MINISTRY OF EDUCATION
Te Tāhuhu o te Mātauranga

Literacy and numeracy at work

Skills, education and job tasks

New Zealand Government

Beyond tertiary study

This report forms part of a series called Beyond tertiary study.
Other topics covered by the series include how graduates' earnings change over time, labour market outcomes, education and economic growth, and qualifications and income.

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Acknowledgements
The author gratefully acknowledges comments provided by Sylvia Dixon (Department of Labour).

All views expressed in this report, and any remaining errors or omissions, remain the responsibility of the author.

Published by
Tertiary Sector Performance Analysis and Reporting
Strategy and System Performance
MINISTRY OF EDUCATION

This report is available from the Ministry of Education's Education Counts website:
www.educationcounts.govt.nz

May 2011

ISBN (web) 978-0-478-36757-7

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SUMMARY

Introduction

Around 40 percent of people in employment have literacy and numeracy skills below a level needed to use and understand the increasingly difficult texts and tasks that characterise a knowledge society and information economy, according to the Adult Literacy and Life Skills (ALL) survey. However, there is limited information about how well employees' skills match the literacy and numeracy practices they undertake in their jobs. The ALL survey data can provide some insight to this issue.

This report addresses the following questions:

- What are the different types of literacy and numeracy practices at work?
- How do these literacy and numeracy job practices relate to measures of job type and skill?
- What is the relationship between the skills, qualifications and experience of employees and the literacy and numeracy practices in their jobs?
- What is the extent of match and mismatch between the literacy skills of employees and their literacy and numeracy practices at work?
- What access do people with low skills and frequent literacy and numeracy job practices have to further education and training?

Literacy and numeracy job practices

Three types of literacy and numeracy job practices can be identified using the questions in the ALL survey about the frequency of literacy and numeracy tasks undertaken on the job. These job practices are:

- **Financial literacy and numeracy** – working with bills, invoices and prices
- **Intensive literacy** – reading and writing letters, emails, reports and manuals
- **Practical literacy and numeracy** – reading diagrams and directions, writing directions, measuring and estimating size and weight, and using numbers to keep track of things.

These job practices map well to measures of job type and skill. They map to occupation and industry in a way that would be expected given the kinds of tasks involved in each occupation and industry. The advantage of these measures is that they provide a unique assessment for each individual based on their reported job tasks.

These measures are limited by the questions in the ALL survey, which only asked about the frequency of literacy and numeracy tasks. They do not capture the complexity of the activities.

Relationship to skills, qualifications and experience

Each of the three types of literacy and numeracy job practices has a different relationship to the skills, qualifications and experience of employees. Undertaking frequent financial literacy and numeracy practices at work is strongly related to having high document literacy, rather than qualifications and experience. Undertaking frequent intensive literacy practices at work is

related to having both higher document literacy and higher qualifications. Undertaking frequent practical literacy and numeracy practices at work is strongly related to being male and having high-level vocational qualifications, but not strongly related to document literacy levels.

Skills match and mismatch

It is possible to look at the relationship between literacy skills of employees and their literacy and numeracy job practices. People with low literacy who undertake frequent literacy and numeracy job practices can be considered to have a skills shortfall, and people with low literacy and moderate literacy and numeracy job practices or medium literacy and frequent literacy and numeracy job practices can be considered to have a partial skills shortfall.

People with skills shortfalls and partial shortfalls are spread across industries and occupations. People with management responsibilities are slightly more likely have a skills shortfall or partial shortfall. This reflects the more frequent literacy and numeracy demands of their jobs.

For people with English as a first language, those with qualifications below degree-level are much more likely to be in skills shortfall or partial shortfall. People with English as an additional language are more likely to have skills shortfalls or partial shortfalls, even if they have a degree-level qualification.

Access to education and training

People who have a skills shortfall or partial shortfall are slightly more likely to participate in formal education and training. They are much less likely to participate in non-formal education and training, including employer provided training. Across all groups the most common barriers to participating in training are time, family responsibilities, making it a priority and cost. For those with skill shortfalls, the lack of availability of suitable courses is also a significant barrier.

Conclusion

It is possible to use the information in the ALL survey to look at types of literacy and numeracy job practices and the relationship of these to the skills and qualifications of workers.

The data identifies three distinct types of practices – each of which probably requires a different combination of literacy and numeracy skills.

By comparing literacy levels against job practices, we can examine skill matches and mismatches.

The analysis points to people with managerial responsibilities having more frequent literacy and numeracy job practices, but not necessarily higher levels of literacy skills. This results in a slightly higher incidence of skill shortfalls for managers.

People with English as an additional language are more likely to be in a position of skill shortfall, irrespective of their qualification level.

People in a position of skill shortfall are less likely to participate in non-formal education and training, including employer provided training. The significant barrier to training for them is the unavailability of courses that meet their needs.

1 INTRODUCTION

1.1 Literacy and numeracy skills used at work

Around 40 percent of people in employment have literacy and numeracy skills below a level needed to use and understand the increasingly difficult texts and tasks that characterise a knowledge society and information economy, according to the Adult Literacy and Life Skills (ALL) survey (OECD and Statistics Canada, 2005; Satherley, Lawes and Sok, 2008). However, there has been limited information about how employees skills match with the literacy and numeracy skill tasks they undertake in their jobs. Information on this is important for understanding the extent to which having low literacy and numeracy is a significant issue for job performance and where initiatives to address literacy and numeracy in the workplace can best be targeted.

This report makes use of data from the ALL survey to develop a profile of literacy and numeracy job practices and look at how these match with the skills and experience of employees. The report addresses the following questions:

- What are the different types of literacy and numeracy practices at work?
- How do these literacy and numeracy job practices relate to measures of job type and skill?
- What is the relationship between the skills, qualifications and experience of employees and the literacy and numeracy practices in their jobs?
- What is the extent of match and mismatch between the literacy skills of employees and their literacy and numeracy practices at work?
- What access do people with low skills and frequent literacy and numeracy job practices have to further education and training?

1.2 Research to date

Previous research in New Zealand shows that literacy and numeracy in English are related educational level, and also to other factors including first language and computer use. Literacy and numeracy skills are recognised and rewarded through wages, particularly for people in higher-wage jobs. There is a definite relationship between literacy and numeracy skills of employees and the literacy and numeracy practices of their jobs. However, there are a number of people who appear to be under-skilled or over-skilled for their jobs. People with low literacy and numeracy are less likely to access job-related training, particularly non-formal training.

Factors associated with low literacy and numeracy

Literacy and numeracy skills are related to education level, as well as to other factors.

People who have low literacy and numeracy skills generally have low educational attainment. However, there is a significant group of people with low or no qualifications with adequate literacy and numeracy, and conversely, some people with tertiary qualifications have low literacy and/or numeracy (Ministry of Education 2009, Smyth and Lane 2009 and Lane 2010).

People with low literacy and numeracy in English also include a significant group of recent immigrants with English as an additional language. This includes a significant proportion of people with degree qualifications and above (Earle 2009b and Lane 2010).

Low literacy and numeracy is also strongly associated with not using a computer at home or work. Use of a computer for work is strongly associated with being in a professional, technical or clerical occupation and with undertaking a wider range of regular work activities related to literacy and numeracy (Lane 2010).

Lane (2010) found that it was the combination of education, first language and computer use that most clearly defined the population with low literacy and numeracy skills in English.

Literacy, numeracy and work

The ALL survey shows that there are workers with low literacy and numeracy skills in most industries and occupations in New Zealand. Industries with a larger proportion of workers with low literacy skills include agriculture, manufacturing, transport, retail trade and accommodation and food services. Workers with low literacy skills are more likely to work as labourers, machinery operators and assemblers, drivers, personal service workers, sales workers and agricultural workers (Dixon and Tuya, 2010).

Literacy and numeracy skills are associated with wages. This suggests that the literacy and numeracy skills of workers are generally recognised in their jobs and reflected in their pay. However, this additional recognition is much greater in higher paid job than in low paid jobs. Earle (2009a) found that a one standard deviation difference in literacy or numeracy accounted for, on average, a 20 percent difference in hourly wages. When literacy or numeracy skills and qualifications were considered together, the difference was reduced to around 10 percent. Earle (2010) went on to show that it is people who were in higher wage jobs that gained the most additional benefit from having higher literacy and numeracy skills. For people earning under the median wage, there was a much lower association between skills and wages. Experience was also has a strong association with higher wages in high wage jobs, but not low wage jobs.

Ryan and Sinning (2009a) explored the relationship of literacy and numeracy use at work and literacy and numeracy skills in Australia. They found that workers with higher literacy and numeracy skills used them more often at work than workers with lower skills. They found evidence for increased use of literacy and numeracy at work from 1996 to 2006. Their analysis showed that literacy and numeracy use also increased with educational level. They found that literacy use increased with age and was similar for males and females, while numeracy use decreased in the older age groups and was higher for men than for women.

Lane (2010) found that the number of different types of reading activities undertaken at work was strongly associated with higher levels of literacy and numeracy. Furthermore, people who used computers at work were much more likely to do three or more different types of reading activities. A similar result was found for writing activities. This finding reinforces the idea that of the computer as “the primary literacy and numeracy tool in the modern workplace.”

Skill match and mismatch

There has been very little information available on skills mismatch within employment. The 2008 Business Operations Survey collected information from employers on their perceptions of internal skill shortages. Half of firms in New Zealand reported having staff who were not sufficiently skilled to do their job. Businesses were more likely to report these staff to be in lower skilled occupations, such as labourers, clerical sales and service staff and tradespersons. Lack of experience was the most commonly reported reason for staff not having sufficient skills. Customer service and sales was the most commonly reported area where staff needed to improve their skills. Oral communication was also commonly reported. Written communication and numeracy were less often reported (Statistics New Zealand, 2008).

Krahn and Lowe (1998) used data from the International Adult Literacy Survey to compare the frequency of literacy and numeracy tasks at work with the literacy and numeracy levels of

workers in Canada. They concluded that the majority of Canadians were employed in jobs where the literacy and numeracy practices more or less matched their literacy and numeracy skills. They found the larger mismatched group were those with high literacy and numeracy skills and apparently less frequent literacy and numeracy job tasks.

The first international report on the ALL survey also looked at skills match and mismatch, following the methodology established by Krahn and Lowe (OECD and Statistics Canada, 2005). They found for all six countries that participated in the first round, that there was a good match between literacy and numeracy skills and literacy and numeracy job tasks for the majority of employees. Between 10 to 30 percent of the workforces were under-skilled for the frequency of literacy and numeracy job tasks. Of the six countries covered, those with higher average literacy and numeracy were more likely to have a greater proportion of workers who appeared to be over-skilled for the frequency of literacy and numeracy tasks undertaken in their job.

Ryan and Sinning (2009b) looked at literacy and numeracy use at work relative to literacy and numeracy skills in Australia. They found that workers whose literacy skills were around average had the greatest job complexity relative to their skills. Relative job complexity was lower for low-skilled workers, suggesting that literacy use was less relevant to their jobs. It was also lower for high-skilled workers, suggesting they had few opportunities to apply their high skills in their work. The relationships between numeracy use and numeracy skills revealed a different pattern, with relative demands being highest for the lowest skilled workers.

Access to further education and training

Lane (2010) found that people with higher levels of literacy and numeracy were more likely to have undertaken formal or non-formal education and training in the previous year. Lane also found that people with higher levels of completed education were more likely to participate in education and training. And, at each level of completed education, those who had higher literacy and numeracy skills were more likely to participate in further education and training.

Dixon and Tuya (2010) found that people in employment aged 25 and over were as likely to access formal industry training or provider-based education irrespective of literacy levels. However, lower literacy employees were less likely to access short, non-formal courses and employees with very low literacy were somewhat less likely to attend formal courses. Also low literacy employees who only had school or no qualifications were less likely to participate in formal study.

Ryan and Sinning (2009b) found in Australia that employees with higher educational achievement were more likely to participate in further education and training. However, this effect was not significant for formal education and training. Their findings suggest that workers were more likely to undertake training courses if they had higher literacy or numeracy job practices compared to their literacy and numeracy skills. However, they were only more likely to participate in formal education and training if their literacy job practices were high compared to their skills.

People do not necessarily have a good sense of their own literacy and numeracy skill levels. The ALL survey asked respondents to self rate their ability with “numbers and calculations”. When this self assessment was compared with the actual assessed scores, 73 percent of people with low or very low assessed numeracy rated themselves as being good with numbers and calculations. People who had low numeracy but assessed themselves as being good with numbers and calculations were more likely to participate in formal education, than those with low literacy who had a more realistic assessment of their own skills (Satherley, Lawes and Sok, 2008).

2 LITERACY AND NUMERACY JOB PRACTICES

Using the ALL survey it is possible to develop measures of literacy and numeracy job practices which characterise different types of jobs.

The ALL survey included a set of questions about the reading, writing and mathematics activities that respondents undertook in their main job. Respondents were asked to how often they undertook each activity on a four-point scale from "at least once a week" to "never".[1] These questions provide information on frequency and range of literacy and numeracy activities.

2.1 Previous approaches to analysis

Several approaches have been taken to analysing this information in previous research. Krahn and Lowe (1998) used similar questions from the International Adult Literacy Survey (IALS) 1996 to develop a simple index. The index was constructed by assigning a value from 1 to 5 to each response and taking the average for each respondent across the each of the reading, writing and mathematics tasks.

Lane (2010) looked at the number of regular reading and writing activities that employees undertook. Each questions that a person responded to as "at least once a week" counted as one regular activity. This provided a scale of the range of reading and writing activities undertaken at work.

OECD and Statistics Canada (2005) developed a more sophisticated approach to scaling the data. They created four scales: a reading scale; a writing scale; a numeracy skill and a combined scale. The scales were developed through a three-step process of exploratory factor analysis (to explore and model the data), confirmatory factor analysis (to validate the models and indices) and scale development using the Rasch item response model.

Ryan and Sinning (2009a) also used item response theory to look at this data from both the IALS and ALL surveys. They modelled literacy and numeracy use as unobserved variables that can be measured through their effect on the observed data. They used an extension of Rasch modelling that allows for ordered, multiple response categories. They derived a literacy use scale based on the reading and writing questions and a numeracy use scale based on the mathematics questions.

2.2 Approach used in this study

This study follows a similar analytical path as taken by OECD and Statistics Canada (2005). An exploratory factor analysis was undertaken to explore and model the data. This analysis was conducted across the entire set of 17 activities to establish which groupings of activities were evident within the responses, rather than working from the original categorisation of the questions. This approach led to identifying three underlying factors that represent three different combinations of literacy and numeracy job practices. These factors have been called:

- **Financial literacy and numeracy** – working with bills, invoices and prices
- **Intensive literacy** – reading and writing letters, emails, reports and manuals

[1] Fuller details are the questions are set out in Appendix B .

- **Practical literacy and numeracy** – reading diagrams and directions, writing directions, measuring and estimating size and weight, and using numbers to keep track of things.

Each respondent was scored on these factors according to the answers they provided to the related questions. The scores are presented on a range from 1.0 to 4.5 and represent the frequency of practices at work. A score of 1.0 can be taken to mean never undertaking any of the practices at work and 4.5 as undertaking all of the practices at least once a week.[2]

The document literacy scores from the ALL data have been converted to a standardised scale with a mean of 0 and standard deviation of 1. The standardisation was done across the entire data set, including those aged 16 to 24 and those not in employment. One standard deviation roughly equates to one level on the ALL scale.

This analysis looks just at people aged 25 to 65 who were currently employed at the time of the survey. This excludes younger people who may have been working part-time while studying and/or still building experience in the workforce.

2.3 Strengths and limitations

The advantage of the approach used in this study is that it provides a precise score of job practices for each individual that is independent of other variables, such as occupation, industry and qualifications. These scores are derived from the patterns of literacy and numeracy use reported by respondents. In particular, these scores can be used to examine within occupation differences and how these are distributed by gender, age and other characteristics.

The approach is limited by the nature of the questions. There are three major limitations in the questions.

First is that the most frequent response was "at least once a week", which attracted a very high response rate on number of the questions. It would have been more useful to break this category into "daily" and "one or more times each week". The factoring method used makes some allowance for this problem by not assuming that responses are normally distributed.

Second is that the difficulty or complexity of the activity is not assessed. For example, there could be a vast range in literacy demands for people "writing letters, memos and emails" from basic notes through to formal business correspondence. The factors need to be read as a representation of the type of literacy and numeracy practices workers undertake and not necessary of the difficulty of the activities involved.

Related to this is that the responses may be influenced by the respondent's own level of skill and perception of the activities. For example, a worker with low literacy, who struggles with reading and writing, may report they undertake frequent reading and writing as part of their job. A worker with high literacy doing the same job may consider the same tasks to be too trivial to report as meaningful reading and writing tasks.

[2] Full details of the methodology are available in Appendix B .

3 HOW WELL DO THE LITERACY AND NUMERACY PRACTICE FACTORS MATCH MEASURES OF JOB SKILL?

The purpose of this section is two fold: firstly to validate the literacy and numeracy practice factors; and secondly to better understand the relationship between the factors and measures of job skill. This section looks at how well the three job practice factors match to measures of job skill, including occupational group, occupation skill level, computer use, management responsibility and industry.

MAIN POINTS

The three literacy and numeracy practice factors map well to measures of job skill and differentiate types of job practices across occupations and industries.

Financial literacy and numeracy practices were associated with management, clerical and sales worker occupations. These practices were frequent in the finance and real estate and professional and administrative service industries. They were more frequent in high skill jobs than in very high skill jobs. They had a strong association with the use of a computer and being self-employed with staff.

Intensive literacy practices were associated with professional and management occupations and were frequent in the finance and real estate, professional and administrative services and education and training industries. They were more frequent in high and very high skilled jobs. It was the set of practices most strongly associated with computer use and was associated with managing staff.

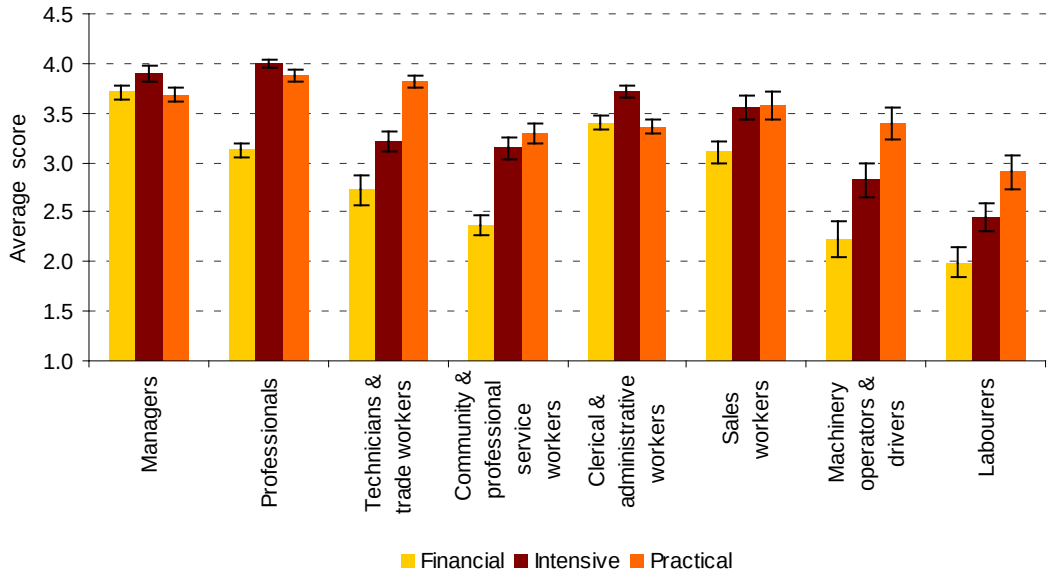
Practical literacy and numeracy practices were associated with professional and technical and trade worker occupations. Of the three sets of practices, it was the most frequent in the manufacturing and construction industries. These practices were more frequent in medium to very high skilled jobs. It was the set that was least associated with computer use at work and was also associated with staff management responsibilities.

3.1 Occupational group

The distribution of the job practice factors by occupation provides a validation of the factors. If the job practice factors are valid, they should line up with occupations where those kinds of practices would be expected to occur. This analysis also shows differences within and between occupational groups for different types of practices. Figure 1 shows the relationships of job practices by broad occupational groups. The relationships for more detailed occupational groups are presented in Appendix A .

Financial literacy and numeracy practices were most frequent for managers, followed by clerical and administrative workers and sales workers. The more detailed occupational groups (see Figure 27) show that it was a less frequent practice for farm managers than for other managers. In other occupational areas it was most frequent for business, human resource and marketing professionals, personal assistants and secretaries and numerical clerks.

Figure 1
Relationship between occupation groups and job practice factors



Note: The error bars show the 95 percent confidence interval for the estimate.

Intensive literacy was most frequent in professional and management occupations, and to a lesser degree in clerical and administrative and sales occupations. The more detailed occupational groups (see Figure 28) show that the practices were similarly frequent across management and professional occupations, with the exception of lesser frequency for farm managers. Other occupations with a frequent intensive literacy practices included engineering, ICT and science technicians, electrotechnology and telecommunications trades workers, health and welfare support workers, protective service workers, office managers, personal assistants and secretaries and sales representatives and agents.

Practical literacy and numeracy was most frequent in professional and technical and trade worker occupations. It was a more frequent than the other two factors for machinery operators and drivers and labourers. The more detailed occupations groups (see Figure 29) show that the occupations where it was most frequent were design, engineering, science and transport professionals and electrotechnology and telecommunications trade workers.

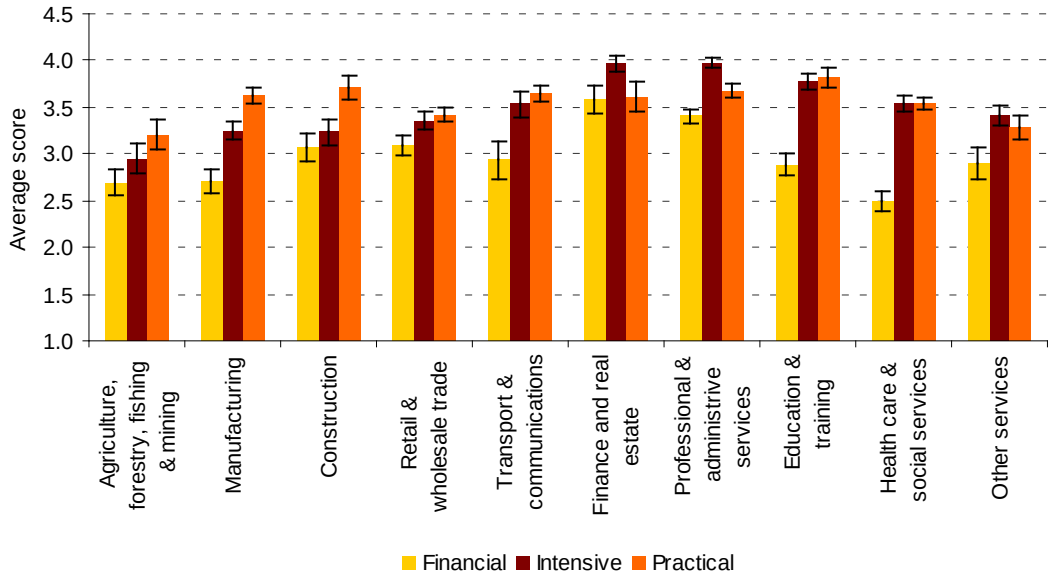
3.2 Industry

Industry provides a different view of jobs based on the types of products and services being produced. Figure 2 shows the relationship between the job practice factors and industry groupings.

Financial literacy and numeracy was more frequent in finance and real estate and professional and administrative services. It also showed up as a frequent practice in retail and wholesale trade and construction.

Intensive literacy was a frequent practice in finance and real estate, professional and administrative services and education and training. It also showed up as a frequent practice in transport and communications and health care and social services.

Figure 2
Relationship between occupation groups and job practice factors



Note: The error bars show the 95 percent confidence interval for the estimate.

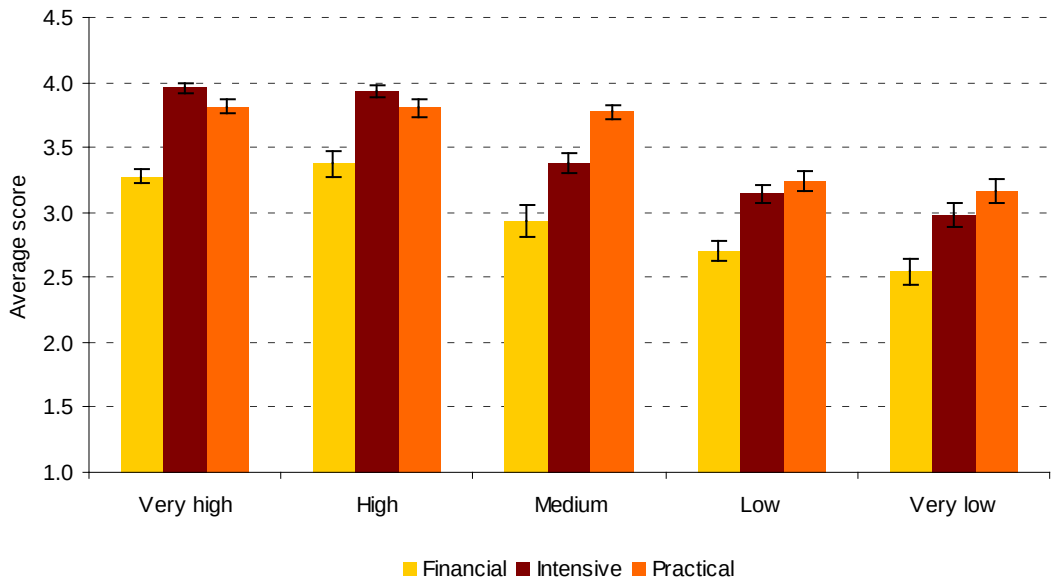
Practical literacy and numeracy was the most frequent of the three practice factors in manufacturing and construction. It also showed up as quite frequent in transport and communication and education and training.

3.3 Occupational skill level

The Australia New Zealand Standard Classification of Occupations includes a skill indicator for each occupation. This indicator ranges from 1 for very high skilled jobs to 5 for very low skilled jobs. It has been allocated based on the level of qualifications required for the occupation. It is mapped at the lowest level of the classification, so that occupations within the same broad group can have different skill ratings.

Figure 3 shows the relationships between the three job practice factors and the occupation skill indicator. Financial literacy and numeracy practices were slightly more frequent in jobs with skill level 2 than level 1 and less frequent in lower skilled jobs. Intensive literacy practices were most frequent in levels 1 and 2 and less frequent in lower skilled jobs. Practical literacy and numeracy practices were similar across levels 1 to 3 and somewhat less frequent in level 4 and 5.

Figure 3
Relationship between occupation skill and job practice factors

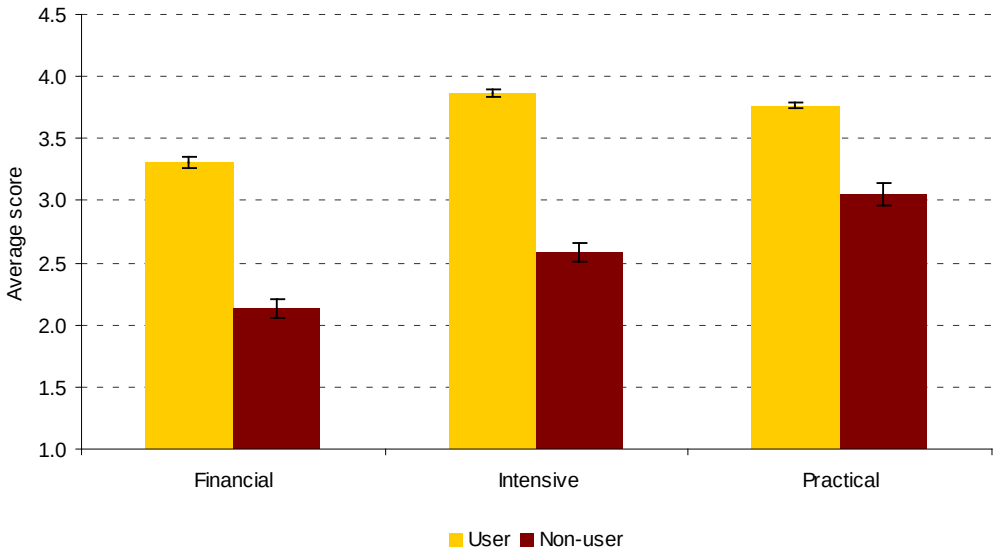


Note: The error bars show the 95 percent confidence interval for the estimate.

3.4 Computer use at work

As discussed in section 1.2, Lane (2010) found that using a computer at work was a strong indicator of literacy skills. Figure 4 shows that for each job practice factor there was a large difference in the average score between those who do and do not use a computer at work. The difference was largest for intensive literacy practices and smallest for practical literacy and numeracy practices. This reinforces Lane's analysis of the relationship between computer use and range of regular reading and writing tasks.

Figure 4
Relationship between computer use at work and job practice factors



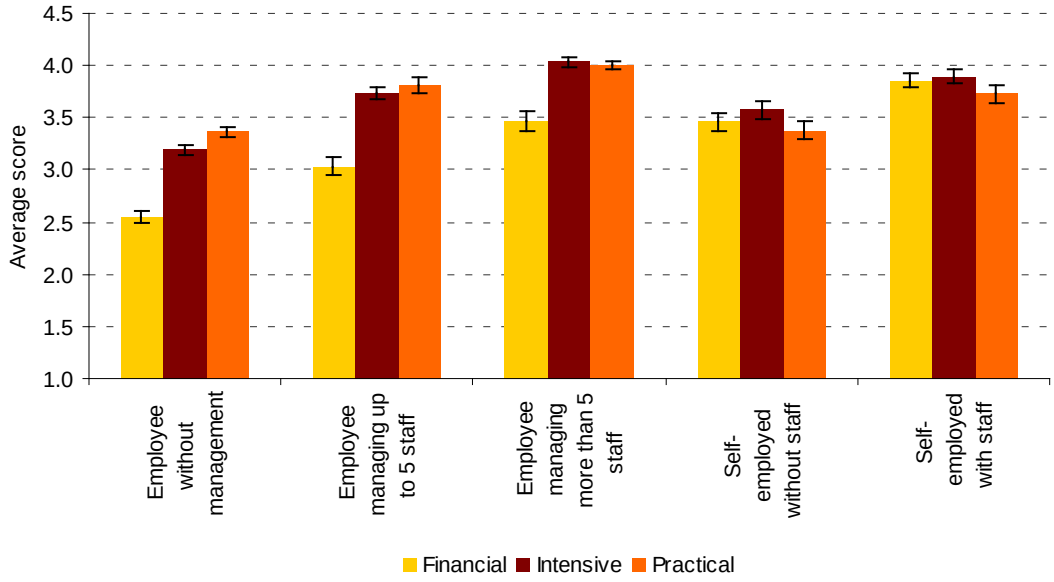
Note: The error bars show the 95 percent confidence interval for the estimate.

3.5 Management responsibility

The ALL survey also included information on the type of management responsibilities that people had. This included a distinction between employed and self-employed. Figure 5 shows that job practice factors varied according to the type of management responsibility and showed definite relationships of the job practice factors to the level of management responsibility. The relationships for those without management responsibilities were averaged out across the range of jobs involved.

Financial literacy and numeracy practices were most frequent people in self employment with staff. Intensive literacy practices were most frequent for employees managing more than five staff, followed by self-employed with staff. Practical literacy and numeracy practices were most frequent for people with management responsibilities.

Figure 5
Relationship between management responsibilities and job practice factors



Note: The error bars show the 95 percent confidence interval for the estimate.

4 SKILLS, QUALIFICATIONS AND EXPERIENCE

This section looks at the relationship between the skills, qualifications and experience of employees and their literacy and numeracy practices at work. It examines the extent to which these characteristics of employees predict the likelihood of undertaking more frequent literacy and numeracy practices at work, as measured by each factor.

MAIN POINTS

Document literacy was the strongest predictor of whether people were more likely to undertake **financial literacy and numeracy** practices at work. Qualification level and experience, as measured by age, had some effect. However, these effects were much weaker once document literacy was controlled for.

Document literacy was also a strong predictor of whether people were more likely to undertake **intensive literacy** practices at work. The relationship was strongest for people with below-average literacy. Qualification level also had an effect, even once document literacy was controlled for. Experience had a fairly weak effect.

Qualification level and gender were the strongest predictors of whether people were more likely to undertake **practical literacy and numeracy** practices at work. Document literacy had a weak effect. This may reflect higher incidence of these practices in trade and technical occupations, which are male dominated and have specific qualification entry requirements. People with English as an additional language were slightly less likely to undertake practical literacy and numeracy practices at work than those with English as a first language, even after controlling for document literacy in English. This was not the case for the first two factors.

4.1 Financial literacy and numeracy

Figure 6 shows the relationship between literacy and numeracy scores and financial literacy and numeracy job practices. It shows that there was a positive relationship between having higher literacy or numeracy scores and being in a job with more frequent financial literacy and numeracy practices.

In the middle range of ALL skill scores, there is a similar relationship across all three domains to the frequency of financial literacy and numeracy practices at work. The interesting differences emerge for those with very high skills (more than one standard deviation above the mean). For those with high document literacy the frequency of practices continued to increase, while for those with high prose literacy, the frequency of practices flattened out. Numeracy followed an intermediate path. This suggests that having high document literacy is the best predictor of being in a job with frequent financial literacy and numeracy practices.

Figure 6
Relationship between literacy and numeracy scores and financial literacy and numeracy job practices

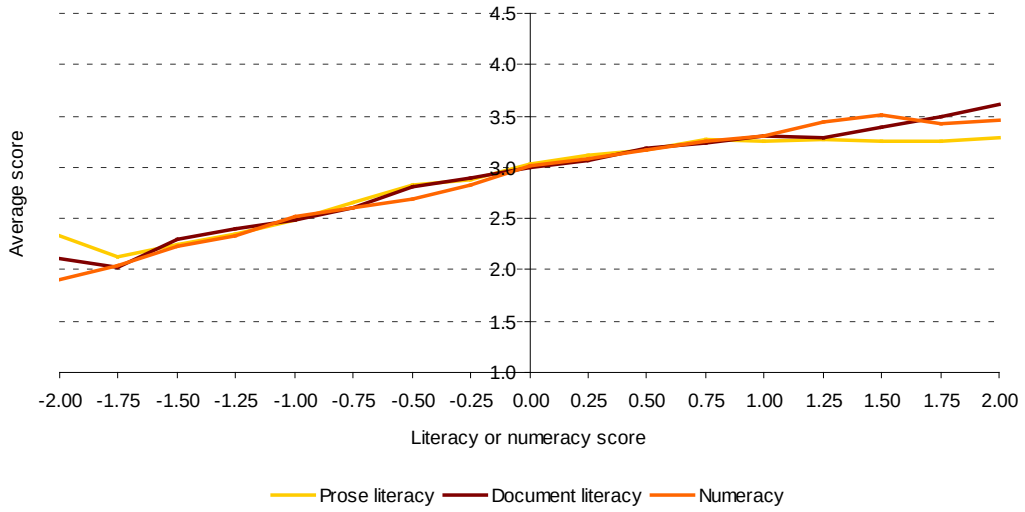
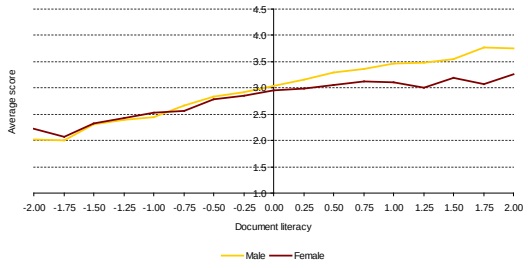


Figure 7 shows the relationship between document literacy and the frequency of financial literacy and numeracy job practices by gender. The figure on the left shows the observed (or unadjusted values) from the data. It shows that for both men and women with document literacy below the average, the frequency of financial literacy and numeracy job practices were the same on average. For those with document literacy above the mean, men are likely to have more frequent financial literacy and numeracy job practices than women.

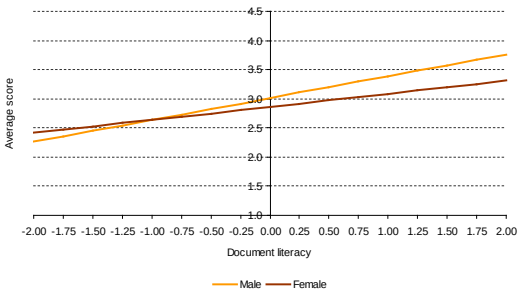
The figure on the right shows the predicted (or adjusted values) once qualifications and age were controlled for. These results show a similar relationship, particularly for men. This suggests that document literacy is an important determinant of working in a job with frequent financial literacy and numeracy practices, particularly for men.

Figure 7
Relationship between document literacy and financial literacy and numeracy job practices by gender

Observed values



Controlling for other factors



Note: Modelled values are the result of a regression which controlled for document literacy, age, gender and qualification level. Reference group was people aged 35 with a level 4 certificate. First language was not statistically significant.

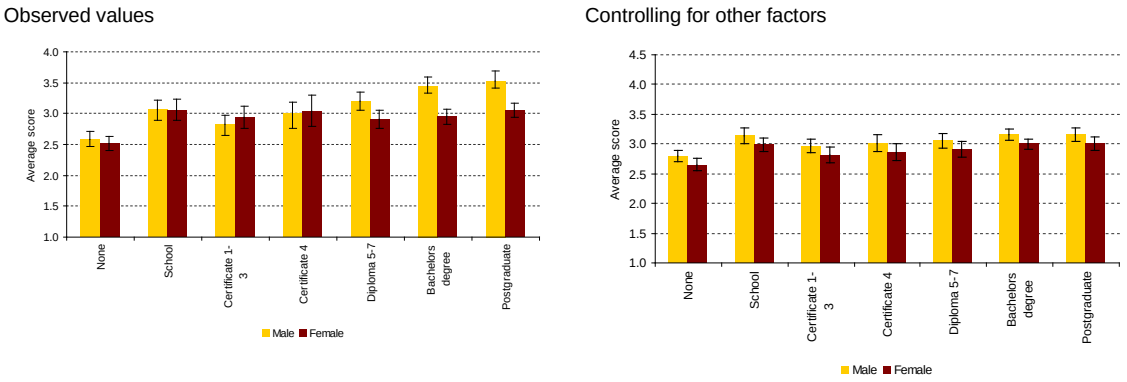
Figure 8 shows the relationship between the highest qualification attained and the frequency of financial literacy and numeracy job practices, by gender. The figure on the left shows the observed values from the data. It shows that men with diplomas, bachelors degrees and postgraduate degrees were much more likely to work in jobs requiring financial literacy and numeracy practices, than those with lower or no qualifications. For women, the relationship was much weaker and the only significant difference was between those with and without qualifications.

The figure on the right shows the predicted values once document literacy and age were taken into account. The results shows a very weak relationship between qualifications and job practices for men and women. The result suggests that qualifications per se are not the main determinant of being in a job with frequent financial literacy and numeracy practices. The major determinant in the model was document literacy skills.

The ALL survey only collected data on the highest level of qualification and did not include field of study. If the fields of study of educational qualifications were known and controlled for, specific qualifications might show up as a stronger predictor.

Figure 8

Relationship between qualifications and financial literacy and numeracy job practices by gender

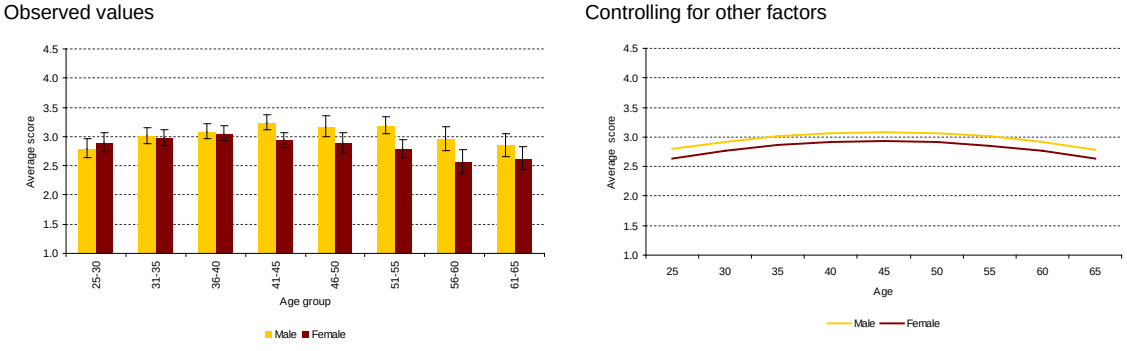


Note: Modelled values are the result of a regression which controlled for document literacy, age, gender and qualification level. Reference group was people aged 35 with average document literacy. First language was not statistically significant. The error bars show the 95 percent confidence interval for the estimate.

Figure 9 shows the relationship between age and the frequency of financial literacy and numeracy job practices by gender. Age is used here as a proxy for experience. The figure on the left shows the observed values from the data. It shows that for men, those aged 40 to 55 were most likely to undertake financial literacy and numeracy practices at work. For women the peak age was around 35 to 40. The figure on the right shows the values having controlled for other factors, including document literacy. It shows a similar overall relationship. The relationship was slightly weaker once other factors were taken into account.

Figure 9

Relationship between age and financial literacy and numeracy job practices by gender



Note: Modelled values are the result of a regression which controlled for document literacy, age, gender and qualification level. Reference group was people with level 4 certificates and average document literacy. First language was not statistically significant. The error bars show the 95 percent confidence interval for the estimate.

4.2 Intensive literacy

Figure 10 shows the relationship between literacy and numeracy scores and intensive literacy job practices. It shows that there was a positive relationship between having higher literacy or numeracy scores and being in a job with more frequent intensive literacy practices.

In the middle range of scores, there is a similar relationship across all three domains to the frequency of intensive literacy practices at work. As with financial literacy and numeracy, the interesting differences emerged for those with very high skills (more than one standard deviation above the mean). For those with high prose literacy, the average frequency of job practices flattened out, while for those with high document literacy the average frequency of job practices continued to increase. This suggests that having high document literacy is the best predictor being in a job with frequent intensive literacy practices.

Figure 10
Relationship between literacy and numeracy scores and intensive literacy job practices

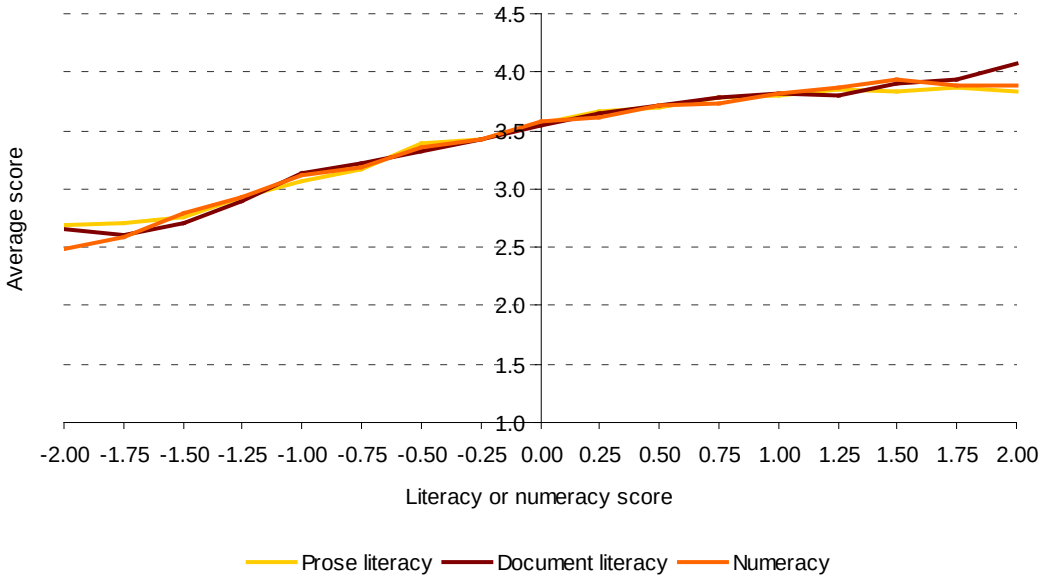
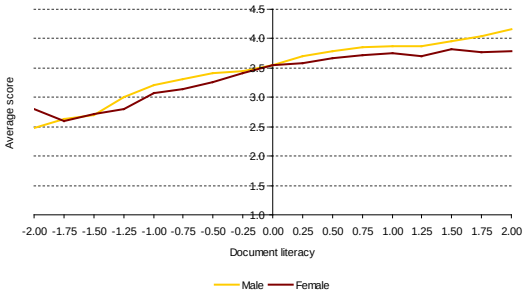


Figure 11 shows the relationship between document literacy and the frequency of intensive literacy job practices by gender. The figure on the left shows the observed from the data. It shows that for both men and women the frequency of intensive literacy practices increased with document literacy. This relationship was stronger for those with below average document literacy than for those with above average document literacy.

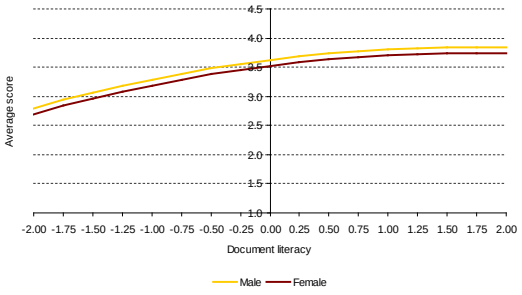
The figure on the right shows the predicted values once qualifications and age were controlled for. These results confirm that the curvilinear relationship, where differences were greater at the lower end than at the upper end.

Figure 11
Relationship between document literacy and intensive literacy job practices by gender

Observed values



Controlling for other factors



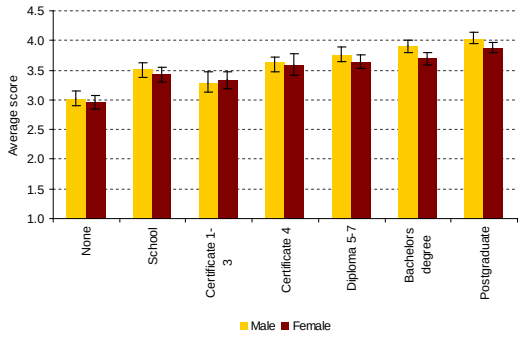
Note: Modelled values are the result of a regression which controlled for document literacy, age, gender and qualification level. Reference group was people aged 35 with a level 4 certificate. First language was not statistically significant.

Figure 12 shows the relationship between the highest qualification attained and the frequency of intensive literacy job practices, by gender. The figure on the left shows the observed values from the data. It shows that the average frequency of job practices increased steadily with qualification level. The only exception is for level 1 to 3 tertiary certificates, where the average job practices were lower than for those with school qualifications only. At all levels, women tended to have slightly less frequent intensive literacy practices in their jobs on average, although the differences are generally not statistically significant.

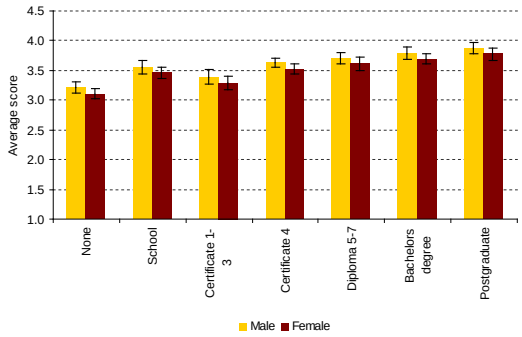
The figure on the right shows the predicted values once document literacy and other characteristics are taken into account. The results show a weaker relationship with qualification level and persistent gap between men and women. Looking at the effects of literacy and qualifications together suggests that both are important to being in a job with frequent intensive literacy practices.

Figure 12
Relationship between qualifications and intensive literacy job practices by gender

Observed values



Controlling for other factors

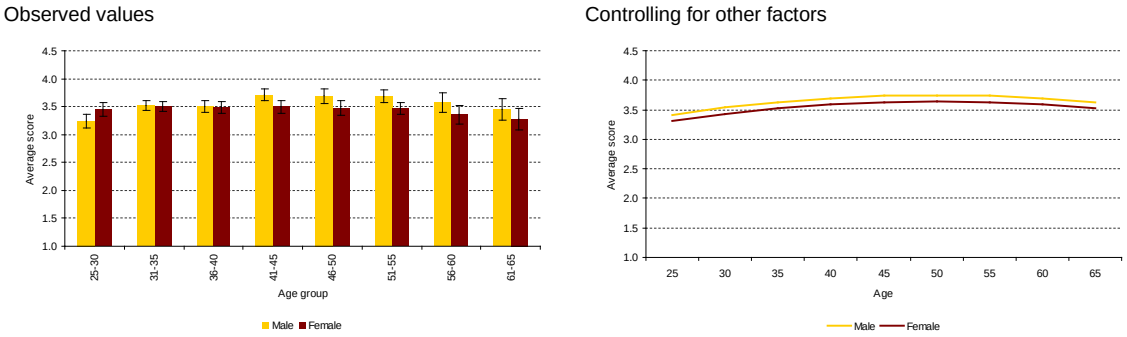


Note: Modelled values are the result of a regression which controlled for document literacy, age, gender and qualification level. Reference group was people aged 35 with average document literacy. First language was not statistically significant. The error bars show the 95 percent confidence interval for the estimate.

Figure 13 shows the relationship between age and the frequency of intensive literacy job practices by gender. The figure on the left shows the observed values from the data. It shows a small increase in job practices by age, which peaked in the 41 to 55 year old age group, with men having a greater likelihood of undertaking intensive literacy and numeracy practices at work than women in this age range. The figure on the right shows the predicted values from the regression model. This shows that age is a small but significant predictor of intensive literacy job practices, even once document literacy and qualifications are controlled for.

Figure 13

Relationship between age and intensive literacy job practices by gender



Note: Modelled values are the result of a regression which controlled for document literacy, age, gender and qualification level. Reference group are people with level 4 certificates and average document literacy. First language was not statistically significant. The error bars show the 95 percent confidence interval for the estimate.

4.3 Practical literacy and numeracy

Figure 14 shows the relationship between literacy and numeracy scores and practical literacy and numeracy job practices. The relationships are strongest for those with literacy or numeracy levels ranging from very low to average. For these people, the graph follows a similar pattern to the previous two factors. The relationship flattens out for people with above average literacy or numeracy, unlike the previous two factors. There is little to no variation across the domains.

Figure 14

Relationship between literacy and numeracy scores and practical literacy and numeracy job practices

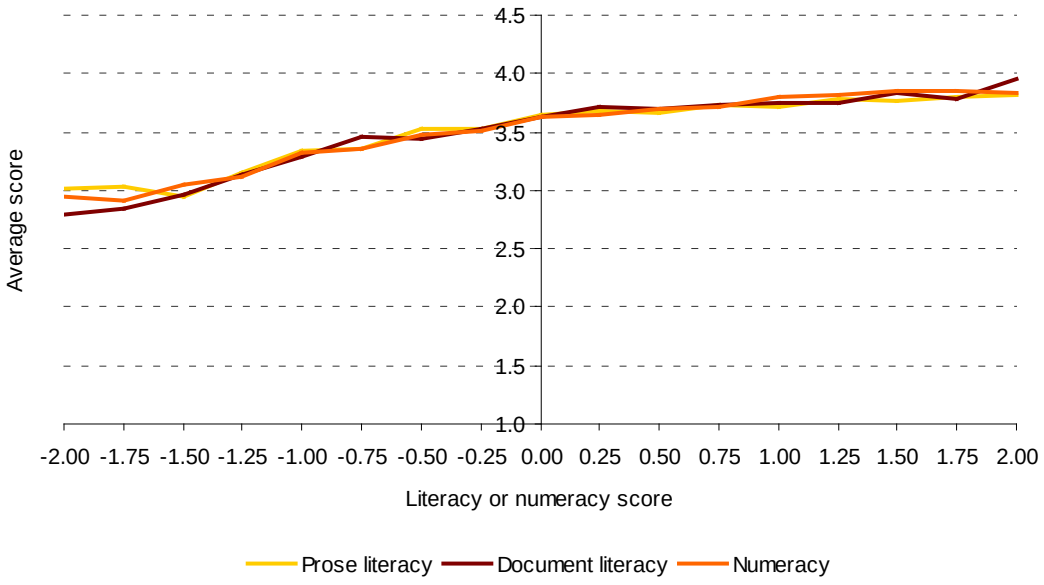


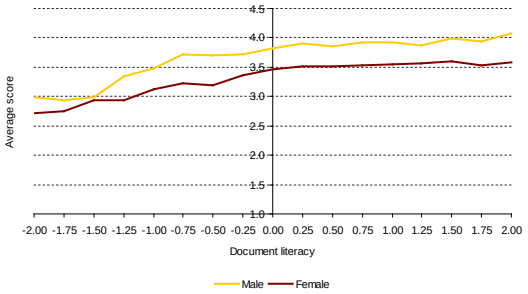
Figure 15 shows the relationship between document literacy and the frequency of practical literacy and numeracy job practices by gender. The figure on the left shows the observed values from the data. It shows that for those with below average document literacy, practical literacy and numeracy job practices increased with document literacy. For those with above average document literacy there is little to no relationship. This was true for both men and women. Overall, men were likely to have more frequent practical literacy and numeracy practices in their jobs.

The figure on the right shows the predicted once qualifications and age are controlled for. These results show a similar relationship to the observed data.

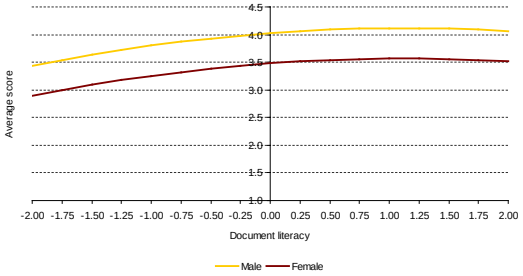
Figure 15

Relationship between document literacy and practical literacy and numeracy job practices by gender

Observed values



Controlling for other factors



Note: Modelled values are the result of a regression which controlled for document literacy, age, gender and qualification level. Reference group was people aged 35 with a level 4 certificate and English as a first language.

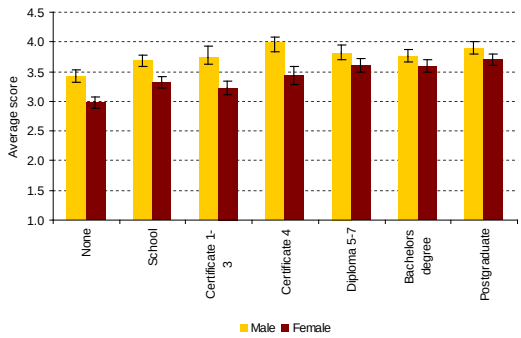
Figure 16 shows the relationship between highest qualification achieved and the frequency of practical literacy and numeracy job practices, by gender. The figure on the left shows the observed values from the data. It shows that at each level of qualification, including no qualifications, men were much more likely than women to undertake practical literacy and numeracy job practices. The group with the most frequent practices were men with level four certificates, which includes qualifications for entry to most trade occupations. The group with the least frequent practices were women with no qualifications. This reflects a pattern of occupations with frequent practical literacy and numeracy job practices having a majority male workforce and those with less frequent job practices having a majority female workforce.

The figure on the right shows the predicted values once document literacy and other characteristics are taken into account. The results show a similar pattern and strength of relationship between qualifications and gender and practical literacy and numeracy job practices. The model suggests that the combination of qualification level and gender is as, if not more important than the level of document literacy. This is consistent with the weaker relationship to document literacy reported above.

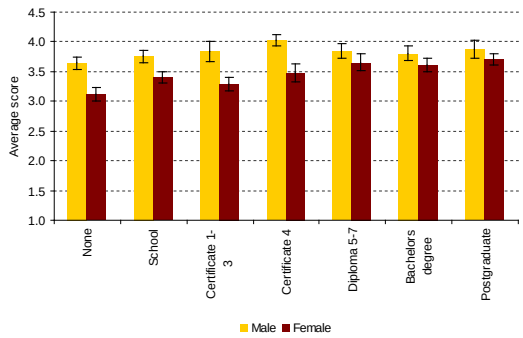
Figure 16

Relationship between qualifications and practical literacy and numeracy job practices by gender

Observed values



Controlling for other factors

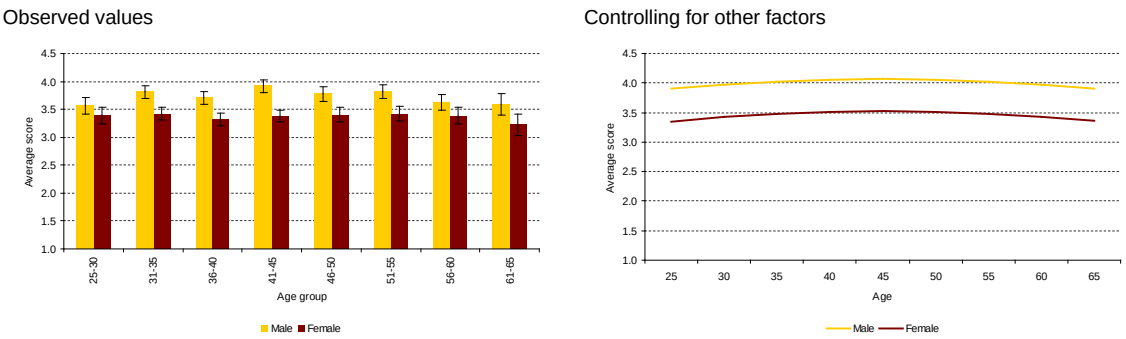


Note: Modelled values are the result of a regression which controlled for document literacy, age, gender, first language and qualification level. Reference group was people aged 35 with average document literacy and English as a first language. The error bars show the 95 percent confidence interval for the estimate.

Figure 17 shows the relationship between age and the frequency of practical literacy and numeracy job practices by gender. The figure on the left shows the observed values from the data. It shows some increase in practical literacy and numeracy job practices for men with age, which tails off for older men. The gap between men and women is very evident in this graph, with there being little relationship to age for women. The figure on the right shows the predicted values from the regression model. This confirms there is a small relationship to age. However, the gender differences are much greater than age differences.

Figure 17

Relationship between age and practical literacy and numeracy job practices by gender



Note: Modelled values are the result of a regression which controlled for document literacy, age, gender, first language and qualification level. Reference group are people with level 4 certificates, average document literacy and English as a first language. The error bars show the 95 percent confidence interval for the estimate.

A difference was also found in the frequency of practical literacy and numeracy job practices by first language, which persisted even once document literacy in English and qualifications were controlled for. After controlling for those factors, the average score for people with English as an additional language was about 0.13 lower than for people with English as a first language. That is, people with English as an additional language are likely to undertake slightly fewer practical literacy and numeracy practices at work on average than people with English as a first language, even when comparing people with the same qualifications and English literacy skills. This effect was not found to be statistically significant for the other two factors.

5 SKILLS MATCH AND MISMATCH

MAIN POINTS

It is possible to explore the skills match and mismatch of people to their jobs by comparing their literacy skills and job practices. Using this approach we estimate that 41 percent of people in employment were well matched to the literacy and numeracy skill practices in their work. People with low literacy skills and highly frequent literacy and numeracy job practices can be described as having a skills shortfall. We estimate that 9 percent of people in employment had a skills shortfall on one or more of the job practice scales and a further 33 percent may have had a partial skills shortfall.

Workers with skills shortfalls and partial shortfalls were spread across industries and occupations. The construction and retail and wholesale trade industries had the largest proportion of workers with a skills shortfall or partial shortfall.

People with management responsibilities were slightly more likely to have a skills shortfall or partial shortfall. The results suggest that people with management responsibilities have more frequent literacy and numeracy job practices but not necessarily higher document literacy skills.

There was very little difference in the distribution of skills matches and mismatches by age. While there was little overall difference between men and women, differences were more evident by qualification level.

For people with English as a first language, people with qualifications below degree-level were much more likely to have a skills shortfall or partial shortfall than those with degrees or higher. People with English as an additional language were more likely to have a skills shortfall or partial shortfall than people with English as a first language, even if they had a degree-level qualification.

5.1 Skills shortfall and skills excess

The previous section established that there was a clear set of relationships between literacy, qualifications and experience and literacy and numeracy job practices. These were evident on average across the population. However, there is also considerable interest in understanding the groups for whom these relationships do not hold true. That is, those who have relatively low literacy and highly frequent literacy-related job practices and those who have high literacy and infrequent literacy-related job practices.

People with low literacy and highly frequent literacy-related job practices can be considered as having a skills shortfall. This group can be identified with some certainty from the ALL data – in that they have responded as undertaking a range of regular literacy and numeracy activities. Some caution does need to be exercised in that ALL does to capture the complexity of the tasks. For example it does not differentiate between doing simple repeated tasks or complex irregular tasks.

People with high literacy and infrequent literacy-related job practices can be considered as having a skills excess. There is an international literature which focuses on this group as being at risk of skill decline, according to the 'use it or lose it' proposition (Krahn and Lowe 1998 and de Grip et al 2008). Evidence from longitudinal studies does support the hypothesis that highly skilled people working in lower skilled job can have reduced cognitive functioning over time (de Grip et al 2008). However, the ALL survey does not provide sufficient information to

identify which workers are at risk of skills decline. Within the group of people identified as having high literacy and infrequent literacy-related job practices, there will be a number of people using other high-level skills which were not captured in the survey. There will also be people who choose to not to work in a high-demand job to balance other life demands, such family. They may obtain mental stimulation from their activities outside of work. Also, as the survey is cross sectional, it only shows current skill level. Those whose literacy skills have declined due to lack of use are more likely to show up in the 'matched' group.

Within the New Zealand policy context, the greater interest is in the skills shortfall group. These are workers whose lack of skills could be holding back productivity and growth.

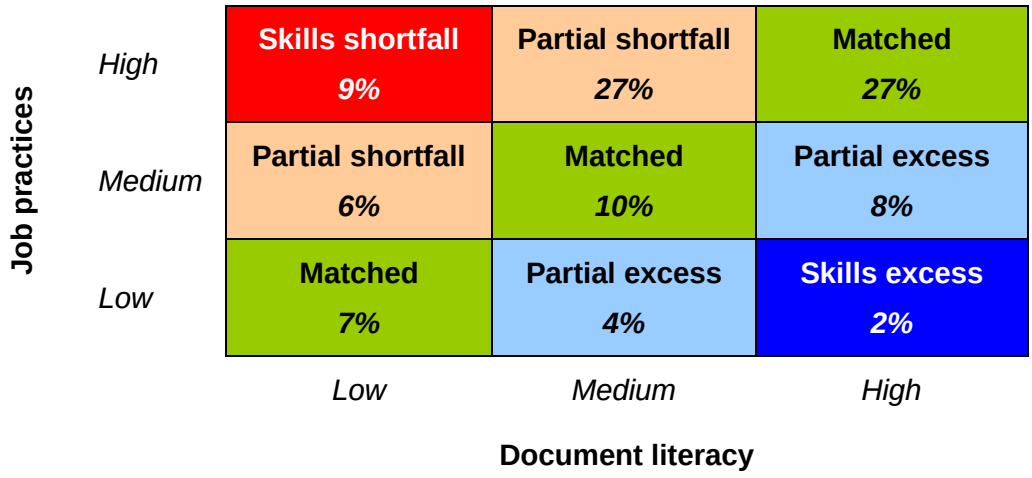
5.2 Identifying mismatch

This section uses the job practice scores to provide a general picture of where mismatches between skills and job practices may be found, and the characteristics of the people in those circumstances, particularly those in skills shortfall.

The match and mismatch between skills and job practices were identified using a three by three grid as shown in Figure 18. Job practices and document literacy scores were divided into low, medium and high, with respondents allocated to one of the nine categories. Those with low literacy and highly frequent job practices are described as having a "skills shortfall" and those with high literacy and infrequent job practices are described as having a "skills excess." Those whose literacy category matched their job practices category are described as "matched". The remained are described as having "partial shortfall" or "partial excess".

The upper and lower cut points for medium document literacy skills was set at plus and minus half a standard deviation from the population mean. For those in employment, this produced groups that were roughly 20 percent (low), 40 percent (medium) and 40 percent (high). The cut points for medium frequency job practices were set at 3.0 and 4.0. 4.0 and above represents undertaking all of the tasks in the literacy and numeracy practice set at least once a week. Below 3.0 represents undertaking the tasks only occasionally, if at all.

Figure 18
Match and mismatch of literacy and job practices



Note: Percentages are for the overall skills match.

These points were chosen based on examination of the distributions. While they are reasonably meaningful, they are arbitrary. Choosing different ranges would produce different results. The

purpose of the analysis is to establish the relative pattern of distributions. It doesn't provide absolute measures of shortfalls and excesses.

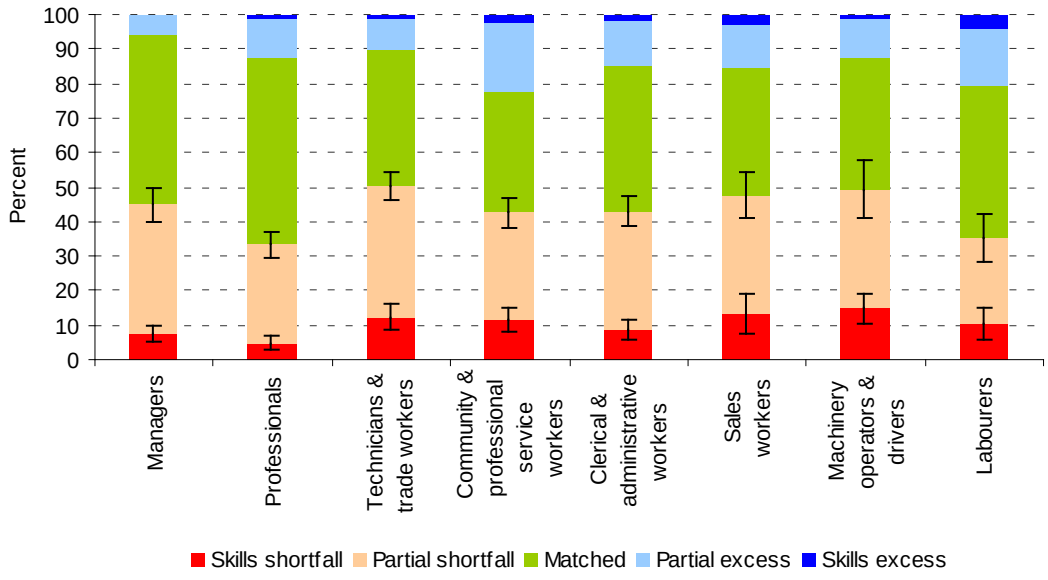
This analysis was undertaken for each of the three job-practice factors. The distribution of matches and mismatches by job and worker characteristics was generally similar. Therefore, the analysis presented in this section uses an overall indicator of skills match. This indicator assigns the minimum value for each person across the three results, where "skills shortfall" is treated as the lowest position and "skills excess" as the highest position. This indicator is weighted towards identifying who have a skills shortfall or partial shortfall on at least one job practice scale.

Using this overall indicator, it is estimated 9 percent of the workforce has a skills shortfall, 33 percent has a partial shortfall, 41 percent is matched, 12 percent has a partial excess and 2 percent has a skills excess. The distribution varies by occupation, industry and management level, as well as employee characteristics.

5.3 Job characteristics

Figure 19 shows the distribution of skills matches and mismatches across occupations. All occupations had at least 30 percent of workers with a skills shortfall or partial shortfall in one or more the job practice areas. People working as professionals or labourers were less likely to have a skills shortfall or partial shortfall than people in other occupations. Most occupations had 10 percent or more of workers with a skills shortfall. The lowest proportions were in professional and manager occupations.

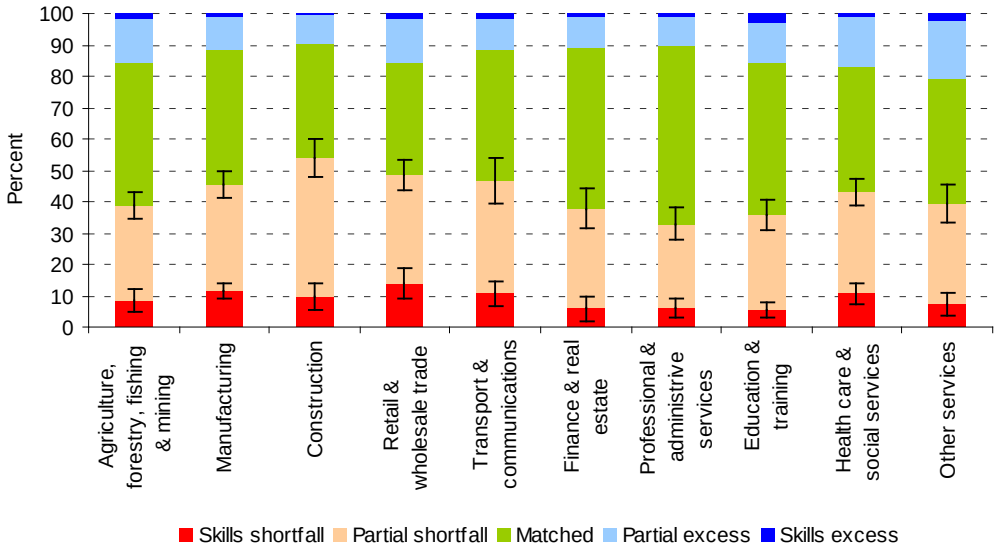
Figure 19
Distribution of overall skills match and mismatch by occupation



Note: The error bars show the 95 percent confidence interval. The bars for the partial shortfall category are the error on the combined proportion of "skills shortfall" and "partial shortfall".

Figure 20 shows the distribution of skills matches and mismatches across industries. All industries had at least 35 percent of workers with a skills shortfall or partial shortfall. Construction had the largest proportion of workers with a skills shortfall or partial shortfall. Retail and wholesale trade had the largest proportion with a skills shortfall.

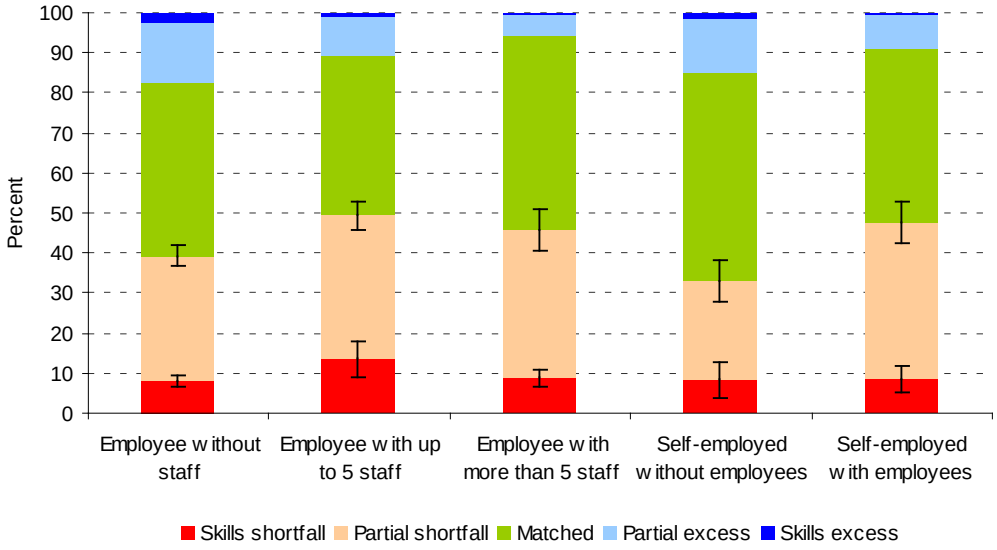
Figure 20
Distribution of overall skills match and mismatch by industry



Note: The error bars show the 95 percent confidence interval. The bars for the partial shortfall category are the error on the combined proportion of "skills shortfall" and "partial shortfall".

Figure 21 shows the distribution of skills matches and mismatches by type of management responsibility. People who manage five or fewer staff or were self employed with staff were more likely to have a skills shortfall or partial shortfall. The proportions were lower for people without staff management responsibilities, whether employed or self employed. When the results were looked at for each job practice factor, they very closely matched the average job practices of people in each position, as shown in Figure 5 above. This suggests that people with management responsibilities have more frequent literacy and numeracy job practices but not necessarily higher document literacy skills.

Figure 21
Distribution of overall skills match and mismatch by management responsibility



Note: The error bars show the 95 percent confidence interval. The bars for the partial shortfall category are the error on the combined proportion of "skills shortfall" and "partial shortfall".

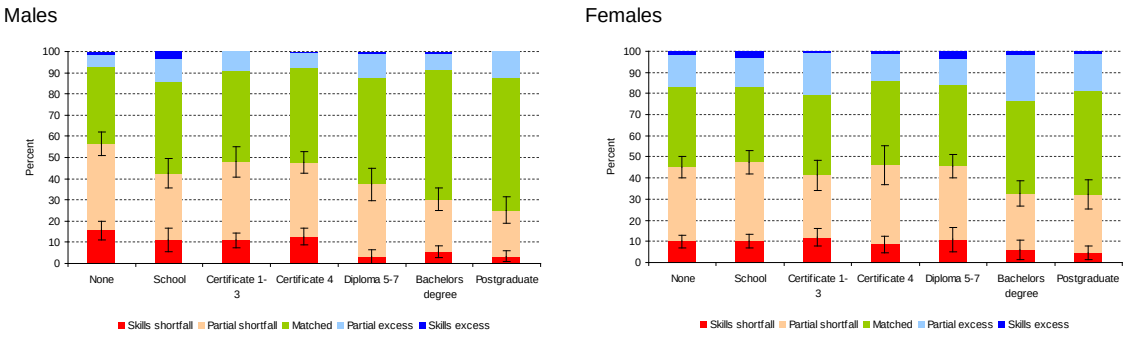
5.4 Employee characteristics

There was very little difference in the distribution of skills matches and mismatches by age. However, differences by gender and first language are evident.

Overall, 42 percent of both men and women had a skills shortfall or partial shortfall, while 18 percent of women had a skills excess or partial excess compared with only 10 percent of men. Gender differences are more evident when looked at by qualification level, as shown in Figure 22. Men with no educational qualifications were more likely to have had a skills shortfall or partial shortfall than women with no qualifications. Men with school qualifications or tertiary certificates are more likely to have had a skills shortfall or partial shortfall than higher qualified men. For women, the proportion with a skills shortfall or partial shortfall was similar from no qualifications through to diploma level.

Figure 22

Distribution of overall skills match and mismatch by gender and highest qualification



Note: The error bars show the 95 percent confidence interval. The bars for the partial shortfall category are the error on the combined proportion of "skills shortfall" and "partial shortfall".

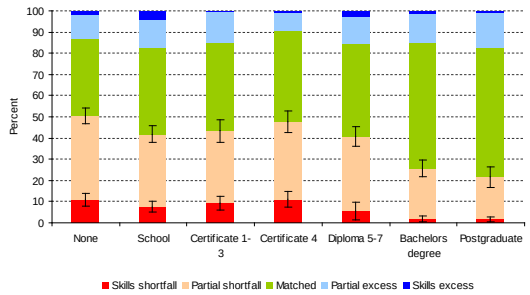
Twenty-two percent of people with English as an additional language were estimated to have a skills shortfall in at least one job practice area compared with only 7 percent of those with English as a first language. Only 37 percent of people with English as an additional language were in the matched group, compared with 45 percent of those with English as a first language. This reflects document literacy being measured in English. However, most jobs in New Zealand require employees to be able to perform tasks in English.

The differences between first languages showed up more clearly when looking at the distributions by qualification level. Figure 23 shows the distribution of skill matches and mismatches by first language and qualification. For people with English as a first language, the highest proportion with skills shortfalls and partial shortfalls were those with qualifications below degree-level. For people with English as an additional language, there was a large proportion with skills shortfalls and partial shortfalls at all qualification levels, including those with degrees and postgraduate qualifications.

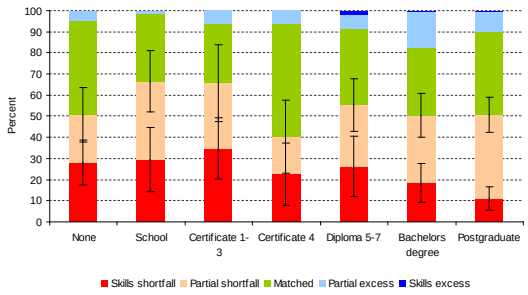
Figure 23

Distribution of overall skills match and mismatch by first language and highest qualification

English



Other



Note: The error bars show the 95 percent confidence interval. The bars for the partial shortfall category are the error on the combined proportion of “skills shortfall” and “partial shortfall”.

6 SKILLS MATCH AND UPSKILLING

This final chapter looks at the extent to which people with skills shortfalls are able to access opportunities for further training and upskilling. It starts by looking at the extent to which each match or mismatch group feels confident in their current work skills, then looks at the extent of participation on formal and non-formal education and training, and concludes with barriers to accessing work-related training and education.

MAIN POINTS

People with a skills shortfall or partial shortfall were less likely to say they have enough reading, writing and maths skills to do their job well. The area they felt least skilled in was maths.

People with a skills shortfall or partial shortfall were slightly more likely to participate in formal education than those whose skills were matched to their job. However, they were much less likely to participate in non-formal education and training, including employer-provided training.

People with a skills shortfall were slightly less likely to have undertaken the job-related training that they had wanted to do. The main barriers for them were time constraints, personal or family responsibilities, training not being a high priority and courses not matching needs. Courses not matching needs was a much larger barrier for this group than for the rest of the workforce.

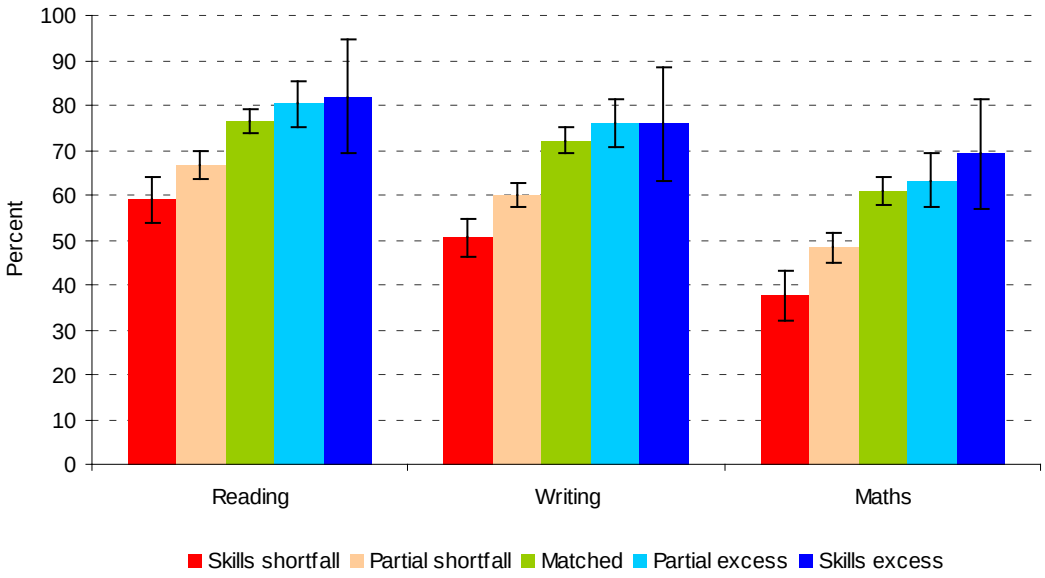
People with a skills excess also appeared less likely to have engaged in non-formal education and training than those with a skills match. While this group was less interested in training overall, those who did want to participate were more likely to say high cost, lack of confidence or preparedness and personal health were significant barriers. This suggests that being in a position of skills excess could be related to personal circumstances that constrain access to high-skilled employment, such as ongoing health problems.

6.1 Confidence in job-related skills

The ALL survey asked respondents the extent to which they agreed that they had the reading, writing and maths skills to do their job well. Figure 24 shows the proportions of each skills match and mismatch group who strongly agreed they had enough skills for their job.

In each area, people with a skills shortfall or partial shortfall were less likely to say they had the reading, writing or maths skills to do their job well than those who were matched or had a skills excess. People with a skills shortfall or partial shortfall were more confident about their reading skills than about their writing or maths skills.

Figure 24
Proportion of people in employment who strongly agreed they had the reading, writing or maths skills to do their job well



Note: The error bars show the 95 percent confidence interval for the estimate.

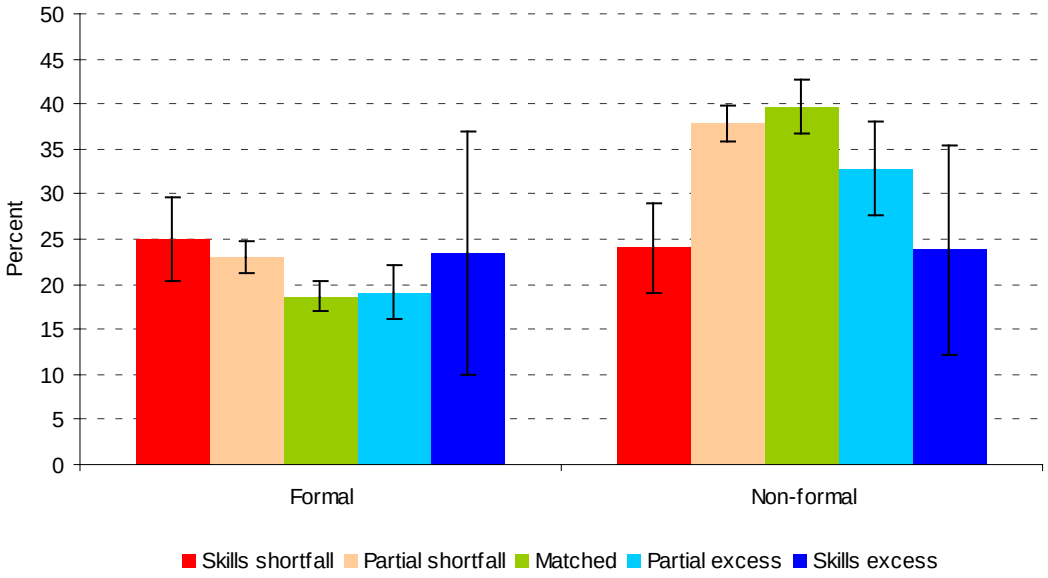
6.2 Participation in formal and non-formal education and training

The ALL survey asked respondents if they had participated in formal education (leading to a qualification) or non-formal education and training (not part of a qualification) within the last twelve months. Non-formal education and training includes work-based training coursed organised and/or paid for by the employer. Figure 25 shows the proportion who participated in each type of education and training for each skill match and mismatch group.

People with a skills shortfall or partial shortfall were slightly more likely to participate in formal education than those with a skills match. For non-formal education and training, those with skills shortfalls were least likely to participate, while those with a skills match were most likely to participate. People with a skills excess were also less likely to participate in non-formal education and training.

These findings concur with Dixon and Tulay (2010) who found that people with low document literacy skills were as likely as other employees to participate in formal education, but much less likely to access non-formal education.

Figure 25
Proportion reporting participating in formal and non-formal training in previous twelve months

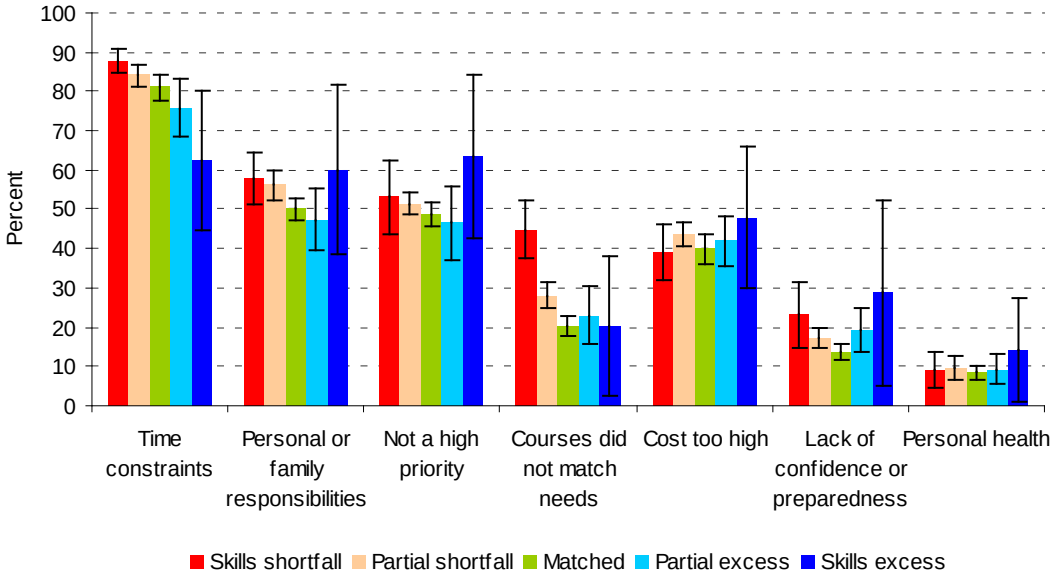


Note: The error bars show the 95 percent confidence interval for the estimate.

6.3 Barriers to job-related education and training

Around 41 percent of people in work said that they had wanted to undertake training or education for career or job-related reasons but did not. This proportion was lower for those with skills excesses or partial excesses at 34 percent.

Figure 26
Reasons for not undertaking career or job-related training



Note: The error bars show the 95 percent confidence interval for the estimate.

Figure 26 shows the proportion of people who did not take the training or education they wanted to who reported various reasons for not doing so.

The most common reason overall for no doing training or education was time constraints. This was a more frequent reason for people with skills shortfalls and less frequent for people with skills excesses. Personal or family responsibilities and training not being a high priority were the next most common reasons, with frequency being fairly similar across all groups. Courses not matching needs the next most common reason for people with a skills shortfall, much more so than any other group. Cost, lack of confidence or preparedness and personal health were more commonly given as reasons by people with skills excesses. This suggests that being in a position of skill excess could be related to personal circumstances that constrain access to high-skilled employment, such as ongoing health problems.

7 CONCLUSION

It is possible to use the information in the Adult Literacy and Life Skills survey to look deeply the types of literacy and numeracy practices undertaken at work. The literacy and numeracy job-task questions in the survey can be used to identify different groups of job practices which relate well to occupation, industry and skill-level.

Each type of job practice has a different relationship to literacy, qualifications and experience. Being in a job with frequent financial literacy and numeracy practices is related to having high levels of document literacy, but less strongly related to qualifications. Being in a job with frequent intensive literacy practices is related to both document literacy and qualification levels. Being in a job with frequent practical literacy practices is mostly related to qualification level and gender.

The ALL data suggests that 40 percent of people in employment have literacy and numeracy skills below a level needed to use and understand the increasingly difficult texts and tasks that characterise a knowledge society and information economy. By comparing literacy levels to the frequency of literacy and numeracy job practices, we can estimate that about 9 percent of people in employment have low literacy and high frequency literacy and numeracy job practices. A further 33 percent have either low literacy and medium frequency job practices or medium literacy and high frequency job practices. This suggests that within the 40 percent of people with lower levels of literacy and numeracy, there is a small group whose skills fall short of the what may be needed for their jobs and a larger group who may have difficulty performing some aspects of their jobs.

People whose literacy skills were low compared with their job practices were spread across occupations and industries. There was a slightly higher incidence of mismatch among managers, who have a higher frequency of literacy and numeracy job practices on average than people without staff responsibilities. Some people with bachelors degrees and above can be in the situation of having low literacy compared to their job practices. Most of these people have English as an additional language.

People with low literacy compared to their job practices are as likely to access formal training as other people in employment. They are much less likely to access informal training, including training organised by employers. A significant barrier to further training for them is the unavailability of courses that meet their training needs.

APPENDIX A DISTRIBUTION OF JOB PRACTICES

Figure 27
Average score for financial literacy and numeracy by occupation

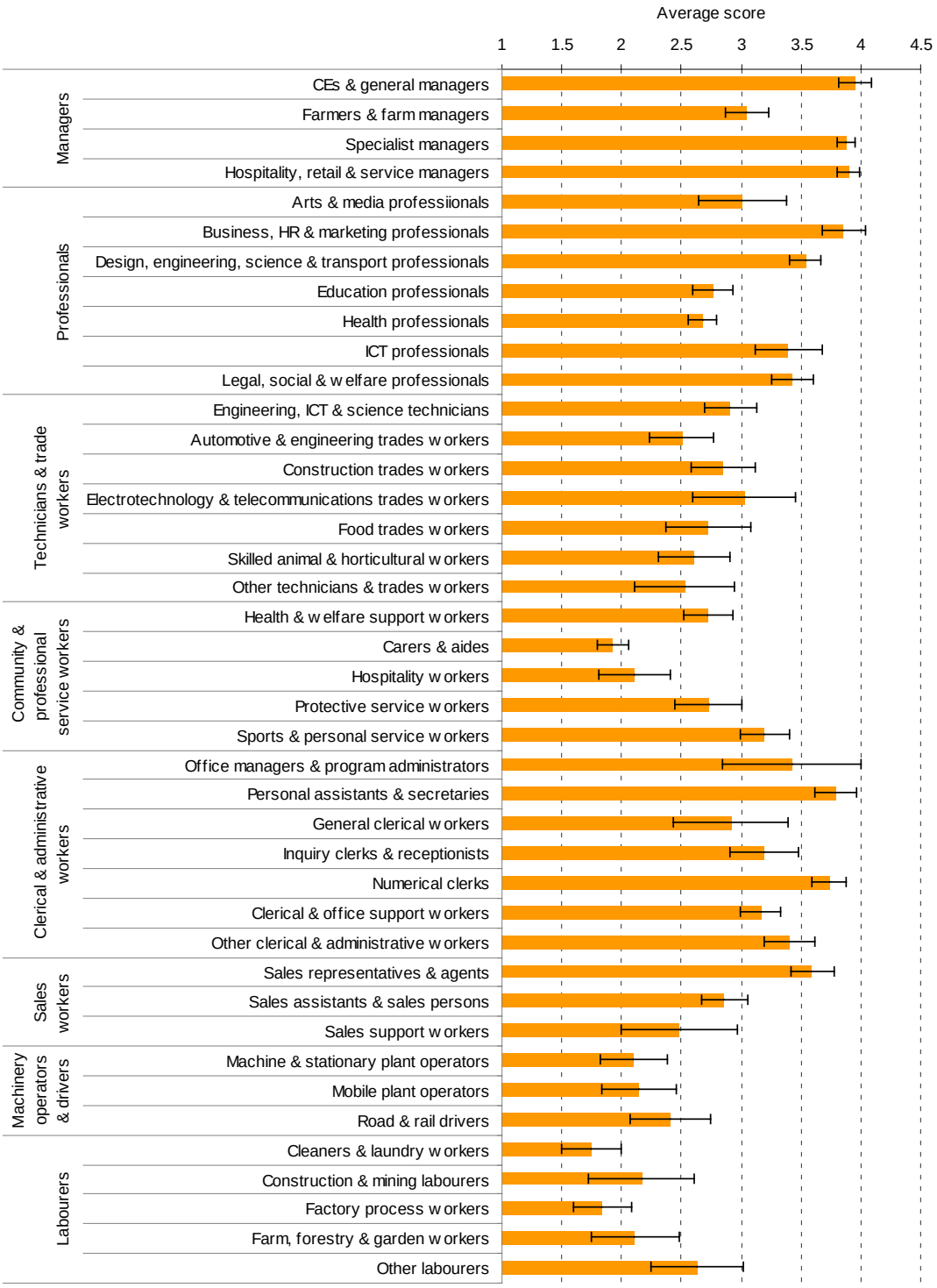


Figure 28
Average score for intensive literacy by occupation

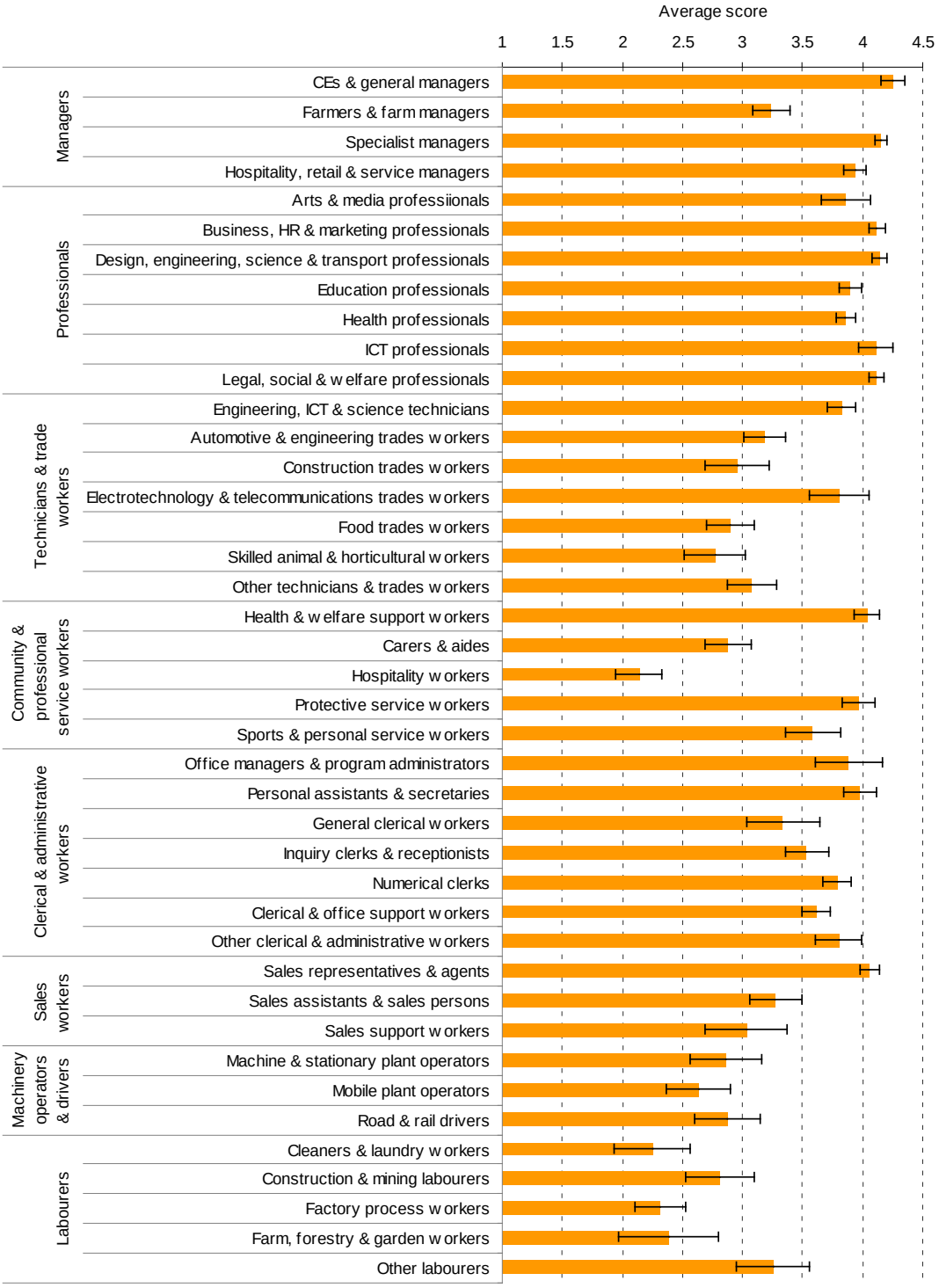
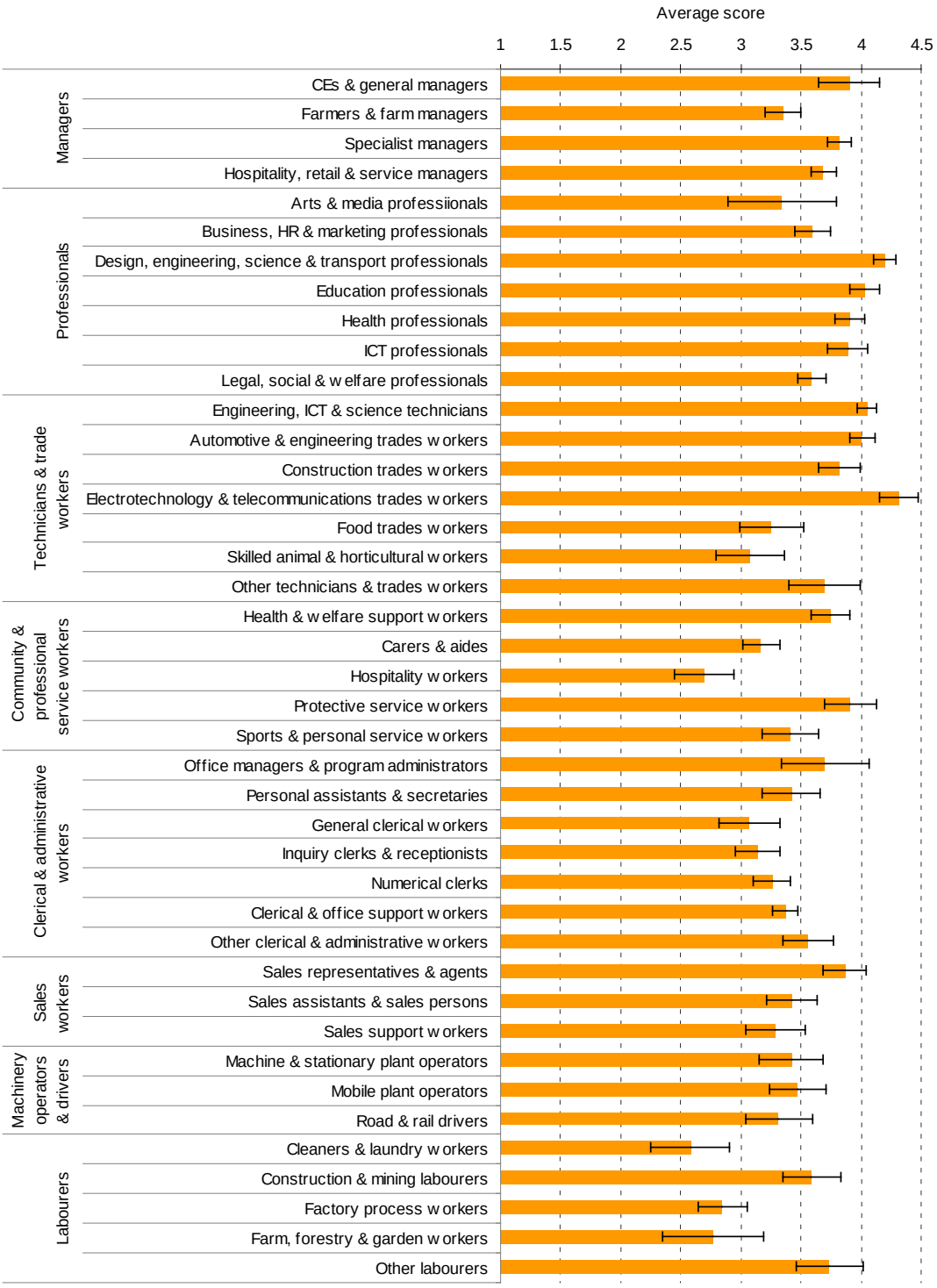


Figure 29
Average score for practical literacy and numeracy by occupation



APPENDIX B MODELING THE JOB-PRACTICE SCORES

The data

The ALL survey included a set of questions about reading, writing and mathematics activities in the main job of the respondent. These include activities done on paper and on computer. The questions ask how often the activity was undertaken, with response options being "at least once a week", "less than once a week", "rarely" or "never". The activities listed were:

Read or use information from:

- Letters, memos or e-mails
- Reports, articles, magazines or journals
- Manuals or reference books including catalogues
- Diagrams or schematics
- Directions or instructions
- Bills, invoices, spreadsheets or budget tables

Write or fill in:

- Letters, memos or e-mails
- Reports, articles, magazines or journals
- Manuals or reference books including catalogues
- Directions or instructions
- Bills, invoices, spreadsheets or budget tables

Do any of the following:

- Measure or estimate the size or weight of objects
- Calculate prices, costs or budgets
- Count or read numbers to keep track of things
- Manage time or prepare timetables
- Give or follow directions or use maps or street directions
- Use statistical data to reach conclusions

The data was recorded in a four point scale. For analysis, 4 represented "at least once a week" and 1 represented "Never". Table 1 shows the descriptive statistics for the responses. Responses to most of the questions are heavily skewed towards the top end, that is "at least once a week". Most of them had quite large values for kurtosis, an indication that responses fail to fit a normal distribution.

Table 1
Descriptive statistics of variables

Variable	Mean	Standard deviation	Skewness	Kurtosis
Read letters etc	3.35206	1.13416	-1.33401	0.00435
Read reports etc	3.16920	1.17773	-0.95786	-0.77241
Read manuals etc	3.11820	1.14654	-0.85687	-0.85164
Read diagrams	2.66186	1.25224	-0.18175	-1.61440
Read directions	3.30999	1.03349	-1.17956	-0.07970
Read bills and spreadsheets etc	2.76952	1.32003	-0.35267	-1.65455

Write letters etc	3.08319	1.26009	-0.82583	-1.11362
Write reports etc	2.62528	1.27366	-0.15527	-1.65478
Write manuals etc	2.09910	1.16009	0.56567	-1.17998
Write directions	2.76178	1.23307	-0.31246	-1.53208
Write bills and spreadsheets etc	2.52682	1.32531	-0.03374	-1.75814
Measure and estimate	2.59813	1.31980	-0.09349	-1.74761
Calculate prices	2.65913	1.31075	-0.20390	-1.70362
Count or read numbers	3.54200	0.94340	-1.88943	2.06530
Manage time	3.14714	1.21859	-0.92983	-0.89326
Give or follow directions or maps	2.75068	1.22730	-0.29878	-1.52689
Use statistical data	2.36445	1.23038	0.18036	-1.56747

Model development

The factor model was developed in two stages: an exploratory factor analysis to explore and model the data and a confirmatory factor analysis to validate the models and generate the scores.

Both the exploratory factor analysis and the confirmatory factor analysis used the full data set of 5939 records. There is a view that the data set should be divided, with each procedure run on separate subsets. This was not done for two reasons. The data set is very large, so the possibility of model misspecification through random chance is low. The complex survey design used in the survey can introduce unknown biases into subsamples.

In both stages, the analysis was undertaken from the polychoric correlation matrix. The polychoric correlations are more reliable with scale data that has less than 5 values.

Exploratory factor analysis

An exploratory factor analysis was undertaken (using PROC TCALIS in SAS). All 17 variables were used and solutions involving one through to four factors were tested for fit[3] and interpretability. The four factor solution was chosen as providing good fit and interpretable factors. While the fit statistics continued to improve with more than four factors, each factor became more narrowly focused on specific questions, which decreased the usefulness of this approach as a data reduction technique.

Table 2
Measures of model fit for exploratory factor analysis

Statistic	Desired level	One factor	Two factors	Three factors	Four factors
Standardised Root Mean Square Residual	<0.05	0.0873	0.0652	0.0333	0.0273
Root Mean-Square Error of Approximation	<0.05	0.1892	0.1562	0.1313	0.1156

The factors were extracted using maximum likelihood estimation obliquely rotated using the oblique varimax option.

Table 3 shows the factor loadings for the initial four factor solution. The highest loadings for each factor are highlighted in bold. Factor 1 relates to financial tasks, factor 2 to reading a range of material and writing letters and emails, factor 3 to writing substantive documents and factor 4 to practical literacy and numeracy tasks.

[3] Residual indexes were used to test fit. The chi-square statistic was significant in all cases, reflecting the large size of the dataset.

Table 3
Rotated factor loadings for initial exploratory factor analysis

Variable	Factor1	Factor2	Factor3	Factor4
Read letters, emails etc	0.1115	**0.9827**	-0.0933	-0.0194
Read reports etc	0.0417	0.5989	0.3181	0.0269
Read manuals etc	0.0051	0.3860	0.4526	0.1756
Read diagrams	-0.0027	0.2358	0.4353	0.2934
Read directions	-0.1250	0.2378	0.4004	0.3494
Read bills and spreadsheets etc	**0.8135**	0.1680	0.0458	-0.0125
Write letters, emails etc	0.2829	**0.6530**	0.1681	-0.1303
Write reports etc	0.1121	0.2258	**0.6811**	-0.1027
Write manuals etc	0.2210	-0.0097	**0.7210**	0.0130
Write directions	0.1318	0.1171	0.5676	0.1476
Write bills and spreadsheets etc	**0.9380**	-0.0059	0.1373	-0.0697
Measure and estimate	-0.0101	-0.1283	-0.0051	**0.7354**
Calculate prices	**0.6623**	0.0725	-0.0672	0.2902
Count or read numbers	0.2911	0.1602	-0.0844	**0.6232**
Manage time*	0.2156	0.1774	0.2432	0.3041
Give or follow directions or maps*	0.0587	0.1833	0.1631	0.3946
Use statistical data*	0.2149	0.2556	0.3046	0.2237

The last three items had low loading across all four factors, without much differentiation across factors. The factor model was rerun without these items. The results showed little change to the loadings of the remaining items on the factors. This suggests that these items are not essential to the formation of the factors.

Table 4
Rotated factor patterns for final exploratory factor analysis

Variable	Factor1	Factor2	Factor3	Factor4
Read letters, emails etc	0.1099	**0.9686**	-0.0761	-0.0007
Read reports etc	0.0420	0.5924	0.3231	0.0517
Read manuals etc	0.0040	0.3809	0.4614	0.2093
Read diagrams	0.0016	0.2422	0.4324	0.3090
Read directions	-0.1171	0.2379	0.4093	0.3535
Read bills and spreadsheets etc	**0.7962**	0.1762	0.0609	0.0154
Write letters, emails etc	0.2822	**0.6484**	0.1772	-0.1250
Write reports etc	0.1172	0.2306	**0.6721**	-0.0961
Write manuals etc	0.2201	-0.0044	**0.7199**	0.0362
Write directions	0.1366	0.1239	**0.5695**	0.1498
Write bills and spreadsheets etc	**0.9209**	0.0063	0.1499	-0.0458
Measure and estimate	-0.0105	-0.1152	0.0040	**0.7470**
Calculate prices	**0.6499**	0.0871	-0.0466	0.2911
Count or read numbers	0.2904	0.1746	-0.0582	**0.5970**

The covariance matrix for the final exploratory factor model is shows that there is low correlation between these factors, which suggests they have a good degree of discriminant validity.

Table 5
Rotated Factor Covariance Matrix

	Factor1	Factor2	Factor3	Factor4
Factor1	1.0000			
Factor2	0.5262	1.0000		
Factor3	0.3452	0.6462	1.0000	
Factor4	0.2895	0.2822	0.3441	1.0000

Confirmatory factor analysis

The exploratory factor analysis results were used to build a confirmatory model. In the first model, the variables with the highest loadings in the exploratory model were loaded to each factor, so as no variable was loaded to more than one factor. The four factors were covaried with each other. This produced a model that had moderately poor fit with the data and high correlations between factors (greater than 0.7).

The factor modification indices were then used to select variables to load onto more than one factor. This was done incrementally and resulted in small improvements to model fit. As it proceeded, correlations between most factors decreased to below 0.7, with the exception of factors 2 and 3, which increased to 0.9.

The next stage was to treat factors 2 and 3 as one factor describing both reading and writing activities. The first version of the model used one to one matches only, collapsing the variables for factors 2 and 3 onto a single factor. The factor modification indices were then used to select variables to load onto more than one factor. The selection was also informed by the relationship of the variable to the factor. This process resulted in the three factor model displayed below. The factors have moderate correlations with one another. The final model has moderate fit with the data (SRMSR=0.0695, RMSEA=0.0797).

Table 6
Factor loadings for final confirmatory factor analysis model

Variable	Factor1 Financial	Factor2 Intensive literacy	Factor3 Practical literacy and numeracy
Read letters, emails etc	0	0.8981	0
Read reports etc	0	0.8793	0
Read manuals etc	0	0.5567	0.3744
Read diagrams	0	0.2578	0.6137
Read directions	0	0	0.8270
Read bills and spreadsheets etc	0.9597	0	0
Write letters, emails etc	0	0.8968	0
Write reports etc	0	0.8148	0
Write manuals etc	0	0.7291	0
Write directions	0	0.4076	0.4396
Write bills and spreadsheets etc	0.9396	0	0

Measure and estimate	0	-0.3126	0.6583
Calculate prices	0.7685	0	0
Count or read numbers	0.3865	0	0.3892

Table 7
Rotated Factor Covariance Matrix

Variable	Financial	Intensive	Practical
Financial	1.0000		
Intensive	0.7440	1.0000	
Practical	0.4567	0.6741	1.0000

The data was scored against the factor model to generate the practice scores. The scoring was done on the unstandardised values in the data. This produced scores in the range from 1.0 to 4.5. 1.0 can be read as meaning never undertaking the set of literacy and numeracy practices at work and 4.5 as undertaking all of the practices in the set at least once a week.

APPENDIX C REGRESSION MODELS

The regression results shown in chapter 4 are from ordinary least squares regressions that use the job practices variable as the dependent variable and age, qualifications and document literacy as the independent variables. First language was also tested in each model and was only significant in one of them.

The models were run using PROC SURVEYREG in SAS. The procedures were run for each plausible value of document literacy, using the jack-knife option and the 30 replicate weights in the ALL data set. The estimates are the average of the estimates across the results for the five plausible values. The standard error of the estimate was calculated as the square root of the sample variance and imputation variation. The sample variance is the mean of the variances across the five plausible values. The imputation variance is the variance of the estimates. The standard errors were then used to calculate the p-values using the t-test.

Table 8
Regression model for financial literacy and numeracy job practices

Parameter	Estimate	p-value
Intercept	1.237	
Document literacy	0.224	0.000
Age	0.066	0.001
Age squared	-0.001	0.001
Qualification = None	0.000	
Qualification = School	0.341	0.000
Qualification = Certificate 1-3	0.168	0.026
Qualification = Certificate 4	0.213	0.022
Qualification = Diploma 5-7	0.259	0.005
Qualification = Bachelors degree	0.354	0.000
Qualification = Postgraduate	0.363	0.000
Gender = Male	0.151	0.001
Gender = Female	0.000	
Document literacy * Male	0.152	0.006
Document literacy * Female	0.000	

Table 9
Regression model for intensive literacy job practices

Parameter	Estimate	p-value
Intercept	1.901	
Document literacy	0.260	0.000
Document literacy squared	-0.077	0.000
Age	0.053	0.001
Age squared	-0.001	0.002
Qualification = None	0.000	
Qualification = School	0.351	0.000
Qualification = Certificate 1-3	0.179	0.015
Qualification = Certificate 4	0.419	0.000
Qualification = Diploma 5-7	0.501	0.000
Qualification = Bachelors degree	0.581	0.000
Qualification = Postgraduate	0.665	0.000
Gender = Male	0.102	0.010
Gender = Female	0.000	

Table 10
Regression model for practical literacy and numeracy job practices

Parameter	Estimate	p-value
Intercept	2.307	
Document literacy	0.156	0.000
Document literacy squared	-0.068	0.000
Age	0.038	0.035
Age squared	0.000	0.034
Qualification = None	0.000	
Qualification = School	0.282	0.000
Qualification = Certificate 1-3	0.167	0.047
Qualification = Certificate 4	0.357	0.001
Qualification = Diploma 5-7	0.531	0.000
Qualification = Bachelors degree	0.489	0.000
Qualification = Postgraduate	0.586	0.000
Gender = Male	0.516	0.000
Gender = Female	0.000	
Qualification = None * Male	0.000	
Qualification = School * Male	-0.163	0.033
Qualification = Certificate 1-3 * Male	0.030	0.386
Qualification = Certificate 4 * Male	0.030	0.382
Qualification = Diploma 5-7 * Male	-0.325	0.002
Qualification = Bachelors degree * Male	-0.321	0.009
Qualification = Postgraduate * Male	-0.347	0.016
First language = Other	-0.127	0.018
First language = English	0.000	

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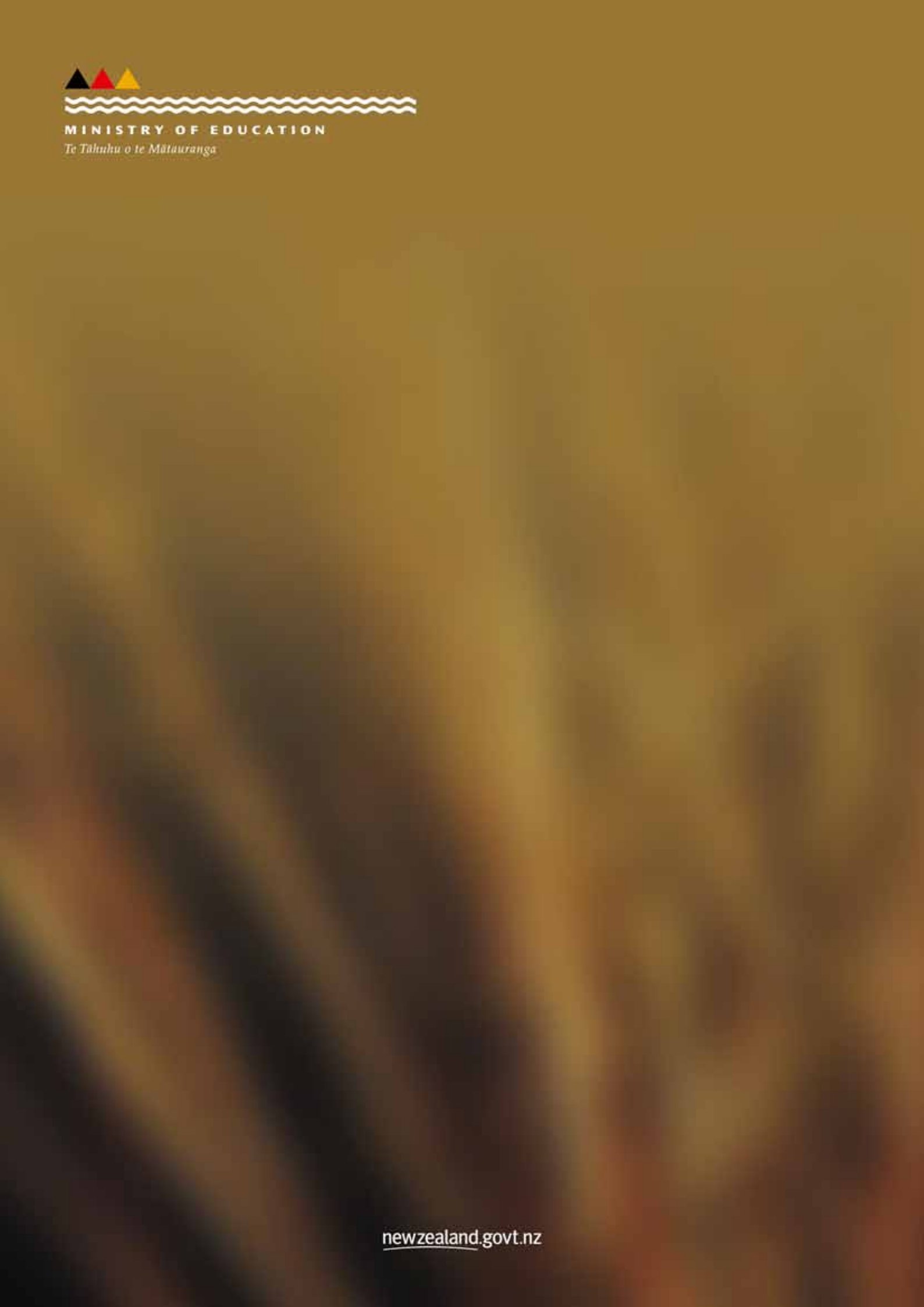

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