

The salience of diversity in foundation skills contexts, pedagogies and research

Lynda Cameron

Foundation Skills Literature Review Project
Scholarship recipient

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Level 11, 33 King William Street, Adelaide, SA 5000
PO Box 8288 Station Arcade, Adelaide SA 5000, Australia

Phone +61 8 8230 8400 Fax +61 8 8212 3436

Email ncver@ncver.edu.au Web <<https://www.ncver.edu.au>> <<http://www.isay.edu.au>>

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About the research

The salience of diversity in foundation skills contexts, pedagogies and research

Lynda Cameron

Building the research capacity of the vocational education and training (VET) sector is of key interest to the National Centre for Vocational Education Research (NCVER). The Foundation Skills Literature Review Project, funded by NCVER, provided scholarships to practitioners to develop their research skills through undertaking literature reviews focused on key topics relating to foundation skills. Here 'foundation skills' refers to adult language, literacy (including digital literacy) and numeracy skills, as well as employability skills, such as problem-solving, collaboration and self-management.

The four main topic areas were:

- perspectives on adult language, literacy and numeracy
- policy contexts and measures of impact
- context and sites – pedagogy and the learners
- workforce development.

The literature reviews will form a key information source for the Foundation Skills Pod, a new resource hosted on VOCEDplus <<http://www.voced.edu.au/pod-foundation-skills>>. The Foundation Skills Literature Review Project is a partnership between NCVER and the University of Technology Sydney and the Australian Council for Adult Literacy.

This review focuses on 'contexts and sites – pedagogy and the learners'. In reviewing both national and international research, as well as grey literature, the author has delved into the different contexts in which adult language, literacy and numeracy are being delivered, who the learners are and the pedagogies in use, to elucidate what works best for whom and why.

Through this review Cameron highlights the complexity of teaching foundation skills: the diversity of learners and their learning needs; the varied contexts or places in which teaching or training takes place; and the ongoing technological changes, all of which impact on what works and for whom and why.

She draws attention to the benefits of longitudinal research and the need for further research into the impact of non-formal learning environments on the development of foundation skills as ways of expanding our knowledge of good teaching and learning practices.

Dr Craig Fowler
Managing Director, NCVER

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Introduction

This report reviews Australian and overseas research and 'grey literature' on foundation skills training for adults delivered in formal, community and workplace contexts. Foundation skills encompass literacy, numeracy, technology and employability skills.

The report begins with an explanation of key terms, followed by an overview of the identity of the learners and a description of what shapes their learning. The literature review is then organised according to key areas: literacy; numeracy; technology; the workplace; vocational and employability skills.

The report concludes with suggested areas for further investigation.

Method

The review commenced with a search of online databases for academic publications relating to foundation skills training in peer-reviewed journals. The search also included grey literature, in the form of reports and general documents available on the websites of organisations involved with literacy and numeracy, either in Australia or internationally. Literature less than ten years old was preferred, although in some cases older literature has been included. A range of research methodologies was sought out and literature not focused on adult learners was generally excluded.

Theoretical explanations

An essential starting point before considering the literature is a discussion on what is meant by the terms 'literacy' and 'numeracy'. Both terms are contested: there is no single universally accepted definition of either. The definition applied has relevance for the learning environment, as it influences how the constructs are taught and assessed. The definition is also relevant to a critical understanding of the research, as it can influence the methodologies used by the researchers. The discussion of these key terms will encompass alternative perspectives, including literacy and numeracy viewed as a form of human capital, as a social practice and as a means of emancipation. The review that follows will demonstrate how each of these perspectives can be useful.

What is 'literacy'?

Two currently predominant perspectives in the literature are those that view literacy either as a form of human capital, which proposes that literacy is comprised of identifiable skills that can be performed independently of context; or those that view literacy as a social practice, which positions literacy in relation to the context in which it is being performed and the purpose for which it is being used (Papen 2005). Some researchers acknowledge the complementarity of these perspectives, such as Wolf and Evans (2011) and St Clair (2010). A relatively less common view in the literature reviewed is that of literacy as a means to achieve emancipation, where reading and writing abilities are believed to enable greater participation in life (Hamilton 2010). These will be discussed below prior to commencing a review of the literature.

The human capital perspective defines literacy and numeracy in functional terms – it considers the activities people can do based on their abilities, abilities which enable them to function in society and attain their goals (Shomos 2010). According to Shomos and Forbes (2014): ‘human capital improves labour productivity, which in turn makes it more likely that a person will gain employment and earn higher wages’ (p.8). At an individual level, human capital can be exchanged for employment and further education opportunities, which according to the model translates to national gains in national productivity. In their framework, which maps human capital relative to labour market outcomes, Shomos and Forbes (2014) include cognitive and non-cognitive skills, abilities and health as components of human capital. Cognitive skills include aspects of information processing, while non-cognitive skills include motivation and perseverance. Health incorporates emotional, psychological and physical wellbeing. This perspective may also be referred to as a ‘skills’ view (Papen 2005).

Large-scale literacy assessments, which compare performance of large populations, are commonly based on a functional definition of literacy. This includes the Programme for International Assessment of Adult Competencies (PIAAC), which compares literacy levels in Australia with those of more than 20 other countries (Shomos & Forbes 2014). Critics of functional definitions of literacy highlight the difficulty of identifying precisely *what* functions can be applied across populations that enable measurement of literacy and numeracy (St Clair 2010). Indeed, Shomos (2010) notes that ‘care should be taken in cross-country comparisons of skills’ (p.11) and White (2011) also states that large-scale assessments are designed for ‘the *general* population’ (p.169). But in Australia in 2016, what exactly is ‘the general population’?

Pedagogical and research approaches that followed a human capital perspective are likely to be focused on discrete skill development, on the assumption that skills developed are transferable from the classroom to other contexts (Papen 2005). Condelli, Wrigley and Yoon (2009), for example, include reading forms, labels and maps in their definition of functional literacy. Other examples in the literature but not included in this review focus on efficiency of word reading (Mellard, Anthony & Woods 2011), auditory working memory (Eme, Lambert & Alamargot 2014), or phonics (Burton et al. 2010; Condelli et al. 2010). The human capital perspective is evident in Australian Government programs such as Skills for Education and Employment (SEE), where client attributes are assessed against the Australian Core Skills Framework (ACSF), a model of assessment designed according to the principle that ‘core skills can be seen as discrete skills’ (Department of Industry 2012, p.4).

In contrast to this, the social practices perspective proposes that literacy is a highly context-dependent ‘activity’ rather than a set of skills, and is undertaken to achieve a particular purpose within a sociocultural context (Papen 2005). This perspective posits that literacy exists in multiple forms, rather than a single form (Papen 2005; Wolf & Evans 2011). Papen (2005) provides the contrasting literacy examples of reading a book, reading the continuous text of a web page and reading a milk carton. St Clair (2010) also provides an instructive example, describing the different steps involved in reading a report at work compared with reading a newspaper at home. This perspective has evolved through research by Heath (1983), Street (1984), Baynham (1995) and Barton and Hamilton (1998).

Pedagogical and research approaches following a social practices perspective are likely to explore how literacy is used by learners across contexts, and why some literacies are more valued than others, either by society or individuals (Hamilton 2010). This perspective can provide insight into the complex facets of learning such as learner identity, as illustrated in research by Ollerhead (2012, 2016) and Simpson and Gresswell (2012). Shomos (2010) acknowledges the 'more pluralistic and inclusive set of definitions of literacy' (p.11) afforded by social practices perspectives, but also notes the relative difficulty in measuring literacy for the purposes of empirical analysis when following this perspective.

In some cases, researchers incorporate both social practice and human capital perspectives. This is used to positive effect by Wolf and Evans (2011) in their exploration of workplace literacy and numeracy, where they seek to measure performance as well as understand how literacy and numeracy are used across contexts. It is also used effectively by Reder (2009) in longitudinal research that tracks proficiency measures in conjunction with literacy and numeracy practices over a period of several years. St Clair (2010) also offers a pluralistic approach: his 'capability model' recognises the importance of both social context and cognitive processes in helping learners to increase their 'pool of literacy practices' (p.38) in order to achieve better outcomes across various life domains, such as health and family. St Clair suggests that his model could be used to investigate what a diminished literacy capability *obstructs* people from doing. The pluralistic approaches provide interesting alternatives to the human capital and social practice perspectives described above.

The final perspective of literacy relevant to the literature review is the emancipatory view, whereby increased literacy provides a pathway to greater independence and democratic participation, as well as improved control over life and an enhanced ability to confront injustices (Hamilton 2010). An emancipatory perspective is evident in Howard and Logan (2012), who investigate connections between literacy proficiency and experiences of exclusion. This perspective has evolved through the work of critical educators such as Freire (1972) and Shor (1992).

No single perspective is being positioned as universally superior in this report: each perspective can be useful. The functional definition in the human capital perspective can be instructive for new teachers who may wrestle with a seemingly insurmountable learning curve as they grapple with teaching reading, writing, numeracy and technology skills, and, in the case of ESOL (English for speakers of other languages) teachers, teaching speaking and listening, as well. A clear model of functional literacy, such as that provided by White (2011), could be an invaluable tool for new teachers who need to understand the sub-skills that underpin reading in order to effectively teach their students. Indeed, this could be considered a pre-teaching requirement. A social practices perspective is instructive for new and experienced teachers alike, so that student interests are considered when planning lesson materials and lesson content is related to real-world activities and interests. And finally, an emancipatory perspective is useful for any teacher interested in facilitating learning that enables students to confidently participate in a democratic society. In terms of reviewing the literature, the main consideration is that the perspective followed can influence both the learning environment and the research approach.

What is 'numeracy'?

Overarching perspectives of numeracy can also have a primarily human capital, social practice or empowerment focus, with consequences for teaching approaches and assessment, as well as for research perspectives. A range of these perspectives is described below; in addition, the concepts of 'invisible' mathematics and different types of mathematical 'understanding' are introduced.

Shomos (2010) employs a functional definition, which views numeracy as a set of discrete skills that can be objectively tested and which 'contribute to an individual's ability to participate in the labour market and to be productive' (p.9). Embedded in this definition is the assumption that skills taught are transferable from the classroom to non-classroom situations. This perspective is evident in large-scale surveys such as the Program for the International Assessment of Adult Competencies (PIAAC), which aims 'to identify and measure differences within and across countries' and also 'to assess the relationship of adult competencies with economic and social outcomes believed to underlie both personal and societal success' (PIAAC Numeracy Expert Group 2009, p.7). The numeracy definition developed by the PIAAC Numeracy Expert Group is somewhat broader than that proposed by Shomos as we see here:

Numeracy is the ability to access, use, interpret, and communicate mathematical information and ideas, in order to engage in and manage the mathematical demands of a range of situations in adult life.

(PIAAC Numeracy Expert Group 2009, p.21)

In order to manage the mathematics in 'a range of situations', learners must have a certain level of conceptual understanding, to enable them to identify which mathematical concept to invoke for a given situation. This introduces an important point of departure from a purely 'skills' definition of numeracy, a point explored by Strasser et al. (1991) in their examination of how people learn mathematical skills in a way that enables them to transfer the skills gained in the classroom to real-life contexts. Strasser et al. (1991) explain the importance of 'varied contexts to encourage the development of generalizable skills' (p.163). They note that this teaching approach, in conjunction with a focus on whole tasks rather than discrete mathematical components, facilitates 'relational' understanding. This meaningful relational understanding contrasts with a purely skills-focused approach to maths teaching, which provides 'rules without reasons', resulting in 'instrumental' understanding (Strasser et al. 1991, p.159, citing Skemp 1976). Relational understanding involves learners comprehending the *meaning* of mathematics, rather than just the *mechanics* of mathematics. Understanding the meaning enables a greater ability to identify which mathematical approach to use when confronted with the diversity of real-world contexts. This contrasts with instrumental understanding, which equips learners with the technical skills to perform mathematical tasks, but not necessarily with the ability to identify which mathematical approach is required for a specific context. A 'whole task in context' approach, where the contexts relate to real-world learner experiences, epitomises a social practice perspective of numeracy. Many adult numeracy learners are motivated to prove to themselves that they can succeed in a high-status subject or to help their children (Swain 2005), and at times are only interested in gaining an instrumental understanding of maths (Strasser et al. 1991). The key is for teachers to know what motivates their learners to attend numeracy classes, so that lessons can be designed and delivered accordingly.

Critical mathematical teaching approaches aim to empower learners to question the numeracy information that surrounds them and 'to give them the skills they need to make sound judgements and decisions in their lives' (Brooks 2013, p.154). According to Frankenstein (2009), the primary aim of critical mathematics is 'to understand how to use mathematical ideas in struggles to make the world better' (p.112). This links mathematics to ideas of social justice and democratic participation. Yasukawa and Brown (2012) describe how critical mathematics is relevant in workplace contexts, to enable staff to 'read' the politics of the environment; for example, by analysing the logic of pay structures and probing data on workplace productivity. They also view the aim of critical mathematics in workplace contexts as exposing the background and details of mathematical models, the workings and historical purposes of which would otherwise be invisible to the staff who are affected by them. As such, higher-level numeracy embraces sophisticated abilities and encourages critical thinking.

Critical perspectives can also be employed by researchers. They are used by Evans, Wedege and Yasukawa (2013) in their international survey of contexts of adult numeracy to trace 'ambiguous and contested meanings of key concepts' and to relate them to the goals and power held by specific groups (p.206); to challenge dominant discourses; and to examine how organisations and governments can shift the meaning of key concepts in ways that affect society.

An additional concept to consider in relation to numeracy is that of 'invisible' mathematics. Coben (2000) describes 'invisible' mathematics as something attributed to 'common sense' rather than mathematical ability, with some people not recognising their own mathematical proficiency 'unless it is in the form of a standard algorithm or formula' (p.55). Additionally, the maths knowledge of many adults is a combination of partially remembered concepts, learnt at school, in combination with methods learnt as adults: when this fragmented knowledge is united for learners, it can come as a 'revelation'. Evans, Wedege and Yasukawa (2013) describe this phenomenon of invisibility as widespread and state the importance of 'its effects on the beliefs and motivations of learners, and especially on their confidence' (p.226).

The learners

Who are the learners?

The studies included in the review encompass a diverse range of learners and learning contexts, and span multiple countries. There are learners studying in their country of origin, as well as those from migrant backgrounds. In addition, there are learners from Indigenous Australian and New Zealand cultures studying in their country of origin, where English may be an additional language in their social groups and where the definition of what it means to be 'literate' includes gesture, sign language and reading meaningful symbols in the natural landscape (Furness 2013; Kral 2016). Many learners are also acquiring language skills through the process of learning literacy, numeracy, technology and workplace skills. This group must first learn the vocabulary that makes communication possible in order to learn about the concepts presented in the classroom. As such, language learners participate in three different processes:

- learning the language
- learning literacy, numeracy, technology and workplace skills through language
- learning about how English language works.

(de Silva Joyce & Feez 2012, citing Halliday 2007)

This review includes studies from Australia, New Zealand, the United States, Ireland and England; the first languages of students include Vietnamese, Farsi, Korean, Mandarin, Dinka, Spanish, Urdu, Kurdish, Arabic, Portuguese and Chinese. Learners include young and older adults who have fled civil unrest and are studying English as a second language (Ollerhead 2016), participants on family literacy and numeracy programs (Coben et al. 2007; Furness 2013), as well as employees attending workplace development programs (Wolf & Evans 2011). A number of learners have physical, mental or learning disabilities (Marston & Johnson-Abdelmalik 2015; Mellar et al. 2007; Reder 2009). The amount of formal schooling varies as much as the languages and countries of origin, with learners affected by civil unrest typically having minimal or disrupted schooling (Condelli, Wrigley & Yoon 2009; Ollerhead 2016; Simpson & Gresswell 2012).

Learners are motivated by a range of factors. Some adults want to improve their parenting skills or help children with their homework (Appleby 2010; Baker & Rhodes 2007; Furness 2013), while other participants are motivated to get a qualification (Byrne & Sellers 2013; Coben et al. 2007). Some learners from migrant backgrounds study to enable them to integrate more fully into their new communities (Ollerhead 2016). Some want to find a job, find a better job, or to prove to themselves that they can acquire skills that eluded them during their formal schooling (Appleby 2010; Baker & Rhodes 2007; Coben et al. 2007), while others attend as part of government programs aimed at developing work-readiness skills (Ollerhead 2012; Kral 2016). A minority in workplace training are compelled to attend; the majority are voluntary participants (Wolf & Evans 2011). Personal development can be a motivator for both workplace and non-workplace attendees (Appleby 2010; Coben et al. 2007; Wolf & Evans 2011). As Marston and Johnson-Abdelmalik (2015) note, 'one of the most significant reasons to be literate is to gain a greater degree of autonomy and control over one's life' (p.6). This is borne out in the literature reviewed.

How do they learn?

Two perspectives are provided to consider 'what shapes learning'. The first is a framework of motivation developed by Wlodkowski and Ginsberg (1995). Describing motivational conditions in classrooms, this framework can also be used as a planning tool by teachers. The second perspective highlights the role of 'identity' in learning. There is some overlap between the two, specifically regarding the impact of inclusionary/exclusionary teaching practices. However, the second perspective gives specific insight into language acquisition and the critical role of relationships in this process. Both perspectives provide a lens through which to view how participant learning has taken place, or not taken place, in the literature reviewed. This section concludes with some specific considerations relating to learning numeracy: the psychological notion of 'influence of affect' on maths performance and the gender-based differences in reported numeracy proficiency.

Wlodkowski (1999) argues that motivation is 'the natural human capacity to direct energy towards a goal' (p.7) and posits that motivation is inseparable from culture. He provides a Motivational Framework for Culturally Responsive Teaching, which incorporates four intersecting conditions that both teachers and students can influence:

- establishing an atmosphere of inclusion
- developing favourable attitudes towards learning through choice and personal relevance
- enhancing meaning
- engendering competence.

Wlodkowski (1999) identifies that 'what may enhance the motivation of some students may diminish the motivation of others' (p.9), and that a lack of teacher cultural sensitivity can unwittingly result in declined student motivation. He also notes that failure to account for student norms can induce student resistance. Wlodkowski's model positions the teacher as a 'valuable resource and vital partner', who can use the framework to 'respectfully evoke, support and enhance the motivation to learn that all students possess' (Wlodkowski 1999, p.15). He also recognises that motivation levels can fluctuate and promotes attention to planned motivation in order to 'sustain intrinsic motivation' (p.15).

Much of the research reviewed provides examples of aspects of Wlodkowski's framework. The importance of establishing an inclusive learning environment is evident in research by Wolf and Evans (2011), which found that group composition can be critical for some learners, and that learners 'need to feel part of the group and the quality of the teaching alone will not be enough for them to stay' (p.67). The importance of learning content that is relevant to learners' lives is evident in Condelli, Wrigley and Yoon (2009), Byrne and Sellers (2013), Simpson and Gresswell (2012) and Wolf and Evans (2011).

As noted earlier, examining learner 'identity' is an alternative perspective from which to consider what shapes learning. Ollerhead (2016) suggests that 'identity refers to the ways in which individuals understand their relationship to their social world' (p.79) and that identity fluctuates in response to social contexts and community memberships. Citing Weedon (1997), Ollerhead also claims that 'language is the medium through which individuals negotiate a sense of self identity' (Ollerhead 2012, p.65), and that identity is

affected by power relations. Drawing on work by Norton (2000, 2010), Ollerhead (2012) describes how learners' goals and efforts to learn a language are bound up with their identity in a construct termed 'investment'. This can explain why motivated learners can appear to become uninterested in lessons that lack cultural relevance or that are perceived as exclusionary in some way: they have a relatively low 'investment' in such learning situations. The role of identity in learning is the focus of research by Simpson and Gresswell (2009), who examine identities rejected, identities challenged and identities claimed by ESOL learners in England.

The concept of 'agency' is a central idea in this perspective, as is the fact that language learners may use different identities with which to communicate in English, which subsequently increases their potential to acquire English language skills. Where teachers foster learner use of agency, they facilitate conditions for English language acquisition (Ollerhead 2012). Students' use of silence in the classroom, use of first language in classroom discussions and non-completion of tasks are identified as some examples of learner agency to express resistance (Ollerhead 2012).

A possible example of learner agency could be evident in Coben et al. (2007), specifically the description of a successful class, where mathematics learning 'was conceived as participating in a network where the teachers and learners construct concepts together' (p.55). Admittedly, Ollerhead focuses on language rather than numeracy learning, but the description by Coben et al. (2007) of a 'non-threatening atmosphere' and 'strong collaborative culture' illustrates the favourable conditions that encourage human agency and language learning. A possible example of agency used for resistance could be the return of blank test forms, described by Condelli, Wrigley and Yoon (2009).

Additional considerations in relation to mathematical literacy include the influence of affect and reported gender-based differences in proficiency. Citing McLeod (1992, 1994), Evans (2000) separates affect into three dimensions: beliefs, attitudes and emotions (p.43). Affective variables that may shape maths performance include perceived usefulness and difficulty of mathematics, degree to which maths is experienced as interesting or enjoyable, and maths anxiety. Evans also lists aspects of confidence, which include locus of control, self-concept and self-efficacy (p.44, citing Weiner 1986). The relationship between emotional self-efficacy (ESE) and mathematical performance is also investigated by Tariq et al. (2013), who found that 'gender plays an important role' in emotional intelligence, emotional self-efficacy and mathematics test performance (p.1158) and that 'interventions focused on improving ESE may improve learning strategies towards mathematics' (p.1157). This gender-based difference is a pertinent topic for Australia. Australian PIAAC numeracy scores show a higher percentage of females in the lower two proficiency levels than males: data for 2011–12 show 59% of females occupying the bottom two levels, compared with 49% of male respondents (ABS 2013). Furthermore, the proportion of females performing at the lower levels has increased, compared with 2006.

Teaching and learning foundation skills – what does the research tell us?

Researchers take different approaches to considering the teaching and learning of literacy, numeracy, technology and employability skills. Their approach is generally guided by the perspective they adopt; for example, whether 'literacy' or 'numeracy' is viewed as a functional skill that can be impartially observed and measured, or whether they are socially situated practices that can best be understood through more direct contact with research participants. In the review that follows, the literature is grouped according to the area of focus, commencing with research into literacy, followed by numeracy, then technology, followed by workplace and vocational contexts. Each focus area includes language learners. Employability skills are generally embedded in the literacy and numeracy programs reviewed, so this section will end with some comments summarising how these skills are represented in the literature.

Teaching and learning literacy

The research synthesised below was selected to present a variety of learner groups, diversity of learning contexts and different perspectives of literacy. The research discussed covers two longitudinal studies (one on learners from ESL backgrounds, the other examining long-term changes in adult literacy and numeracy), along with research focusing on learners with disabilities, the impact of family literacy programs on the wellbeing of participants, and the relationship between literacy and experiences of exclusion.

The research approaches

Condelli, Wrigley and Yoon (2009) seek to identify what instructional strategies work best for several hundred US-based adult learners from ESL backgrounds enrolled in 38 different classes. They use longitudinal research to measure the effectiveness of teaching instruction on learner literacy over a nine-month period. A total of 495 learners are included in the final sample, with an average attendance of 129 hours across a four-month period. Classes are located across seven different states.

The purpose of this research was to identify the characteristics of program design, pedagogical approaches and resources that would enhance learning outcomes for students. Condelli, Wrigley and Yoon (2009) analysed data from a range of standardised and non-standardised assessments, class observations, and interviews to investigate 'what works'; they also established 'study liaisons' to maintain contact with students individually. This contact was used to closely monitor absences from class and facilitate student participation for the duration of the project.

Reder (2009) conducted research in five waves spanning a period from 1998 to 2005. Over 900 participants were involved in the study, with approximately 90% retained through to the final wave. Participants were representative of a local population, rather

than a national target population. One-third represented minority groups and one-tenth were born outside the United States.

The aim of Reder's research was to identify whether, why and how adults' literacy abilities and training participation change over time. He also sought to identify how formal skills training influences further learning and how literacy development impacts on social and economic outcomes. Reder used standardised proficiency tests and in-home participant interviews at each data wave, which also included participant self-reporting of everyday reading, writing and numeracy practices. The latter covered such practices as 'writing a note, reading fiction, reading the news section of the newspaper, doing math for a bank statement' in workplace, home and community settings (Reder 2009, p.73). Data were also analysed to identify relationships between literacy and numeracy proficiency levels and practices and whether characteristics such as ethnicity and gender influence development.

Marston and Johnson-Abdelmalik (2015) use action research to investigate 'how literacy education can act as an instrument of social connection to the community' (p.3). Their research was funded by Anglicare Southern Queensland and focuses on a small community literacy program in Brisbane, identified as having 'successfully helped people make big improvements in their social engagement' (p.4). The Reading and Writing Group (RAW) program is delivered with the support of volunteer tutors; the initial focus of learning sessions is on the development of specific functional literacy skills, followed by a session oriented towards the students' own goals and interests. While the program pedagogy is described as 'consciously functionalist' (Marston & Johnson-Abdelmalik 2015, p.15), it is also viewed as one that recognises the value of a multi-literacy approach.

Marston and Johnson-Abdelmalik (2015) set out to identify the contributing factors to the program's success. They observed lessons over a three-month period and conducted semi-structured interviews with the teacher, teaching support staff and volunteer tutors, as well as current and previous course participants. Seventeen learners were included in the study, although attendance varied greatly between students.

Furness (2013) uses a participatory research approach to investigate the impact of New Zealand-based family literacy programs on the wellbeing of individuals, families and communities. The programs were oriented to the literacy development of either children or adults, or both. Nineteen learners participated in the study and the majority of participants were raising their children; two were supporting the education of their grandchildren. While a social practice perspective of literacy is followed in the research, an alternative model is described that reflects greater Māori sociocultural inclusion. In this definition, 'literacy includes both English and Māori language; oral linguistic traditions, performance and texts; and "reading" other text forms such as tribally significant land features' (Furness 2013, p.35, citing Hohepa & McNaughton 2002, Māori Adult Literacy Educators Working Party 2001).

The participatory approach used by Furness allowed participants themselves to add questions to the research. Furness conducted repeated interviews, 'in which insights could be revisited and meaning clarified' (2013, p.43); transcriptions of recorded interviews were checked with interviewees. Field notes, formal class observations and thematic analyses were also used in the investigation. This active engagement meant the

participants were integral to the interpretation of the program and the formulation of the research findings.

Howard and Logan (2012) used collaborative action research to investigate the exclusion and equality experienced by adult literacy learners in Ireland. Five male learners participated in the study, most of whom had studied together for six months or more. The research was underpinned by critical literacy theory, which views literacy not only as the ability to decode the literal meaning, but also to read between the lines, 'and to engage in a critical discussion of the positions a text supports' (Papen 2005, p.11). Howard and Logan (2012) identify 'equality' as a key tenet of literacy education and a 'central consideration' for their research (p.62). Furthermore, they view literacy education as entwined with notions of human rights and justice.

This research used focus groups and photography to investigate 'the links between exclusion, equality and adult literacy provision' (Howard & Logan 2012, p.59). Students first discussed the key concepts of 'exclusion' and 'literacy' in a focus group, before taking pictures to represent these concepts in their day-to-day life. A second focus group provided the space for students to discuss the photographs taken, and consider whether and how the exclusion might be prevented in future.

The findings

Four of the studies illustrate the importance of using contextualised learning content. In Condelli, Wrigley and Yoon (2009), this is presented as a finding – the first of three instruction strategies found to influence literacy and language development – while in the other three studies this approach is already embedded in the framework provided by the social practices or critical literacy perspectives that inform the teaching. Condelli, Wrigley and Yoon (2009) explain contextualised lesson content as instances 'where teachers brought real-world materials and examples into their instruction' (p.141), such as grocery flyers or electricity bills. By definition, a social practices view positions the *reason* for engaging with written material at the heart of what it means to be literate: 'It is these activities that give meaning to people's reading and writing' (Papen 2005, p.25). This is illustrated by Marston and Johnson-Abdelmalik (2015), when they describe the use of reading material on the topics of body building and role plays relating to train travel, both of which link learning to students' real-life interests or needs. And Furness (2013) cites 'English reading, writing and numeracy strategies, which matched those that their children learned in school' (p.44) to allow the adult learners to actively support their child's learning. So, while the use of standardised tests in the research by Condelli, Wrigley and Yoon (2009) reflects a human capital/skills approach, the finding that learning occurs best when linked to real-world contexts aligns with a social practices perspective, where 'literacy practices are always embedded in a social and cultural context' (Papen 2005, p.26).

Another common theme is literacy's impact on social connections. Marston and Johnson-Abdelmalik (2015) find a 'connection between literacy and the processes of social connectedness' (p.17), while Howard and Logan (2012) refer to 'the "joined up" nature of social exclusion and the associated "knock-on effects"' (p.67). Howard and Logan (2012) identified two main locations where students experienced literacy-related exclusion: in the workplace and when filling in forms and managing everyday correspondence. Workplace exclusion resulted in students struggling to attend or

complete courses, and manage tasks such as 'logging information and registering/responding to complaints' (p.65). An example given of difficulties with form-filling was when a learner who was donating blood encountered a form that was 'worse than anything ... I don't understand half the questions' (p.67). Navigating an appeal process with a financial institution was cited as an example of exclusion: the process required a written appeal, which left the learner 'scared to go near the bank' (p.67).

Marston and Johnson-Abdelmalik (2015) identify the importance of having the literacy program co-located with trained community service workers to streamline support for their clients so that they can 'respond to learning and social needs as they arise' (p.17). They provide a positive example of how new accommodation arrangements for one learner led to greatly enhanced family connections, increased self-respect and the development of leadership behaviours with social peers.

While both longitudinal studies measured participant proficiency at different points in time, the power of Reder's (2009) study lies in the inclusion of both proficiency *and* practice information over successive waves conducted across an extended timeframe; it also lies in the inclusion of data for people who did not participate in skills programs. Reder found that, while literacy and numeracy continue to progress after leaving school, the rate of development varies and that, while some participants show increased proficiency over time, others show decreased proficiency or little change. The study also found that participation in a skills program had 'a strong, immediate connection' with engagement in literacy and numeracy practices (Reder 2009, p.80), but not with actual changes in short-term proficiency levels (as measured via test scores), prompting the suggestion that 'changing levels of engagement in everyday literacy and numeracy practices, may be better indicators of program impact and effectiveness' (Reder 2009, p.80). A subsequent article (Reder 2015) advances this idea by showing that increased earnings 'typically takes several years to develop after participation' (Reder 2015, p.26). The new analysis identified a 53% increase in average earnings for skills program participants, compared with a 2% decrease for non-participants, with the greatest gains made by those who participated for 100 hours. These findings greatly expand our understanding of participants' post-training literacy and numeracy development and highlight the limitations of program measurement based on short-term changes in performance.

Teaching and learning numeracy

This section considers four research articles dealing with:

- measures of learners' numeracy proficiency and why changes may occur
- contextualising numeracy topics for lesson delivery
- capitalising on the diversity of numeracy learners
- the influence of maths performance and gender differences in proficiency scores.

The research approaches

In their extensive investigation into numeracy teaching and learning, Coben et al. (2007) aimed to measure learners' progress and 'establish correlations between this progress and the strategies and practices used by teachers' (p.7). The study included 412 learners

enrolled across a total of 47 classes at different locations in England: further education colleges, workplaces, family numeracy groups, a community group, a prison, the army and a private training provider.

In the Coben et al. (2007) study, learners' numeracy proficiency was assessed at the beginning and towards the end of their course; participants also completed attitude surveys at both time intervals. The researchers also observed teaching sessions and collected background information about the learners and teachers. The study incorporated quantitative and qualitative approaches: quantitative data were used for correlation analysis to identify the relationships between learner progress and the practices used by teachers, while qualitative data were used to identify the reasons for changes in performance indicators. Qualitative methods included in-depth semi-structured interviews with 112 learners and 34 teachers; 243 learners completed both proficiency assessment and attitude surveys.

Byrne and Sellers (2013) investigated the pedagogical approaches used to teach adult numeracy across five locations in Ireland. They aimed to 'capture and document effective approaches in using specific numeracy teaching strategies with adults' (p.5), as well as disseminate examples of practice to other numeracy teachers. Learners were attending the courses as part of apprenticeship and job-activation programs, work-based return-to-education schemes and referrals from the criminal justice system. They used case studies and incorporated in-depth semi-structured interviews in their research. Interview transcripts were analysed and coded following principles of grounded theory methodology, which means that researchers commenced the study with no preconceptions; theory is generated and revised based on observations (Crano, Brewer & Lac 2015).

Baker and Rhodes (2007) researched how practitioners can use learners' 'funds of knowledge' in the numeracy classroom. Funds of knowledge are considered to encompass learners' 'different histories, identities, dispositions, beliefs, personal attributes, expectations, aspirations, experiences, relationships to learning and to mathematics, practices, knowledge and motivations' (Baker & Rhodes 2007, p.3). The researchers aimed to investigate 'valuable, productive and useful ways of thinking about learners' funds of knowledge' (p.4), as well as explore how to access and use this knowledge. The study included data for learners based across three sites in England: one at a further education college, one at a factory-based workplace, and one at a university. The research methods included class observations and focus groups.

The final research included in this section is by Tariq et al. (2013), who explored the relationships between gender, emotional intelligence (EI) and emotional self-efficacy (ESE). The research formed part of a larger study focused on enhancing the employability of undergraduate students; the 175 participants are UK university undergraduates.

Tariq et al. (2013) addressed four research questions including 'what associations exist between test performance and a range of constructs linked to attitudes and beliefs towards mathematics' (p.1146); what are the effects of EI and ESE; and finally 'how does gender influence the associations under investigation' (p.1146). The researchers used a standardised assessment tool to score mathematical proficiency and an online survey to

measure emotional intelligence and emotional self-efficacy, before conducting statistical analyses to identify correlations.

The findings

The first theme that emerges from these studies relates to affect and maths performance. Coben et al. (2007) identify that 'some adults have strong negative feelings and/or anxiety about mathematics', which can be considered 'mathophobia' (citing Winter 1992, p.58). They find that once learners overcome this anxiety, 'courses can have a significant and positive effect on their identities' (Coben et al. 2007, p.8). Byrne and Sellers (2013) also describe how 'most if not all of the learners in the numeracy class have some degree of anxiety about numeracy or maths' (p.21). They also describe various 'fears': fear of maths (p.37), fear of feeling inadequate (p.21), fear of fractions (p.43), even fear of using calculators (p.59). While learners of literacy may also be anxious when undertaking formal study as adults, there is considerably less comment in the literature regarding 'fears'. Tariq et al. (2013) explore this concept more fully in their study into whether emotional intelligence and self-esteem 'help students cope with stress and negative emotions surrounding mathematics in order to improve performance' (p.1146). Encouragingly, their findings suggest that 'enhancing an individual's emotional capabilities may encourage improvements in learning strategies' for maths and maths-related subjects (p.1158).

The second theme addresses how to effectively manage teaching and learning with diverse groups. Baker and Rhodes (2007) describe how 'funds of knowledge' can increase teaching effectiveness, where funds of knowledge are defined as learners' skills, backgrounds, dispositions, relationships to learning and to mathematics, expectations and motivations, and more. This definition extends beyond earlier views, which were limited only to skills and needs (Baker & Rhodes 2007). The 'expanded' view of funds of knowledge is evident in most case studies described by Byrne and Sellers (2013). In one, the tutor noticed that more learners were asking for sewing classes, so he introduced classes in metric measurement, conversion tables and angles into the course maths. The same tutor also 'uses discussion to identify where someone's fears lie' and then identifies 'all the numbers that they use in their everyday lives' (p.12); for example, discussing with one learner how he used ratios when he gambled. Another tutor in Byrne and Sellers's (2013) study prepared lesson plans that 'are flexible enough to be able to accommodate learners' needs that arise during the session' (p.20), while a third tutor 'aims to identify a common interest among group members and build projects around that interest' (p.36); for example, designing a room layout. Byrne and Sellers (2013) also provide a list of recommended teaching strategies in the appendix, which can be read in conjunction with the case studies from which they were drawn. The teaching strategies include topics such as decimals and fractions, ratio, algebra, understanding shapes and handling data.

A third finding, by Coben et al. (2007), was that 'numeracy courses can have a significant and positive effect' on learner identities, confidence and self-esteem, and that courses can 'enable learners to develop new aspirations and form new dispositions towards learning' (p.8). This is corroborated by findings in Reder (2009) and Wolf and Evans (2011).

The final discussion in this section relates to gender-based differences in reported mathematical proficiency. This is evident in Australian PIAAC scores: data for 2011–12 show that 59% of females occupy the bottom two proficiency levels, compared with 49% of male respondents (ABS 2013). Additionally, the proportion of females performing at the lower levels has increased compared with 2006 (ABS 2013). Wedege (2007) provides four perspectives from which gender can be analysed in maths education: structural, symbolic, personal and interactional. The perspectives can be applied to the same situations to provide alternative ways of viewing 'gender'. Structural gender refers to social structures such as education, earnings and job occupations, while symbolic gender refers to discourses and the ways by which gender is perceived as normal for society; for example, it becomes 'normal and natural that men take the leading positions in society while women have part-time jobs to take care of home and family' (Wedege 2007, p.253). Lower mathematical performance can affect occupational prospects for women by virtue of being a 'critical filter' and because it is 'an underpinning discipline for studying nearly all areas of science, engineering and technology' (Mendick, Moreau & Hollingworth 2008, p.3). Tariq et al. (2013) found that emotional intelligence and self-esteem 'play a more significant role in female undergraduates compared with males' (p.1157) and that for women, 'development of actual emotional competencies and confidence in using them may improve mathematical performance' (p.1157).

Teaching and learning technology

Digital technology is widely recognised by governments and educators as integral to modern-day learning and is one of the 'key theoretical underpinnings' in the Australian Core Skills Framework (Department of Industry 2012, p.4) and is embedded in the ACSF's five core skills areas. Digital technology provides opportunities to innovate pedagogical approaches; moreover, it is changing 'not only the context of learning, but the learning itself' (Merriam & Bierema 2014, p.5). The following articles highlight how technology can be harnessed in literacy and numeracy learning environments; they also point out areas of tension.

The research approach

Byrne and Sellers (2013) investigated the technology-based pedagogical approaches used to teach adult numeracy across five locations in Ireland. Their case studies incorporated in-depth semi-structured interviews; they also provide detail about software applications for specific numeracy topics. This research is also discussed in the section, 'Teaching and learning numeracy' above. This section focuses on the technology aspect of their study.

Mellar et al. (2007) developed and evaluated the effectiveness of technology-based teaching strategies to support literacy, numeracy and ESOL learning. They also examined the motivational impact of classroom technology for learners, the impact of technology on the broader learning context, and support requirements for tutors. The researchers took an interventionist approach and used practitioner-researchers in the development and evaluation stages of the study. The development stage extended across one year and involved the iterative formulation of technology-based teaching approaches. The evaluation stage spanned two teaching terms, during which the practitioner-researchers applied the new pedagogy. Classroom observations, reflective diaries and learner testing

were all used in the research. Eighty learners completed both pre- and post-intervention tests and 150 students took part in the evaluation phase.

Simpson and Gresswell (2012) investigated how young adult refugees in England could use digital literacy practices to 'challenge the identity positions offered to them by the discourses and policies that affect their lives and learning' (p.193). The researchers propose that learner 'identity options' can be increased when students are able to use technology practices that mirror those used in their lives outside the classroom, such as web logs, video creation and sharing, phone text messaging and other social media tools. The research discusses the positioning of students by government policies as that of: a learner of skills, a potential employee, or an immigrant and potential 'citizen' (Simpson & Gresswell 2012, p.196). Two analytical vignettes show how new technology can be used in the classroom to facilitate students' identity negotiation.

Kral (2016) investigated language socialisation in the Indigenous Australian context. Following an ethnographic perspective, Kral examined contemporary communication and sociocultural practices in two remote Indigenous communities. The researcher shows how sign language and gesture are incorporated with speech and drawing in the storytelling that forms part of children's early socialisation experiences. She also discusses the impact of digital technologies on forms and modes of communication and describes how youth are emerging as agents of this change.

The findings

The overarching theme in this section is change: how technological changes in the environment drive the need for curriculum changes and how the practices of learners themselves act as forces for change.

Byrne and Sellers (2013) and Mellar et al. (2007) provide informative summaries of technology-inclusive pedagogies. Mellar et al. state that 'there is no single best way of using technology in teaching' (2007, p.21). This is borne out by the findings in Byrne and Sellers (2013), where a range of technologies are effectively used by the practitioners. The main difference between these studies is that Byrne and Sellers observe practice in situ, whereas Mellar et al. investigate practitioner-developed approaches that were subsequently introduced into classrooms.

Mellar et al. (2007) evaluate the use of WebQuests¹, ePortfolios, tablets and other mobile devices, digital video and electronic mind maps. Some of these are what Lankshear and Knobel (2006) describe as 'old wine in new bottles', where technology is infused into the existing 'long-standing school literacy routines' that reflect the centralised authority of the teacher (p.55). Nevertheless, improvements in technological proficiency, as measured by pre- and post-intervention tests, were found for all strategies. Lankshear and Knobel (2006) state that new practices associated with new technologies 'are being invented on the streets' (p.57), and they recognise that incorporating real-world practices into teaching is an area of tension for educational institutions. In the adult learning context, curriculum requirements imposed by national

1 A WebQuest is an inquiry-oriented lesson format, in which most or all of the information that learners work with comes from the web.

programs introduce rigidities. In relation to ESOL learners, Simpson and Gresswell (2012) note that 'institutional practices (and, most significantly, assessment) must start to develop a greater awareness of the role that media such as video, images and blogs can play in the education of young adult learners' (p.205).

Case studies by Byrne and Sellers (2013) reveal a range of strategies, including the use of technology, to support numeracy learning; some of these mirror those used by Mellar et al. (2007). Byrne and Sellers (2013) found teachers used technology to suit the learner. For example, one tutor recognised that some students were motivated by using technology; as such, she 'facilitates this wherever possible, to introduce or consolidate concepts' (p.22). Another tutor described an occasion when he introduced a specific website to a learner who was working on the concepts of speed, distance and time. This tutor attributes his use of technology in teaching to his recognition that it makes him 'more open to try a range of new teaching ideas and strategies, whether they use technology or not' (p.13). A wealth of valuable detail on how specific technologies can be successfully deployed in the numeracy classroom is contained in this research.

Both Simpson and Gresswell (2012) and Kral (2016) frame their work in relation to how learners use technology in their everyday life. Simpson and Gresswell (2012) found that, by using modern technology, learners were able to expand their language development and 'claim a broader range of identity positions' (p.205). Kral (2016) found that 'oral, written, gestural, visual and now computer-mediated' communication forms are interdependent and that these 'can never be extracted from the social, cultural and historical context from which they emerge' (p.73). Like Kral (2016), Simpson and Gresswell (2012) criticise the overly narrow employment focus of national skills training programs because they fail to acknowledge the reality of multimodal, multi-contextual literacy in contemporary practice.

Simpson and Gresswell (2012) describe how a map activity appeared to leave a learner and her partner demotivated. The researchers contrast this with the learner's successful use of Flickr to upload digital images, which encouraged her to talk extensively about the places on the map she had visited, the friends she had seen, and a special church service she had attended. The technology helped the learner link her own experience with the lesson about city names. The researchers contrast the 'identity options' available to the learner in each of these situations: the traditional map-reading task provided limited positive identity options, while the technology-based task helped her to communicate her knowledge, talk about her social activities and express her religious identity.

While Kral (2016) also orients her work to learners' real-world technology use, her focus is on the critical role of non-formal learning environments. Merriam and Bierema (2014) distinguish non-formal from formal learning 'by the activities typically being short-term, voluntary, and often occurring in public places' (p.17). Kral (2016) describes non-formal learning environments where youth can participate in technology-mediated activities, ranging from simple events such as watching YouTube and downloading music, to more complex film and music making. Following an account of historical literacy and communicative practices in remote Indigenous Australian contexts, she describes how Indigenous youth draw on 'traditional communication styles integrated with new embedded literacy traditions' (p.71). Facebook is an example of a popular modern-day communication tool. Kral emphasises the need for non-formal learning settings, which

she views as essential for effective community participation of Indigenous youth and for their long-term success.

While Kral's focus is on remote Indigenous contexts, non-formal literacy support environments also play a critical role in urban settings. In a study focused on 'Neighbourhood Houses' in Victoria, Thompson (2015) describes the support provided by 'literacy mediators', who work 'to bridge divides for marginalised people' (p.492). This study reports an increasing work volume, as 'bureaucratic texts and processes become digitised and only accessible online' (p.479). Kalman (2008) identifies literacy mediators as being especially important 'social actors for literacy learning and use' in community settings, as they help people to manage the reading and writing requirements of everyday life (p.530). This requires knowledge of the discourses that need to be navigated across a range of contexts. The Neighbourhood Houses provide informal literacy support for all community members, but particularly encourage participation from the 'socially isolated and disadvantaged members of their community' (p.479), many of whom have poor digital literacy skills. Literacy support examples relate to 'texts that have the potential to significantly impact' on people's lives and livelihoods, such as documents – often web-based – relating to housing, immigration and social support payments. Additional examples included a participant who needed help to resolve issues with electricity bill payments and another who needed assistance managing the literacy requirements of his lawn-mowing job. These illustrate the 'joined up' nature of literacy with other life domains, as described by both Howard and Logan (2012) and Marston and Johnson-Abdelmalik (2015).

Teaching and learning – workplace and vocational contexts

The research that follows was selected to encompass both literacy and numeracy in pre-employment vocational training as well as workplace contexts.

The research approach

Wolf and Evans (2011) conducted a large-scale longitudinal study into workplace literacy. Over 200 learners, representing 53 different workplaces in England and Scotland, participated in the research to the final stage. Data were collected from participants at different stages, spanning two-and-a-half years: reading and writing skills were tested upon commencement of a workplace course, one year after course completion and a final test was conducted 18 months after the first follow-up. Most courses were voluntary for learners, although in three organisations participation was compulsory. In order to avoid possible stigma and to increase the practical relevance, some courses were presented as technology rather than literacy-oriented.

Wolf and Evans (2011, p.1) had three research objectives:

- to identify whether workplace training produces 'long-term changes in measured basic skills and other life course variables'
- to identify whether these programs increase 'potential productivity of sponsoring enterprises'
- 'to develop an interdisciplinary understanding of the interrelationships between formal learning, workplace experience, and life-course trajectories'.

The latter included work and non-work activities relating to family, leisure and learning. The research used mixed methods, including standardised tests and in-depth interviews. It incorporated both human capital and social practices perspectives, which enabled exploration of 'literacy "gains" in their human capital sense, and how literacy is actually employed in differing contexts' (Wolf & Evans 2011, p.19).

Williams and Wake (2007) analyse mathematical workplace practices. They specifically examine how mathematics is 'shaped and black-boxed' by the workplace (p.318). 'Black boxes' is the term used to describe mathematics being hidden either by technological tools and processes or workplace activity systems. They also examine what workplace processes cause mathematics to appear different from the way it was taught in college, which subsequently result in 'gaps' between knowledge required and knowledge taught.

Williams and Wake (2007) use multiple case study visits to workplaces involving teacher-researchers and students. Guided by a social practices perspective, they describe mathematics as it is situated within workplaces, including an industrial chemist laboratory, a small metal workshop and a chemical plant. The researchers use Cultural-Historical Activity Theory (CHAT) as an analytical tool with which to examine workplace mathematical processes; this includes analysis of workplace rules, division of labour, tools and methods (Williams & Wake 2007).

The Australian Industry (Ai) Group argues there is a need for a national foundation skills strategy to 'seriously tackle workplace LLN' (Australian Industry Group 2016). Their 2016 report presents recommendations for consideration by government and employers. It includes data from a range of sources on occupation trends and internet penetration, as well as national literacy and numeracy proficiency scores. It also includes case studies of employers who have seen returns from investment in language, literacy and numeracy training.

Hoyles et al. (2010) investigate the techno-mathematical literacies in UK-based organisations spanning automotive manufacturing, pharmaceutical manufacturing, financial services, and manufacturers and intensive users of packaging systems. The study included three to four companies from each of these industries. Techno-mathematical literacy is the ability to 'understand and use mathematics as a language' where work intersects with technological tools, and where the language used is not explicitly mathematical (p.14); this is seen to characterise an increasing number of workplaces.

Hoyles et al. (2010) conducted their research in two phases. The initial ethnographic phase was intended to uncover 'how different companies deployed IT-based systems, and the forms of (mathematical) knowledge required by employees to operate these effectively' (Hoyles et al. 2010, p.19). The second phase aimed to produce, in collaboration with the companies involved in the study, 'prototype computationally enhanced learning materials', materials that would help to develop employee techno-mathematical literacies and close skills gaps (Hoyles et al. 2010, p.19). These learning tools are called 'technologically-enhanced boundary objects' and typically use a graph or other symbolic information to demystify the maths embedded in the process. The research methods included site visits, semi-structured interviews with a wide range of staff, work shadowing, document analyses and observation of training courses.

The findings

The themes from the workplace literature relate to the impact of technology, perceptions around 'skills gaps', black-boxed work practices, and misalignment of formal mathematics coursework and actual workplace practice. Discussion of these will be followed by thematic connections between Wolf and Evans (2011) and the other literature included more broadly in this foundation skills literature review.

The first common theme identified relates to technology and its impact on the workplace. The Australian Industry Group (2016) claims that 'the presence of ICT in the workplace and the related changes in the delivery of many services make the mastery of literacy and numeracy skills even more important for full participation in modern life' (p.9). Williams and Wake (2007) note 'the centrality of technology' (p.339) and point to the critical need for pre-vocational maths to include technology in a way that prepares students for the workplace. Hoyles et al. (2010) find that the contemporary, 'technology-mediated' workplace requires 'fluency in using and interpreting outputs from IT systems' rather than 'explicit pen-and-paper calculations' (p.7) and that 'the major skills problem for workplaces is the understanding of systems, not an ability to calculate or manipulate' (p.183).

This leads to the next theme: 'skills gaps'. There is a divergence of perspectives on the nature and magnitude of the skills gaps indicated by surveys such as PIAAC. Interestingly, while The Australian Industry Group (2016) makes reference to Australian PIAAC data, saying it 'is clear that a major literacy and numeracy problem persists in the general population and the workforce' (p.11), both Hoyles et al. (2010) and Wolf and Evans (2011) question discourses about large-scale workplace skills deficiencies. Wolf and Evans show how 'skills gaps' result from workplace changes. In one case study, training was provided in a 'bid to encourage employees to take on more responsibility within their existing job roles as part of an overall trend towards the "levelling out" of management structures' (p.140). They also note a synergetic 'interplay between formal and informal learning' (Wolf & Evans 2011, p.148). They found that employees frequently use informal learning to meet workplace skill or competency needs, and also that informal learning occurs through observing others, searching independently for information, practising without supervision, and focused workplace discussions (citing Taylor & Evans 2009).

Jacobson (2016) speculates that the 'skills gap' is 'mostly a rhetorical device' (p.6) used to deflect attention from the structural weaknesses in capitalist economies that can contribute to market-level employment instability. Citing Kunkel (2014), Jacobson lists the 'overproduction of commodities', 'over-accumulation of capital', and 'vulnerability of the system to speculation' as 'consistent elements of economic crisis within capitalist economies' (2016, p.7).

However, there is agreement that overall benefit can be gained from workplace training. Hoyles et al. (2010) and the Australian Industry Group (2016) agree on the critical role of the employer in the upskilling of staff, with the latter noting 'a need to significantly expand the focus and associated initiatives of workforce foundation skills' (p.20), while Hoyles et al. (2010) state that the 'skills gap needs to be systemically addressed by employers, working together with educators' (p.168). Wolf and Evans (2011) argue for training demand 'driven by individual learners, not by government preconceptions about

skill gaps and skill needs' (p.163) and emphasise the need to be realistic about the benefits of workplace training. They see it as 'a form of provision which may have multiple benefits, over a long period of time, rather than an immediate productivity-enhancing intervention' (Wolf & Evans 2011, p.165).

The notion of 'black boxes' is the next theme identified. Williams and Wake (2007) identify two different types of black box processes: one relates to divisions of labour, while the other represents mathematical processes as being 'crystallised within instruments' (p.333). They cite an example of an industrial chemical plant where work processes obfuscate the maths for all but the engineer, who is the designated 'keeper of the spreadsheets' (Williams & Wake 2007, p.334). Black boxes are also exemplified in Hoyles et al. (2010): the purpose of their technologically enhanced boundary objects is to expose the mathematical detail contained within the workplace tools and processes. The researchers identify techno-mathematical literacy as 'most evident in workplaces that are involved in changes in working practices'. They say it is rarely explicitly recognised until it is pointed out, at which point 'it often resonated with managers and trainers' (Hoyles et al. 2010, p.183).

The next theme relates to the mismatch between formal mathematics coursework and actual workplace practice. Williams and Wake (2007) and Hoyles et al. (2010) both acknowledge the mismatch. Yasukawa and Brown (2012) describe four purposes for workplace-related mathematics: enabling, technical, functional and critical mathematics. 'Enabling' mathematics relates to the learning of mandatory specialist skills for job-related qualifications and credentials, while 'technical' mathematics relates to actual job-based mathematical practices. Following this model, the mismatches identified by Williams and Wake (2007) and Hoyles et al. (2010) relate to enabling versus technical mathematics. Referring to previous workplace studies, Hoyles et al. (2010) provide an example of drug dose calculations by nurses, whereby the mathematical approaches taught in courses were superseded by workplace practices influenced by drug type and drug packaging. Williams and Wake (2007) suggest that vocational training should ensure that 'students meet a diversity of mathematical conventions and methods, have experience of developing mathematical thinking in contexts that reflect realistic, complex workplace situations' (p.339), and that training should inculcate 'flexible attitudes' about what mathematics can look like. However, the ongoing nature of technology-driven workplace changes can make the task of *emulating* real-world workplace numeracy increasingly difficult. Regardless of whether a gap in mathematical knowledge or a skill gap is caused by the difference between enabling and technical maths or a lack of techno-mathematical literacy, the workplace training described by the Australian Industry Group (2016) could be effectively applied to address the need.

The final observations in this section relate to motivation and the influence of formal literacy programs on other life domains. Wolf and Evans (2011) found that 'peers can play an important role in helping those who are unconfident, negative, worried or have low self-esteem' (p.67) and that collaborative learning can be a substantial factor in assisting adults to 'recontextualise' what they have learnt. Their research also found that 'the make-up of the group can be critical to some learners' (p.67). These findings illustrate the importance of creating inclusive and supportive learning spaces, as described by Wlodkowski (1999). This is also evident in Hoyles et al. (2010), where a

senior executive from a participating company in the study stated that the techno-mathematical literacy development program had positively affected job satisfaction and staff empowerment – ‘giving voice and autonomy to the expertise of employees’ (p.186).

Wolf and Evans (2011) also found in the final questionnaire that three-quarters of participants ‘felt differently about education after their course, in uniformly positive ways’ (p.88) and that reading habits had also changed substantially several years after course completion, with at least one-quarter reading books, magazines or newspapers more than they did prior to the workplace training. This finding mirrors that of Reder (2009), discussed above in the ‘Teaching and learning literacy’ section.

Teaching and learning employability skills

The Core Skills for Work (CSfW) framework provides the current Australian education and training policy framework for employability skills (Department of Industry, Innovation, Climate Change, Science, Research and Tertiary Education & Department of Education, Employment and Workplace Relations 2013). The core skills are considered as the generic, non-technical skills that foster work performance and ‘underpin successful participation in work’ (p.1) and are constituted across ten skill areas, each of which can be assessed against one of five performance stages, ranging from ‘novice’ to ‘expert’. The skills are grouped into three clusters: navigate the world of work; interact with others; get the work done. These are different from job-seeking skills, which are focused on writing resumes and job applications and developing interview skills. This framework of employability skills aligns with a human capital perspective, where personal skills and knowledge contribute to national productivity.

An initiative to develop a framework for employability skills emerged from discussions between employer groups and government, with a view to creating a more demand-driven skills system (Department of Education, Science and Training 2006). Employability skills are believed to help people to gain employment, sustain employment and progress within their work (Belt, Drake & Chapman 2010, p.4). Employability skills are embedded in nationally accredited industry training packages, including the Foundation Skills (FSK) Training Package (Commonwealth of Australia 2014) and in statements of graduate attributes in higher education (de la Harpe & David 2012; Oliver 2013) to assist students’ transition from study to work, although, needless to say, attainment of these skills alone is no guarantee of post-course employment. Moreover, the framing of employability skills, as defined by frameworks such as the Core Skills for Work, is not uncontested: they are critiqued by some as a mechanism by the government to shift responsibility for the labour market conditions that drive unemployment (Jacobson 2016; Haasler 2013; Simmons 2009). Examples of how they are being researched and taught are outlined below.

Newton and Kusmierczyk (2011) survey research into workplace language and identify employability skills as one of four aspects of workplace language programs. Citing Yates (2010), they state the importance of occupation- or industry-specific language content in training programs. The Settlement Language Pathways to Employment and Training (SLPET) program is currently provided in Australia as part of the Adult Migrant English Program (AMEP) and provides up to 200 hours of occupation-specific language tuition in high-demand fields such as hospitality, aged care, warehouse operations and childcare

(Department of Education and Training 2015). The Settlement Language Pathways to Employment and Training program also includes work experience placement. Work placement is one of three critical success factors for employability skills, according to Belt, Drake and Chapman (2010). Their synthesis of research on behalf of the UK Commission for Employment and Skills also identifies 'experimental action learning' and 'reflection and integration' as critical aspects, explaining that learners have to understand the value of employability skills and be able to use them in different settings.

Moir and Crowther (2014), Haasler (2013), Simmons (2009) and Jacobsen (2016) critique underpinning policy assumptions relating to employability skills. Writing from a UK perspective, Moir and Crowther (2014), Haasler (2013) and Simmons (2009) view training and the assessment of employability skills as an attempt by the government to make individuals responsible for their employment status, irrespective of the structural issues within the overall economy. Examples of structural issues include the contraction of traditional employment sectors of low to intermediate skilled workers, such as manufacturing (Moir & Crowther 2014; Simmons 2009), and the questionable notion of a 'free and neutral' market, which works 'in the best interests of consumers' (Moir & Crowther 2014, p.50). Haasler (2013) states that 'structural inequalities may persist within the labour market despite individuals possessing highly developed employability skills' (p.240), and describes studies that report the unemployment of UK graduates, regardless of their willingness to work and possession of employability skills. Jacobson (2016) critiques the rhetoric of workforce development, which is influencing both employment training programs and adult basic education. Writing from a US perspective, Jacobson identifies 'fundamental aspects of capitalism as the source of instability' (p.3). He suggests that the ability of training programs to relocate people out of poverty is restricted and that adult education classes should focus on understanding the current situation and lobbying for changes in the economic model.

In terms of how these skills are being taught, some programs described in the literature include employability skills or workforce development as a program goal, but the majority do not explicitly describe employability skills. Gallo (2004) delivered workplace training that improved employee relations and communication skills, as well as increased staff ability to solve problems and work effectively with rights and protocols. She used workplace projects to help staff to identify ways to improve outcomes for their employer in areas such as reducing scrap, increasing productivity or improving safety. In one factory-based example, employees developed the language skills that led to their submitting a collaboratively written memo to management requesting improvements to workplace facilities. In this instance, empowering the learners led to gains for both the employer and their staff. Other examples from the literature mentioned in preceding sections include Byrne and Sellers (2013), Coben et al. (2007), Simpson and Gresswell (2012) and Wolf and Evans (2011). Byrne and Sellers (2013) report on a case study in which the 'majority are working towards accreditation in Employability Skills' (p.35), while Coben et al. (2007) claim 'basic skills and workforce development' as one of the purposes in programs included in their study (p.13). Simpson and Gresswell (2012) provide examples that represent 'interacting with others' and 'getting the work done'; they describe student participation on a class blog, and also the production of a class video, which was developed 'in collaboration with their teacher and others in their local community' (p.203). Wolf and Evans (2011) provide many workplace examples of

'interacting with others', in particular when they describe peer support in groups and learners discussing answers. These examples of learners working collaboratively illustrate the 'establishing inclusion' component of Wlodkowski's (1999) Motivational Framework for Culturally Responsive Teaching, where 'students and teachers feel respected and connected to one another' (p.11).

Conclusion and areas for further investigation

The literature reviewed illustrates diverse groups of learners studying in a multitude of contexts, where ongoing technological change is exerting continual pressure on curricula, pedagogies and workplace performance. At the same time, there is an increasing focus on short-term performance gains, as measured by assessment tools such as the Australian Core Skills Framework, and calls for government-funded training to address workplace 'skills gaps', as reported by international assessments such as the Programme for the International Assessment of Adult Competencies.

Technology represents an area of monumental challenge. It is driving workplace change, which in turn creates new areas of knowledge and skill that need to be mastered by existing and potential employees. Research to identify black-boxed work processes in Australian workplaces could inform targeted workplace training. Technological change has also led to new ways of 'doing' literacy in home, classroom and community contexts. How can practitioners keep up with this change? Lankshear and Knobel (2006) argue for teachers, curriculum developers and others involved in education to actively consider their 'personal experience of the phenomena being reported in the research' (p.247) to enable them to form their own interpretations of contemporary literacy practices.

Longitudinal research by Reder (2009, 2015) illustrates the flaws in using short-term changes in proficiency scores as a measure of program impact: post-training changes can take years to manifest in learners' lives. Wolf and Evans (2011) also view workplace training gains as long-term rather than short-term. Reder (2015) suggests that an Australian longitudinal study examining learning trajectories and the social and economic impact of training could help to inform future program evaluation.

Further research into the impact of non-formal learning environments could be valuable. Kral (2016) and Thompson (2015) provide examples of who is using these learning spaces and why. Literacy mediators perform the vital role of helping people to build the literacy practices required to navigate everyday life (Kalman 2008). Uncovering how literacy mediation and skill development from these locations affects other domains of people's lives, such as work, health, family, and community participation, would expand our understanding of the 'joined up' nature of literacy. Focusing on non-formal environments would also allow the collection of data for populations who may otherwise be omitted, due to their non-participation in formal training.

Gender-based differences in mathematical performance reflect a structural gender concern in Australia; a more granular understanding of the relationship between gender and reported maths proficiency is critically important. Research that builds on that by Tariq et al. (2012), by exploring the role of affect on performance, will be important to follow. The gender-based disparity in PIAAC scores also warrants examination to determine whether this standardised assessment tool contains elements of gender bias.

At the end of this extensive literature review, it is interesting to ponder which research approach tells us most about the teaching and learning of foundation skills for adults. The answer depends on what information is being sought. To know which teaching and learning approaches make an impact on learners' lived experiences, it appears that

research that includes learner perspectives is likely to reveal how and why particular approaches are helpful or unhelpful; it also has the capacity to expose what learners could do in their lives after training that they could not, or would not, do before. To identify which interventions yield improvements across large populations, it appears that quantitative research methodologies are likely to reveal correlations, but correlation does not mean causation. We may be measuring something, but what do the numbers actually represent? Mixed-methods research, such as that by Wolf and Evans (2009), provides a rich blend of quantitative data to show us what changes occur, as well as qualitative data, which tell us why something changes. St Clair describes literacy as 'an irreducibly complicated, tangled, multi-faceted set of activities' (2010, p.37), which probably explains why it is such an interesting field to teach and research.

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National Centre for Vocational Education Research

Level 11, 33 King William Street, Adelaide, SA 5000
PO Box 8288 Station Arcade, Adelaide SA 5000, Australia

Phone +61 8 8230 8400 **Fax** +61 8 8212 3436

Email ncver@ncver.edu.au **Web** <https://www.ncver.edu.au> <http://www.isay.edu.au>

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