



MINISTRY OF EDUCATION

Te Tāhuhu o te Mātauranga

Factors linked to young adult literacy

Comparing the skills of the young with those of their elders

This series covers research on teaching and learning in literacy, language and numeracy and analyses of international surveys on adult literacy and numeracy.

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Factors linked to young adult literacy

1	Introduction	7
1.1	The Adult Literacy and Life Skills (ALL) Survey 2006	7
1.2	Literacy and numeracy in ALL	8
1.3	Structure of this report	9
2	Building models of document literacy for people aged 16-24 and 25-65	10
2.1	Demographic and home background variables	11
2.2	Education	15
2.3	Models including demographic, home background and education variables	17
2.4	Labour force status, occupation and industry	21
2.5	Models including demographic, home background, education and employment-related variables	22
2.6	Technology use and literacy-related activities	25
2.7	Full models	27
2.8	Reduced models	33
3	Conclusion	35
4	Data and Definitions	37
4.1	The Adult Literacy and Life Skills Survey data	37
4.2	Demographic and home background variables	38
4.3	Education variables	40
4.4	Labour force status, occupation and industry	40
4.5	Technology use and literacy-related practices	42
Appendix A	Statistical modelling procedures	44
References		45

TABLES

1	Correlations between skills for people aged 25-65	8
2	Correlations between skills for people aged 16-24	8
3	Model 1a: Regression model for document literacy for people aged 25-65, incorporating demographic and home background variables	12
4	Model 1b: Regression model for document literacy for people aged 16-24, incorporating demographic and home background variables	14
5	Model 2a: Regression model for document literacy for people aged 25-65, incorporating education variables	16
6	Model 2b: Regression model for document literacy for people aged 16-24, incorporating education variables	17
7	Model 3a: Regression model for document literacy for people aged 25-65, incorporating demographic, home background, and education variables	18
8	Model 3b: Regression model for document literacy for people aged 16-24, incorporating demographic, home background, and education variables	20
9	Model 4a: Regression model for document literacy for people aged 25-65, incorporating employment-related variables	21
10	Model 4b: Regression model for document literacy for people aged 16-24, incorporating employment-related variables	22
11	Model 5a: Regression model for document literacy for people aged 25-65, incorporating demographic, home background, education and employment-related variables	22
12	Model 5b: Regression model for document literacy for people aged 16-24, incorporating demographic, home background, education and employment-related variables	24
13	Model 6a: Regression model for document literacy for people aged 25-65, incorporating variables for technology use and literacy-related activities	25
14	Model 6b: Regression model for document literacy for people aged 16-24, incorporating variables for technology use and literacy-related activities	26
15	Full regression model for document literacy for people aged 25-65	28
16	Full regression model for document literacy for people aged 16-24	31
17	Reduced regression model for document literacy for people aged 25-65	33
18	Reduced regression model for document literacy for people aged 16-24	34

19	Classification of occupations	41
20	Classification of industries	42
21	ALL survey question on personal reading activities	43

SUMMARY

This report explores the factors linked to the literacy of young adults (aged 16-24) in New Zealand using statistical modelling. Literacy here refers to literacy in English only, and the particular aspect of literacy considered is document literacy, which refers to the ability to read and interpret non-continuous texts, such as tables, diagrams and maps. To identify the factors especially important to young people, it compares these with the factors related to document literacy in the population aged 25-65.

Key findings

FACTORS MOST STRONGLY ASSOCIATED WITH DOCUMENT LITERACY SKILLS FOR PEOPLE AGED 16-24

- The language spoken most often at home
- Ethnic identification (among those who speak English most often at home)
- Participation and achievement in formal education
- Home computer use
- Library use

FACTORS MOST STRONGLY ASSOCIATED WITH DOCUMENT LITERACY SKILLS FOR PEOPLE AGED 25-65

- First language learned, and language spoken most often at home
- Ethnic identification (among those who speak English most often at home)
- Age and gender
- Level of completed formal education
- Work computer use
- Home computer use
- Number of books in the home

Contribution of this report

The Adult Literacy and Life Skills (ALL) Survey 2006 measured the literacy and numeracy skills of New Zealanders aged 16-65. A series of previous studies of the survey data have shown differences in literacy and numeracy according to a range of individual characteristics, including completed education, age, gender, geographical region, ethnicity, immigrant status, first language, labour force status, occupation and industry.

This report considers these factors along with a number of additional factors, and seeks to develop an overall view of how strongly these factors relate to document literacy and how the factors interact with each other, for people aged 16 to 24, in comparison to people aged 25-65.

This report adds to previous work in three ways:

- by highlighting the factors associated with the literacy skills of people aged 16-24
- by analysing the effects of a number of previously under-studied variables, namely:
 - purposes of computer use
 - mobile phone use
 - watching television and videos
 - library use
 - number of books in the home
 - patterns of personal reading
- by constructing comprehensive statistical models (based on ordinary least squares regression) in order to identify which variables are most directly associated with document literacy for the 16-24 and 25-65 age groups

This report complements the report *Literacy skills of young adult New Zealanders*, which is also based on the ALL survey.

Models for document literacy

This report focuses on document literacy, which is the ability to interpret non-linear texts such as tables and diagrams.

Statistical models for document literacy scores in the 25-65 and 16-24 age groups were developed including the following potential explanatory factors:

- demographic and home background factors:
 - age
 - gender
 - ethnic identification
 - first language and main language spoken at home
 - socioeconomic deprivation
 - parents' education
- education factors:
 - level of education completed
 - recent formal or non-formal learning
 - a measure of school achievement
 - experience of New Zealand education
- employment-related factors:
 - labour force status
 - occupation
 - industry
- technology use and literacy-related activities:
 - home and work computer use
 - computer use for writing or editing
 - mobile phone use
 - watching television and videos
 - library use
 - number of books in the home
 - patterns of personal reading

For the 25-65 age group, previous work has identified three key factors related to literacy and numeracy:

- language (especially first language learned at home)
- completed education
- computer use (especially at work)

This report identifies three additional factors which are also strongly associated with document literacy for the 25-65 group (when the effects of language, education, computer use and other variables are already accounted for):

- the number of books in the home
- particular combinations of language and ethnic identification (Māori and Pasifika who speak English most often at home, compared with Europeans who speak English most often at home)
- particular combinations of age and gender (older women compared with younger men)

For the 16-24 age group, the factors most strongly associated with document literacy (in a comprehensive statistical model including all the factors listed above) are:

- language spoken most often at home
- Māori or Pasifika ethnic identification (where English is the language spoken most often at home)
- educational participation and achievement
- home computer use
- library use

Building the statistical models

In order to gain some understanding of the connections between different potentially explanatory factors, separate models were constructed for the relationships between document literacy scores and four sets of factors:

- 1) Demographic and home background factors
- 2) Education factors
- 3) Employment-related factors, and
- 4) Technology use and literacy-related activities

The comprehensive models were constructed by combining these models sequentially in the order 1, 2, 3, 4.

For both the 16-24 and 25-65 age groups, within each of the four separate models, almost all the factors had significant associations with document literacy.

The exceptions to this generalisation within the 25-65 age group were: gender within the 25-44 age subgroup, current student status, and television/video watching.

There were more exceptions within the 16-24 age group, namely: age, gender, first language, mother's qualifications, non-degree tertiary study (compared with upper secondary), recent non-formal learning, experience of New Zealand education, frequency of using a computer for writing or editing, mobile phone use, and patterns of personal reading. One reason there were

fewer significant associations in this age group was that this age group is not as heterogeneous as the 25-65 age group. It is clearly not as heterogeneous in age. Similarly, almost all those aged 16-24 had experience of New Zealand education, and almost all were mobile phone users, while few had been involved in non-formal learning, which means that people in this age group are not differentiated by these factors. Another reason could be that the size of the subsample for this age group is smaller and so factors with subtle effects may not be identifiable as significant.

When the four separate models are combined for each age group, a number of the factors no longer appear to be significant, because their effects are now better accounted for by other factors or combinations of factors.

For example, in the models based on demographic and home background factors, parents' education has strong associations with document literacy scores; but in the combined models, this factor is no longer significant. This appears to be because parents' education approximately predicts respondents' educational outcomes, while it is the respondents' education that is more directly associated with their literacy scores. Similarly, for the 16-24 age group, the effect of the socioeconomic deprivation of the neighbourhood is subsumed in the effects of respondent education variables.

Because education is an important factor affecting respondents' labour force status, their occupation, and the industry they have been employed in, some of the education and employment-related variables become non-significant in the combined models. For the 25-65 age group, non-degree tertiary education (compared with upper secondary) and recent non-formal learning are no longer significant; nor are labour force status and industry. For the 16-24 age group, having Year 11 as the highest completed education level is no longer significant; nor are labour force status, occupation or industry. The loss of significance of employment-related variables in the 16-24 age group is not too surprising, considering that many people in this age group are only marginally involved in the labour market, and if they have employment it may not reflect their literacy skills.

For the 25-65 age group, technology use and literacy-related activities (apart from television/video watching) remain significantly associated with document literacy in the full combined model. However, for the 16-24 age group, the only variables in this set which are significant in the full combined model are home computer use and library use. Computer use at work, computer use for writing or editing, and books in the home are no longer significant: their effects must be accounted for by home computer use and library use, and/or by the effects of home language, ethnic identification and education.

Key factors for people aged 16-24

For the 16-24 age group, the full combined model accounts for 39 per cent of the variation in document literacy scores in this age group. A reduced model based on

- main home language
- main home language/ethnic identification
- formal education
- home computer use

accounts for 32 per cent of the variation.

For people aged 16-24, the factors in the reduced model are related to document literacy in the following ways:

- Document literacy scores are negatively associated with speaking a language other than English most often at home (compared with speaking English most often at home).
- Among people who speak English most often at home, having Māori or Pasifika ethnic identification is negatively associated with document literacy (compared with not having Māori or Pasifika ethnic identification).
- Highest completed education of Year 10 or less is negatively associated with document literacy, while having completed a degree or recently studied at degree level is positively associated with document literacy (compared with having highest completed education of upper secondary).
- Document literacy scores are positively associated with achieving (self-reported) good grades in mathematics at school. Mathematics grades are likely to be indicative of overall school achievement.
- Document literacy is positively associated with using a computer at home for 5 or more hours per month (compared with using a home computer for fewer hours or not having access to a computer at home). This may well be because computer use provides practice which enhances document literacy.

Key factors for people aged 25-65

The full combined model for the 25-65 age group accounts for 48 per cent of the variation in document literacy scores in this age group. A reduced model based on the factors with the strongest effects, covering

- first and main home language
- home language/ethnic identification
- age/gender
- formal education
- work and home computer use
- books in the home

accounts for 45 per cent of the variation.

For people aged 25-65, the factors in the reduced model are related to document literacy in the following ways:

- Document literacy scores are negatively associated with having a language other than English as a first language, or as the language spoken most often at home (compared with having English as a first or main home language).
- Among people who speak English most often at home, having Māori or Pasifika ethnic identification is negatively associated with document literacy (compared with not having Māori or Pasifika ethnic identification).
- Document literacy scores are negatively associated with being female, especially female aged 45-65, compared with being male aged 25-44.

- Highest completed education of Year 11 or less is negatively associated with document literacy, while having completed a degree or having studied recently at degree level is positively associated with document literacy (compared with having highest completed education of upper secondary).
- Document literacy scores are positively associated with using a home computer at least 5 hours per month (compared with using a home computer for fewer hours or not having home computer access). Document literacy is also positively associated with having used a computer at work in the past year (compared with being employed but not using a computer at work, or not having been employed).
- Having 25 or more books in the home is positively associated with document literacy scores (compared with having fewer than 25 books).

1 INTRODUCTION

This report examines the factors associated with literacy skills in the 16-24 age group and compares this age group with people aged 25-65. It complements a descriptive study (Lane 2011) of how literacy among people aged 16-24 varies according to a wide range of individual characteristics and behaviours. That study, too, compares the 16-24 year olds with the 25-65 age group.

This report is based on document literacy (ability to read and interpret non-continuous text) as measured in the Adult Literacy and Life Skills (ALL) Survey 2006. Of the 7,131 respondents to the ALL Survey, 1,082 were aged 16-24. This is a sufficiently large subsample to allow detailed analysis of literacy skills, and also to allow for some comparisons between people aged 16-19 and those aged 20-24.

This report outlines the relationships between document literacy and a number of factors which are relevant to variation in literacy and numeracy among younger people in New Zealand. Some of these factors – for instance the purposes of computer and internet use, literacy-related practices (such as library use and books in the home) and television viewing – have not been extensively explored in previous work on the New Zealand ALL Survey data. This report also deals with factors such as age, gender, ethnicity, region, education, labour force status, occupation, industry and computer use, which have been investigated in earlier reports (including Satherley and Lawes 2008a, 2008b; Satherley, Lawes and Sok 2008; Earle 2009b; Lane 2010a, 2010b), in order to see how relevant they are for people aged 16-24.

The analysis in Lane (2011) focuses on variation in mean literacy scores according all these factors, while this report uses statistical modelling to gauge the relative strengths of association of these factors with document literacy scores.

The respondents in the ALL Survey formed a representative sample of people aged 16 to 65. The analyses in some earlier reports (Lane 2010a, 2010b; Earle 2009b), however, are based only on the data from the subset of people aged 25 to 65. Initial study of the full sample indicated that the key factors related to literacy and numeracy included the highest level of education completed and employment-related factors such as occupation and computer use at work. These factors do not apply to the majority of people aged 16 to 24 who are still in education. For the geographical analyses, there is also the issue that people in this age group also tend to be geographically mobile, with many moving between regions for study and work. They are not necessarily in their region of origin and are not necessarily living in their current region of residence on a long-term basis. Accordingly a separate analysis is required for the 16-24 age group.

1.1 The Adult Literacy and Life Skills (ALL) Survey 2006

The Adult Literacy and Life Skills (ALL) Survey was an international survey coordinated by the Organisation for Economic Cooperation and Development (OECD) and Statistics Canada. The main data collection for the New Zealand survey was carried out between May 2006 and March 2007. All survey respondents were interviewed face to face and their skills were directly tested during the interviews: each respondent was asked to complete test booklets in English selected from a bank of test material covering literacy, numeracy and problem-solving. The survey achieved a representative national sample of 7,131 New Zealanders aged 16 to 65. The survey also collected extensive background information on demographic characteristics, language, education, employment, income, health, literacy and numeracy practices and the use of information and communication technologies. (For more information on the survey, see section 3.1).

1.2 Literacy and numeracy in ALL

The ALL survey tested skills in English across four domains:

- **Prose literacy** – the ability to read continuous texts, such as news stories and instruction manuals
- **Document literacy** – the ability to read discontinuous texts, such as maps and timetables
- **Numeracy** – the ability to read and work with numeric information
- **Problem solving** – the ability to reason in situations where no routine procedure exists.

The tests were designed to assess skills across the full range of competency, from limited to highly-developed skills. The tests were designed to cover general, cognitive skill levels and did not attempt to assess specialist knowledge and skills (Satherley and Lawes, 2007).

The literacy and numeracy skills measured in the ALL survey are reported either as scores ranging from 0 to 500, or more commonly, in terms of five levels, from Level 1 (very low skills) to Level 5 (very high skills). A detailed description of the levels is given in section 3.1.

The four skills measured in the ALL survey are highly correlated with one another, as shown in Table 1 for people aged 25-65 and Table 2 for people age 16-24. The strongest correlation was that between document literacy and prose literacy. The strongest correlation with numeracy was also with document literacy. The weakest correlations were between prose literacy and numeracy and between numeracy and problem solving.

Table 1

Correlations between skills for people aged 25-65

	Document literacy	Numeracy	Problem Solving
Prose literacy	0.93	0.83	0.90
Document literacy		0.89	0.89
Numeracy			0.83

Source: New Zealand results of the Adult Literacy and Life Skills Survey. Ministry of Education calculations

Note: All correlations were significant ($p < 0.001$)

Table 2

Correlations between skills for people aged 16-24

	Document literacy	Numeracy	Problem Solving
Prose literacy	0.91	0.79	0.84
Document literacy		0.86	0.83
Numeracy			0.75

Source: New Zealand results of the Adult Literacy and Life Skills Survey. Ministry of Education calculations

Note: All correlations were significant ($p < 0.001$)

The focus in this report is on document literacy, as in Lane (2011). Of the literacy or numeracy measures, this is the single most representative measure, which provides a good indicator of the literacy and numeracy spectrum. This is not just because document literacy has the highest correlation both with prose literacy and with numeracy, but also because mean document literacy scores tend to fall midway between the prose literacy and numeracy scores for particular

population groups, as can be seen in Lane (2011, section 1.6) and in earlier reports (e.g. Satherley and Lawes 2008a, 2008b; Satherley, Lawes and Sok 2008).

1.3 Structure of this report

Statistical models are outlined and discussed in Chapter 2, with additional technical information provided in Appendix A. The broader implications of the analysis are discussed in Chapter 3. Chapter 4 provides technical information on the data and the definitions of variables used in this report.

2 BUILDING MODELS OF DOCUMENT LITERACY FOR PEOPLE AGED 16-24 AND 25-65

This chapter takes the main variables which are covered in the descriptive analysis in Lane (2011) and incorporates them in a series of multivariate models (using ordinary least squares regression). The modelling procedure estimates how much of a contribution each variable needs to make in order for the total of all the variable contributions to best fit the actual document literacy scores. These models provide a means of investigating the relationships between particular variables (or sets of variables) and document literacy, while at the same time taking into account the effect of other variables on document literacy.

The variables on which the models are based are:

- first language
- language spoken most often at home
- ethnic identification
- age
- gender
- socioeconomic deprivation of the neighbourhood (as measured by the New Zealand Deprivation Index)
- mother's and father's highest educational qualifications
- respondent's highest level of completed education
- type and level of study (if any) in the past 12 months
- self-reported grades in mathematics at school
- experience of New Zealand education
- current labour force status
- employment in the past 12 months
- occupation
- industry
- home computer use
- use of a computer at work
- purpose of computer use
- mobile phone use
- library use
- number of books in the home
- types of regular personal reading
- hours watching television or videos/DVDs

Several of these variables were selected as being of particular interest for the 16-24 age group. But essentially the same variables are also used in the models for the 25-65 age group.

These variables are not all completely independent of each other; rather there are correlations between some of the variables. For instance, respondents' level of education tends to be similar to their parents' level of education. Such links between variables are taken account of as far as possible in building the models.

The models for the 16-24 and 25-65 age groups are built in the order: home background and demographic variables (language, ethnic identification, parents' education, gender, age, deprivation), then education variables, then the labour force and employment-related variables, then the technology-use variables and the variables representing literacy-related practices. This order follows Desjardins (2003) in building models in an order that approximates an

individual's life course¹, i.e. home background and demographic variables, then education, then variables related to current employment and personal activities.²

The independent variables in the models are all binary categorical variables, with the value 1 for membership of the relevant category and 0 for non-membership. This means that the regression coefficients for all the variables are on the same scale and can be directly compared. The definition of categories is informed by the descriptive analysis (Lane 2011). The document literacy scale has been standardised with a mean of 0 and a standard deviation of 1. See Appendix A for further technical documentation of the statistical modelling.

2.1 Demographic and home background variables

The first models incorporate language and ethnic identification variables, age and gender variables, and variables which approximate socioeconomic status, namely socioeconomic deprivation of the neighbourhood and parents' education. The models are the same for the 25-65 and 16-24 age groups, with the exception of the age and gender variables.

Language and ethnic identification are closely related. The language variables (see Lane 2010a) are based on whether or not English is a first language and/or English is the language most often spoken at home. European ethnic identification is highly correlated with having English as a first and main home language, while Asian ethnic identification is highly correlated with not having English as a first or main home language. Māori and Pasifika ethnic identifications are not so strongly correlated with first or main home language, and it is possible to ethnically subdivide the group of people who speak English most often at home, to identify groups of Māori and Pasifika whose main home language is English. The variables which identify these groups have low correlations with the language variables. By this means it is possible to get some separation between language and ethnic effects.

The reference category³ for language is that of people with English as both first language and language most often spoken at home. The reference category for the language-and-ethnic-identification variables is Europeans with English as main home language⁴.

Following Lane (2010a), the 25-65 age group is divided into two age bands, namely 25-44 and 45-65. In order to allow for an age-by-gender interaction, these age bands are subdivided by gender, with males aged 25-44 as the reference group. The 16-24 age group is divided into a 16-19 and a 20-24 age band.

Socioeconomic deprivation is measured by whether the New Zealand Deprivation Index (see section 3.2) is above or below the median, with low deprivation as the reference group.

The parents' education variables focus on the extremes, one being whether the highest level of completed education is Year 10 or less, and the other extreme being completion of a bachelors or higher degree, with all other values being grouped into a single category. This approach is based on the descriptive analyses in Lane (2011). That category, used as the reference group, encompasses mainly upper secondary (Year 11-13 or Level 1-3 certificate) and tertiary non-degree (i.e. certificate or diploma) qualifications, although it also includes a small number for whom data on the mother's or father's qualifications are lacking.

¹ However, Desjardins' model is actually a more complex statistical model (a structural equation model) which incorporates effects of explanatory variables on each other as well as on the dependent variable, literacy.

² Note that this ordering of variables differs from the order in which they are considered in Lane (2011).

³ The reference category provides a basis for comparison. The coefficients in the model can be understood as indicating the effect of a variable included in the model (the two variables here being: both first and home language not English, and first language not English but home language English) when compared with the reference category.

⁴ Strictly, this group also includes the relatively small group of people whose main home language was not English.

Model for people aged 25-65

The model for the 25-65 age group (Model 1a) is outlined in Table 3.⁵

Table 3

Model 1a: Regression model for document literacy for people aged 25-65, incorporating demographic and home background variables

Factor	Independent variable	Dependent variable		
		Document literacy		
		Coefficient	p-value	R ²
	Intercept	0.51	< 0.001	
Language	Neither first nor main home language is English	-1.07	< 0.001	0.100
	First language is not English, but home language is English	-0.44	< 0.001	
Language & ethnic identification	Home language English, Māori ethnic identification	-0.48	< 0.001	0.111
	Home language English, Pasifika ethnic identification	-0.34	< 0.001	
Age and gender	Female 25-44	-0.01	<i>ns</i>	
	Male 45-65	-0.16	< 0.01	
	Female 45-65	-0.25	< 0.001	
Deprivation	New Zealand Deprivation Index above median (deciles 6-10)	-0.34	< 0.001	
Parents' education	Mother/female guardian has a degree	0.22	< 0.05	
	Mother completed Year 10 or less	-0.12	< 0.01	
	Father/male guardian has a degree	-0.05	< 0.01	
	Father completed Year 10 or less	-0.01	< 0.05	
R² for model				0.211

Source: New Zealand results of the Adult Literacy and Life Skills Survey. Ministry of Education calculations

ns = not statistically significant ($p = 0.05$ or greater)

Interpreting the model

Model 1a accounts for 21.1 per cent of the variation in document literacy in the 25-65 age group. In Model 1a, each of the independent variables has a statistically significant association with document literacy, in the presence of the other independent variables, apart from being female aged 25-44, which indicates there is not a significant gender effect within the 25-44 age group.

However, there is a significant age effect on literacy: those aged 45-65 have significantly lower document literacy; and within this age group, there is a gender effect, with a stronger negative association for women than men.

The model does not directly provide explanations for these effects. A plausible explanation for the age effect is a shorter average time spent in education, and lower overall qualification levels, in the older age band than the younger. In Lane (2010a) I noted that women aged 45-65 had significantly lower mean numeracy than other age-gender groupings, but comparable prose literacy. The lower document literacy for the older women could reflect those aspects of

⁵ In this and subsequent tables, each coefficient represents the average difference in document literacy due to membership in the independent variable category (compared to the reference category, with all other factors held constant), where 1 represents one standard deviation in the document literacy score distribution. The intercept represents the group of respondents who are in the reference category for all factors. The p-value is the probability that the coefficient is different from zero due to chance (taking into account the sample size and the variability in the sample): the smaller the p-value, the more significant the effect. R² represents the variation in scores accounted for by the coefficients in the model, as a proportion of the total variation in scores in the model.

document literacy that resemble numeracy. Plausible explanations could include: lower levels of education than the men in the same age band, with less emphasis on mathematical and technical subjects, in the then-prevalent belief that these were less relevant to women; lower participation by women in the labour force, and consequently fewer work opportunities to develop or maintain document literacy skills; and possibly, less experience among older women of using computers and other technology which rely on non-linear texts (document literacy being concerned with interpreting non-linear texts). One way to get some sense of whether these explanations have substance is to add variables to the model to reflect such explanations (for instance, education, labour force and technology variables) and see if the age-gender effect is still significant. This will be carried through later in the chapter as the models are built up with the addition of variables related to education, labour force, technology and other factors.

Similar explanations could be offered for the negative associations with document literacy of speaking mainly English at home and having Māori or Pasifika ethnic identification. An additional possibility here is a cultural factor: the ALL survey was designed for use mainly in Europe and North America; the examples of test items in the survey documentation could be described as Eurocentric, suggesting that the actual test items may have been less relevant or less accessible for Māori and Pasifika than for Europeans.

The language variable is clearly related to the fact that all the literacy testing in the survey was based on English-language test items, and people whose first language is not English or who mainly speak another language at home (presumably reflecting the language they are most comfortable in) are at a disadvantage.

The New Zealand Deprivation Index is not a direct measure of the socioeconomic status of individuals, since it applies instead to local geographical areas. However, it reflects a tendency of people with similar social and economic characteristics to cluster geographically, and provides an indication of typical characteristics of individuals in each area. It is therefore an indirect and approximate indicator of the socioeconomic status of an individual survey respondent, as well as possibly measuring the influence on the individual of other people in their area. Parents' education is also indirect in that it indicates possible family influences on the individual's learning and on literacy-related behaviour, and also (again, indirectly) family socioeconomic status and resources. These variables could be related to literacy through the modelling by family, friends and neighbours of literacy learning and literacy-related behaviours, and because neighbourhood deprivation and parents' education are known to be strongly correlated with the levels of education eventually achieved by individuals. Higher neighbourhood deprivation predicts lower educational achievement (and vice versa), and higher parental qualifications predict higher educational achievement by the next generation. In Model 1a, although both fathers' and mothers' qualifications are significantly associated with respondents' document literacy, the mother's educational qualifications have stronger effects as indicated by the size of the coefficients.

In fact, in Model 1a, the strongest effects (coefficients of 0.2 or higher) are: (negatively) both the language variables, both the combined language/ethnic variables, being female aged 45-65, and (positively) having a mother with a degree.

Model for people aged 16-24

Table 4 outlines a model of document literacy for people aged 16-24, incorporating demographic and home background variables.

Table 4

Model 1b: Regression model for document literacy for people aged 16-24, incorporating demographic and home background variables

Factor	Independent variable	Dependent variable		
		Document literacy		
		Coefficient	p-value	R ²
	Intercept	-0.10	ns	
Language	Neither first nor main home language is English	-0.57	< 0.001	0.020
	First language is not English, but home language is English	0.12	ns	
Language & ethnic identification	Home language English, Māori ethnic identification	-0.63	< 0.001	0.173
	Home language English, Pasifika ethnic identification	-0.30	< 0.05	
Gender	Female	0.16	ns (< 0.1)	
Age	20-24	0.16	ns	
Deprivation	New Zealand Deprivation Index above median (deciles 6-10)	-0.15	< 0.05	
Parents' education	Mother/female guardian has a degree	0.16	ns	
	Mother completed Year 10 or less	-0.19	ns	
	Father/male guardian has a degree	0.36	< 0.001	
	Father completed Year 10 or less	-0.29	< 0.05	
R² for model				

Source: New Zealand results of the Adult Literacy and Life Skills Survey. Ministry of Education calculations

ns = not statistically significant (p = 0.05 or greater)

Interpreting the model

Model 1b accounts for 19.3 per cent of the variation in the document literacy scores of people aged 16-24.

The significant variables are: main home language (and first language) not being English; having English as main home language and Māori or Pasifika ethnic identification; high socioeconomic deprivation; and father's educational qualifications. Of these, the ones with the strongest effects (with coefficients of 0.2 or more) are: main home language not English, the combined language/ethnic variables, and father's education.

Among people aged 25-65, first language has a strong negative association with document literacy even when English is the language most often spoken at home, so that in Lane (2010a and 2010b) I took first language as the key language variable in simplified models of prose literacy and numeracy and in making comparisons between regions, for people aged 25-65. However, for people aged 16-24, first language is not a key factor, while the language most often spoken at home not being English still has a strong negative association with document literacy.

The importance of main home language for the 16-24 age group is the reason for using main home language in combination with ethnic identification. (Note that in Lane 2010a I used combinations of first language and ethnic identification). The coefficient for Māori with English as main home language (which means 97 per cent of Māori in this age group) is

comparable with that for people whose main home language is not English. The coefficient for Pasifika with English as main home language is not as great (though still negative). But note that this represents a subgroup of Pasifika: the language most often spoken at home for 35 per cent of Pasifika in this age group is not English.

It is not entirely clear why father's education should have such a strong effect, while mother's education is not significant. Part of the reason may relate to children of immigrants who have entered the country under the General Skills category, where it is more commonly the father rather than the mother whose high educational qualifications have been part of the reason the family is able to settle in New Zealand (see Lane 2011).

The effect of neighbourhood deprivation is significant for the 16-24 age group, but not as strong as it is for the 25-65 age group. Because residence is often more temporary for people aged 16-24, and is more likely to be in neighbourhoods with a lot of rental properties, which are likely to have higher deprivation, neighbourhood deprivation does not necessarily relate so closely to individual characteristics, including literacy skills, in this age group as in the 25-65 age group.

Because the sample of people aged 16-24 is relatively small (1,082, compared with the 25-65 sample of 6,049) the more subtle associations of variables with document literacy are less likely to show up as statistically significant. In Model 1b, a number of independent variables are non-significant. These include: having English as main home language but not as a first language; gender; being aged 20-24 rather than 16-19; and mother's educational qualifications. The gender variable is close to being significant, with $p > 0.05$ but $p < 0.1$, and the coefficient indicates that if there is an effect, it represents a female advantage in document literacy. With a larger sample this might have shown up as significant.

On the other hand, variables may be non-significant because there may not be as much differentiation in literacy in the 16-24 age group as in the 25-65 age group. In the older age group, it is more likely that initial differences in literacy during the young adult years become magnified: those starting out with higher literacy are more likely to gain employment in jobs requiring higher literacy skills and using literacy-related technology such as computers, with the result that their literacy skills increase, while those starting out with somewhat lower literacy are more likely to be employed in jobs in which their literacy skills are not maintained.

2.2 Education

Several of the education variables reflect different levels of study or completion in the education system. Year 10 (or less) and Year 11 could have been completed by most respondents in the 16-24 age group, but many respondents in this age group may be only partially through the process of undertaking tertiary study, and so the tertiary variables include either completion or recent study at the relevant level. The reference category for this set of variables is upper secondary: Year 12-13 or Level 1-3 certificate.

The variable 'self-reported good grades in mathematics' is based on agreement, disagreement or neutral responses to a statement about mathematics experiences at school. The relevant statement is "I got good grades in maths." This is the nearest variable in the ALL data to a measure of how well participants achieved in their school studies. The reference category here is neutral or disagreeing responses to the statement.

Non-formal learning refers to taking one or more courses which were not part of a qualification. The majority of such courses were employment-related (Scott and Lane 2010). The reference category here is not having taken any non-formal courses in the past year.

The remaining variable in the education set, at least one year of education in New Zealand, is mainly relevant to immigrants, since almost everyone born in New Zealand has at least one year of New Zealand education. Earle (2009b) found that experience in New Zealand education was strongly related to higher literacy for immigrants whose first language was not English. The reference category is less than a year of education in New Zealand.

Model for people aged 25-65

Model 2a, outlined in Table 5, incorporates the set of education variables for survey respondents aged 25-65.

Table 5

Model 2a: Regression model for document literacy for people aged 25-65, incorporating education variables

Factor	Independent variable	Dependent variable		
		Document literacy		
		Coefficient	p-value	R ²
	Intercept	0.087	< 0.001	
Education	Highest completed education is Year 10 or less	-0.91	< 0.001	0.283
	Highest completed education is Year 11	-0.40	< 0.001	
	Self-reported good grades in mathematics	0.18	< 0.001	
	Completed non-degree tertiary or recent non-degree tertiary study	0.22	< 0.001	
	Completed degree or recent degree-level study	0.45	< 0.001	
	Non-formal learning in past year	0.27	< 0.001	
	At least one year of education in New Zealand	0.56	< 0.001	
R² for model				0.283

Source: New Zealand results of the Adult Literacy and Life Skills Survey. Ministry of Education calculations

ns = not statistically significant (p = 0.05 or greater)

Interpreting the model

The model accounts for 28.3 per cent of variation in document literacy in this age group. This set of education variables thus provides a more effective model of document literacy for this age group than the demographic and home background variables included in Model 1a. In particular, this means that respondents' own educational experiences are more strongly associated with their document literacy scores than their parents' educational achievement (as might be expected).

All the dependent variables in the model have highly significant effects. The variables representing different levels of progression through the education system (Year 10 or less, Year 11, tertiary non-degree study, degree-level study) are particularly strong, as indicated by the size of the coefficients. This is probably both an indication that more education leads to higher literacy, and an indication that higher literacy is needed to undertake higher levels of study.

Also very strong is the positive effect of experience of New Zealand education on document literacy, reflecting the importance of this factor for immigrants whose first language is not English.

The variable 'self-reported good grades in mathematics' does not have such a strong effect, but it is possible that if a more precise measure of achievement at school was available, it could have shown up as a stronger effect.

Model for people aged 16-24

Model 2b, outlined in Table 6, is a model for document literacy for people aged 16-24, incorporating the same set of education dependent variables as Model 2a for the older age group.

Table 6

Model 2b: Regression model for document literacy for people aged 16-24, incorporating education variables

Factor	Independent variable	Dependent variable		
		Document literacy		
		Coefficient	p-value	R ²
	Intercept	-0.31	0.208	
Education	Highest completed education is Year 10 or less	-0.81	< 0.001	0.228
	Highest completed education is Year 11	-0.33	< 0.05	
	Self-reported good grades in mathematics	0.38	< 0.001	
	Completed non-degree tertiary or recent non-degree tertiary study	0.07	ns	
	Completed degree or recent degree-level study	0.57	< 0.001	
	Non-formal learning in past year	0.04	ns	
	At least one year of education in New Zealand	-0.11	ns	
R² for model				0.228

Source: New Zealand results of the Adult Literacy and Life Skills Survey. Ministry of Education calculations

ns = not statistically significant (p = 0.05 or greater)

Interpreting the model

Model 2b accounts for 22.8 per cent of the variation in document literacy in the 16-24 age group, not as much as Model 2a for the older age group. And fewer of the variables are significant. Because very few people in this age group are involved in non-formal learning, it is not surprising that experience of non-formal learning does not help to account for variation in document literacy in this age group. On the other hand, almost everyone in this age group has had at least a year in New Zealand education, so that this variable does not help to differentiate literacy skills in this age group either. The fact that experience of non-degree tertiary study is non-significant reflects the small difference in document literacy between people with experience of non-degree tertiary study and people with just upper secondary experience (the reference group).

As was found for the 25-65 age group though, highest completed education of Year 10 or less, or of Year 11, have strong negative associations with document literacy, while experience of degree-level study has a strong positive association, and these variables are all significant. The variable ‘self-reported good grades in mathematics’ is also significant, and has a much stronger positive association with document literacy for people aged 16-24 than for those aged 25-65, which reflects a more direct relationship between literacy and school performance for this age group than for people aged 25-65.

2.3 Models including demographic, home background and education variables

If we now build a model incorporating all of the demographic and home background variables as well as the education variables, we can compare the effects of the different variables on document literacy.

Model for people aged 25-65

The combined model for people aged 25-65 is model 3a, outlined in Table 7.

Table 7

Model 3a: Regression model for document literacy for people aged 25-65, incorporating demographic, home background, and education variables

Factor	Independent variable	Dependent variable		
		Document literacy		
		Coefficient	p-value	R ²
	Intercept	0.09	ns	
Language	Neither first nor main home language is English	-1.12	< 0.001	0.100
	First language is not English, but home language is English	-0.49	< 0.001	
Language & ethnic identification	Home language English, Māori ethnic identification	-0.32	< 0.001	0.111
	Home language English, Pasifika ethnic identification	-0.29	< 0.001	
Age and gender	Female 25-44	-0.04	ns	
	Male 45-65	-0.06	ns	
	Female 45-65	-0.21	< 0.001	
Deprivation	New Zealand Deprivation Index above median (deciles 6-10)	-0.16	< 0.001	
Parents' education	Mother/female guardian has a degree	0.11	ns	
	Mother completed Year 10 or less	-0.04	ns	
	Father/male guardian has a degree	-0.04	ns	
	Father completed Year 10 or less	-0.00	ns	
Education	Highest completed education is Year 10 or less	-0.81	< 0.001	0.191
	Highest completed education is Year 11	-0.37	< 0.001	
	Self-reported good grades in mathematics	0.21	< 0.001	
	Completed non-degree tertiary or recent non-degree tertiary study	0.18	< 0.001	
	Completed degree or recent degree-level study	0.48	< 0.001	
	Non-formal learning in past year	0.18	< 0.001	
	At least one year of education in New Zealand	0.14	< 0.01	
R² for model				0.402

Source: New Zealand results of the Adult Literacy and Life Skills Survey. Ministry of Education calculations

ns = not statistically significant (p = 0.05 or greater)

Interpreting the model

Model 3a accounts for 40.2 per cent of the variation in document literacy in this age group, considerably more than just the demographic/home background variables or the education variables on their own. If the demographic and home background variables are entered into the model first, then the education variables account for an additional 19.1 per cent of the variation, rather than the 28.3 per cent that the education variables can account for on their own. This is an indication that the variables are not all totally independent of each other, that there is some degree of correlation among them.

Desjardins' (2003) model of adult literacy is based on a series of assumptions: that the effects of the demographic and home background variables on literacy are all indirect; that these variables are all associated with education; and that educational outcomes that are in turn indirectly

related to the literacy score. If the relationships of the demographic and home background variables to literacy in the New Zealand ALL data were entirely indirect, we might expect that the demographic and home background variables would all become non-significant once the education variables were included in the model.

This is only partially the case. The most obvious change from the earlier models is that while the parents' education variables were all significant in Model 1a, they are all non-significant in Model 3a. This is consistent with the relationship between parents' education and literacy being indirect and mediated by the respondent's educational experience. Because the relationship of literacy with the respondent's education is more direct than the relationship with parents' education, it is the relationship with respondent's education that now shows up as significant.

The other variable which becomes non-significant is that of being male aged 45-65. This is an indication that the age difference in literacy (compared with males aged 25-44) can be accounted for by differences in educational experiences.

The other demographic/home background variables remain significant but there is a reduction in the coefficients for deprivation and for English home language and Māori ethnic identification, which is an indication that the effect of these variables in Model 1a was partially mediated through education. Satherley and Lawes (2009) constructed models of document literacy for Māori and found the strongest predictor was time spent in formal education.

The coefficients for the language variables, for women aged 45-65 and for Pasifika with English as main home language are not greatly different in Model 3a compared with Model 1a, which is an indication that these variables are less likely to affect literacy through their effect on education (although it is possible that with more precise and detailed variables representing educational experiences, an education effect might be more apparent).⁶

Comparing Model 3a with Model 2a, the education variables remain significant, with similar coefficients apart from those for non-formal learning and for experience of New Zealand education. In other words, the education variables remain significant after controlling for parents' education and other demographic and home background variables. Overall this reinforces the importance of an individual's education as having a strong and direct relationship with his or her literacy score.

Model for people aged 16-24

Model 3b is parallel to Model 3a, combining the demographic, home background and education variables for the 16-24 age group, and is outlined in Table 8.

⁶ Although I have followed Desjardins in putting demographic/home background variables into the model first, they are not necessarily logically or chronologically prior to education. The language variables, for instance, largely reflect the language disadvantage that arises when immigrants settle in New Zealand *after* completing their education in a language other than English (Earle 2009b; Smyth and Lane 2009). Similarly, the deprivation variable is based on residence at the time of the survey rather than residence during education.

Table 8

Model 3b: Regression model for document literacy for people aged 16-24, incorporating demographic, home background, and education variables

Factor	Independent variable	Dependent variable		
		Document literacy		
		Coefficient	p-value	R ²
	Intercept	0.01	ns	
Language	Neither first nor main home language is English	-0.64	< 0.001	0.020
	First language is not English, but home language is English	0.01	ns	
Language & ethnic identification	Home language English, Māori ethnic identification	-0.44	< 0.001	0.173
	Home language English, Pasifika ethnic identification	-0.26	ns (< 0.1)	
Gender	Female	0.11	ns	
Age	20-24	-0.01	ns	
Deprivation	New Zealand Deprivation Index above median (deciles 6-10)	-0.15	ns (< 0.1)	
Parents' education	Mother/female guardian has a degree	0.07	ns	
	Mother completed Year 10 or less	-0.08	ns	
	Father/male guardian has a degree	0.17	ns	
	Father completed Year 10 or less	-0.23	ns (< 0.1)	
Education	Highest completed education is Year 10 or less	-0.65	< 0.01	0.143
	Highest completed education is Year 11	-0.26	< 0.05	
	Self-reported good grades in mathematics	0.37	< 0.001	
	Completed non-degree tertiary or recent non-degree tertiary study	0.09	ns	
	Completed degree or recent degree-level study	0.51	< 0.001	
	Non-formal learning in past year	0.06	ns	
	At least one year of education in New Zealand	-0.01	ns	
R² for model				0.336

Source: New Zealand results of the Adult Literacy and Life Skills Survey. Ministry of Education calculations

ns = not statistically significant (p = 0.05 or greater)

Interpreting the model

Model 3b accounts for 33.6 per cent of the variation in document literacy in the 16-24 age group, and as for Model 3a this is considerably more than for the model incorporating demographic and home background variables or the model incorporating education variables only. However, after the demographic and home background variables are included in the model, the education variables account for an additional 14.3 per cent of variation, rather than the 22.8 per cent they account for on their own, indicating some degree of correlation between the demographic, home background and education variables.

As with Model 3a, once the education variables are added to the model, the parents' education variables are no longer significant: for the 16-24 age group, comparing Model 1b and Model 3b, it is the fathers' education variables which have changed from highly significant to non-significant. The other variable which has become non-significant is that for Pasifika with English as main home language, even though the estimated coefficient is still quite large. This is an indication that the education variables are more directly associated with document literacy than these demographic/home background variables are.

In Model 3b, the only demographic/home background variables which are significant are: main home language (and first language) not English; and Māori ethnic identification with English as main home language. The same four education variables which were significant in Model 2b are still significant in Model 3b, although their coefficients are somewhat smaller.

2.4 Labour force status, occupation and industry

The reference group for labour force is people who were not students, or were not employed in the past year: although this is a heterogeneous grouping, the literacy scores are similar for these different categories in the descriptive analysis (see Lane 2011). The reference group for occupation is clerks, services workers, tradespeople and skilled agriculture, forestry and fisheries workers: again, a heterogeneous group, but one with similar document literacy across these categories. Finance, business and community services refers to a wide range of industries which generally require specialised skills: health and education are important subsets of this group. Descriptively, the main industry difference in document literacy is between this industrial category and all other industries.

Model for people aged 25-65

Model 4a, outlined in Table 9, is a model for document literacy in the 25-65 age group which incorporates labour force, occupational and industry variables.

Table 9

Model 4a: Regression model for document literacy for people aged 25-65, incorporating employment-related variables

Factor	Independent variable	Dependent variable		
		Document literacy		
		Coefficient	p-value	R ²
	Intercept	-0.56	< 0.001	
Labour force status	Current student	0.19	<i>ns</i>	0.043
	Employed in the past year	0.44	< 0.001	
Occupation and industry	Managerial, professional or technical occupation	0.45	< 0.001	0.129
	Machine operator or elementary occupation	-0.55	< 0.001	
	Finance, business or community service industry	0.13	< 0.01	
R² for model				0.172

Source: New Zealand results of the Adult Literacy and Life Skills Survey. Ministry of Education calculations

ns = not statistically significant ($p = 0.05$ or greater)

Interpreting the model

Model 4a accounts for 17.2 per cent of the variation in document literacy scores in this age group, less than Models 1a (demographic and home background variables) and 2a (education variables), although the variation accounted for might be a little higher if more narrowly defined variables were used (note that the choice of variables here is informed by the descriptive analysis in Lane 2011).

Only a very small proportion of people in the 25-65 age group have ‘student’ as their main current labour force status, and this probably accounts for the non-significance of current student in the model. All the other variables are significant, with the employment and occupation variables having the strongest effects.

Models for people aged 16-24

Model 4b, outlined in Table 10, is a model for document literacy for people aged 16-24 which incorporates the same labour force, occupation and industry variables as Model 4a.

In this age group, occupation and industry will often be based on part-time or temporary jobs that young people may have undertaken alongside study, or on entry-level positions that may not indicate people's long-term careers. Thus one would expect that this model would not show associations as strong as those in Model 4a, for people whose labour force status, occupation and industry are more established and probably more strongly related to their literacy skills.

Table 10

Model 4b: Regression model for document literacy for people aged 16-24, incorporating employment-related variables

Factor	Independent variable	Dependent variable		
		Document literacy		
		Coefficient	p-value	R ²
	Intercept	-0.60	< 0.001	
Labour force status	Current student	0.48	< 0.001	0.077
	Employed in the past year	0.44	< 0.001	
Occupation and industry	Managerial, professional or technical occupation	0.33	< 0.01	0.046
	Machine operator or elementary occupation	-0.19	< 0.05	
	Finance, business or community service industry	0.28	< 0.05	
R² for model				0.123

Source: New Zealand results of the Adult Literacy and Life Skills Survey. Ministry of Education calculations

ns = not statistically significant (p = 0.05 or greater)

Interpreting the model

Model 4b accounts for 12.3 per cent of the variation in document literacy in this age group, not as much as Model 4a. However, all the variables are significant, and all the associations are quite strong. The strongest are the positive associations of being a student and of having been employed in the past year (and note that both of these can be true of the same individual). However, there are also strong positive associations with literacy of being in a managerial, professional or technical occupation and of working in finance, business or community services. These occupational and industry associations are likely to be more pronounced for people in the 20-24 age group who have completed their initial period of full-time education.

2.5 Models including demographic, home background, education and employment-related variables

Model for people aged 25-65

In Model 5a, outlined in Table 11, the labour force, occupation and industry variables are added to Model 3a (that is, the model for people aged 25-65 which includes demographic, home background and education variables).

Table 11

Model 5a: Regression model for document literacy for people aged 25-65, incorporating demographic, home background, education and employment-related variables

Factor	Independent variable	Dependent variable		
		Document literacy		
		Coefficient	p-value	R ²
	Intercept	0.087	< 0.001	
Language	Neither first nor main home language is English	-1.05	< 0.001	0.100
	First language is not English, but home language is English	-0.46	< 0.001	
Language & ethnic identification	Home language English, Māori ethnic identification	-0.30	< 0.001	0.111

	Home language English, Pasifika ethnic identification	-0.28	< 0.01	
Age and gender	Female 25-44	-0.04	<i>ns</i>	
	Male 45-65	-0.07	<i>ns</i>	
	Female 45-65	-0.23	< 0.001	
Deprivation	New Zealand Deprivation Index above median (deciles 6-10)	-0.14	< 0.001	
Parents' education	Mother/female guardian has a degree	0.08	<i>ns</i>	
	Mother completed Year 10 or less	-0.03	<i>ns</i>	
	Father/male guardian has a degree	-0.04	<i>ns</i>	
	Father completed Year 10 or less	-0.00	<i>ns</i>	
Education	Highest completed education is Year 10 or less	-0.72	< 0.001	0.191
	Highest completed education is Year 11	-0.33	< 0.001	
	Self-reported good grades in mathematics	0.20	< 0.001	
	Completed non-degree tertiary or recent non-degree tertiary study	0.13	< 0.05	
	Completed degree or recent degree-level study	0.37	< 0.001	
	Non-formal learning in past year	0.13	< 0.01	
	At least one year of education in New Zealand	0.13	< 0.01	
Labour force status	Current student	0.03	<i>ns</i>	0.004
	Employed in the past year	0.16	< 0.001	
Occupation and industry	Managerial, professional or technical occupation	0.15	< 0.001	0.015
	Machine operator or elementary occupation	-0.29	< 0.001	
	Finance, business or community service industry	-0.03	<i>ns</i>	
R² for model				0.421

Source: New Zealand results of the Adult Literacy and Life Skills Survey. Ministry of Education calculations

ns = not statistically significant ($p = 0.05$ or greater)

Interpreting the model

Model 5a accounts for 42.1 per cent of variation in document literacy in this age group, only 1.9 per cent more than Model 3a. The demographic, home background and education variables which were significant in Model 3a are still significant in Model 5a, although most of their coefficients are a little smaller. The largest change is for the degree-level education variable: its coefficient has dropped 0.11, and this is probably because of overlap with the managerial, professional or technical occupation variable, which has a moderately high correlation with having completed a degree (Earle 2009a; Lane 2010a).

Comparing Model 5a with Model 4a, the main change is that the industry variable is not significant in Model 5a. This is probably because the association of industry with literacy is already largely accounted for by the occupation and education variables. However, the employment and occupation variables are still highly significant, and the negative association with literacy of the category machine operator or elementary occupation (which includes a range of relatively lowly skilled occupations) is particularly large.

Model for people aged 16-24

In Model 5b, outlined in Table 12, the labour force, occupation and industry variables are added to Model 3b, the model incorporating demographic, home background and education variables.

Table 12

Model 5b: Regression model for document literacy for people aged 16-24, incorporating demographic, home background, education and employment-related variables

Factor	Independent variable	Dependent variable		
		Document literacy		
		Coefficient	p-value	R ²
	Intercept	-0.23	ns	
Language	Neither first nor main home language is English	-0.64	< 0.001	0.020
	First language is not English, but home language is English	0.01	ns	
Language & ethnic identification	Home language English, Māori ethnic identification	-0.40	< 0.001	0.173
	Home language English, Pasifika ethnic identification	-0.28	< 0.05	
Gender	Female	0.11	ns	
Age	20-24	0.04	ns	
Deprivation	New Zealand Deprivation Index above median (deciles 6-10)	-0.17	< 0.05	
Parents' education	Mother/female guardian has a degree	0.06	ns	
	Mother completed Year 10 or less	-0.07	ns	
	Father/male guardian has a degree	0.14	ns	
	Father completed Year 10 or less	-0.20	ns	
Education	Highest completed education is Year 10 or less	-0.60	< 0.01	0.143
	Highest completed education is Year 11	-0.25	< 0.05	
	Self-reported good grades in mathematics	0.33	< 0.01	
	Completed non-degree tertiary or recent non-degree tertiary study	0.07	ns	
	Completed degree or recent degree-level study	0.40	< 0.01	
	Non-formal learning in past year	0.04	ns	
	At least one year of education in New Zealand	-0.04	ns	
Labour force status	Current student	0.26	< 0.05	0.015
	Employed in the past year	0.20	< 0.05	
Occupation and industry	Managerial, professional or technical occupation	0.01	ns	0.006
	Machine operator or elementary occupation	-0.02	ns	
	Finance, business or community service industry	0.19	ns	
R² for model				0.357

Source: New Zealand results of the Adult Literacy and Life Skills Survey. Ministry of Education calculations

ns = not statistically significant (p = 0.05 or greater)

Interpreting the model

Model 5b accounts for 35.7 per cent of the variation in document literacy, 2.1 per cent more than Model 3b. The labour force status variables are still significant, though not as strong as in Model 4b, but the occupation and industry variables are no longer significant, probably because the effects of occupation and industry are already largely accounted for by the education variables.

The same education variables are significant in Model 5b as in Model 3b, although their coefficients are somewhat smaller. However, among the demographic and home background variables, high deprivation is now significant, as is being Pasifika with English as main home

language, which may indicate that the positive associations with literacy of student status and of being employed are not so strong for the high deprivation and Pasifika groups.

2.6 Technology use and literacy-related activities

The variables included under this heading are: home computer use, computer use at work, computer use for writing or editing, mobile phone use, library use, number of books in the home, types of regular personal reading and television/video watching.

The reference category for the home computer use variable encompasses using a home computer for less than 5 hours a month, not having home computer access, or never having used a computer (see section 3.5). Using a computer at work in the past year entails having been employed in the past year. The reference category for this variable includes being employed but not using a computer at work, and not being employed in the past year (descriptively, these two groups have similar literacy scores, see Lane 2010a). Using a computer to write or edit text frequently means doing this daily or a few times a week; the reference category includes using a computer to write or edit a few times a month, or never, or never having used a computer. The reference category for mobile phone use is using a mobile phone daily, a few times a week, or a few times a month.

The reference category for library use is library use at least once or twice a year. The reference category for books in the home is less than 25.

There are four possible types of personal reading, referring to reading or using information from newspapers; magazines or articles; books; or letters, notes or emails. ‘Regular’ means at least weekly. The reference category is 0-2 types of reading done on a regular basis. Viewing television/videos also includes DVDs, and the reference category is viewing for less than 5 hours per day.

Model for people aged 25-65

Model 6a, outlined in Table 13, for document literacy for people aged 25-65, incorporates variables for technology use and literacy-related activities.

Table 13

Model 6a: Regression model for document literacy for people aged 25-65, incorporating variables for technology use and literacy-related activities

Factor	Independent variable	Dependent variable		
		Document literacy		
		Coefficient	p-value	R ²
	Intercept	-0.98	< 0.001	
ICT use	Used home computer at least 5 hours per month	0.27	< 0.001	0.247
	Used computer at work in the past year	0.52	< 0.001	
	Use computer to write or edit frequently	0.19	< 0.001	
	Never use mobile phone	-0.29	< 0.001	
Literacy-related practices	Never use a library	-0.27	< 0.001	0.059
	25+ books in the home	0.47	< 0.001	
	3+ types of regular personal reading	0.14	< 0.001	
	Watch television/video 5+ hours per day	-0.14	<i>ns</i>	
R² for model				0.306

Source: New Zealand results of the Adult Literacy and Life Skills Survey. Ministry of Education calculations

ns = not statistically significant ($p = 0.05$ or greater)

Interpreting the model

Model 6a accounts for 30.6 per cent of variation in document literacy scores in the 25-65 age group, even greater than the set of education variables. All variables are highly significant, apart from television/video watching.

In general, technology use and engagement in literacy-related practices are positively associated with higher document literacy (given that never using a mobile phone and never using a library are negatively associated with document literacy). The strongest effects (in terms of the regression coefficients) are for home and work computer use, mobile phone use, library use and books in the home, with work computer use and books in the home standing out as having particularly strong effects.

Model for people aged 16-24

Model 6b, outlined in Table 14, for document literacy for people aged 16-24, incorporates the same variables for technology use and literacy-related activities as Model 6a.

Table 14

Model 6b: Regression model for document literacy for people aged 16-24, incorporating variables for technology use and literacy-related activities

Factor	Independent variable	Dependent variable		
		Document literacy		
		Coefficient	p-value	R ²
	Intercept	-0.55	< 0.01	
ICT use	Used home computer at least 5 hours per month	0.49	< 0.001	0.141
	Used computer at work in the past year	0.36	< 0.001	
	Use computer to write or edit frequently	-0.07	<i>ns</i>	
	Never use mobile phone	-0.17	<i>ns</i>	
Literacy-related practices	Never use a library	-0.36	< 0.01	0.052
	25+ books in the home	0.20	< 0.05	
	3+ types of regular personal reading	-0.03	<i>ns</i>	
	Watch television/video 5+ hours per day	-0.39	< 0.01	
R² for model				0.193

Source: New Zealand results of the Adult Literacy and Life Skills Survey. Ministry of Education calculations

ns = not statistically significant ($p = 0.05$ or greater)

Interpreting the model

Model 6b accounts for 19.3 per cent of variation in document literacy for this age group, considerably less than the 30.6 per cent accounted for by Model 6a.

Mobile phone use probably does not have a significant effect because almost all people in this age group are mobile phone users.

The variable ‘using a computer to write or edit’ does not appear to add anything to the general effects of home and work computer use, for the 16-24 age group. The descriptive analysis (Lane 2011) indicates that those who used a computer frequently for writing or editing had significantly higher mean document literacy than those who used it infrequently for this purpose in the 20-24 age group, but the difference was not significant in the 16-19 age group.

Several possible explanations for the descriptive pattern are offered in Lane (2011). Using a computer for writing may be more related to being employed in the 20-24 and 25-65 age groups and to being a student in the 16-19 age group, and whether people need to do writing and editing in their employment may depend more on their prior literacy than is the case for the

younger students. There could also be a practice effect, with people's literacy improving the longer they are involved in writing and editing on computer.

The survey questionnaire did not include a specific question about frequency of using a computer for reading; it may be that the strong association of computer use with literacy for this age group relates more to using the computer for reading than for writing, but it is not possible to test this directly.

The number of types of regular personal reading is not significant for this age group, unlike the older age group. The questions on personal reading ask about 'newspapers', 'magazines or articles', 'books' and 'letters, notes, e-mails' (see section 3.5). In spite of the mention of e-mails, these questions could be understood as oriented mainly towards documents on paper, and the lack of significance for this variable may reflect a greater orientation in this age group towards reading texts in electronic form.

On the other hand, television/video watching is significant. The model does not indicate whether television viewing leads to lower literacy or lower literacy leads to more television watching: in fact, a 'vicious circle' process is possible, in which both directions of causation are true.

All the significant variables (home and work computer use, library use, books in the home and television/video watching) have strong effects on document literacy, as indicated by the regression coefficients (which all have absolute values of 0.20 or more).

The model-building process is completed by adding the variables reflecting technology use and literacy-related activities to the models which incorporate the demographic, home background, education, labour force status, occupation and industry variables. Accordingly, the completed models are discussed in the next section.

2.7 Full models

The full regression models for document literacy are obtained by adding the variables for technology use and literacy-related activities (Model 6a or 6b) to the models which incorporate demographic and home background variables, education variables, and employment-related variables (Model 5a or 5b).

Model for people aged 25-65

The full model for document literacy for people aged 25-65 is outlined in Table 15.

Table 15

Full regression model for document literacy for people aged 25-65

Factor	Independent variable	Dependent variable		
		Document literacy		
		Coefficient	p-value	R ²
	Intercept	0.087	< 0.001	
Language	Neither first nor main home language is English	-0.93	< 0.001	0.100
	First language is not English, but home language is English	-0.42	< 0.001	
Language & ethnic identification	Home language English, Māori ethnic identification	-0.27	< 0.001	0.111
	Home language English, Pasifika ethnic identification	-0.20	< 0.01	
Age and gender	Female 25-44	-0.10	< 0.05	0.111
	Male 45-65	-0.08	ns	
	Female 45-65	-0.25	< 0.001	
Deprivation	New Zealand Deprivation Index above median (deciles 6-10)	-0.10	< 0.01	
Parents' education	Mother/female guardian has a degree	0.04	ns	0.191
	Mother completed Year 10 or less	-0.02	ns	
	Father/male guardian has a degree	-0.05	ns	
	Father completed Year 10 or less	-0.01	ns	
Education	Highest completed education is Year 10 or less	-0.58	< 0.001	0.191
	Highest completed education is Year 11	-0.27	< 0.001	
	Self-reported good grades in mathematics	0.18	< 0.001	
	Completed non-degree tertiary or recent non-degree tertiary study	0.06	ns	
	Completed degree or recent degree-level study	0.25	< 0.001	
	Non-formal learning in past year	0.07	ns	
	At least one year of education in New Zealand	0.09	< 0.05	
Labour force status	Current student	0.04	ns	0.004
	Employed in the past year	-0.05	ns	
Occupation and industry	Managerial, professional or technical occupation	0.07	ns	0.015
	Machine operator or elementary occupation	-0.18	< 0.01	
	Finance, business or community service industry	-0.00	ns	
ICT use	Used home computer at least 5 hours per month	0.20	< 0.001	0.042
	Used computer at work in the past year	0.27	< 0.001	
	Use computer to write or edit frequently	0.08	< 0.05	
	Never use mobile phone	-0.17	< 0.01	
Literacy-related practices	Never use a library	-0.15	< 0.001	0.017
	25+ books in the home	0.29	< 0.001	
	3+ types of regular personal reading	0.08	< 0.05	
	Watch television/video 5+ hours per day	-0.08	ns	
R² for model				0.480

Source: New Zealand results of the Adult Literacy and Life Skills Survey. Ministry of Education calculations

ns = not statistically significant (p = 0.05 or greater)

Interpreting the model

This model accounts for 48 per cent of the variation in document literacy scores in this age group, 5.9 per cent more than Model 5a.

A number of variables which were significant in Model 5a are no longer significant in the full model. Because using a computer at work in the past year entails being employed in the past year, much of the effect of employment is taken up by the computer use at work variable, and employment in the past year is no longer significant on its own. Use of a computer at work is also correlated with being in a managerial, professional or technical occupation, and this is probably the main reason why this occupational category is no longer significant. The broader effects of the variables for technology use and literacy-related activities also lead to the effects of tertiary non-degree study and non-formal learning becoming non-significant.

At the same time, being female and aged 25-44 is significant in the full model whereas it was not significant in Model 5a. A significant negative association of this variable with document literacy is apparently needed to offset positive correlations of being female aged 25-44 with at least some of the variables for technology use and literacy-related activities.

Comparing the full model with model 6a (based on technology use and literacy-related activities), the same variables are significant, but the coefficients in the full model are considerably smaller.

To summarise the full model, there are significant effects for eight broad factors, namely:

- language
- language and ethnic identification
- age and gender
- deprivation
- education
- technology use
- occupation and industry
- literacy-related practices.

All the component variables of these factors are significant except for:

- male 45-65
- completed or recent non-degree tertiary study
- non-formal learning in the past year
- managerial, professional or technical occupation
- finance, business or community services industry
- watch television/video 5+ hours per day.

The variables with the largest coefficients (in terms of absolute value of 0.20 or more) are:

- neither first nor home language is English
- first language is not English, but home language is English
- home language English, Māori ethnic identification
- home language English, Pasifika ethnic identification
- female 45-65
- highest completed education is Year 10 or less
- highest completed education is Year 11

- completed degree or recent degree-level study
- used home computer at least 5 hours per month
- used computer at work in the past year
- 25 or more books in the home.

Model for people aged 16-24

The full model for document literacy for people aged 16-24 is outlined in Table 16. As with the full model for people aged 25-65, this model incorporates variables covering demographic characteristics, home background, education, labour force status, occupation, industry, technology use and literacy-related activities.

Table 16

Full regression model for document literacy for people aged 16-24

Factor	Independent variable	Dependent variable		
		Document literacy		
		Coefficient	p-value	R ²
	Intercept	-0.46	ns	
Language	Neither first nor main home language is English	-0.65	< 0.001	0.020
	First language is not English, but home language is English	0.02	ns	
Language & ethnic identification	Home language English, Māori ethnic identification	-0.32	< 0.01	0.173
	Home language English, Pasifika ethnic identification	-0.23	< 0.05	
Gender	Female	0.13	ns	
Age	20-24	0.10	ns	
Deprivation	New Zealand Deprivation Index above median (deciles 6-10)	-0.15	ns (< 0.1)	
Parents' education	Mother/female guardian has a degree	0.04	ns	
	Mother completed Year 10 or less	-0.02	ns	
	Father/male guardian has a degree	0.13	ns	
	Father completed Year 10 or less	-0.18	ns	
Education	Highest completed education is Year 10 or less	-0.49	< 0.05	
	Highest completed education is Year 11	-0.20	ns	
	Self-reported good grades in mathematics	0.31	< 0.01	
	Completed non-degree tertiary or recent non-degree tertiary study	0.05	ns	
	Completed degree or recent degree-level study	0.34	< 0.01	
	Non-formal learning in past year	0.05	ns	
	At least one year of education in New Zealand	-0.01	ns	
Labour force status	Current student	0.19	ns (< 0.1)	0.015
	Employed in the past year	0.20	ns (< 0.1)	
Occupation and industry	Managerial, professional or technical occupation	0.02	ns	0.006
	Machine operator or elementary occupation	-0.01	ns	
	Finance, business or community service industry	0.13	ns	
ICT use	Used home computer at least 5 hours per month	0.31	< 0.01	0.021
	Used computer at work in the past year	0.03	ns	
	Use computer to write or edit frequently	-0.01	ns	
	Never use mobile phone	-0.01	ns	
Literacy-related practices	Never use a library	-0.23	< 0.05	0.015
	25+ books in the home	0.08	ns	
	3+ types of regular personal reading	-0.08	ns	
	Watch television/video 5+ hours per day	-0.22	ns (< 0.1)	
R² for model				0.393

Source: New Zealand results of the Adult Literacy and Life Skills Survey. Ministry of Education calculations

ns = not statistically significant (p = 0.05 or greater)

Interpreting the model

The full model accounts for 39.3 per cent of the variation in document literacy in this age group, 3.6 per cent more than Model 5b. Compared with Model 5b, the deprivation, Year 11

completion, student and employment in past year variables are no longer significant: it appears that the variation associated with those variables in Model 5b is now better accounted for by the home computer use and library use variables. Compared with Model 6b, the work computer use, books in the home, and television/video watching variables are no longer significant.

There are significant effects for five of the broad factors:

- language;
- language and ethnic identification;
- education;
- technology use; and
- literacy-related practices.

More specifically, the significant variables are:

- neither first nor main home language is English;
- Māori ethnic identification with English as main home language;
- Pasifika ethnic identification with English as main home language;
- highest completed education is Year 10 or less;
- self-reported good grades in mathematics;
- completed degree or recent degree-level study;
- used home computer at least 5 hours per month; and
- never use a library.

Lane (2010a) identified three key factors associated with prose literacy and numeracy in people aged 25-65, namely language, completed education and computer use, and noted that ethnic identification also had a large effect in relation to numeracy. More specifically, the variables first language, completion of upper secondary or tertiary education and computer use at work could account for a large part of variation in prose literacy and numeracy.

This report has added two other factors to the list of factors with strong associations with document literacy for people aged 25-65, namely age/gender (female aged 45-65) and number of books in the home.

In the 16-24 age group, although we see a similar set of general factors, namely language, ethnic identification, education and computer use, some of the specific variables behave quite differently. In particular, first language is not a significant variable, although main home language is; computer use at work is not a significant variable, but home computer use is.

It is interesting that home computer use is such a strong predictor of literacy among people aged 16-24, while library use is just significant, and other literacy-related practices are not significant. This presents a contrast with the 25-65 age group, among whom the number of books in the home is a particularly strong predictor of literacy, and library use and types of personal reading are highly significant.

The 16-24 age group is also distinctive in not showing significant effects for occupation, deprivation, age and gender. In the case of occupation and deprivation this may reflect that fact that younger people are not as established in occupation or where they live as the 25-65 age group. The narrow nine-year age range of the 16-24 age group does not allow as much scope for an age-by-gender interaction as does the 41-year range of the 25-65 age group. The lack of significance of some of these variables may also reflect the smaller sample size of the 16-24 age group and consequent lower statistical power.

2.8 Reduced models

Reduced model for people aged 25-65

If we take the strongest effects from the full model for people aged 25-65 (that is, the effects with coefficient absolute value of 0.20 or more), we get the reduced model outlined in Table 17.

Table 17

Reduced regression model for document literacy for people aged 25-65

Factor	Independent variable	Dependent variable		
		Document literacy		
		Coefficient	p-value	R ²
	Intercept	0.087	< 0.001	
Language	Neither first nor main home language is English	-1.01	< 0.001	0.100
	First language is not English, but home language is English	-0.48	< 0.001	
Language & ethnic identification	Home language English, Māori ethnic identification	-0.29	< 0.001	0.035
	Home language English, Pasifika ethnic identification	-0.23	< 0.001	
Age and gender	Female 45-65	-0.17	< 0.001	0.018
Education	Highest completed education is Year 10 or less	-0.73	< 0.001	0.215
	Highest completed education is Year 11	-0.36	< 0.001	
	Completed degree or recent degree-level study	0.33	< 0.001	
Computer use	Used home computer at least 5 hours per month	0.27	< 0.001	0.063
	Used computer at work in the past year	0.38	< 0.001	
Literacy-related practices	25+ books in the home	0.38	< 0.001	0.016
R² for model				0.447

Source: New Zealand results of the Adult Literacy and Life Skills Survey. Ministry of Education calculations

ns = not statistically significant (p = 0.05 or greater)

Interpreting the model

This model accounts for 44.7 per cent of the variation in document literacy in this age group, only 3.3 per cent less than the full model. It incorporates 11 variables, rather than the 32 of the full model. All the independent variables are highly significant. In terms of variation accounted for, the education variables stand out, along with language and computer use. These are the three key factors identified in Lane (2010a). In terms of the size of coefficients, the number of books in the home is another particularly strong predictor of document literacy.

Reduced model for people aged 16-24

The reduced model for document literacy for people aged 16-24 is outlined in Table 18.

Table 18

Reduced regression model for document literacy for people aged 16-24

Factor	Independent variable	Dependent variable		
		Document literacy		
		Coefficient	p-value	R ²
	Intercept	-0.37	< 0.01	
Language	Main home language is not English	-0.65	< 0.001	0.022
Language & ethnic identification	Home language English, Māori ethnic identification	-0.48	< 0.001	0.090
	Home language English, Pasifika ethnic identification	-0.32	< 0.05	
Formal education	Highest completed education is Year 10 or less	-0.52	< 0.05	0.177
	Self-reported good grades in mathematics	0.38	< 0.001	
	Completed degree or recent degree-level study	0.61	< 0.001	
Computer use	Used home computer at least 5 hours per month	0.37	< 0.001	0.027
R² for model				0.316

Source: New Zealand results of the Adult Literacy and Life Skills Survey. Ministry of Education calculations

Interpreting the model

This reduced model accounts for 31.6 per cent of the variation in document literacy for this age group, 7.7 per cent less than the full model.

This model is restricted to the four key factors of language, language and ethnic identification, education and computer use, and incorporates seven variables. It nevertheless covers the bulk of the variation accounted for by the full model.

It may seem somewhat odd that the partial R² for education (three variables) in this model is greater than that for education (seven variables) in the full model. This arises because a large part of the variation accounted for by the factors of gender, age, deprivation and parents' education in the full model is in a sense transferred to the education variables in the restricted model, and this is reflected in the larger coefficients for the education variables in this reduced model.

3 CONCLUSION

As indicated by the reduced model in Table 18, the key factors related to document literacy for people aged 16-24 were:

- Main home language
- Ethnic identification (among those with English as main home language)
- Educational participation and achievement
- Home computer use

Knowledge of English is clearly a prerequisite for demonstrating literacy skills in an English-based test. However, it is interesting that first language does not have a significant effect for people aged 16-24, whereas it is highly significant for people aged 25-65. This is likely to be a result of the fact that a large proportion of people aged 16-24 whose first language is not English have had experience of the New Zealand education system, unlike many speakers of English as an additional language in the 25-65 age group. This suggests that workplace exposure to English may not be as effective as formal education in developing English literacy among those with a non-English first language. For the 16-24 age group, although language background is not a major factor in English literacy, current language use in the home remains important.

Among people aged 16-24 with English as the main language spoken in the home, ethnic identification (essentially Māori and Pasifika compared with European) is strongly associated with literacy even when all the other factors in the full model are taken into account. The socioeconomic status variables in the model (neighbourhood deprivation and parental education) probably do not fully capture socioeconomic effects, and so the ethnic variables may in part reflect socioeconomic differences with which they are correlated. Nevertheless, the strength of these ethnic effects indicates that cultural factors as well as linguistic factors have an important part to play in the development and measurement of literacy.

Of the four key factors, participation and achievement in formal education accounts for the greatest proportion of variation in document literacy scores. A particular feature of the models for people aged 16-24 is the strong effect on document literacy of experience of degree level study. In contrast, non-degree tertiary study does not have a significant effect when compared with upper secondary completion, even in the model which only incorporates education variables (Model 2b, Table 6). It is not clear from the survey data to what extent the effect of degree-level study reflects a process of selection into degree-level study of people who already have higher literacy skills, or a process of development of literacy skills during degree-level study; although both processes are likely to be involved.

In my earlier analysis of key factors related to literacy and numeracy in the 25-65 age group (Lane 2010a), computer use, particularly at work, appeared as one of the factors most strongly associated with literacy and numeracy in this age group. Comparing people's computer use with how often they engaged in literacy and numeracy-related activities at work and at home indicated that computer users were more frequently engaged in such activities. Thus computer use could be taken as an indicator of being more involved in literacy and numeracy practices, and in particular computer use at work could be taken as identifying jobs that entailed heavier engagement in literacy and numeracy practices and thus required higher literacy and numeracy skills. It was not clear that work in itself or computer use in itself facilitated the development of literacy and numeracy skills.

However, a number of literacy researchers have argued that both employment and computer use can facilitate literacy development.

Desjardins (2003: 237), in an analysis of the International Adult Literacy Survey (IALS) results for 18 countries including New Zealand (using structural equation modelling), concludes that although education has the strongest effect on literacy in all the countries,

... the job and other literacy-related factors⁷ ... may be good substitutes for those who complete relatively less education and/or come from an unfavourable home background.

Gerber (1998), in a regression analysis of document literacy scores in the 1992 US National Adult Literacy Survey, provides evidence that workplaces foster specific literacy skills as well as taking advantage of skills learned in formal education, and concludes that the workplace provides an additional literacy learning environment.

Aro and Olkinuora (2007), in a regression analysis of the Finnish results of the 1998 Second International Adult Literacy Survey, find significant associations between computer use for information searching, email, work or study (but not game-playing) and prose and document literacy (at least for particular combinations of occupation and gender). They argue that computer use provides an additional opportunity for literacy learning, especially for people with lower levels of formal education.

Because all of these studies are based on cross-sectional surveys carried out at a single point in time, the conclusions are not necessarily definitive. Longitudinal studies are really required to clarify which comes first: work, computer use or literacy skills.

Bynner et al. (2010) have reported the results of two such longitudinal studies, carried out among people who had not completed secondary education in Britain and the US. Data was collected on employment, computer use and literacy skills in 2000 and among the same subjects in 2004⁸. Bynner et al. reported strong effects of employment and ICT use in 2000 on literacy in 2004 in both locations (Portland, Oregon and London), and in Portland, only weak effects of literacy skills in 2000 on employment or ICT use in 2004.

Given these overseas findings, it is reasonable to suggest that employment and computer use in New Zealand may enhance document literacy skills rather than just indicating the level of literacy already achieved. The effect of employment shows up strongly in the 25-65 age group, though mainly in conjunction with computer use. However, for the 16-24 age group, the effect of employment is not strong, nor is computer use at work. On the other hand, for this age group, use of a computer at home has a strong association with document literacy, even after accounting for the other three key factors of language, ethnic identification and education, and this may well be because home computer use provides practice which enhances document literacy.

⁷ That is, other than demographic characteristics, home background and education. The 'job' factor includes labour force participation, occupational status, literacy practice at work and job-related training. Other factors considered by Desjardins were personal literacy practices, personal interest adult education, and volunteering.

⁸ Except that literacy data was not collected in 2000 in the London study.

4 DATA AND DEFINITIONS

4.1 The Adult Literacy and Life Skills Survey data

Sampling and weighting for the Adult Literacy and Life Skills Survey 2006

Sampling for the survey was based on Statistics New Zealand's geographical framework, in which the smallest units are called meshblocks. There were over 38,000 meshblocks in 2001. The survey was based on a probability (proportional to size) sample of 896 meshblocks (from the 2001 meshblock classification) in the North and South Islands and Waiheke Island. Within each meshblock a sample of permanent private dwellings was sought, consisting of an initial sample and then a screened sample designed to over-sample Māori and Pasifika. One person usually resident in each sampled dwelling and aged between 16 and 65 was sought. The achieved response rate was 64 per cent.

Each respondent was interviewed face-to-face, the interviewer completed the background questionnaire and the respondent was asked to complete test booklets in English selected from a bank of test material covering literacy, numeracy and problem-solving. The distribution of test material among respondents favoured prose literacy and document literacy, so that these two measures could be estimated with sufficient accuracy for comparison with the International Adult Literacy Survey (IALS) 1996 (which did not include numeracy or problem-solving). This was a consideration in the choice of document literacy as the focus of this report.

A pilot survey was undertaken between July and September 2005 and the main survey took place from May 2006 to March 2007. The pilot data was included in the final data set, which consists of records from 7,131 respondents, of whom 1,082 were aged between 16 and 24.

The sample data was validated against Statistics New Zealand census and household survey data and Ministry of Education statistics.

Each respondent was assigned a weight, which can be thought of as the number of people in the population represented by that respondent. The weight was a product of a probability weight (based on the probability of the respondent being selected in the initial sample), a non-response weight (to adjust for the proportion of the initial sample not interviewed) and a benchmark adjustment (to adjust for different rates of responding in different demographic categories). The benchmark adjustment was based on 2006 Census data for gender, ethnicity and age.

Number and percentage estimates are sensitive to sampling error, which can be thought of as the variation that would arise in estimates if the survey were repeated many times with a new set of geographical areas selected each time and consequently a different set of respondents. Sampling errors were estimated by a process (jackknife variance estimation) which involves assigning a set of weights to each respondent (replicate weights) to approximate repeating the survey multiple times with different samples.

To calculate replicate weights, the 896 meshblocks were divided into 30 groups (each of 29 or 30 meshblocks with a wide geographical spread) and weights recalculated based on deleting one group in turn and readjusting to the benchmarks. Standard errors (which measure the accuracy of estimates) have been derived from the jackknife variance estimation procedure using these 30 replicate weights.

Scores in the Adult Literacy and Life Skills Survey

Satherley and Lawes (2007) give an account of the scoring approach in the ALL survey:

To each individual, and for each of the domains, a score from zero to 500 is assigned. Zero indicates extremely low proficiency, and 500 extremely high. In addition, based on this score, one of five ‘cognitive levels’ is assigned. These cognitive levels are used in national and international comparison, essentially as a benchmark. The following list provides descriptions of typical tasks associated with each cognitive level.

Level 1 (Scores 0–225):

Tasks at this level require the ability to read simple documents, accomplish literal information-matching with no distractions, and perform simple one-step calculations.

Level 2 (Scores 226–275):

This level includes tasks that demand the capacity to search a document and filter out some simple distracting information, achieve low-level inferences, and execute one- or two-step calculations and estimations.

Level 3 (Scores 276–325):

Typical tasks at level 3 involve more complex information-filtering, sometimes requiring inferences and the facility to manipulate mathematical symbols, perhaps in several stages.

Level 4 (Scores 326–375):

A level 4 task might demand the integration of information from a long passage, the use of more complex inferences and the completion of multiple-step calculations requiring some reasoning.

Level 5 (Scores 376–500):

Level 5 tasks incorporate the capability to make high-level inferences or syntheses, use specialised knowledge, filter out multiple distractors, and to understand and use abstract mathematical ideas with justification.

OECD and Statistics Canada (2000) provide the following characterisation of Level 3:

Level 3 is considered a suitable minimum for coping with the demands of everyday life and work in a complex, advanced society. It denotes roughly the skill level required for successful secondary school completion and college entry.

4.2 Demographic and home background variables

First language and main language spoken at home

Information on first language(s) was derived from responses to ALL questions B1A and B1B which asked “What is the language that you first learned at home in childhood and still understand?” Respondents could nominate two languages if they were learned at precisely the same time, and 56 did so. Respondents who provided English as a response to one of these questions were categorised as having English as a first language, and all others as not having English as a first language.

Main language spoken at home is based on responses to question B2 in the ALL background questionnaire, which asked “What language do you speak most often at home?”

Ethnic identification

Ethnic identification is based on questions AA3ZA-AA3ZE of the ALL background questionnaire. This set of questions allows each respondent to nominate up to five ethnic

identifications. There were 12 categories of response to the five questions, and these categories were aggregated as total response variables. As noted above, Māori and Pasifika were deliberately over-sampled, but the weighting adjusts the ethnic population estimates so that they correspond with 2006 Census figures.

Parents' education

Question C2 asked “What was the highest level of schooling that your mother or female guardian ever completed?” and question C6 was the corresponding question relating to father or male guardian.

New Zealand Deprivation Index

The New Zealand Deprivation Index (NZDep) was developed by public health researchers in the Department of Public Health, University of Otago, Wellington, and has since been adopted by the Ministry of Health for a range of purposes including research and the allocation of funding. The index has been calculated on the basis of each Census since 1991 and is a well established measure. The latest index is NZDep2006 (Salmond et al., 2007; White et al. 2008).

The index applies to small geographical areas (not individuals), namely meshblocks and area units as defined by Statistics New Zealand. The index is a measure of the socioeconomic deprivation of people living in each small area, expressed in terms of deciles (decile 1 represents the least deprivation, and decile 10 the greatest deprivation). NZDep2006 was derived from the proportions of people in each small area

- receiving a welfare benefit
- with low household income
- living in a home they do not own
- living in a single parent family
- unemployed
- without educational qualifications
- in overcrowded housing
- without access to a telephone
- without access to a car

The Ministry of Health provides concordance tables matching meshblock numbers with the New Zealand Deprivation Index 2001 and 2006. These were downloaded from the Ministry of Health website and merged with the ALL data set.

Respondents were assigned the NZDep2006 value where it could be matched with the 2001 meshblock number used in the survey design. This could not be done for 727 respondents in the analysis data set because of changes in Statistics New Zealand's meshblock classification between 2001 and 2006. For all but one of these respondents, a value for New Zealand Deprivation Index could be imputed by assigning the NZDep2001 value. For the subsample of 6404 respondents with assigned values for both NZDep2006 and NZDep2001, the weighted correlation between NZDep2001 and NZDep2006 was 0.87, indicating that this imputation was unlikely to distort the analysis.

The variable used in modelling has two values: low deprivation (NZDep deciles 1-5) and high deprivation (NZDep deciles 6-10).

4.3 Education variables

Completed education

Highest level of completed education was derived from responses to questions A4B and A4C of the ALL background questionnaire which asked respectively “What is the highest level of primary or secondary school that you have ever completed?” and “What is the highest level of formal education or training that you have ever completed?” The New Zealand coded responses were used and grouped into lower secondary (up to Year 11), upper secondary (Year 12 or 13, or Level 1, 2 or 3 certificate) and tertiary (Level 4 certificate and above, including all diplomas and degrees).

Years in New Zealand education were calculated by subtracting years of formal education completed outside New Zealand (from responses to questions A3A and A3B) from total years of formal education (from responses to question A3).

Study or training in the past year

The number of people who had taken formal courses (which count towards a qualification), non-formal courses (which do not), or self-directed study or training not involving courses, in the 12 months before the interview was determined from responses to questions F1 to F16 in the ALL background questionnaire. The level of formal study or training (if taken) was determined from question F4, which asked “What type of certificate, degree or diploma were you taking this education or training towards? If there was more than one, tell me about the most recent one.” Experience of degree level study is determined from the responses to questions A4C (on completed education) and F4 (on formal study in the past year).

Self-reported school performance in mathematics

This variable was derived from responses to question A9C, which asked “Think about learning maths and how you were taught maths while a student at secondary school. Please tell me whether you strongly agree, agree, disagree, or strongly disagree with the following statements: ... c) I got good grades in maths.”

4.4 Labour force status, occupation and industry

Labour force status

Current labour force status is based on responses to question D1 in the ALL background questionnaires, which asked “I would now like to talk about your employment status. What is your current work situation?” Respondents were asked to select one option only from the following list:

- Employed or self-employed [‘employed’]
- A student (including work programmes) [‘student’]
- Not working and looking for work [‘unemployed’]
- Retired [‘retired’]
- Doing unpaid household work [‘homemaker’]
- Other, specify ... [‘other’]

Employment

Employment in the past year was based on responses to question D2 in the ALL background questionnaire, which asked “Did you work at a job or business at any time in the last 12 months ... (regardless of the number of hours per week)?” According to the instructions to the interviewers, ‘the last 12 months’ covered the period up to the month prior to the month of the interview. It needs to be noted that those who were ‘employed’ in terms of employment status

in the past year were not necessarily ‘employed’ in terms of current labour force status (and vice versa).

Occupation and industry

The ALL background questionnaire contains a series of questions (D17 to D43) about the most recent job that the respondent had worked at within the last five years. Occupation and industry categories were assigned on the basis of this job. People who had not been employed in the previous five years were not assigned an occupation or industry.

Occupation

Occupation is coded to the International Standard Classification of Occupation (ISCOR) in the ALL data set. This has been concorded to the New Zealand Standard Classification of Occupation 1999 (NZSCO99). Occupations at level one of this classification have been aggregated for this analysis, as shown in Table 10.

A small number of people with military occupations were included in the survey but these are excluded from the occupational analysis. Because the survey was limited to permanent private dwellings, a large number of military personnel living in military institutional dwellings were not eligible to be surveyed, and so the survey could not fairly represent this occupational category.

Table 19

Classification of occupations

Group	NZSCO99
White collar workers	Administrators and managers Professionals Technicians and associate professionals Clerks
Service workers	Service and sales workers
Manual workers	Agricultural workers Trades workers Plant and machinery operators and assemblers Labourers
Other (excluded from analysis)	Military

Industry

Industry is coded in the ALL data set using the International Standard Industry Classification (ISIC). For this analysis, the ISIC has been concorded to the Australia and New Zealand Standard Industry Classification 2006 (ANZSIC06), and industries in the top level of classification have been grouped together, following Pool et al. (2005), as shown in Table 11.

Table 20
Classification of industries

Group	ANZSIC06
Agriculture, manufacturing and construction	A Agriculture, forestry and fishing B Mining C Manufacturing E Construction
Wholesale and retail trade, transport and communications	F Wholesale trade G Retail trade H Accommodation and food services I Transport, postal and warehousing J Information media and telecommunications
Finance, business and community services	D Electricity, gas, water and waste services K Finance and insurance services L Rental, hiring and real estate services M Professional, scientific and technical services N Administrative and support services O Public administration and safety P Education and training Q Health care and social assistance R Art and recreation services S Other services
Other (excluded from analysis)	Military

4.5 Technology use and literacy-related practices

Computer use at home

The variable used in analysis was based on the number of hours per month of home computer use. This variable is based on question H13 in the ALL background questionnaire, which was only asked of people who had answered yes to H2, “Have you ever used a computer?” and yes to H11, “Do you have personal access to a computer in your home (including a laptop you bring home from your work)?”. H13 asked “In a typical month, how many hours did you use a computer at home?” Home computer use was analysed using the aggregated categories of use for 5 or more hours per month as opposed to less than 5 hours use, not having home computer access, or never having used a computer.

Computer use at work

The work computer use variable was based on question H7 in the ALL background questionnaire. This question was only asked of people who had answered yes to D2 (see Employment above) and yes to question H2, “Have you ever used a computer?”. H7 asked “In the last 12 months, did you use a computer in your job? (If you have more than one job, tell us about the one at which you work the most hours)”.

Purposes of computer use

Question H3 asked “In a typical month, how often did you use a computer for the following purposes?” The list of purposes includes: a) “Writing or editing text” and g) “Playing games”. The responses ‘Daily’ and ‘A few times a week’ were grouped as frequent use, while the

responses ‘A few times a month’ and ‘Never’ were grouped as infrequent, and this category also included people who had never used a computer.

Mobile phone use

Question H1 asked “In a typical month, how often did you use each of the following?” The subsequent list include item a) “A mobile phone”. The responses ‘Daily’, ‘A few times a week’ and ‘A few times a month’ were grouped as ever using a mobile phone; the other possible response was ‘Never’.

Library use

This variable is based on question G1A which asked “About how often do you do the following activities whether these activities are done in person or on computer? Would that be weekly, monthly, several times during the year, once or twice during the year or never? The list of activities includes “a) use a library?”

Types of regular personal reading

Survey question G3 asked about personal reading habits, that is, reading which is not done for work or study purposes. Question G3 had four sub-questions as shown in Table 21.

Table 21

ALL survey question on personal reading activities

- G3** How often do you read or use information from each of the following sources as part of your daily life? Please don't include time spent as part of your job or schooling. Would you say at least once a week, less than once a week, rarely or never.
- a) How often do you read or use information from newspapers?
 - b) How often do you read or use information from magazines or articles?
 - c) How often do you read or use information from books – fiction or non-fiction?
 - d) How often do you read or use information from letters, notes, e-mails?

From this question we can construct a scale of the number of types of personal reading activity done on a regular basis, i.e. at least weekly. This is then simplified into two groups: those who read 3 or 4 types of personal reading on a regular basis, and those who read less than 3.

Books in the home

This variable is based on responses to question G6, which asked “How many books do you have in your household? Do not include magazines.” The possible responses were less than 25, 25 to 100 and over 100. For the modelling, this is simplified to less than 25 or 25 and over.

Television and video viewing

This variable is based on responses to question G2, which asked “How much time do you usually spend each day watching television, videos or DVDs?” Descriptive analysis (Lane 2011) shows lower mean document literacy for those responding “5 or more hours per day”. The variable has two values: 5 or more hours per day, and less than 5 hours per day.

APPENDIX A STATISTICAL MODELLING PROCEDURES

Ordinary least-squares regression models for document literacy were run in SAS using PROC SURVEYREG, initially based on the models used in Lane (2010a) for the analysis of prose literacy and numeracy among people aged 25-65. Five additional factors were considered: parents' education, library use, television viewing, number of books in the home and mobile phone use.

Because each respondent is only asked to answer a subset of the test materials, an imputation procedure (based on the data from all respondents) is used to generalise from the subset answered to a set of five imputed scores ('plausible values') for each respondent.

The SURVEYREG procedure was run for each plausible value of the literacy (or numeracy) variables, using the jack-knife option and the 30 replicate weights in the ALL data set. The coefficients are the average of the coefficients across the results for the five plausible values. The standard error is the square root of the sample variance and the imputation variance. The sample variance is the mean of the variances across the five plausible values. The imputation variance is the variance of the coefficients.

As a check on this procedure, the models were also run using the SAS macro STATTOOL, developed by Statistics Canada for analysis of the ALL survey data. STATTOOL uses an approximation in its estimates of variances, which means the estimates of p-values for t-tests of the regression coefficients are also approximate. The p-values in the tables in this report are expressed in ranges which are true for both the SURVEYREG and STATTOOL results, with one exception. Where the p-value is close to 0.05, the SURVEYREG values are used rather than the STATTOOL values.

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