

Differing skill requirements across countries and over time

Chris Ryan

Mathias Sinning

AUSTRALIAN NATIONAL UNIVERSITY



Australian Government

Department of Education, Employment
and Workplace Relations

NATIONAL VOCATIONAL EDUCATION
AND TRAINING RESEARCH AND
EVALUATION PROGRAM
RESEARCH REPORT

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The views and opinions expressed in this document are those of the author/
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Publisher's note

Additional information relating to this research is available in *Differing skill requirements across countries and over time: support document*. It can be accessed from NCVER's website <<http://www.ncver.edu.au/publications/2428.html>>.

To find other material of interest, search VOCED (the UNESCO/NCVER international database <<http://www.voced.edu.au>>) using the following keywords: job requirements; literacy; numeracy; skill needs; Australia; New Zealand; United States; Canada.

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This document should be attributed as Ryan, C & Sinning, M 2011, *Differing skill requirements across countries and over time*, NCVER.

This work has been produced by NCVER under the National Vocational Education and Training Research and Evaluation (NVETRE) Program, which is coordinated and managed by NCVER on behalf of the Australian Government and state and territory governments. Funding is provided through the Department of Education, Employment and Workplace Relations.

The NVETRE program is based upon priorities approved by ministers with responsibility for vocational education and training (VET). This research aims to improve policy and practice in the VET sector. For further information about the program, go to the NCVER website <<http://www.ncver.edu.au>>. The author/project team was funded to undertake this research via a grant under the NVETRE program. These grants are awarded to organisations through a competitive process, in which NCVER does not participate.

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ISBN 978 1 921955 51 8 web edition
978 1 921955 52 5 print edition

TD/TNC 104.42

Published by NCVER, ABN 87 007 967 311

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

P +61 8 8230 8400 F +61 8 8212 3436 E ncver@ncver.edu.au W <http://www.ncver.edu.au>

About the research

Differing skill requirements across countries and over time

Chris Ryan and Mathias Sinning, Australian National University

This report comes from a three-year program of research, *Securing their future: older workers and the role of VET*. Previous work from the program looked at how well workers were matched to their jobs, based on their literacy and numeracy skills and the use of these skills in the workplace. In a continuation of that work, the research reported here investigates the relationship between skills and skills use at work in four Organisation for Economic Co-operation and Development (OECD) countries: Australia, New Zealand, the United States and Canada.

This research takes advantage of two international surveys coordinated by Statistics Canada and the OECD: the International Adult Literacy Survey (IALS) and the Adult Literacy and Life Skills (ALLS) survey. These two surveys, conducted ten years apart, contain unique information about the literacy skills of workers and the frequency with which they undertake a range of literacy- and numeracy-related tasks. These data allow the authors to investigate skill matches to job requirements for workers in the four countries noted above.

Key findings

- While it might be expected that factors such as economic growth, technological innovation and structural change in the labour markets of these different countries have led to differences in the use of skills over time, the broad match of workers to jobs that use their skills was quite similar across the four countries.
- The relationship between individual skills and skill requirements at work was positive for all four countries. High-skilled workers indicated that they use their skills more often at work than less-skilled workers.
- Despite the fact that these countries have probably experienced similar developments and adoption of new technology, they do not exhibit the same patterns of change in skill use over time.
 - The use of literacy skills at work increased more in Australia than in the other countries, although the starting levels were substantially lower in Australia to begin with. While the authors do not speculate on the reason for this, it is possibly due to structural changes in the economy and the labour market specific to Australia over that time period.
 - The use of numeracy skills also increased substantially in Australia, while it decreased in the other countries over the same time period. The authors speculate that this might be due to the introduction of the goods and services tax in Australia and the associated additional record-keeping requirements for businesses.

Earlier reports coming from this three-year program of research are available from the NCVET website.

Tom Karmel
Managing Director, NCVET

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Executive summary

Do workers in different countries use their skills differently? How has the way skills are used in jobs changed over time in different countries? A variety of social and economic histories of countries has produced institutions that govern key aspects of the operation of their labour markets. These include minimum wage arrangements; the degree of centralisation in wage determination arrangements; the role of trade unions and the structures that guide how productivity improvements are negotiated in workplaces; the existence of formal vocational training structures, such as the operation of apprenticeship systems; and the way that observed or practised skills can be rewarded through increased wages. Differences in the effectiveness of the institutions that help workers to develop their skills and the extent to which these skills are utilised across countries may contribute to differences in worker productivity and, hence, national incomes.

This study aims to inform consideration of these issues by looking at evidence on the relationship between the skills of workers and the tasks they undertake in their jobs across countries and over time. We are interested in the relationship between skills and skill use at work, because we expect differences in the way workers from Australia, New Zealand, the United States and Canada are matched to their jobs.

We utilise two cross-sections surveyed about ten years apart as part of international studies coordinated by Statistics Canada and the Organisation for Economic Co-operation and Development (OECD). The data contain comparable measures of worker skills – notably their literacy skills – as well as information on the frequency with which they undertake a range of literacy- and numeracy-related tasks. These measures are typically not available for analysis in most studies, where educational attainment is used as a proxy for skills. Moreover, the data allow us to employ information on the use of skills at work to construct measures of job requirements; that is, job requirements are measured by self-reports of individuals about their literacy use and numeracy use at work.

By comparing individual skills and skill use measures, we provide a comprehensive descriptive analysis of skill matches to job requirements for workers in these OECD countries. As a starting point, we examine the relationship between individual skills and skill requirements at work by estimating a ‘matching’ function that relates the skill characteristics of workers to jobs involving specific tasks.

Despite the potential for the skill levels of workers and the way they use their skills in their jobs to differ substantially across countries, we find the broad match of workers with skills to jobs that use them to be quite similar across the four predominantly English-speaking countries studied here.

While these countries have probably been subject to the same broad developments in the adoption of new technologies, they do not exhibit the same patterns of change over time. The use of literacy skills at work increased more in Australia than other countries between the two surveys studied here, although the starting levels were substantially lower in Australia and the change amounted to Australia catching up to the other countries. The experience with numeracy skills was a little different. The use of numeracy skills increased substantially between the surveys in Australia, but fell even more substantially in the other countries. An analysis of the types of tasks captured in the numeracy skills suggested that these were tasks associated with the processes of running the business, involving account-keeping and invoicing procedures, for example. It is possible that the introduction of a consumption tax in Australia from 2000, with additional record-keeping requirements for businesses, induced this departure from the experience of the other countries.

Other empirical findings include:

Literacy use:

- Literacy skill levels changed in the same direction as literacy requirements in all countries.
- Higher levels of education are associated with higher skill requirements at work, even though the way in which educational attainment translates into literacy use is slightly different across countries.
- Workers in occupations that typically require high skills and a high level of education are those with high levels of average literacy use at work, indicating that our measure of literacy use picks up variations in skill requirements across occupations quite well.
- Full-time jobs provide a greater opportunity to apply literacy skills at work than part-time jobs.
- Employment in larger establishments is positively associated with increased literacy use, suggesting that large companies tend to require workers to undertake more complex tasks in their jobs.
- Older workers report considerably higher levels of literacy use at work than the youngest age group; the decline in literacy use for the older aged is rather moderate.

Numeracy use:

- While workers with relatively high numeracy skills use numeracy more often in their jobs than workers with relatively low numeracy skills, the positive relationship between numeracy skills and their use is less pronounced than the relationship between literacy skills and their use in all countries.
- Further, while the average level of numeracy use increases with education for both male and female workers, the relationship between the two variables seems to be non-linear, as demonstrated by a slight decline for the highest educational levels.
- While managers and administrators make more use of their skills than low-skilled workers, other groups of high-skilled workers do not.
- Full-time employment is positively associated with increased skill requirements at work, while employer size has a significantly negative effect on numeracy use in all countries.
- Finally, the numeracy use levels of younger workers increase as they get older, while the numeracy use levels of older workers typically decline after the age of 45 years.

Introduction

How do workers' skills differ across countries? Do workers use these skills differently in their jobs in differing countries? How has the way skills are used in jobs changed over time in different countries? The differing social and economic histories of countries have produced quite different institutions that govern key aspects of the operation of their labour markets. These include minimum wage arrangements; the degree of centralisation in wage determination arrangements; the role of trade unions and the structures that govern how productivity improvements are negotiated in workplaces; the existence of formal vocational training structures, such as the operation of apprenticeship systems; and the way that observed or practised skills can be rewarded through increased wages. Differences in the effectiveness of the institutions that help workers develop their skills and the extent to which these skills are utilised across countries may contribute to differences in worker productivity and, hence, national incomes.

This study aims to inform consideration of these issues by looking at evidence on the relationship between the skills of workers and the tasks they undertake in their jobs across countries and over time. We are interested in the relationship between skills and skill use at work, because we expect differences in the way workers from different countries are matched to their jobs. Moreover, economic growth, technological innovations and structural changes in the operation of labour markets may have caused substantial changes in the use of skills in jobs over the last decade. Our empirical findings permit inferences about cross-country differences in the impact of such factors and the way in which labour market conditions have changed.

Empirical evidence on the relationship between direct measures of individual skills and the use of such skills at work is limited, although skill mismatches may create costs through a loss of productivity associated with unused skills. While technological innovations and structural changes in the labour market could reduce skill mismatches by reallocating workers who do not make good use of their skills, it seems likely that such adjustment processes differ across countries, since institutions differ so much. Investments in the development and adoption of new technologies and the flexibility of the labour market are likely to be important in mitigating skill mismatches, but again are likely to vary substantially across countries. It is against this background that the empirical analysis in this study aims to provide evidence on individual skills and skill use at work in different countries and how these have changed over time.

We utilise two cross-sections surveyed about ten years apart as part of international studies coordinated by Statistics Canada and the OECD. We use these data to identify the relationship between individual skills and skill use at work for workers in four OECD countries: Australia, New Zealand, the United States and Canada. We focus on these four countries because they are predominantly English-speaking countries and their institutional settings and labour market regulations are more similar than the small number of other countries included in both surveys.

The interpretation of our international comparison is complicated by the fact that individual skills and the way workers use them in their jobs may depend on a variety of factors. In particular, economic growth, technological innovations and structural changes in the operation of labour markets may have caused substantial changes in skill use over time. While we may expect that changes in some of these factors tend to be common across countries (for example, technological innovations typically affect many countries in the same way within a short time period), changes in other factors likely to be important, such as economic growth or labour market conditions, may vary considerably

internationally. Differences in these factors may have different effects on the extent to which workers develop their skills and consequently use them in their jobs. In the support document to this study, we discuss changes in some of the relevant macroeconomic factors that may have had an impact on individual skills and skill use at work. The aim of this exercise is to ensure that the broad direction of the changes in macroeconomic conditions is comparable across the countries we study over the relevant period. Comparability of changes in macroeconomic factors facilitates the interpretation of our results. Fortunately, we find that the broad macroeconomic developments are roughly comparable across the four countries.

In most empirical analyses of skill use and worker skills, limited information about worker skills is available and information about educational attainment is taken as a proxy for skills. In addition to the usual education-related measures of skills, we are able to use the outcomes of tests undertaken by subjects that cover their literacy and numeracy skills, as well as the assessment by the individuals themselves on how good their skills are for both the requirements of their jobs and the needs of daily life. Moreover, in this study we utilise workers' reports of their use of skills in the workplace to construct measures of job requirements. We employ a number of variables measuring the tasks that individuals undertake in their jobs to construct measures of job requirements; that is, job requirements are measured by self-reports of individuals about their literacy use and numeracy use at work.¹ These data, in conjunction with the objective individual skill measures, provide a much richer picture of the match of workers to jobs than is typically available in other data.

This study provides a descriptive analysis of skill matches to job requirements for workers in the four countries specified. To examine the relationship between the skills of workers and the skill requirements in their jobs, we estimate a 'matching' function, which maps individual skills to jobs. The empirical findings of our analysis should not be interpreted as suggesting that skills solely determine usage at work, or any single effect in the other direction. Due to the complex interactions between usage, skills and education, we tend to talk about the 'match' of workers with certain skills to jobs with certain requirements, rather than any causal relationships.

Our study also provides evidence on the relationship between educational attainment, broad occupational categories and skill requirements and investigates variations in job requirements across age groups. Since we would expect that job requirements increase with educational attainment and be higher among more skilled occupations, this analysis may be viewed as a check on our job requirement measures – and we find that our measures are broadly in line with these expectations.

The empirical findings of this study suggest that the relationship between individual skills and skill requirements at work is, indeed, positive: in all countries high-skilled workers indicate they use their skills more often at work than less skilled workers. The relationship between literacy use and document literacy is, however, weaker at higher document literacy levels. The literacy skill requirements of Australian workers were lower than other countries in the first survey, and increased substantially between the surveys, while the changes in other countries were either more moderate or slightly negative. Higher levels of education are also associated with higher skill requirements at work in all countries, although the way in which educational attainment translates into literacy use differs slightly across countries. In addition, workers in full-time jobs indicate they make greater use of their literacy skills at work than those in part-time jobs. Employment in larger establishments is also positively associated with increased literacy use across all countries, suggesting that large companies tend to require workers to undertake more complex tasks in their jobs. Older workers report

¹ We use the terms 'skill use' and 'job requirements' interchangeably throughout the entire text.

considerably higher levels of literacy use at work than the youngest age group, while the decline in literacy use for the older aged is rather moderate.

We also find that workers with relatively high numeracy skills use those skills more often in their jobs than workers with relatively low numeracy skills, although the relationship is less pronounced than that between literacy skills and their use. While numeracy skill requirements increased in Australia between the surveys, they declined substantially elsewhere, which suggests that factors at play in Australia which determined usage differed from those in other countries. The average level of numeracy use increases with education for both male and female workers, although the relationship seems to be non-linear. In addition, high-skilled workers (such as managers and administrators) make more use of their skills than low-skilled workers (such as plant and machinery operators and drivers). Full-time workers indicate they undertake more numeracy-related tasks in their work. Unlike literacy use, employer size has a significantly negative effect on numeracy use in all countries. Finally, the numeracy use levels of younger workers increase up to age 45 years, after which usage typically declines.

The next chapter contains a description of the data used for the analysis, while later chapters provide evidence on the relationship between skills and skill requirements for workers in the four different countries, separately for literacy and numeracy. A final chapter gives some conclusions.

Description of the data

The analysis uses information from two cross-sections of data collected about ten years apart. The first cross-section was part of an international project led by Statistics Canada called the International Adult Literacy Survey (IALS).² In 1994, nine countries were surveyed (Canada, France, Germany, Ireland, The Netherlands, Poland, Sweden, Switzerland and the United States). Five additional countries or territories followed in 1996 (Australia, the Flemish community in Belgium, Great Britain, New Zealand and Northern Ireland). Finally, nine other countries or regions participated in a third round of data collection in 1998 (Chile, the Czech Republic, Denmark, Finland, Hungary, Italy, Norway, Slovenia and the Italian-speaking region of Switzerland).

The second cross-section – the Adult Literacy and Life Skills (ALLS) Survey – was collected as part of an international study coordinated by Statistics Canada and the OECD. The Adult Literacy and Life Skills Survey began in 2003 and covered Bermuda, Canada, Italy, Norway, Switzerland, the United States and the Mexican state of Nuevo Leon. Australia and New Zealand followed in a second phase in 2006, along with three other countries (Hungary, The Netherlands and South Korea).

International Adult Literacy Survey (IALS)

The International Adult Literacy Survey was designed to measure certain aspects of the literacy and numeracy skills of adults. The data include information about the literacy and numeracy skills of individuals that are deemed necessary for using printed materials typically found at work, at home, and in the community (Statistics Canada 1996).

The survey includes the following self-assessed reports by individuals of their reading, writing and basic mathematical skills for the needs of daily life and their main job:

- Respondents were asked a series of questions to obtain background socio-demographic information (such as age, gender etc.).
- Respondents were asked to rate their reading, writing and basic mathematical skills.
- Information was collected about the frequency with which respondents undertook selected literacy and numeracy activities in daily life and at work, and about their English and other language skills.

The data from the International Adult Literacy Survey further includes three objective skill measures:

- *Document literacy*: the effective use of information contained in materials such as tables, schedules, charts, graphs and maps.
- *Prose literacy*: the skills required to understand and use information from various kinds of prose texts, including texts from newspapers, magazines and brochures.
- *Quantitative literacy*: the ability to perform arithmetic operations using numbers contained in printed texts or documents. This is a very narrow measure of the numeracy skills of individuals.

² For Australia, the questionnaire and task booklets were administered in English and people with poor English language were excluded from the survey. This might have excluded a lot of migrants, and probably Indigenous Australians. Since remote and very remote areas were excluded from the sampling frame, a significant proportion of the Indigenous population was excluded from the survey as well.

Adult Literacy and Life Skills (ALLS) Survey

The Adult Literacy and Life Skills (ALLS) Survey builds on the survey design of the International Adult Literacy Survey. Due to the similar design of questionnaires and largely overlapping definitions of variables, the Adult Literacy and Life Skills Survey may be used as a follow-up of the International Adult Literacy Survey, that is, comparisons of two cross-sections are possible for several countries (including those considered in our empirical analysis).

The Adult Literacy and Life Skills Survey includes four objective skill measures:

- *Document literacy*: the efficient use of information contained in various formats including job applications, payroll forms, transportation schedules, maps, tables and charts.
- *Prose literacy*: the knowledge and skills required to understand and use information from various kinds of narrative texts, including texts from newspapers, magazines and brochures.
- *Numeracy*: the ability to effectively manage and respond to the mathematical demands of diverse situations.
- *Problem-solving*: goal-directed thinking and the ability to act in situations for which no routine solution is available.

As in the International Adult Literacy Survey, individuals also provided self-assessments of their English reading and writing skills for the needs of daily life and of their main job. Both surveys include background questionnaires for collecting individual and household information such as general demographic information, linguistic information, parental information, labour force activities, literacy and numeracy practices in daily life and at work, frequency of reading and writing activities, participation in education and learning, social capital and wellbeing, information and communications technology and personal and household income.

Job task and individual literacy measures

The data allow us to develop two types of scales for use in our empirical analysis: measures of job tasks and measures of individual literacy. Measures of job tasks reflect reports by individuals of the frequency with which they undertook literacy and numeracy tasks at work; that is, respondents in all surveys were asked a partially overlapping set of questions about the literacy and numeracy tasks they undertook at work. These included, for example, how often they wrote ‘reports or articles’, or ‘letters or memos’, or how often they filled in forms such as ‘bills, invoices or budgets’, or how often they calculated ‘prices, costs or budgets’. The measures of individual literacy we use are document literacy, prose literacy, numeracy (using scales contained in the data) and self-assessed skills (based on a scale we develop). We place all the scales we develop onto a 0–500 range, consistent with the literacy and numeracy scales provided in the data.

While the measures of individual literacy in the second cross-section contain both an underlying continuous score on a 0–500 range and a summary indicator in the form of a five-point scale (with known thresholds from the underlying scale), the literacy skill levels of the Australian 1996 survey were only published on the same summary five-point scale used in 2006. To overcome this problem, we employed a matching mechanism to impute missing values and perform the empirical analysis.

Skill requirement measures can be generated by using information about the frequency of the literacy and numeracy use of workers in their jobs. The support document to this report provides a description of the underlying variables that were used to generate these measures. Ryan and Sinning (2008)

provide a detailed description of the empirical approach (an application of item response theory) that was applied in the Australian context.

Tables 1 and 2 contain the mean values of the individual literacy and numeracy measures and the skill usage measures for male and female workers in the four countries in the two surveys. All measures range on a 0–500 scale. While the average observed skill measures are comparable over time and similar across countries, there is evidence of substantial heterogeneity across countries and over time in the skill usage measures.

Table 1 Job tasks and individual literacy measures in Australia and New Zealand

	Mean value by gender and year			
	1994–96		2003–06	
	Males	Females	Males	Females
Australia				
Job task measures				
Literacy use	265.4 (3.65)	244.6 (3.59)	301.7 (4.52)	297.0 (4.06)
Numeracy use	246.9 (3.19)	190.4 (3.18)	252.8 (4.53)	210.0 (3.74)
Individual literacy measures				
Document literacy	286.0 (1.12)	286.9 (1.18)	288.9 (1.59)	289.4 (1.24)
Prose literacy	281.1 (1.32)	292.3 (1.31)	282.5 (1.65)	291.9 (1.20)
Numeracy	-	-	287.3 (1.88)	277.3 (1.21)
Self-assessed skills	235.9 (4.71)	297.4 (4.95)	340.0 (5.48)	382.3 (6.11)
Number of observations	3138	2918	2349	2263
New Zealand				
Job task measures				
Literacy use	279.9 (6.43)	271.0 (6.76)	293.6 (4.06)	285.4 (4.34)
Numeracy use	294.5 (5.18)	231.6 (6.91)	239.0 (2.82)	186.4 (4.45)
Individual literacy measures				
Document literacy	281.1 (2.05)	282.2 (1.73)	284.4 (1.39)	283.7 (0.94)
Prose literacy	279.7 (1.92)	292.5 (1.76)	278.4 (1.22)	285.5 (1.03)
Numeracy	-	-	281.8 (1.65)	272.7 (1.05)
Self-assessed skills	219.1 (6.99)	313.2 (8.69)	323.4 (4.84)	361.6 (6.38)
Number of observations	1128	1273	2674	3128

Notes: Weighted numbers; standard errors in parentheses.

Source: ABS, Survey of Aspects of Literacy, Australia, basic confidentialised unit record file, 1996, 4228.0; ABS, Adult Literacy and Life Skills Survey, Australia, basic confidentialised unit record file, 2006, 4228.0; Adult Literacy and Life Skills Survey, New Zealand, 2006.

The literacy use and numeracy use measures of male and female workers increased between surveys in Australia. By contrast, the numeracy use measures declined in all other countries. Moreover, the literacy use measures increased in New Zealand, but dropped in the United States and Canada.

These changes point to considerable differences in the development of skill requirements across countries between the surveys. Since it seems likely that changes in skill requirements are the result of economic, technological and labour market changes, these numbers suggest that the numeracy use measure picks up certain tasks that became less relevant with the introduction of new technologies in most countries, but not Australia. In fact, the numeracy use measure is based on a number of tasks that may have become easier or less time-consuming with the introduction or spread of new information technologies. These tasks include writing spreadsheets and tables, measuring or estimating the size or weight of objects and the calculation of prices, costs or budgets. This issue of why numeracy usage might have increased in Australia but not elsewhere is discussed in more detail below.

Table 2 Measures of job tasks and individual literacy in the United States and Canada

	Mean value by gender and year			
	1994–96		2003–06	
	<i>Males</i>	<i>Females</i>	<i>Males</i>	<i>Females</i>
United States				
Measures of job tasks				
Literacy use	303.5 (5.86)	300.8 (6.57)	282.7 (5.07)	280.8 (5.16)
Numeracy use	269.9 (5.32)	213.6 (6.52)	220.5 (4.44)	171.6 (4.52)
Measures of individual literacy				
Document literacy	279.5 (2.71)	283.4 (2.59)	276.4 (1.81)	276.1 (1.82)
Prose literacy	280.9 (2.58)	291.4 (2.73)	270.1 (1.65)	278.3 (1.81)
Numeracy	-	-	273.2 (1.81)	261.3 (2.04)
Self-assessed skills	246.3 (8.86)	288.8 (10.84)	320.0 (7.32)	361.0 (6.08)
Number of observations	1072	1014	1347	1422
Canada				
Measures of job tasks				
Literacy use	284.5 (15.14)	278.0 (18.97)	273.3 (3.81)	268.8 (3.47)
Numeracy use	258.4 (6.94)	205.0 (11.81)	222.1 (2.91)	182.4 (2.88)
Measures of individual literacy				
Document literacy	297.2 (3.89)	298.0 (4.32)	287.3 (1.25)	287.5 (1.09)
Prose literacy	286.9 (4.26)	302.4 (5.26)	282.2 (1.28)	291.7 (1.12)
Numeracy	-	-	284.5 (1.47)	273.1 (0.95)
Self-assessed skills	250.8 (10.18)	315.8 (21.25)	321.9 (5.31)	366.7 (4.12)
Number of observations	1461	1498	7676	7989

Notes: Weighted numbers; standard errors in parentheses.

Source: International Adult Literacy Survey (IALS).

Literacy use at work

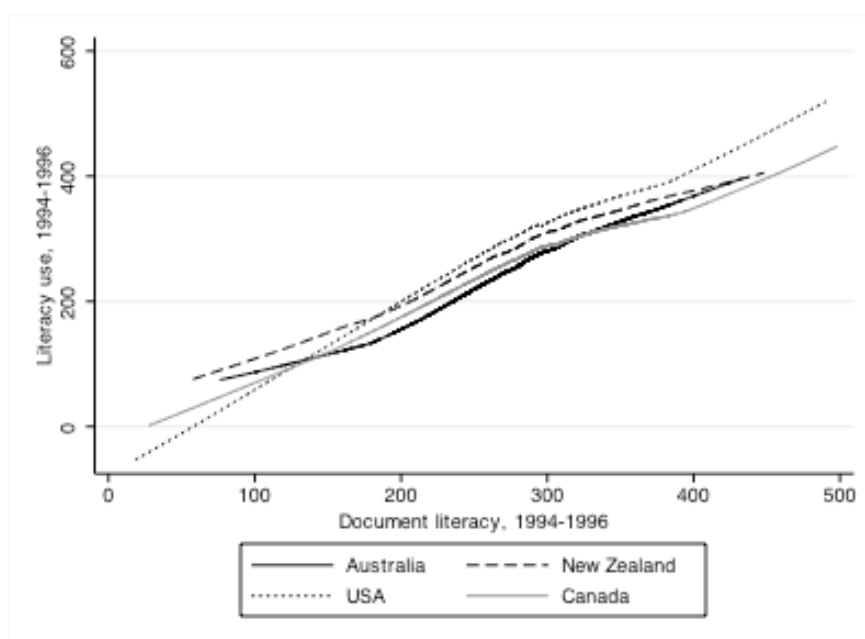
This chapter compares literacy use measures across countries and over time, paying particular attention to

- the relationship between literacy skills and literacy use at work
- changes in literacy use and document literacy over time
- the relationship between education, occupation and literacy use
- the role of demographic factors.

The relationship between literacy use at work and document literacy

Figures 1 and 2 depict the relationship between our literacy use measure and the objective skill measure for the four countries in the two surveys.

Figure 1 Literacy use and document literacy by country, 1994–96



Source: International Adult Literacy Survey (IALS).

The figures provide evidence that the relationship between individual skills and skill requirements at work is positive, indicating that relatively high-skilled workers report that they use their skills more often at work than less skilled workers. However, the relationship between document literacy skills and literacy use is not always linear. Instead, the literacy use measure increases at a higher rate at lower document literacy levels (especially in figure 2).³

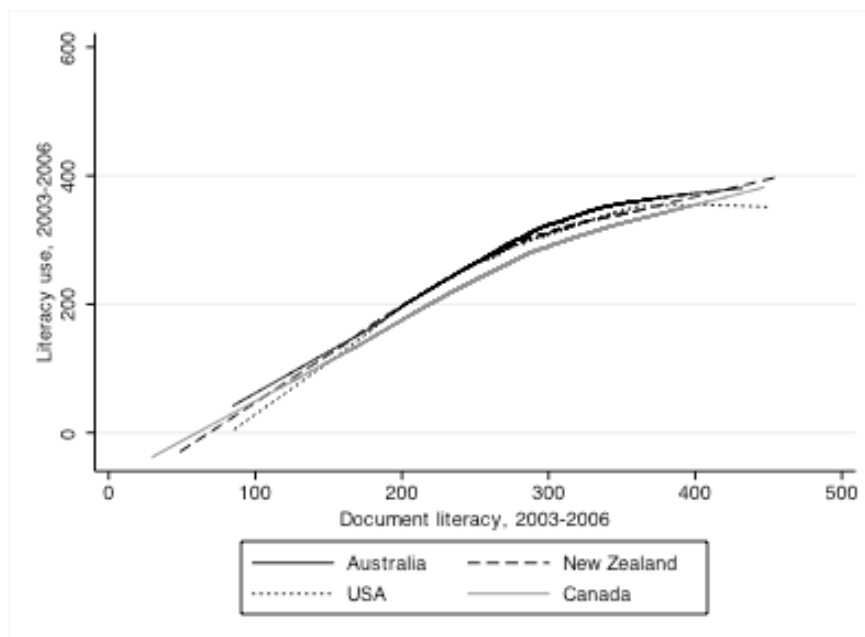
A comparison across countries of the estimated relationships between document literacy skills and literacy use for the period 1994–96 suggests that the relationships are broadly similar, but that a consistent hierarchy exists between values of about 150 and 400 of the skills scale: skills usage was

³ Using prose literacy instead of document literacy produces similar results (Ryan & Sinning 2008).

greater for a given individual literacy skill level in the US than in New Zealand, where it was higher than in either Australia or Canada. However, due to the almost linear relationship between literacy use and document literacy there, low-skilled workers in the US seemed to make less use of their literacy skills than in other countries. However, since the functions are estimated with uncertainty, and the number of observations for some countries is small, differences in the estimated relationships are not statistically significant.

The corresponding relationships between document literacy skills and literacy use for the period 2003–06 are presented in figure 2. Once more the estimated relationship is similar in the four countries, although it has changed somewhat towards the upper part of the literacy skills distribution, with increases in observed skills associated with much smaller increases in skills use compared with the 1994–96 survey. Further, it appears that literacy skill use at work by Australian workers is higher than that of workers from other countries, reflecting the increase in literacy use for Australian workers (and the decline in literacy use for workers from other countries) reported in tables 1 and 2. The literacy use measure of medium- and high-skilled Canadian workers appears substantially lower than in other countries. Again, however, the resulting cross-country differences are mostly insignificant.⁴

Figure 2 Literacy use and document literacy by country, 2003–06



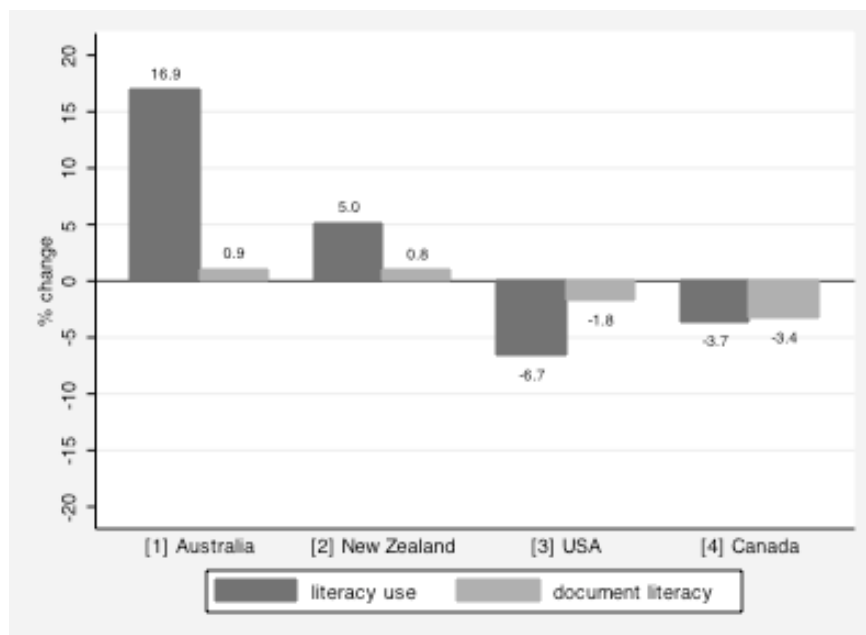
Source: Adult Literacy and Life Skills (ALLS) Survey.

Finally, figure 3 presents changes in literacy use and document literacy between the survey periods 1994–96 and 2003–06 for the four countries. Overall, the literacy skill requirements of (male and female) Australian workers have increased substantially (by 16.9% – a statistically significant change), while the change in other countries was either moderately positive (New Zealand) or negative (US and Canada, where the decline was statistically significant). Document literacy skills have remained rather stable in Australia, New Zealand and the US but declined in Canada (by 3.4% – the decline there is significant for both males and females). Interestingly, document literacy levels changed in the same direction as literacy requirements in all countries, suggesting not only that literacy

⁴ To investigate the difference between these functions, we derived the quadratic prediction plots with confidence intervals, which suggest that only the Canadian literacy use level presented in figure 2 is significantly lower than elsewhere at document literacy levels of about 200–350.

requirements increase with higher skill levels (as shown in figures 1 and 2) but also that changes in literacy use may be associated with changes in literacy skills. However, it remains unclear whether increases in skills use are the result of skill increases in the labour force (which would suggest that matches of workers to certain jobs are supply-side driven) or whether they cause an increase in high-skilled workers in the pool of employed labour force participants (which would suggest that matches of workers to certain jobs are demand-side driven).

Figure 3 Change in literacy use and document literacy between 1994–96 and 2003–06



Source: Adult Literacy and Life Skills (ALLS) Survey.

Educational attainment and occupation and literacy use

The support document contains an analysis of the relationship between literacy use at work and educational attainment and occupations in the four countries. Skills use clearly rises with educational level in all countries and is higher in more skilled occupations (professional occupations and managers and administrators) than in less skilled occupations. These patterns really do little more than confirm that our literacy skills use variable captures an important dimension of the jobs of individuals, and that those with higher levels of skills who report the greatest level of skills use really are those who are among the most skilled workers, using other measures of skill.

One further point of interest from the occupational patterns is that those working as craft and trade-related workers report below-average conduct of literacy-related tasks in their jobs in all four countries. This is true for males, but is especially marked in the case of females working in these occupations. Workers in trade-related occupations report making relatively little use of their literacy-related skills, regardless of the institutions used in countries to develop individuals in skilled vocational occupations.

Determinants of literacy use

The descriptive analysis presented above indicated there was a positive relationship between the literacy skills of workers and their use at work. We also found that the relationship between literacy skills and their use at work was not always linear, suggesting that increases in the level of literacy use

at work were smaller at higher skill levels. To investigate whether these patterns remain when other determinants of literacy use are taken into account, we estimate a multivariate linear regression model of our literacy use measure on a set of relevant determinants for each country. The estimates of such a model can answer a number of important questions, including:

- Are there significant differences in the use of literacy at work between male and female workers?
- Does the relationship between education and literacy use remain once the actual skills of workers are taken into account?
- Does literacy use differ significantly between full-time and part-time workers?
- Is literacy use associated with employer size?
- Is document literacy associated with increased literacy use at work once other factors are taken into account and is the shape of the relationship apparent in figures 1 and 2 robust to the incorporation of these other effects?
- Are higher self-assessed skills also associated with increased literacy use at work?
- Does literacy use at work differ significantly across age groups?

To answer these questions, the following regression model is estimated separately for each country and survey period (all explanatory variables have an associated parameter that we estimate):

$$\begin{aligned}
 & \text{intercept} \\
 & + \text{document literacy} + \text{document literacy squared} \\
 & + \text{self-assessed skills} \\
 \text{Literacy use at work} = & + \text{female indicator} \\
 & + \text{highest level of education indicators} \\
 & + \text{full-time employment indicator} \\
 & + \text{employer size indicators} \\
 & + \text{age indicators} \\
 & + \text{occupation indicators} \\
 & + \text{residuals}
 \end{aligned}$$

Tables 3 and 4 contain the estimates of the linear regression model – the first table contains the results for Australia and New Zealand in the two surveys, the second the results for the US and Canada. The R-squared indicates that the equations explain about 30–40% of the variation among workers in their literacy use at work. In general, the results are quite consistent across the four countries and exhibit similar changes in relationships between surveys for the countries as well.

Table 3 Determinants of literacy use, Australia and New Zealand

	1994–96		2003–06	
	Estimate	t-ratio	Estimate	t-ratio
Australia				
Intercept	-146.3	-3.21	-335.6	-7.39
Document literacy	0.836	2.54	2.191	6.44
Document literacy squared/100	-0.077	-1.30	-0.324	-5.22
Self-assessed skills	0.066	6.60	0.066	5.02
Female	-21.200	-4.33	-3.502	-0.64
Highest level of education				
Year 12	4.703	0.70	30.344	4.20
Certificate, advanced diploma/diploma	34.683	6.02	39.007	4.92
Bachelor degree, postgraduate degree	62.455	8.40	34.034	3.73
Full-time employed	83.065	16.12	83.408	11.19
Employer size				
20–99	27.722	3.97	23.102	2.68
100–499	32.952	4.73	38.314	4.18
500 and over	53.823	10.87	49.725	7.07
Age				
25–34	36.837	5.50	53.219	6.18
35–44	44.841	6.63	68.735	7.91
45–54	43.896	6.07	65.799	7.52
55–64	30.536	3.44	64.026	6.49
R-squared	0.38		0.37	
N	6056		4612	
New Zealand				
Intercept	-120.1	-1.29	-248.3	-3.84
Document literacy	0.897	1.39	1.899	4.10
Document literacy squared/100	-0.111	-1.01	-0.314	-3.95
Self-assessed skills	0.007	0.41	0.036	2.47
Female	-3.952	-0.51	-14.359	-2.48
Highest level of education				
Year 12	4.450	0.39	22.633	2.84
Certificate, advanced diploma/diploma	33.550	3.23	56.733	6.29
Bachelor degree, postgraduate degree	27.822	1.72	37.035	4.02
Full-time employed	93.018	10.07	83.588	14.81
Employer size				
20–99	-7.257	-0.66	0.172	0.03
100–499	25.511	2.02	6.724	1.23
500 and over	20.445	1.76	21.072	1.87
Age				
25–34	61.332	5.32	63.363	6.91
35–44	85.353	6.65	84.534	12.40
45–54	79.230	5.73	87.649	10.49
55–64	56.652	2.92	84.717	9.38
R-squared	0.37		0.35	
N	2401		5802	

Notes: Weighted linear regression. The regression model further includes occupation indicators.
Source: International Adult Literacy Survey (IALS); Adult Literacy and Life Skills (ALLS) Survey.

Table 4 Determinants of literacy use, United States and Canada

	1994–96		2003–06	
	Estimate	t-ratio	Estimate	t-ratio
United States				
Intercept	-280.2	-6.66	-273.2	-4.90
Document literacy	1.520	5.08	2.193	4.90
Document literacy squared/100	-0.185	-3.21	-0.327	-3.72
Self-assessed skills	0.046	1.97	0.065	4.12
Female	-19.594	-2.33	-19.027	-2.98
Highest level of education				
Year 12	28.116	2.67	4.117	0.56
Certificate, advanced diploma/diploma	84.032	4.88	-4.002	-0.23
Bachelor degree, postgraduate degree	79.909	6.81	27.446	2.39
Full-time employed	89.211	8.70	71.328	7.79
Employer size				
20–99	-13.170	-0.97	1.400	0.18
100–499	5.424	0.41	10.665	1.16
500 and over	20.728	2.46	40.133	2.94
Age				
25–34	61.194	4.88	44.162	4.58
35–44	54.010	4.31	65.840	7.00
45–54	59.267	4.19	69.788	5.95
55–64	64.223	4.27	67.662	6.18
R-squared	0.41		0.31	
N	2 086		2 769	
Canada				
Intercept	-193.3	-2.33	-341.3	-7.35
Document literacy	1.589	2.53	2.224	7.00
Document literacy squared/100	-0.234	-2.06	-0.324	-5.83
Self-assessed skills	0.072	1.73	0.048	5.04
Female	-6.126	-0.24	-9.938	-2.03
Highest level of education				
Year 12	-5.796	-0.32	22.244	2.55
Certificate, advanced diploma/diploma	43.345	2.08	29.494	3.27
Bachelor degree, postgraduate degree	65.465	1.74	51.166	5.79
Full-time employed	53.326	3.73	59.764	15.48
Employer size				
20–99	10.434	0.59	18.690	3.11
100–499	-11.060	-0.40	21.185	3.30
500 and over	40.588	1.55	29.412	3.86
Age				
25–34	37.735	2.85	52.491	5.85
35–44	64.921	3.54	72.079	10.05
45–54	62.699	2.70	70.873	8.53
55–64	29.384	1.18	69.266	7.95
R-squared	0.33		0.33	
N	2 959		15 665	

Notes: Weighted linear regression. The regression model further includes occupation indicators.

Source: International Adult Literacy Survey (IALS); Adult Literacy and Life Skills (ALLS) Survey.

In summary, skills use increases with actual skills, education level, full-time employment status, firm size and age. However, the relationship with actual literacy skills and education appeared to change

in all countries between the surveys, becoming flatter among the most skilled and most educated individuals in all countries.

The coefficients of the linear and quadratic document literacy terms have the expected signs; that is, the positive coefficient on the linear term indicates that high literacy skills are associated with high levels of literacy use at work, while the negative coefficients of the squared term suggest a declining rate of change at higher literacy skill levels, as in figures 1 and 2. However, the parameters on the two terms increase in absolute value in all countries between the surveys, indicating that the relationship between skills and skills use became steeper for individuals with lower-level skills and flatter for those with higher-level skills. We further include self-assessed skills in our model and find a positive association between self-assessed skills and literacy use at work.⁵

In general, variables are interpreted to have a significant effect on the dependent variable of a regression equation where their t-value (parameter estimate/standard error) exceeds 1.96. The parameters on such variables are said to be statistically different from zero at the 95% level. Using this criterion, the coefficients on literacy and self-assessed skill variables can be considered significantly different from zero in most cases. Only the squared term of document literacy and the coefficient of self-assessed skills are not always significant in the first survey period in New Zealand and Canada. The insignificant squared term indicates that the relationship between document literacy and literacy use at work is linear, rather than quadratic. Our interpretation of other variables included in the regression equation is as follows:

- *Female indicator*: after controlling for relevant determinants, male workers use their literacy skills significantly more often at work than female workers (although the effect is not always significant).
- *Highest level of education*: the coefficients on the indicator variables for the highest level of education suggest that education is positively associated with increased use of literacy skills at work. The relatively high t-values of the coefficients of higher levels of education suggest that education is an important contributor to the application of literacy use at work. However, the relationship seems to be changing, especially at the top of the skills distribution. The parameter associated with having a bachelor's/postgraduate degree or other post-school qualification declined between surveys in most countries. The results for the education indicators were also qualitatively different in the second survey in the US, where only a university degree increased the level of literacy use significantly (compared with the reference group of workers who did not complete high school). Coefficients of lower levels of education are even negative in the US, pointing to substantial non-linearity in the relationship between educational attainment and literacy use at work.
- *Full-time employment*: literacy use at work is about 50–90 points higher for full-time employed workers compared with part-time workers, suggesting that full-time jobs provide a greater opportunity to undertake literacy tasks than part-time jobs.
- *Employer size*: the coefficients of the variables denoting the number of persons employed at the location of the individual's main job suggest that employer size is another strong predictor of literacy use at work. Employment at larger establishments is positively associated with increased literacy use, suggesting that large companies tend to require workers to undertake more complex tasks in their jobs.

⁵ We do not include a quadratic term for self-assessed skills in our model because it was not significant.

- **Age:** almost all coefficients of the age indicators are significantly positive, indicating that differences between age groups are important in analysing the determinants of literacy use at work. The coefficients are steadily increasing for older age groups (although in some cases they decline for the two oldest age groups), suggesting that older workers have jobs where they use more of their literacy skills than the reference group (that is, the group of workers aged between 15 and 25 years). Since the coefficient of the oldest group of workers is smaller than the coefficient of the second-oldest group in some cases, it is possible that there is some decline in literacy use at work among the older aged.

Overall, the estimates of the regression model reveal that literacy use at work increases with literacy skills, although at a declining rate, while the relationship between self-assessed skills and literacy use at work was linear. Male workers use their literacy skills at work significantly more often than (comparable) female workers. Educational attainment seems to be an important determinant of literacy skill requirements. Moreover, full-time employment and the size of the employer turned out to be strong predictors of the application of literacy skills at work.

Demographic factors

Variation across age groups

The results in tables 3 and 4 suggest that age is an important determinant of literacy use at work in all countries. To investigate this issue further, table 5 contains the average level of literacy use at work by age group and country. In line with the estimates of the regression model, the numbers reveal that older workers report considerably higher levels of literacy use at work than the youngest age group (that is, workers aged 15–24 years). Since the surveys were conducted ten years apart, it is also possible to trace how skills use at work changed between the surveys as birth cohorts actually aged. For example, the group aged 35–44 in the second survey is a random sample from the same birth cohort as the group aged 25–34 years in the first survey. For Australia, this group exhibits a substantial increase in its reported literacy usage at work between the surveys, as is the case for all cohorts of Australian workers. The same patterns of growth are not as apparent across birth cohorts for other countries.

Table 5 Literacy use at work by age group and country

	Literacy use at work by country			
	Australia	New Zealand	United States	Canada
1994–96				
Age 15–24 years (birth cohort 1972–81 in 1996)	190.7	184.8	194.2	205.6
Age 25–34 years (birth cohort 1962–71 in 1996)	275.5	281.7	319.6	284.7
Age 35–44 years (birth cohort 1952–61 in 1996)	282.5	314.8	317.1	319.5
Age 45–54 years (birth cohort 1942–51 in 1996)	275.5	318.8	328.9	307.1
Age 55–64 years (birth cohort 1932–41 in 1996)	246.1	262.1	315.2	278.9
Total	256.3	275.7	302.1	281.5
Number of observations	6056	2401	2086	2959

	Literacy use at work by country			
	Australia	New Zealand	United States	Canada
2003–06				
Age 15–24 years (birth cohort 1982–91 in 2006)	216.6	178.4	194.9	164.0
Age 25–34 years (birth cohort 1972–81 in 2006)	324.9	298.6	279.4	292.0
Age 35–44 years (birth cohort 1962–71 in 2006)	320.9	319.5	304.9	301.9
Age 45–54 years (birth cohort 1952–61 in 2006)	319.0	325.3	319.1	300.5
Age 55–64 years (birth cohort 1942–31 in 2006)	302.5	313.8	305.9	272.8
Total	299.6	289.6	281.8	271.2
Number of observations	4 612	5 802	2 769	15 665

Notes: Weighted numbers.

Source: International Adult Literacy Survey (IALS); Adult Literacy and Life Skills (ALLS) Survey.

Summary

This chapter examined the relationship between literacy skills and literacy use at work in four different countries and investigated variations in literacy use across different levels of educational attainment, occupation and age groups for each country.

The results may be summarised as follows:

- The relationship between individual skills and skill requirements at work is positive, indicating that relatively high-skilled workers use their skills more often at work than less skilled workers.
- The relationship between literacy use and document literacy typically increases most strongly at lower document literacy levels.
- The literacy skill requirements of Australian workers have increased substantially between surveys, while the change in other countries was either moderate or negative.
- Document literacy levels changed in the same direction as literacy requirements in all countries, suggesting that changes in literacy requirements are associated with changes in literacy skills.
- Higher levels of education are associated with higher skill requirements at work, even though the way in which educational attainment translates into literacy use is slightly different across countries (and seems to be changing over time).
- Workers in occupations that typically require high skills and a high level of education are those with high levels of average literacy use at work, indicating that our measure of literacy use picks up variations in skill requirements across occupations quite well.
- People in full-time jobs report greater use of their literacy skills at work than those in part-time jobs.
- Employment in larger establishments is positively associated with increased literacy use, suggesting that large companies tend to require workers to undertake more complex tasks in their jobs.
- Older workers report considerably higher levels of literacy use at work than the youngest age group, with any decline in literacy use amongst the oldest workers appearing to be quite moderate.

Numeracy use at work

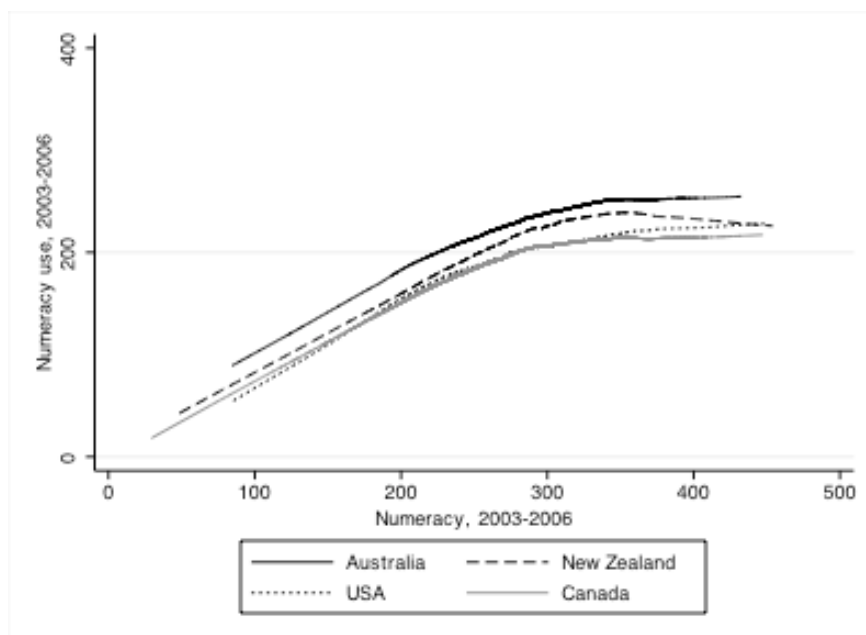
This chapter contains an analysis of the numeracy use scale in the four countries, paying particular attention to:

- the relationship between numeracy skills and numeracy use at work
- changes in numeracy use over time
- the relationship between education, occupation and numeracy use
- the role of demographic factors.

The relationship between numeracy use at work and numeracy skills

The relationship between numeracy use at work and numeracy skills in each country is presented in figure 4 for the second survey only. (Since there was no numeracy skills measure collected for the first survey, we cannot show the relationship for those data.) We find that workers with relatively high numeracy skills use numeracy more often in their jobs than workers with relatively low numeracy skills. Similar to figures 1 and 2, the relationship between numeracy skills and numeracy use is quadratic rather than linear, indicating that numeracy use level is increasing with higher numeracy skills in all countries, but at a declining rate.

Figure 4 Numeracy use and numeracy by country, 2003–06



Source: International Adult Literacy Survey (IALS); Adult Literacy and Life Skills (ALLS) Survey.

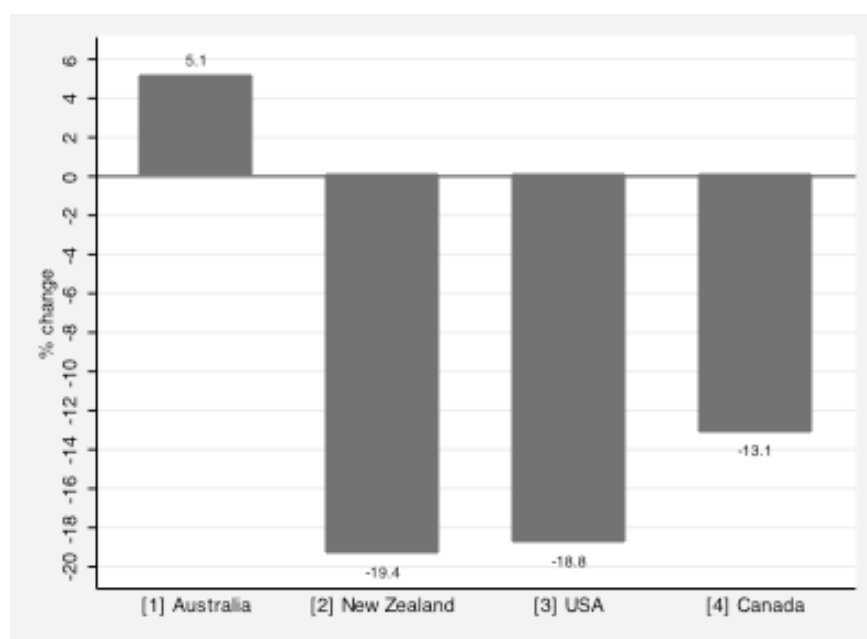
However, the slope of the relationship is much flatter than that shown in figures 1 and 2. Since the average for the numeracy skill measure is of the order of 270–280, it appears that workers with above-average skills do not undertake many more of the numeracy tasks captured in the numeracy use variable than do workers with average skill levels.

Figure 4 also suggests that the extent to which workers apply their numeracy skills in the workplace varies considerably across countries. Specifically, the numeracy use levels of Australian workers are higher in the 2003–06 period than those of workers in other countries. Moreover, Canadian workers have the lowest level of numeracy use at medium- and high-numeracy skill levels, while workers in the US have the lowest level of numeracy use if their numeracy skills are low.

To gain a better understanding of the cross-country differences in numeracy use, it is useful to consider the variations in the changes in levels of numeracy use over time across the countries. Figure 5 presents the percentage change in numeracy use between the two survey periods for all four countries. We find that the numeracy skill requirements of Australian workers have increased by 5.1% and declined substantially (by 13.1%–19.4%) in other countries.

In the analysis that follows, we will point to substantial differences in the relationships between numeracy use and other key variables (education, occupation, firm size and so on) compared with the relationship between literacy use and those variables. Before we describe those relationships and point to reasons why that scale might capture growth in tasks in Australia but decline elsewhere, it seems worthwhile to describe in more detail the tasks covered in the numeracy use measure.

Figure 5 Change in numeracy use between 1994–96 and 2003–06



Source: International Adult Literacy Survey (IALS); Adult Literacy and Life Skills (ALLS) Survey.

Tasks reflected in the numeracy use at work measure

The set of tasks covered in the numeracy use measure included indicators of how often individuals filled in forms such as ‘bills, invoices or budgets’, how often workers used ‘arithmetic’ to calculate ‘prices, costs or budgets’ or ‘measure or estimate the size or weight of objects’ and how often they read or used diagrams or plans in their jobs, among other tasks. The full set of prompts appears in table 5 of the support document, including the frequency of responses for those who undertook the task at least once a week. In Australia, the proportions indicating they undertook these tasks increased for four of the five tasks. In New Zealand and Canada, the proportions decreased for four of the five tasks and in the US the proportions decreased for all five tasks. Hence the experience in Australia between surveys was very different from that of the other countries.

Unlike the literacy tasks, which included writing reports or memos, these tasks seem relatively low-level numeracy-related tasks, and three of them seem to be accounts-related, of a kind we might expect new technologies, such as accounting-related software, to have largely automated.

Hence, we think that it is likely that technological innovation probably drove the decline in numeracy skill use, as captured in our measure, in New Zealand, Canada and the US. Since it seems unlikely that technological innovations were very different in Australia and New Zealand (see, for example, Deloitte 2009), the same factors were probably also at play in Australia, but may have been dominated by some other factor. After we discuss our results about the relationship between the measure of numeracy use and other variables and establish just how different the numeracy use measure is from the literacy use measure, we engage in some speculation about what that factor or factors might have been.

Educational attainment and occupation and numeracy use

Table 6 reports the average levels of numeracy use at work by the highest level of education, gender and country in the second survey period. The numbers in table 6 suggest that there is substantial heterogeneity in the relationship between education and numeracy use at work. For example, while numeracy requirements broadly increase with educational attainment among male workers, there is evidence of a decline at the upper tail of the educational distribution in Australia, New Zealand and the US. Such a non-linear relationship may also be observed for female workers in Australia, New Zealand and Canada. Overall, these numbers suggest that, while the average level of numeracy use increases with education for both male and female workers, the relationship between the two variables appears to be non-linear. Male workers report much greater use of their numeracy skills than do female workers.

Table 6 Numeracy use at work by highest educational attainment and country, 2003–06

	Numeracy use at work by country			
	Australia	New Zealand	United States	Canada
Males				
Bachelor degree, postgraduate degree	266.9	264.5	237.1	252.0
Certificate, advanced diploma/diploma	276.3	274.4	266.7	230.2
Year 12	248.6	227.0	219.2	212.6
Year 10–11	224.5	194.5	152.7	181.0
Year 9 or below	161.7	-	-	134.7
Total	252.8	239.0	220.5	222.1
Number of observations	2349	2674	1347	7676
Females				
Bachelor degree, postgraduate degree	214.4	192.1	175.8	192.7
Certificate, advanced diploma/diploma	221.7	206.8	154.3	193.7
Year 12	228.2	195.2	177.1	183.1
Year 10–11	186.1	158.8	132.4	145.9
Year 9 or below	153.9	-	-	46.5
Total	210.0	186.4	171.6	182.4
Number of observations	2263	3128	1422	7989

Notes: Weighted numbers. Numbers based on less than 30 observations are not reported.

Source: International Adult Literacy Survey (IALS); Adult Literacy and Life Skills (ALLS) Survey.

Table 7 analyses the relationship between numeracy use at work and occupations in the four countries. In this case, skills use is not necessarily higher in more skilled occupations than in less skilled occupations, as was the case for literacy use. It is clear that the numeracy use measured here occurs extensively among managers and administrators, but its reported use among professional occupations tends to be below or around average. Its reported use is also above average among paraprofessional occupations and among craft and trade-related workers.

Table 7 Numeracy use at work by occupation and country, 2003–06

	Numeracy use at work by country			
	Australia	New Zealand	United States	Canada
Males				
Managers and administrators	340.9	363.4	331.0	314.2
Professionals	242.3	254.1	214.6	230.1
Paraprofessionals	296.2	266.6	225.7	260.2
Clerks	222.2	234.7	194.3	180.1
Salespersons and personal service workers	205.4	182.4	184.7	193.7
Craft and related trades workers	272.1	262.7	229.9	247.4
Plant and machinery operators and drivers	173.5	170.3	201.8	180.7
Other	167.2	174.7	148.9	115.4
Total	252.4	239.4	220.5	222.1
Number of observations	2323	2664	1346	7655
Females				
Managers and administrators	289.1	279.3	261.3	260.1
Professionals	191.3	169.8	155.1	169.0
Paraprofessionals	245.1	196.1	192.7	204.4
Clerks	214.8	216.7	183.1	194.3
Salespersons and personal service workers	185.9	166.5	158.8	171.4
Craft and related trades workers	227.6	206.2	105.9	213.7
Plant and machinery operators and drivers	86.2	144.1	111.4	129.0
Other	125.3	111.8	96.3	89.9
Total	209.9	186.5	171.8	182.7
Number of observations	2256	3124	1418	7973

Notes: Weighted numbers.

Source: International Adult Literacy Survey (IALS); Adult Literacy and Life Skills (ALLS) Survey.

Determinants of numeracy use

To investigate the determinants of numeracy use, we estimate a linear regression model. Specifically, we consider a model that is similar to the regression model presented in the last chapter, with the literacy measures now replaced by numeracy measures. Since numeracy skills are not observed in the first survey period, the numeracy skills measure is only included in our model in the second survey period. To ensure full comparability of our results over time, we report estimates for the second survey with and without the numeracy skills measures, in order to assess how their inclusion affects the estimated parameters.

Table 8 presents separate estimates of the determinants of numeracy use for Australia and New Zealand for both survey periods. The corresponding estimates for the US and Canada are provided in table 9. As in the last chapter, variables are interpreted to have a significant effect on the dependent

variable of a regression equation where their t-value (parameter estimate/standard error) exceeds 1.96. The parameters on such variables are said to be statistically different from zero at the 95% level.

The estimates for the second survey period indicate that numeracy requirements increase with numeracy skills at a declining rate, confirming the functional relationships in figure 4. This relationship is statistically significant for all countries. As also anticipated in the discussion of figure 4, the relationship between skills and use is flatter for numeracy than in the literacy results reported in the previous chapter. (The absolute value of the parameters is smaller.) In addition, the effect of self-assessed skills is significantly positive in all sub-samples, with the exception of the Canadian sub-sample in the first survey period.

Gender differences in numeracy use at work are statistically significant in almost all cases, indicating that male workers report more use of their numeracy skills than (comparable) female workers. However, the insignificant difference in the second survey period of the Australian sub-sample indicates that (conditional) gender differences in numeracy use may have disappeared over time in the Australian labour market.

Numeracy use at work tends to increase with the level of educational attainment, although some of the coefficients in tables 8 and 9 are insignificant for the highest level of education, supporting the discussion of the existence of non-linear relationships presented in relation to table 6. Once their skills are taken into account, Australian workers with degrees do not undertake more of these numeracy tasks at work than do individuals with lower-level qualifications.

Similar to the literacy use model discussed in the last chapter, our estimates suggest that full-time employment is also a strong predictor of skill requirements at work. Specifically, numeracy use at work is about 50–100 points higher for full-time than part-time workers.

In contrast to the findings of the literacy use model presented earlier, we find that employer size is negatively associated with numeracy use in all countries. Conduct of these numeracy tasks, then, is more common among individuals employed in small businesses in all countries.

Finally, the levels of numeracy use at work seem to increase with age, although this relationship is much weaker than the relationship between age and literacy use. The coefficients of the Australian samples even suggest that workers aged 25–34 years have the highest level of numeracy use at work, while the numeracy use levels are about the same for workers of other age groups. Overall, the relationship between age and numeracy use seems to vary considerably across countries.

Table 8 Determinants of numeracy use, Australia and New Zealand

	1994–96		2003–06		2003–06	
	Estimate	t-ratio	Estimate	t-ratio	Estimate	t-ratio
Australia						
Intercept	154.6	19.76	151.2	15.77	-85.68	-1.80
Numeracy	-	-	-	-	1.377	3.77
Numeracy squared/100	-	-	-	-	-0.158	-2.29
Self-assessed skills	0.083	8.31	0.086	5.82	0.052	3.53
Female	-29.540	-6.34	-18.289	-2.60	-12.173	-1.78
Highest level of education						
Year 12	21.492	3.22	34.010	4.68	19.681	2.58
Certificate, advanced diploma/diploma	54.666	9.99	38.897	5.53	26.685	3.94
Bachelor degree, postgraduate degree	48.556	7.60	25.590	3.69	-1.143	-0.15
Full-time employed	81.572	15.90	78.129	10.34	79.516	10.68
Employer size						
20–99	-45.128	-6.54	-26.904	-3.21	-25.714	-3.21
100–499	-56.943	-7.84	-34.184	-3.71	-35.814	-4.09
500 and over	-54.467	-11.01	-48.518	-8.47	-50.936	-9.10
Age						
25–34	12.988	1.97	20.403	2.23	20.413	2.24
35–44	9.853	1.49	15.594	1.84	14.215	1.64
45–54	-3.583	-0.50	-0.241	-0.03	3.541	0.45
55–64	-17.002	-1.95	-11.861	-1.17	-4.067	-0.42
R squared	0.15		0.11		0.14	
N	6056		4612		4612	
New Zealand						
Intercept	163.8	11.73	115.7	14.40	-127.9	-2.85
Numeracy	-	-	-	-	1.524	4.69
Numeracy squared/100	-	-	-	-	-0.200	-3.49
Self-assessed skills	0.057	3.32	0.063	5.31	0.031	2.34
Female	-29.505	-3.68	-33.664	-5.35	-29.699	-4.89
Highest level of education						
Year 12	32.581	3.01	31.321	4.89	21.365	3.48
Certificate, advanced diploma/diploma	60.908	5.72	50.287	5.03	36.557	3.62
Bachelor degree, postgraduate degree	54.564	3.91	33.984	5.94	14.328	2.40
Full-time employed	99.237	10.45	64.627	11.77	64.895	12.43
Employer size						
20–99	-25.398	-1.91	-26.945	-3.81	-27.648	-3.89
100–499	-36.377	-2.88	-34.173	-3.55	-33.533	-3.52
500 and over	-31.047	-3.18	-67.795	-5.73	-64.637	-5.64
Age						
25–34	29.287	2.35	37.958	4.34	39.977	4.71
35–44	38.512	2.82	62.285	8.62	60.730	8.20
45–54	44.670	3.02	45.797	5.09	46.787	5.02
55–64	-7.793	-0.54	25.150	3.38	27.785	3.48
R squared	0.15		0.12		0.14	
N	2401		5802		5802	

Notes: Weighted linear regression. The regression model further includes occupation indicators.
Source: International Adult Literacy Survey (IALS); Adult Literacy and Life Skills (ALLS) Survey.

Table 9 Determinants of numeracy use, United States and Canada

	1994–96		2003–06		2003–06	
	Estimate	t-ratio	Estimate	t-ratio	Estimate	t-ratio
United States						
Intercept	134.4	9.66	146.1	16.03	-56.349	-1.09
Numeracy	-	-	-	-	1.303	2.96
Numeracy squared/100	-	-	-	-	-0.183	-2.10
Self-assessed skills	0.069	3.07	0.090	5.69	0.056	2.99
Female	-52.126	-6.49	-44.701	-6.21	-40.854	-6.21
Highest level of education						
Year 12	83.411	8.46	7.666	0.92	9.908	1.12
Certificate, advanced diploma/diploma	119.178	8.54	16.702	1.00	22.391	1.31
Bachelor degree, postgraduate degree	128.218	10.64	9.938	0.93	9.129	0.86
Full-time employed	60.083	7.14	51.143	7.48	50.491	7.41
Employer size						
20–99	-35.837	-2.52	-32.427	-4.10	-33.387	-4.35
100–499	-57.441	-3.28	-31.971	-4.16	-33.035	-4.34
500 and over	-43.741	-3.59	-18.276	-1.48	-21.314	-1.72
Age						
25–34	10.707	0.74	13.981	1.45	14.987	1.64
35–44	16.337	1.15	20.821	2.87	21.443	2.85
45–54	10.226	0.68	25.962	2.62	26.634	2.72
55–64	1.244	0.10	7.460	0.82	8.425	0.99
R squared	0.16		0.07		0.09	
N	2 086		2 769		2 769	
Canada						
Intercept	198.5	8.18	143.1	15.70	-152.3	-4.00
Numeracy	-	-	-	-	1.873	6.32
Numeracy squared/100	-	-	-	-	-0.266	-4.82
Self-assessed skills	0.064	0.99	0.060	5.87	0.035	3.30
Female	-45.357	-3.57	-37.582	-9.16	-31.957	-7.48
Highest level of education						
Year 12	31.547	2.54	25.439	3.94	14.729	2.36
Certificate, advanced diploma/diploma	72.882	3.75	35.225	4.11	22.725	2.56
Bachelor degree, postgraduate degree	46.057	3.09	42.280	5.78	22.080	2.95
Full-time employed	64.314	5.14	49.152	11.15	49.384	11.10
Employer size						
20–99	-73.962	-2.30	-34.692	-7.16	-33.717	-6.89
100–499	-81.682	-1.53	-54.251	-9.10	-53.716	-9.18
500 and over	-57.106	-2.21	-65.939	-5.29	-66.017	-5.48
Age						
25–34	10.288	0.74	29.603	3.90	32.210	4.32
35–44	1.971	0.15	28.405	3.72	33.795	4.39
45–54	0.576	0.02	23.495	3.07	29.735	3.98
55–64	-42.329	-1.26	9.175	1.48	21.768	3.33
R squared	0.11		0.09		0.11	
N	2 959		15 665		15 665	

Notes: Weighted linear regression. The regression model further includes occupation indicators.

Source: International Adult Literacy Survey (IALS); Adult Literacy and Life Skills (ALLS) Survey.

Demographic factors

Variation across birth cohorts

The conditional estimates presented in tables 8 and 9 suggest that the empirical evidence on the relationship between age and numeracy use at work varies substantially across countries and over time. To investigate the unconditional relationship between age and numeracy use at work (that is, the relationship that we observe if we do not condition on the other determinants of numeracy use that were included in the regression model above), we need to consider the average levels of numeracy use at work by age group and country in the two survey periods.

Table 10 includes the average numbers of numeracy use by age group, country and survey period. The numbers in table 10 provide evidence for a quadratic relationship between age and numeracy use at work in all countries and both survey periods. Specifically, the numbers (for the birth cohorts) suggest that the numeracy use levels of younger workers increase as they get older, until age 45 years, and decline after that. Overall, these numbers suggest that the relationship between age and numeracy use at work is broadly similar across countries and time periods.

Table 10 Numeracy use at work by age group and country

	Numeracy use at work by country			
	Australia	New Zealand	United States	Canada
1994–96				
Age 15–24 years (birth cohort 1972–81 in 1996)	199.8	232.0	198.6	220.7
Age 25–34 years (birth cohort 1962–71 in 1996)	238.6	274.1	246.2	250.8
Age 35–44 years (birth cohort 1952–61 in 1996)	232.0	281.1	255.4	236.0
Age 45–54 years (birth cohort 1942–51 in 1996)	220.8	287.2	253.9	229.9
Age 55–64 years (birth cohort 1932–41 in 1996)	204.2	225.7	237.7	200.2
Total	222.1	265.0	242.3	234.2
Number of observations	6 056	2 401	2 086	2 966
2003–06				
Age 15–24 years (birth cohort 1982–91 in 2006)	215.6	160.7	169.4	167.1
Age 25–34 years (birth cohort 1972–81 in 2006)	255.2	222.2	197.7	218.7
Age 35–44 years (birth cohort 1962–71 in 2006)	242.1	242.4	205.2	215.3
Age 45–54 years (birth cohort 1952–61 in 2006)	227.4	225.3	212.8	210.5
Age 55–64 years (birth cohort 1942–31 in 2006)	213.3	202.4	191.9	191.5
Total	233.4	213.6	196.8	203.5
Number of observations	4 612	5 802	2 769	15 665

Notes: Weighted numbers.

Source: International Adult Literacy Survey (IALS); Adult Literacy and Life Skills (ALLS) Survey.

Why might numeracy use have increased in Australia, but declined elsewhere?

The numeracy tasks covered by the skills use measure are more commonly undertaken in small businesses than larger ones; are most commonly undertaken by managers and administrators, but not professionals; and are not undertaken as much by those with the highest level of educational qualifications. From figure 4, they seem to be undertaken by those at the top of the numeracy skill distribution only about as much as by those in the middle of the distribution in most countries. What then, is the nature of these tasks and why might they have increased in Australia?

In part, the tasks seem to be about the business of doing business and of maintaining accounts for that business. They do not seem to involve high-level technical skills such as the pricing of derivatives, the load some structure will bear, or how fast some virus might spread through the population. They seem to encompass account-keeping and aspects of business management – filling in forms to invoice customers and so on.⁶ These are tasks for which it might be imagined that technological change in the form of computerised accounts and payment management packages might have reduced the need, which may be why the conduct of these tasks fell between surveys in New Zealand, Canada and the US. But why might conduct of these tasks have increased in Australia over the same period?

One possible (and speculative) explanation is that from July 2000 a goods and services tax (GST) was introduced into Australia, with increased regular reporting requirements from Australian businesses to the Australian Taxation Office. Such a tax already existed in the other countries. Hence, the increase in conduct of these tasks in Australia may have been something of a ‘catch up’ to the paperwork required in other countries. While there appears to be no substantial literature on the continuing regulatory burden arising from the introduction of the GST in Australia, it seems that its introduction might have had a substantial impact on the set of tasks that employed Australians, and particularly managers in small businesses, undertook in their jobs. While studies point to start-up costs associated with the introduction of the GST (for example, Pope & Rametse 2002), the impact of the GST on the ongoing costs of business has not been studied. One study with results supportive of the activities involved in compliance with the GST is Evans, Carlon and Massey (2005). Their survey of small and medium enterprises indicated that almost all (91%) of them prepared business activity statements and GST reports in-house, while few did their annual tax returns in-house. Since such businesses did not do these specific reports before the introduction of the GST, this was obviously a new and regularly repeated task required in Australian businesses after July 2000.

Summary

- Workers with relatively high numeracy skills use numeracy more often in their jobs than workers with low skills.
- The numeracy use level is increasing, with higher numeracy skills in all countries up, until average numeracy skills are reached, but then changes little in the top of the skills distribution.
- Numeracy skill requirements have increased in Australia and declined substantially in other countries.

⁶ Since our sample includes both employers and employees, we are able to compare numeracy use levels between these two groups. In both years we find that average numeracy use levels of employers are much higher (almost 70 points on the 0–500 scale) than those of employees, suggesting that our numeracy use measure picks up management tasks rather than anything else.

- The average level of numeracy use increases with education for both male and female workers, although the relationship between the two variables seems to be non-linear.
- Some high-skilled workers (such as managers and administrators) make more use of their skills than low-skilled workers (such as plant and machinery operators and drivers). However, not all high-skilled workers undertake these tasks (professionals). These patterns are consistent across countries.
- Full-time employment is positively associated with skill use at work in all countries.
- Employer size has a significantly negative effect on numeracy use in all countries, suggesting that the types of numeracy used at work, as captured in the measure used here, is something of a small business phenomenon.
- The numeracy use levels of younger workers increase as they age, while the numeracy use levels of older workers decline after the age of 45 years. This pattern is consistent across countries.

Conclusions

Despite the potential for the skill levels of workers and the way they use their skills in their jobs to differ substantially across countries, we find the broad match of workers with skills to jobs that use them to be quite similar across the four English-speaking countries studied here: Australia, Canada, New Zealand and the United States. It seems likely that these industrialised countries exploit similar technologies in production and have other institutions that both generate workers with similar skill levels and match those workers to jobs that use those skills. While they have probably been subject to the same broad developments in the adoption of new technologies, they do not exhibit the same patterns of change over time. The use of literacy skills at work increased more in Australia than other countries between the two surveys studied here, although the starting levels were substantially lower in Australia and the change amounted to Australia catching up to the other countries. The experience with numeracy skills was a little different. The use of numeracy skills increased substantially between the surveys in Australia, but fell even more substantially in the other countries. An analysis of the types of tasks captured in the numeracy skills suggested that these were tasks associated with the business of running the business and involved account-keeping and invoicing procedures, for example. It is possible that the introduction of a consumption tax in Australia from 2000, with additional record-keeping requirements for businesses, induced this departure from the experience of the other countries.

The findings drawn from our analysis include:

- *Literacy use:* the relationship between individual skills and skill requirements at work is positive, indicating that relatively high-skilled workers use their skills more often at work than less skilled workers. The relationship between literacy use and document literacy typically increases at a higher rate at lower document literacy levels. The literacy skill requirements of Australian workers have increased substantially, while the change in other countries was either moderate or negative. While higher levels of education are associated with higher skill requirements at work, the way in which educational attainment translates into literacy use is slightly different across countries. In addition, across all countries: full-time jobs provide a greater opportunity to apply literacy skills at work than part-time jobs, and employment in larger establishments is positively associated with increased literacy use, suggesting that large companies tend to require workers to undertake more complex tasks in their jobs. Older workers report considerably higher levels of literacy use at work than the youngest age group, while the decline in literacy use for the older aged is rather moderate.
- *Numeracy use:* Workers with relatively high numeracy skills use numeracy more often in their jobs than workers with relatively low numeracy skills. However, the positive relationship between numeracy skills and their use is less pronounced than the relationship between literacy skills and their use in all countries. Further, while the average level of numeracy use increases with education for both male and female workers, the relationship between the two variables seems to be non-linear. While managers and administrators make more use of their skills than low-skilled workers, other groups of high-skilled workers do not. Full-time employment is positively associated with increased skill requirements at work, while employer size has a significantly negative effect on numeracy use in all countries. Finally, the numeracy use levels of younger workers increase as they get older, while numeracy use levels of older workers typically decline after the age of 45 years. It seems likely that the set of numeracy tasks contained in the data pick out management and account-related job requirements rather than high-order numeracy tasks.

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Support document details

Additional information relating to this research is available in *Differing skill requirements across countries and over time: support document*. It can be accessed from NCVER's website <<http://www.ncver.edu.au/publications/2428.html>>.

Appendix 1 Macroeconomic background

Appendix 2 Definition of variables

Appendix 3 Descriptive statistics

Appendix 4 Construction of scales

Appendix 5 Educational attainment and occupation



National Centre for Vocational Education Research Ltd
Level 11, 33 King William Street, Adelaide, South Australia
PO Box 8288, Station Arcade, SA 5000 Australia
Telephone +61 8 8230 8400 Facsimile +61 8 8212 3436
Website www.ncver.edu.au Email ncver@ncver.edu.au