and identity formation. A sociocultural approach. Educational Psychologist, 30(2), 83-92.

Pye, D. (1968). The nature and art of workmanship. Cambridge, UK: Cambridge University Press.

Rogoff, B. (1990). Apprenticeship in thinking: Cognitive development in social context. New York: Oxford University Press.

Rose, M. (2005). The mind at work: Valuing the intelligence of the American worker. USA: Penguin.

Roth, W-M. & Bowen, G.M. (2001). Of disciplined minds and disciplined bodies: On becoming an ecologist. Qualitative Sociology, 24(4), 459-481.

Roth, W-M. & Lawless, D.V. (2002). How does the body get into the mind? Human Studies, 25, 333-358.

Sennett, R. (2008). The craftsman. London: Allen Lane.

Sheets-Johnstone, M. (2000). Kinetic tactile-kinesthetic bodies: Ontogenetical foundations of apprenticeship learning, Human Studies 23, 343–370.

Schon, D. (1983). The reflective practitioner: How professionals think in action**.** New York: Basic Books.

Silver, R. & Forrest, W. (2007). Learning to become one of us. In D. Kehoe (Ed.). Practice makes perfect: The importance of practical learning (pp. 66-79). London, United Kingdom: The Social Market Foundation.

Spronken-Smith R.,Walker, R., Batchelor, J., O'Steen, B. & Angelo, T. (2011). Enablers and constraints to the use of inquiry-based learning in undergraduate education. Teaching in Higher Education, 1(1), 15-28.

Sorby, S.A. (1999). Developing 3-D spatial visualisation skills. Engineering Design Graphics Journal, 63(2), 21-32.

Tanggaard, L. (2007). Learning at trade vocational school and learning at work: Boundary crossing in apprentices' everyday life. Journal of Education and Work, 20(5), 453-466.

Van de Weil, M. J., Van den Bossche, P., & Koopmans, R. P. (2011). Deliberate practice, the high road to expertise: K. A. Ericcson. In F. Dochy, D. Gijbels. M, Segers & P. Van Den Bosshce (Eds.) Theories of Learning in the Workplace: Building Blocks for Training and Professional Development Programs. London, UK; New York, NY: Routledge.

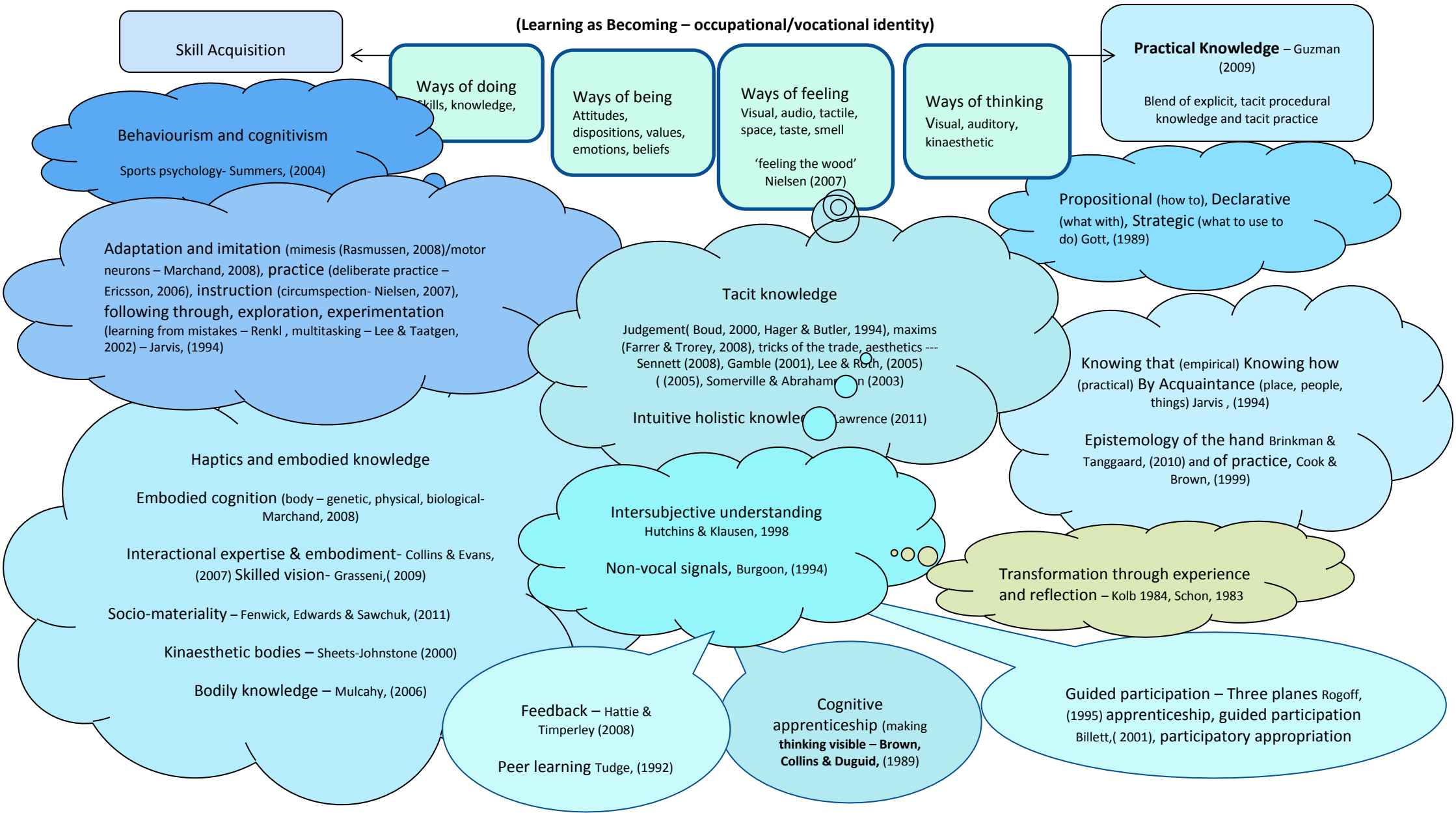
Vickerstaff, S. A. (2003). Apprenticeships in the 'golden age': Were youth transitions really smooth and unproblematic back then? Work, Employment and Society, 17(2), 269-287.

Vickerstaff, S. A. (2007). 'I was just the boy around the place': What made apprenticeships successful? Journal of Vocational Education and Training, 59(3), 331-347.

Wertsch, J. V. (1984). The zone of proximal development: Some conceptual issues. New Directions for Child and Adolescent Development, 23(1), 7-18.

APPENDIX 1

SUMMARY OF LEARNING A TRADE LITERATURE



References for the diagram : Summary of learning a trade literature

Note: references referred to in the main report are not repeated here.

Brinkman, S., & Tanggaard, L. (2010). Toward an epistemology of the hand. Studies in the Philosophy of Education, 29, 243-257.

Boud, D. (2000). Sustainable assessment: rethinking assessment for the learning society. Studies in Continuing Education, 22(2), 151-167.

Cook, D.N., & Brown, J.S. (1999). Bridging epistemologies: the general dance between organizational knowledge and organizational knowing. Organizational Science, 10(4) 381-400.

Gamble, J. (2001). Modelling the invisible: The pedagogy of craft apprenticeship. Studies in Continuing Education, 23(2), 185-200.

Gott, S. (1989). Apprenticeship instruction for real-world tasks: The coordination of procedures, mental models and strategies. Review of Research in Education, 15, 97-169.

Grasseni, C. (2009). Good looking: Learning to be a cattle breeder. In C. Grasseni (Ed.), Skilled Vision: Between apprenticeship and standards. Oxford, UK: Berghahn Books.

Hager, P., & Butler, J. (1996). Two models of educational assessment. Assessment & Evaluation in Higher Education, 21(4), 367-378.

Ingold, T. (2001). From the transmission of representation to the education of attention. In H. Whitehouse (ed.), The Debated Mind: Evolutionary Psychology versus Ethnography . Oxford, UK: Oxford International Publishers.

Kolb, D. A. (1984). Experiential learning: Experience as the source of learning and development (Vol. 1). Englewood Cliffs, NJ: Prentice-Hall.

Lawrence, R. L. (2012) Intuitive knowledge and embodied consciousness. In R.L. Lawrence (Ed.), Bodies of Knowledge: Embodied Learning in Adult Education. New Directions for Adult and Continuing Education, no.134, 5-14.

Lee, F. J., & Taatgen, N. A. (2002). Multitasking as skill acquisition. In W. D. Gray & C. D. Shunn (Eds.), Proceedings of the twenty-fourth annual conference of the cognitive science society (pp. 572-577). Mahwah, NJ: Erlbaum.

Lee, Y-J., & Roth, W-R. (2005). The (unlikely) trajectory of learning in a salmon hatchery. Journal of Workplace Learning, 17 (3/4), 243-254.

Marchand, T. H. J. (2008). Muscles, morals and mind: Craft apprenticeship and the formation of person. British Journal of Educational Studies, 56(3), 245-271.

Mulcahy, D. (2006). Body matters in vocation education: The case of the competently trained. International Journal of Lifelong Education, 19(6), 506-524.

Rasmussen, B. (2008). Beyond imitation and representation: Extended comprehension of mimesis in drama education. Research in Drama Education, 13(3), 307-319.

Renkl, A.; Mandl, H. & Gruber, H. (1996). Inert knowledge: analysis and remedies. Educational Psychologist, 31(2), 115-121.

Rice, T. (2010). Learning to listen: Ausculation and the transmission of auditory knowledge. In T. H. J. Marchand (Ed.). Making Knowledge: Explorations of the indissoluble relation between mind, body and environment. Malden, MA: Wiley-Blackwell.

Rotella, C. (2002). Good with their hands: Boxers, bluesmen and other characters of the Rust belt. Berkeley & Los Angeles, USQ: University of California Press.

Somerville, M., & Abrahamsson, L. (2003). Trainers and learners constructing a community of practice: Masculine work cultures and learning safety in the mining industry. Studies in the Education of Adults, 35(1), 19-34.

Summers, J. J. (2004). A historical perspective of skill acquisition. In A. M. Williams & N. J. Hodges (Eds.). Skill acquisition in sport: Research, theory and practice (pp. 1-26). London, England; New York, NY: Routledge.

Ryle, G. (1945, January). Knowing how and knowing that: The presidential address. In Proceedings of the Aristotelian Society (Vol. 46, pp. 1-16). The Aristotelian Society; Blackwell Publishing.

Tudge, J. R. H. (1992). Processes and consequences of peer collaboration: A Vygostskian analysis. Child Development, 63(6), 1364-1379.

APPENDIX 2

BUILDING GUIDELINES

Apprentices: summary table

Approaches	Ways of learning	Guidelines	Literature	Findings – interview vignettes and themes
Observation	Learning by watching	When watching: Check – where does this task fit in with my learning goals? While watching: Organise a mental picture of the task After watching: Try out the task and concentrate on deliberate practice.	Watching and listening. Not only imitation. Mental rehearsal . (Moran, Campbell, Holmes & MacIntyre, 2012)	Well, I am a bit of a hands-on person so if somebody tells me how to do it, I wouldn't get, in fact if I see someone doing something, I just pick it up really. (carpenter 1) Yeah. You gotta observe something for the first time and then you have your own go at doing it. (Cook 3) I like to watch and tell me how it is to be done. Like we are shown the job and the visual. (Engineer 3)
	Learning through deliberate practice	When practising: Check – where am I going with this? While practising: At each repeat of a work activity, think about How is my body placed? Is there important feedback from my tools / materials I am working with that I need to pay attention to? How can I improve the my task performance?	Measuring and analysing current performance is required to improve on performance – need to act on knowledge of result (KR). Practice activities need to be repetitive to allow for reflection on outcomes and processes. Learner motivations to improve performance is a prerequisite to achieving expertise.	Just practise, practise, practise, pretty much. (Cook 1) And then it just develops with practice. The more you do it, the easier it gets, kind of thing. (Engineer, 2)

Approaches	Ways of learning	Guidelines	Literature	Findings – interview vignettes and themes
		After practise / completion of task: Reflect on feedback from others. Organise new learning and knowledge into my mental picture of the task. Identify the types of theory knowledge related to the task. Work out how you could make connections between your 'learning by doing' and theory principles relating to the task.	Time and effort are required to attain expertise (Ericsson, 2006)	
Engagement / interactions	Getting the most from coaching	Asking the right questions		You learn it mainly from yourself and by asking questions. (Dairy farmer 2)

Coaches: summary table

Approaches	Ways of learning	Guidelines	Literature	Findings
	Modelling	Whole or part task. Number of times to demonstrate a task.	Practice activities need to be specifically defined to improve performance aspects requiring improvement (Ericsson, 2006)	You work with them so you do the job without them by the end of it. So you just learn from them you learn all the good bits. (Engineer 1)

Approaches	Ways of learning	Guidelines	Literature	Findings
Interactions with others				
	Coaching	Introduce appropriate hints. Sequence tasks – simple to complex, least to most responsibility.	Teachers and coaches plan a crucial role in guiding individual development (Ericsson, 2006) Sequence task from low to high accountability (peripheral to full participation) – (Billett, 2001) Use analogies to help build robust mental imageries and frameworks to link theory to practice (Moran, Holmes & MacIntyre, 2012)	Just help to do the actual work. So they talk you through the actual job. Look at what they are doing and why they are doing it. And then any little tips and tricks, you learn as well. (Engineer 1) That would be my employer, who is J. Yup. He is very hands on in the workshop so he gets out there with us, when we are new he shows us, especially the way he wants it done. So you pick up the skills through him. (Engineer 2)
	Scaffolding	Finding out what the learner already knows and can do.		You more or less get taught the basic ways of how to fabricate. In the sense of you are told how to do it step by step when you first start out. (Engineer 2) … because all the skills kind of. The first year you are very like learning the basic principles of how to do everything. The second year it kind of falls into place and then the third year you can concentrate more on the design. (Engineer 2) Yeah, we started off with people that we worked [with], through models and

Approaches	Ways of learning	Guidelines	Literature	Findings
				once we got more confident, we would practise on clients that knew we were trainees. (Hairdresser 1)
	Fading	Deciding on when to let go.		You kind of the first year, you are shown things very closely, the second year you stand on your own feet a little bit more and then like I have signed up to do the Advanced trade which is five hours. So at the beginning of the third year they very much stood back and let me do my own thing, which was leading into the advanced trade side. (Engineer 2) Probably for the first year, I would say. Most days, after that I started on the little odd bit by myself but I am pretty much by myself now, every day. A little too much work. (Glazier 3) There is a lot of repetitive work so I would say it would have been, just how many times I was assigned a job and I waited until people stopped watching over me. (Joiner 2)
	Importance of feedback	Provide feedback on: Task: Process: Feedback cycle includes: Feed up Feed back Feed forward	Informative and immediate feedback is fundamental towards assisting learners to define knowledge and skills. (Ericsson, 2006) Feedback cycle (Hattie & Timperley, 2007)	

APPENDIX 3

COMPOSITE CASE STUDIES

Note the case studies are derived from small samples and a follow up study is recommended to establish generalisability.

Boatbuilders

Boat builders reported the longest apprenticeship period. All the participants in the project were into the fourth year of apprenticeship and all had about a year to go before completion. The length of apprenticeship time reflects the complexities of boat building combining aspects of carpentry, joinery and engineering. Additionally, some apprentice boat builders also have to be familiar with electrical wiring and plumbing systems. Boat builders also work with a wide variety of materials. These include wood, alloys, composites (i.e. fibreglass), steel and canvas. Apprentices train to work with the specific material used in their workplace.

Workplaces vary from boat yards manufacturing designer yachts, jet boats, dinghies and sailing boats to ones undertaking repair, refit or renovation. Work tasks require apprentices to interpret plans and sketches and to undertake calculations to define measurements. Therefore text and numerical literacies along with a wide range of multiliteracies and multimodalities have to be deployed in everyday work practice and problem solving.

The wide range of tools, machines and materials boat builders have to learn about increases the breath / scope of the skill learning demands for this trade. Hence, boat building apprentices in their fourth year of apprenticeship did not report any opportunities in the workplace for them to assist with the training of other workers or more junior staff.

Carpenters

Carpentry has a rich tradition of practice. Carpenters work in small work teams / gangs of between three to six workers. The teams are usually composed of one supervisor or foreman, supported by two or three tradesmen and up to two apprentices. Apprentices' workplace-based curriculum is dependent on the types of houses their workplace builds. Building firms may range from those that specialise in architecturally designed homes to ones working solely on 'spec' homes confined to a set of predefined plans or assembled from 'kit-sets'.

Apprentice carpenters learn a range of wood working and concrete forming skills, using a range of tools. Carpenters learn how to read and interpret plans, requiring the development of good spatial and mental imagery. Numeracy demands are based around measurements both in two and three dimensions.

As carpenters work in small teams, opportunities for senior apprentices to assist or contribute to the training of other workers or junior apprentices are high.

Cooks

Of all the participant groups in the project, cooks had the highest attrition rate. Half the participants had left the trade on completion of their apprenticeship. This could be due to the high pressure of work involved in time-constrained cooking tasks and the need for cooks to work on evenings and weekends. Cooks work in a range of establishments, from fine dining to short order cooking in cafes or within institutional kitchens.

Although cooks work in a team environment in the kitchen, their work is often individualised with each cook responsible for a range of dishes on the menu. There is a requirement for high levels of production consistency. Sensory modalities (visual, tactile, taste, smell) need to be learnt and deployed to ensure visual and textural features and taste of dishes meet quality expectations. The competitive market in food establishments and the high pace work environment means retail sectors of the industry are unable to support apprentices who struggle to learn cookery skills.

Dairy workers

Dairy workers completed training in a traineeship that lasted just over a year. Dairy workers work to ensure the dairy herd is well-cared for and farm infrastructure (pastures, fences, machinery, etc.) is maintained. Therefore, dairy workers learn a range of work tasks including skills from carpentry, engineering and small business management.

Dairy workers who complete training take on farm management roles, overseeing the work of a small number of other workers and the responsibility of herd and farm management. Therefore, there is a need for dairy industry trainees to be provided with opportunities to learn farm management skills.

Engineers

Engineering apprenticeships last for at least four years. This trade had the strongest apprenticeship tradition, with apprentices reporting structured forms of workplace learning. Engineers tend to complete apprenticeships in large organisations. In the main, apprentices are trained by others who have themselves completed an apprenticeship. Engineers learnt a range of practical skills underpinned by the need to understand and apply complex concepts and trade calculations. Problem solving skills to complete machinery diagnostics and maintenance were identified as something all apprentices had to learn.

Apprentices' literacy requirements were work task specific. Apprentices had to learn how to read, interpret and solve problem from technical drawings / plans and communicate with other engineers and customers, using sketches. Standard operating procedures used

throughout the industry have to be learnt or easily referenced when required. Therefore, engineering apprentices need to learn 'research' skills specific to their industry. All the apprentices suggested that computer-aided design (CAD) become part of their off-job training, as the use of technology in engineering, centres around CAD.

Glaziers

In this trade, there was a diversity of workplace dependent skill sets. Block courses were used to assist apprentices to learn the range of skills. So domestic and auto glaziers learnt some of the demands of industrial glaziers (e.g. handling very large glass panes) and industrial glaziers had the opportunity to practise domestic glazing skills (e.g. install glass in domestic settings).

The domestic glazing apprentices became independent workers at an early stage of their training. Team work with an experienced glazier for around six months was then followed by two years of independent work whereby apprentices were assigned a company van and carried out domestic repairs.

Industrial glaziers followed a training pattern similar to carpenters, working in a work team / gang to complete glazing jobs on large building projects. Industrial glaziers required greater communication coordination skills whereas domestic glaziers required service-orientated communication skills to work with customers.

Hairdressers

In this trade, apprentices learnt the trade in a variety of settings including formalised pre-trade, simulated real-world (training salon) and workplace learning. Several apprentices reported formalised training to be advantageous as the learning was not dictated by the salon type the apprentice would learn the trade in.

Hairdressing requires learning practical skills with high sensory components (tactile, smell, visual), literacy and numeracy components related to the trade, and small business management and 'service disposition' requirements. 'Service disposition' communication skills and business management skills were recognised as being just as important as trade skills.

Joiners

Joinery is another trade with a strong tradition of apprenticeship training. Joiners learn a range of practical skills, theory work on understanding of materials and communications using sketches and plans, acquiring dispositions of craftsmanship. Apprentices have ample opportunities to learn how to work with tools, machinery and different types of wood, adhesives and compounds. Although many of the components constructed by joiners might be similar, each job requires careful consideration and attention to detail.

Similar to engineering, joinery has had a long history of apprenticeship training and many apprentices were trained by joiners who had learnt the trade through apprenticeship. Therefore, along with engineers, joinery apprentices' apprenticeship training aligns well with 'cognitive apprenticeship' descriptors.

APPENDIX 4

BUILDING CASE STUDIES

Learning a trade

	Boat builders	**Carpenters**	**Cooks**	**Dairy workers**	**Engineers**	**Glaziers**	**Hairdressers**	**Joiners**
Length of apprenticeship	Longest – 4 – 5 years	3 – 4 years	3 years	traineeship 1 – 2 years	4 years	2 – 3 years	3 years	3 years
Workplace organisation	Hierarchical	Team / work gang	Small business – retail focus	Small business	Hierarchical Large companies	Small business	Small business – retail focus	Hierarchical
Type of work	Boat building – wood, alloy, composites or steel Aspects of carpentry, joinery, engineering (fabrication, machinery installation)	Construction of timber framed housing Concrete work	Cook meals. Prepare salads and desserts.	Animal husbandry Milking Pasture management Fencing Run, clean and maintain machinery	Make engineering products. Install and maintain machinery.	Install glass into windows.	Cut and style hair. Advise clients on hair care and styling trends.	Construct furniture, stairs and other joinery requirements.

	Boat builders	**Carpenters**	**Cooks**	**Dairy workers**	**Engineers**	**Glaziers**	**Hairdressers**	**Joiners**
Workplace types	Bespoke designer yachts to repair / refit, renovation boat yards	Bespoke architecturally designed to 'spec' homes	Fine dining, family, café, short order, institutional catering	Industrial scale (000s of cows) to 'small' (00s of cows)	Fabrication, fitting, turning, tool making / manufacturing or maintenance	Domestic, industrial automotive	Franchise, Neighbourhood Up-market	Bespoke craft furniture to commercial joinery production
Skills	Practical. Work task and organisational type dependent	Practical. Organisational type dependent	Practical. Organisational type dependent	Practical. Organisational type dependent	Practical. Organisational type dependent	Practical. Work task dependent	Practical. Organisational type dependent	Practical. Work task dependent
Knowledge – literacy Numeracy Trade theory digital	Plan reading Sketching High numeracy CAD	Plan reading Sketching High numeracy CAD	Recipe reading Business literacy and numeracy requirements	Business literacy and numeracy requirements Business computing	manuals Plan reading Sketching High numeracy CAD	Sketching numeracy	Business numeracy and Literacy Human relationships	Plan reading Sketching High numeracy CAD
Dispositions	Craftsmanship Diligence Team worker	Craftsmanship Team worker	Consistency creativity	Duty of care to livestock empathy	Craftsmanship Meeting tolerances	Craftsmanship Service	Craftsmanship Extroversion Creativity service	Craftsmanship diligence

	Boat builders	**Carpenters**	**Cooks**	**Dairy workers**	**Engineers**	**Glaziers**	**Hairdressers**	**Joiners**
Communication	Multimodal (visual, gestural, non-verbal etc.)	Multimodal	Multimodal	Multimodal Non-verbal with animals	Multimodal	Multimodal	Multimodal Oral – high level	Multimodal
Consolidation - Problem solving / Critical thinking	Design solutions	Practical Work-focused	Practical work-focused Menu design	Productivity and efficiency	Diagnostics Maintenance	Early independence	Negotiation with customers	Design solutions
multiliteracies	Kinaesthetic Digital Visual Spatial	Kinaesthetic Visual spatial	Kinaesthetic Visual Tactile Sensory (smell / taste)	Kinaesthetic Visual tTemporal	Kinaesthetic Visual Tactile Spatial	Kinaesthetic Visual Social	Kinaesthetic Visual Tactile Social spatial	Kinaesthetic Visual Spatial
Socio-material	Tools Machines Materials Spatial	Tools machines Materials Spatial	Tools, Appliances, Materials Aesthetic	Tools Machines Materials Husbandry	Tools machines Materials Spatial	Tools machines Materials Spatial	Tools machines Materials Relationships Spatial	Tools Machines Materials Spatial

	Boat builders	**Carpenters**	**Cooks**	**Dairy workers**	**Engineers**	**Glaziers**	**Hairdressers**	**Joiners**
				Temporal			Aesthetics	
metacognition	Proprioception (body stance and balance). Knowledge of process (KP)/ result (KR).	Proprioception. Knowledge KP and KR.	Proprioception. Knowledge KP and KR.	Proprioception. Knowledge KP and KR.	Proprioception. Knowledge KP and KR.	Proprioception. Knowledge KP and KR.	Proprioception. Knowledge KP and KR. Service orientation.	Proprioception. Knowledge KP and KR.
Independent practice	Very late into apprenticeship	Late in apprenticeship	Production driven	Early – management positions at end of traineeship	Late in apprenticeship	Independence early in apprenticeship (Domestic glaziers)	Late in apprenticeship	Late in apprenticeship
Signature pedagogies - SP (cognitive) (Donald, 2002)	Hard thinking – applying structured knowledge to unstructured problems	Orderly thinking (learning in a structured discipline)	Criticism and creativity -	Orderly thinking – learning in a structured discipline	Hard thinking – applying structured knowledge to unstructured problems	Hard thinking – applying structured knowledge to unstructured problems	Criticism and creativity -	Hard thinking – applying structured knowledge to unstructured problems
SP- Relevant to trades –	Broad range of orderly, hard and inductive	Orderly thinking with some hard /	Begins with orderly thinking but	Orderly thinking with some hard and	Hard thinking – applying structured	Orderly thinking with some hard	Begins with orderly thinking but extends into	Orderly thinking with some hard /

	Boat builders	**Carpenters**	**Cooks**	**Dairy workers**	**Engineers**	**Glaziers**	**Hairdressers**	**Joiners**
Ways of thinking	thinking. Varied work dependent specialities.	inductive thinking. Emphasis on spatial imagery.	extends into criticism and creativity. High tactile, visio-sensory.	inductive thinking required. Temporal sense.	knowledge to unstructured problems. Spatial imagery.	thinking. Highly work context dependent.	criticism and creativity. 'People skills'. Tactile skills.	inductive thinking. Some criticism and creativity.
SP-examples of learning moments – where workmanship or risk occurs.	Replacing or refitting parts of boats. Discussing modifications as detailed in plans.	Adjusting measurements on plans to allow for site features.	Utilising seasonal ingredients. Adapting recipe for customer dietary needs.	Herd management during inclement weather events (flood, snow etc)	Repairing, retro-fitting machinery. Discussing client requirements as detailed in plans.	Awkward access to window. Fitting glass into warped window frames.	Assisting client to work through hairdo that did not meet client's expectations.	Fitting cupboards into room that is not 'square'. Discussing client requirements as detailed in plans.