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Veröffentlichungsversion / Published Version

Zeitschriftenartikel / journal article

Empfohlene Zitierung / Suggested Citation:

Sulkunen, S., Nissinen, K., & Malin, A. (2021). The role of informal learning in adults' literacy proficiency. *European Journal for Research on the Education and Learning of Adults*, 12(2), 207-222. <https://doi.org/10.3384/rela.2000-7426.1325>

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The role of informal learning in adults' literacy proficiency

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Abstract

This study used the Programme for International Assessment of Adult Competencies (PIAAC) dataset to examine informal literacy learning's effects on adults' literacy proficiency. Also, the factors associated with informal literacy learning at and outside of work were studied. The study participants were Nordic adults aged 35–65 years. The statistical method was regression analysis, and the results indicate that informal literacy activities at work are associated primarily with occupation, and informal literacy activities outside of work with education, parents' education and gender. Initial education, occupation, language background and age exerted the strongest estimated associations with reading literacy proficiency. Informal learning, particularly reading outside of work, exerted a statistically significant effect independent of adults' backgrounds, indicating that it may offer all adults the opportunity to develop literacy proficiency.

Keywords: Adult literacy, informal learning, reading activities, work

Introduction

Literacy is one of the key competencies needed for lifelong learning; it is a significant component of personal development, employability, social inclusion and active citizenship throughout an individual's life. Moreover, literacy also contributes to active aging, which refers to aging individuals' autonomous and independent participation in



social, economic, cultural and civic affairs (Barabasch, Dehmel, & van Loo, 2012; Council of the European Union, 2018; World Health Organisation [WHO], 2002). Particularly in modern knowledge societies, solid literacy skills are necessary in many situations related to education, work and citizenship. From a lifelong learning perspective, literacy can be viewed as an essential competency in such situations. However, literacy also needs to be conceptualised as a lifelong learning goal (e.g., Binkley, Erstad, Herman, Raizen, Ripley, Miller-Ricci & Rumble, 2012). Considering that the technologies related to literacy, as well as literacy requirements, constantly are changing, and given such technologies' rapid growth over the past two decades, lifelong literacy learning (Leu, Kinzer, Coiro, Castek & Henry, 2013) is a challenge that many adults and younger people face today. In many ways, digital literacy is different from traditional literacy and may challenge, and even reform, practices in many areas of life, including adult education (Wildemeersch & Jütte, 2017).

Adult literacy studies have shown that initial formal education is key to the development of reading skills, but that its role is difficult to compensate for (Desjardins, 2003; Green & Riddell, 2012; Organisation for Economic Co-operation and Development [OECD], 2000, 2013a; Sulkunen & Malin, 2018). Gustafsson (2016) concludes that many of the age differences in literacy proficiency derive from cohort effects related to schooling. Similarly, the positive association between parents' education and adults' literacy proficiency is suggested to be indicative of the home environment supporting individuals educating themselves (Desjardins, 2003; Green & Riddell, 2012). While early education provides adults with a foundation for lifelong learning of literacy, it is hardly possible for formal education alone to cater to changing literacy needs throughout an individual's life, as many adults face new literacy challenges decades after completing formal education. Lifelong learning complements early education (Desjardins, 2003, p. 237), as adults must update and develop their literacy skills continuously.

It often has been assumed that the main type of lifelong learning, whether related to literacy or other areas, is adult education and training. In its many forms, adult education can help adults maintain and develop skills, as well as delay age-related declines in proficiency (OECD, 2013a). However, even in countries with high participation in adult education, such as Nordic countries, the participation rate in formal adult education that leads to formal qualifications does not exceed 20% (Sulkunen & Malin, 2014). Nonformal adult education is also popular; it involves organised activities, but does not lead to a new qualification (OECD, 2005). This type of learning is not necessarily related to literacy and, thus, does not contribute to adults' literacy proficiency in general. Even literacy programmes may result in only limited proficiency gains (Alambrese, MacArthur, Price, & Knight, 2011; Reder, 2009; Sabatini, Shore, Holtzman, & Scarborough, 2011). However, some studies have discovered literacy gains attained from basic skills programmes implemented with the broader aims of social inclusion (de Greef, Segers & Verté, 2012; de Greef, Verté & Segers, 2015). These studies report improved reading and writing mastery, as well as engagement in literacy in everyday contexts. Thus, the results reflect increases not only in functional skills, but also in participation in adults' surroundings.

However, adults' literacy proficiency also develops outside formal and nonformal educational settings. Informal learning that occurs through daily activities at work and during leisure time (OECD, 2005) should be considered as well. Studies conducted with adolescents have shown that their use of literacy in various contexts offers them self-generated opportunities to practise and develop their proficiency, and that these opportunities may be equivalent to several years of formal education (Guthrie & Wigfield, 2000). Similarly, informal learning activities also may play a role in adults' literacy

learning, both at and outside of work (Australian Bureau of Statistics, 2007; Desjardins, 2003; Livingstone, 2000). Desjardins (2003) showed that although individually, activities at and outside of work make limited contributions to adults' reading literacy proficiency, when combined, these activities' impacts can outweigh those of formal education. In most countries, informal learning's total effect on reading literacy complements that of formal education (*ibid.*). Also, in a more recent study on problem solving in technology-rich environments, Desjardins and Ederer (2015) concluded that using skills in informal contexts is associated with proficiency, more so at work than outside the workplace, in Norway and Finland.

This study examines informal literacy learning's effect at and outside of work on adults' literacy proficiency using a dataset collected by the OECD's Programme for International Assessment of Adult Competencies (PIAAC), in which literacy assessment was limited to reading literacy and was defined as 'understanding, evaluating, using and engaging with written texts to participate in society, to achieve one's goals and to develop one's knowledge and potential' (OECD, 2012, p. 20). The definition suggests that using literacy, *i.e.*, engaging with texts, is an essential part of reading literacy, as it provides opportunities to maintain and develop proficiency (*ibid.*). However, opportunities for using these skills are not the same for all adults, but rather depend on their social conditions, as discussed below. Related to this, we also examine which factors are associated with informal literacy learning.

In this study, we focus on adults in Denmark, Finland, Norway and Sweden, which have high average literacy proficiency levels (OECD, 2013a, 2015). Moreover, Nordic countries' societies and educational systems share numerous features (Mellander & Anderssen, 2015). This study examined adults aged 35–65 years, an age range that was chosen for two reasons. Adults within this age range are likely to have had opportunities to develop their literacy proficiency in informal and nonformal contexts after completing their initial formal education. Furthermore, they are in a phase of life during which maintaining competencies lays the foundation for active aging (WHO, 2002). The current study will contribute to an understanding of the factors affecting literacy proficiency, particularly informal learning's role in various contexts.

Reading activities as informal literacy learning

This study examines engagement in reading literacy activities as informal literacy learning. Informal (literacy) learning can be characterised as incidental learning. Marsick and Watkins (2001, pp. 25–28) state that informal learning occurs when people have 'the need, motivation and opportunity' to learn. However, informal learning is often unintentional (see also Eraut, 2000; Marsick, Watkins, Callahan & Volpe, 2008) or even unconscious; then it takes place without a learning goal (Tjepkema, 2002; see also Carliner, 2012). According to Schugurensky (2000), informal learning can be categorised into three types based on learning intention and consciousness levels: self-directed learning; incidental learning; and tacit learning. Self-directed learning is intentional and conscious; the participant wants to learn something and is aware of having learnt something. Incidental and tacit learning are unintentional, as no explicit learning goals exist. However, incidental learning is conscious as the learner is aware of having learnt something. Tacit learning is unconscious as the learner remains unaware of the learning.

According to current social theories on literacy (Barton, 2007), literacy activities are situated and embedded in larger social practices. Thus, multiple literacies exist, varying by life domains (Barton, 2007). Also Reder (1994) suggests that the situations in which

literacy is used shape literacy. While individual cognitive processes can be generalised across contexts, literacy activities at work differ from those outside of work. Thus, opportunities for informal literacy learning also vary by context. Informal learning during leisure time has been shown to play a role in the development of literacy proficiency, particularly among unemployed adults (Cameron & Harrison, 2012) who lack the opportunity to learn at work. Taylor (2006) also showed that work is only one context for informal literacy learning, as adults' literacy learning is situated in and driven by their other life roles (e.g., as parents or community volunteers), learning environments (e.g., home, library, church) and everyday literacy activities.

According to studies on reading activities among US adults (Smith, 2000; White, Chen, & Forsyth, 2010), work provides more opportunities for reading than leisure time. Adults spent more time reading on workdays than on non-working days, although they engaged in the same number of reading activities at work as they did at home (Smith, 2000). These studies also found that reading activities at work and during leisure time differ: Prose dominated leisure reading, while work reading is dominated by quantitative literacy tasks and genres (e.g., lists, forms and tables) (White et al., 2010) or by functional, inspirational or miscellaneous materials (Smith, 2000). However, most reading activities at and outside of work do not challenge adults' proficiency levels. In Smith's study (2000), 89% of reading activities at home required little or no effort. Even at work, only 31% of reading required a high level of effort. This suggests that a majority of the participants' reading activities were routine.

However, work-related reading activities are associated with literacy proficiency. For example, Mellander (2014) showed that work experience has a relatively weak, but positive, relationship with literacy proficiency in Nordic countries. He concluded that the possibilities to make up for a lack of initial education through work experience (i.e., by learning at work) are limited, but not insignificant. Albaek, Fridberg and Rosdahl (2014) examined the relationship between occupation type, skill use at work and literacy proficiency, and found that the proficiency level was higher in the occupational groups that used their skills frequently – a finding that held across all age groups. However, it is evident that the relationship between literacy proficiency and occupation is not a simple, causal connection, but rather a more complex one. Different occupations have different literacy requirements, and it is likely that adults with low literacy proficiency only find employment in occupations with low requirement levels. Moreover, occupations differ in the frequency and diversity of literacy activities. Therefore, work-related informal literacy learning opportunities also tend to differ. For example, Athanasou (2012) examined blue-collar Australian adults who work with machinery; these adults had a lower modal level of literacy proficiency than adults in other professions. However, while the workers' literacy proficiency may have been low when entering the trade, it is possible that these occupations offer limited opportunities for literacy learning at work, as they involve mainly routine literacy tasks.

Varying literacy activities in different occupations highlight how adults' opportunities for informal literacy learning are not the same for all adults. These opportunities also vary by age, educational level and gender (Mellard, Becker, Patterson, & Prewett, 2007; Smith, 1996, 2000; Sulkunen, 2002). All these studies dealt with print reading activities, but adults' reading activities are likely to have changed in the past few decades due to technological developments (Leu et al., 2013). Since the turn of the millennium, the most notable change in literacy is the ubiquity of Internet-based and digital texts. The Internet has become the most popular form of media among 18- to 30-year-olds, who use it mainly to access social media, for entertainment outside of work and for information searches for school and work (Findahl, 2012; Herkman & Vainikka,

2012). Young adults actively use the Internet, and working-age adults access it frequently as well. For example, in Finland, Internet use is 90% or higher for all adults except those aged 65 and up (Statistics Finland, 2015). This suggests that a clear difference exists in digital literacy use between working-age adults and those in retirement. However, age has been shown to be a major contributor to skill development among working-age adults as well (Desjardins & Ederer, 2015; Sulkunen & Malin, 2018).

Generally, it appears that using these skills at and outside of work supports the acquisition of new literacy practices, especially considering that, up to now, Internet skills have not been taught in schools and usually have been learnt in informal contexts (Desjardins & Ederer, 2015; Leu et al., 2013). However, adults of all ages also must consider adapting to digital literacy, as governmental authorities, banks and other organisations increasingly are offering their services primarily online. This is important for active aging, i.e., elderly adults' autonomous participation in social, economic, cultural and civic life (WHO, 2002).

Research questions

This study aims to examine informal literacy learning's role in reading literacy proficiency among adults aged 35 to 65 years in Denmark, Finland, Norway and Sweden. Specifically, the study addresses the following questions:

- Which factors are associated with Nordic adults' informal literacy learning at and outside of work?
- What kind of association does informal literacy learning have with Nordic adults' literacy proficiency?

For the first research question, we hypothesised that adults' opportunities for informal literacy learning vary based on several factors related to their social conditions. At work, we expected that opportunities would be related primarily to occupation type (Albaek et al., 2014). Outside of work, we expected that education, gender and age would be associated with literacy activities (Mellard et al., 2007; Smith, 1996, 2000; Sulkunen, 2002). Regarding our second research question, we hypothesised that informal learning is associated positively with literacy proficiency (Desjardins, 2003; Livingstone, 2000; also Desjardins & Ederer, 2015). Moreover, we expected that informal literacy learning at work would have a stronger relationship with literacy proficiency than literacy learning outside of work, as the workplace offers more opportunities for reading than leisure time (Smith, 2000; White et al., 2010). In the context of problem solving in a technology-rich environment, Desjardins and Ederer (2015) have shown that informal learning's role at work has a stronger relationship with proficiency in Nordic countries than outside of work.

Method

Sample

Our study employs data from the OECD's Survey of Adult Skills (PIAAC) Round 1, which was conducted in 2011–2012 in 24 countries. The data comprise nationally representative samples of adult populations (aged 16–65 years) in the participating countries, with a total sample size of around 160,000. The samples include 7,328 adults

from Denmark, 5,464 from Finland, 5,128 from Norway and 4,469 from Sweden. Here, we focus on the subsample of 14,604 Nordic adults aged 35–65 years, comprising 64% of the total Nordic sample. The country-specific subsamples include 5,194 adults in Denmark, 3,525 in Finland, 3,061 in Norway and 2,824 in Sweden.

Procedures

In our analyses, we proceeded in two phases. First, we examined background factors that would explain the variation in individuals' informal learning activities. The statistical approach was linear regression analysis. Based on previous research (cited above), we included age, gender, education, occupation and parental education as explanatory variables in the analysis. In addition to these, we considered individuals' linguistic backgrounds (i.e., whether or not an individual is a native speaker of the PIAAC testing language), which are associated with reading literacy proficiency (OECD, 2013a).

Second, we examined the association between individuals' informal literacy learning activities at and outside of work, and their literacy proficiency, as measured in the PIAAC test, by fitting a linear regression model on PIAAC literacy scores. In this analysis, we controlled for the background variables mentioned above, as well as individuals' recent participation in formal or nonformal adult education or training (AET).

We employed pooled data from four Nordic countries in all analyses, i.e., we fitted regression models to explain variations in reading literacy proficiency to one four-country data set. However, because the average proficiency level varied among the countries, we also added the country effect in all models because omitting the mean differences among the countries might distort the estimated regression coefficients. We started analyses by testing the significance of interactions between these countries and all other explanatory variables in the models. Significant interactions would indicate that the regression models cannot be viewed as equivalent in all four countries. We observed a few significant interactions, but a closer examination showed that the differences between countries actually were small and gave no reason for fitting separate models for the four countries. The differences between countries appeared only in some estimates' magnitudes, and they were found to be statistically significant mainly due to the very large data set. As the model-effect interpretations remained similar in every country, despite the interactions, we decided to proceed with simple models without interaction effects.

Instruments

In PIAAC, adults' proficiency was measured through a non-timed reading test comprising various everyday texts and attached items. The test was implemented primarily as a computer-based assessment, but a paper-and-pen option was available for participants who were unable to take the test on a computer. The items in the computer-based test were coded automatically (OECD, 2013b).

The PIAAC data include two continuous indices measuring reading engagement: use of reading skills at and outside of work. We used these indices as measures of informal literacy learning. The latter includes non-work-related reading activities at home and in everyday life, including academic studies. Both indices comprise eight items. The respondents were asked how frequently they read different types of materials, including both print and digital formats. The choice options included directions or instructions; letters, memos or emails; articles in newspapers, magazines or newsletters; articles in professional journals or scholarly publications; books; reference manuals or materials; bills, invoices, bank statements or financial statements; or diagrams, maps and

schematics. The engagement frequency in each reading activity was rated on a five-point scale, ranging from 'never' (1) to 'every day' (5). Those who were unemployed at the time of data collection responded to the questions about reading at work on the basis of their most recent job. The items were combined into the indices using the item-response theory methodology (OECD 2013b, 41–43). The indices were transformed to have a common scale with a mean of 2 and a standard deviation of 1 across the 24 countries in PIAAC Round 1. In our Nordic subsample, reading at work registered a mean of 1.7 and a standard deviation of 1.5, and reading outside of work registered a mean of 2.2 and a standard deviation of 0.7. Their correlation was 0.29.

As a measure of respondents' formal and nonformal learning activities, respondents were asked whether they had participated in formal or nonformal AET during the 12 months preceding the survey. Thus, compared with PIAAC's measures of informal literacy learning, these measures are very simple.

The respondents' initial formal educational backgrounds were measured using the highest education level completed. Parental educational background was categorised into three groups: neither parent completing secondary education; at least one parent completing secondary education; or at least one parent completing tertiary education.

In considering occupational status, we used the following groups (based on the International Standard Classification of Occupations [ISCO]) in the analyses: skilled occupations (ISCO 1–3, e.g., legislators, senior officials and managers, professionals, technicians and associate professionals); semi-skilled white-collar occupations (ISCO 4–5, e.g., clerks, service workers, and shop and market sales workers); semi-skilled blue-collar occupations (ISCO 6–8, e.g., skilled agricultural and fishery workers, craft and related trade workers, and plant and machine operators and assemblers); and elementary occupations (ISCO 9, e.g., labourers).

Regarding age, we anticipated that the association between age and the response variables may not be linear, so we employed six age groups (35–39, 40–44, 45–49, 50–54, 55–59 and 60–65) as a categorical factor, which in our case is easier to interpret than continuous nonlinear age effect.

Analysis

We performed linear regression analyses for reading indices at and outside of work, as well as for literacy proficiency. In PIAAC, as in most large-scale educational assessments, individual proficiency is estimated using 'plausible values', which are numerical estimates of an individual's 'true' latent proficiency, obtained from a probability distribution estimated for each individual's proficiency based on his/her success on the PIAAC test items and background information (OECD, 2016; see also Rutkowski, Davier & Rutkowski, 2014). In PIAAC, 10 plausible reading literacy values per individual exist. The variation in individuals' plausible values reflects the uncertainty in estimating individuals' latent proficiency through a limited set of test items. To adequately account for this uncertainty, we followed the generally recommended approach to plausible-values data analysis, which is to perform a series of similar analyses with each plausible value as the dependent variable, then average the 10 analytical results using a multiple-imputation methodology to obtain the final result. In our case, this meant that we ran the same regression analysis for each plausible reading literacy value (i.e., only the dependent variable varied) – thereby obtaining 10 estimates of regression coefficients and their standard errors – and combined these into the final estimates to be reported. The standard error estimates were calculated using the design-based jack-knife method, which is used

commonly in analyses of large-scale assessment data sets collected by complex sampling designs. Survey weights were used in all calculations.

The approaches described above are outlined in the PIAAC Technical Report (OECD, 2016), and they are implemented in the SAS® macro-package PIAAC Tool (Denis, 2014) provided by the consortium to be applied specifically to analyses of PIAAC data. The package can be downloaded at no cost from the OECD's PIAAC website. We performed all statistical data analyses in this study using the PIAAC Tool.

Results

The first research question was addressed by fitting linear regression models for the indices measuring use of reading skills at and outside of work. The estimated models are presented in Table 1. We fitted the models to the pooled four-country data, controlling for the between-country mean differences in the dependent variables by having country as a categorical factor in the model.

Table 1. Regression models for reading at and outside of work in four Nordic countries. Beta = standardised regression coefficient

	Reading at work (n=12,130)				Reading outside work (n=12,218)			
R-squared	0.24				0.14			
	b	se(b)	p	beta	b	se(b)	p	beta
Intercept	0.08	0.11	.934		1.72	.05	<.001	
Country								
Denmark	-.17	.03	<.001	-.05	-.02	.02	.266	-.01
Finland	-.19	.04	<.001	-.05	.10	.02	<.001	.06
Norway	-.04	.03	.265	-.01	.21	.02	<.001	.11
Sweden (ref)								
Age								
35-39	.75	.05	<.001	.18	.00	.02	.881	.00
40-44	.76	.05	<.001	.19	-.04	.02	.054	-.02
45-49	.82	.05	<.001	.21	-.02	.02	.429	-.01
50-54	.81	.05	<.001	.20	-.01	.02	.764	-.00
55-59	.71	.05	<.001	.17	-.00	.02	.924	-.00
60-65 (ref)								
Female	-.21	.03	<.001	-.07	-.09	.01	<.001	-.06
Native language background	.23	.04	<.001	.05	.03	.02	.172	.01
Education								
Higher	.50	.05	<.001	.16	.47	.03	<.001	.31
General secondary	.36	.06	<.001	.08	.36	.03	<.001	.15
Vocational secondary	.31	.04	<.001	.09	.23	.03	<.001	.14
Basic (ref)								
Highest parental education								
Tertiary	.02	.03	.539	.01	.18	.02	<.001	.10
Secondary	.03	.03	.220	.01	.08	.02	<.001	.05
Below secondary (ref)								
Occupation								
Skilled	1.27	.07	<.001	.42	.22	.04	<.001	.15
Semi-skilled white-collar	.83	.06	<.001	.24	.15	.04	<.001	.09
Semi-skilled blue-collar	.51	.08	<.001	.14	.08	.04	.046	.04
Elementary (ref)								

Almost all model parameters in Table 1 were highly statistically significant, which is not surprising given the amount of data involved (more than 12,000 individuals, after excluding missing data). The examined variables' explanatory power was higher for reading at work (R-squared 24%) than for reading outside of work (R-squared 14%). Thus, it seems that there are more unobserved factors (e.g., personal characteristics) associated with reading outside of work than with reading at work, which depends more on background variables – age, gender, educational level and occupation in particular.

Skilled occupations were particularly strongly associated with reading activities at work. Educational background typically is correlated with occupation, but it is still worth noting that highly educated respondents tended to read at work more than others, even

when their occupation was controlled. The differences between age groups were minor, except for the oldest group, which was at a remarkably lower level than all others. With other variables controlled, male respondents read more than females on average, although the difference was small. The same goes for respondents tested in their native languages.

Regarding reading outside of work, respondents' educational level played a more important role than occupation, which is understandable considering that leisure-time reading is not determined directly by occupation. Consequently, cultural and educational background factors appeared to be more important determinants of reading engagement. This also can be seen with parental education, which was associated significantly with reading outside of work, but not with reading at work. The age group differences in reading outside of work were non-existent, i.e., no age group reads, on average, more actively during free time than other groups. Again, on average, males read slightly more than females to a statistically significant degree.

The estimated regression model for reading literacy proficiency is presented in Table 2. Again, almost all model parameters were highly significant. The model explained 37% of the variation in individuals' proficiency scores. According to the standardised regression coefficients, language background, high initial education and skilled occupation had the strongest estimated associations with reading literacy proficiency. There was also a tendency for average reading literacy level to decrease with age. Gender did not play any important role here.

Of the two indices measuring reading engagement, reading outside of work had a stronger association with proficiency than reading at work. The standardised coefficients of participation in formal and nonformal AET variables were smaller than those of informal literacy learning variables. However, the negative coefficient of formal AET (with other variables controlled) is worth noting.

Table 2. Regression model for reading literacy proficiency in four Nordic countries. Beta = standardised regression coefficient.

Reading literacy proficiency (n=12,109)				
R-squared	0.372			
	b	se(b)	p	beta
Intercept	179.6	4.0	<.001	
Country				
Denmark	-11.0	1.2	<.001	-.09
Finland	3.0	1.2	.018	.03
Norway	-5.6	1.3	<.001	-.04
Sweden (ref)				
Reading at work	2.4	0.4	<.001	.07
Reading outside work	9.4	0.8	<.001	.14
Participation in formal AET	-7.3	1.4	<.001	-.04
Participation in non-formal AET	3.6	1.2	.003	.04
Age				
35-39	25.8	1.8	<.001	.19
40-44	22.8	1.5	<.001	.17
45-49	17.9	1.4	<.001	.14
50-54	12.6	1.5	<.001	.09
55-59	6.5	1.5	<.001	.05
60-65 (ref)				
Female	-3.7	1.0	<.001	-.04
Native language background	33.9	3.2	<.001	.23
Education				
Higher	26.3	1.6	<.001	.26
General secondary	19.9	2.1	<.001	.13
Vocational secondary	7.8	1.4	<.001	.07
Basic (ref)				
Highest parental education				
Tertiary	10.7	1.3	<.001	.09
Secondary	4.2	1.1	<.001	.04
Below secondary (ref)				
Occupation				
Skilled	20.2	2.5	<.001	.20
Semi-skilled white-collar	10.7	2.4	<.001	.09
Semi-skilled blue-collar	4.1	2.4	.096	.03
Elementary (ref)				

On the whole, Table 2 suggests that the reading activities in informal contexts, particularly outside of work, can contribute to adults' literacy proficiency significantly, independent of educational level and occupational status. Still, background variables such as initial formal education, occupation type and language background are associated more strongly with proficiency. When we fitted a regression model with the background variables only (i.e., with no reading at and outside of work and participation in formal and nonformal AET), the model explained 35% of the variation. In other words, omitting these lifelong learning variables decreased the R-squared by only two percentage points. Of this decrease, reading outside of work alone contributed 1.9 percentage points. Thus, the importance of reading at work, as well as participating in formal or nonformal AET, is minimal, especially when individuals' educational, occupational and language backgrounds are controlled, along with their leisure-time reading activities.

Discussion

This study focussed on informal literacy learning's role in reading literacy proficiency. First, we started by examining factors associated with Nordic adults' informal literacy learning at and outside of work. As expected, Nordic adults' opportunities for informal literacy learning vary by their social conditions and individual experiences. These findings are consistent with earlier research, discussed in detail below, and with social theories that emphasise that literacies vary from one situation and context to the next (Barton, 2007). The explanatory power of the model for reading outside of work was smaller than for reading at work. Thus, informal literacy learning outside of work seems to depend less on an individual's background factors included in this study, such as age, education and occupation.

The relations between background factors and literacy learning were not exactly similar at and outside of work. As hypothesised, reading at work was related strongly to occupation type: Adults with skilled occupations seemed to read more at work than the others, which is consistent with previous research. For example, according to Albaek et al. (2014), Nordic adults working as legislators, senior officials, managers and professionals read at work more than those in sales, services and machinery. When other background factors were controlled, education and age still played an independent role in reading at work. Interestingly, adults aged 60–65 read less at work than younger adults.

However, for reading outside of work, adults' initial education was the main determinant of informal literacy activities. This finding also is consistent with earlier research showing that adults with more education engage in literacy tasks more frequently than less-educated adults (Desjardins, 2003; Smith, 1996). Education has been viewed as playing a role both as a socioeconomic factor affecting life experiences and as a practice-related factor affecting opportunities for developing cognitive skills (Desjardins & Ederer, 2015). However, parental education has been conceptualised as an indication of the home's socioeconomic status (Desjardins, 2003; also Desjardins & Ederer, 2015), which influences individuals' values and choices related to literacy and education, rather than literacy proficiency directly. Thus, it is understandable that parents' education had a significant association with reading outside of work, but not with reading at work.

Slightly unexpectedly, reading outside of work showed no association with age, and the association with gender revealed that men read more than women. In earlier studies (e.g., Smith, 1996; Sulkunen, 2002), older adults have been found to read more than younger adults, particularly newspapers, and women more than men, particularly fiction books. Our findings may result from the fact that in PIAAC indices, various kinds of

reading are combined. Regarding age, which in cross-sectional studies reflects differences between age cohorts (Gustafsson, 2016; Sulkunen & Malin, 2018), and gender, the differences between earlier studies and our results also may derive from changes in reading activities during the past two decades. Much of the earlier research was published near the turn of the millennium and focussed on reading certain print texts. However, due to technological developments, adults' reading activities have changed a great deal (Leu et al., 2013), as the Internet has become the most popular medium, particularly among young adults (Findahl, 2012; Herkman & Vainikka, 2012; Statistics Finland, 2015). These changes also have been reflected in current measures of reading activities; thus, PIAAC indices of reading represent more diverse reading materials than earlier studies – not only print books or newspapers, but also all kinds of print and digital texts, including emails, reference manuals and diagrams.

Second, we examined the relationship between adults' literacy proficiency and informal literacy learning at and outside of work, as well as other known determinants of literacy proficiency. The results showed – as we hypothesised – that informal literacy learning at and outside of work has a positive association with Nordic adults' literacy proficiency. They also showed that the main determinants of adults' literacy proficiency are education, language background, occupation and age. These findings are consistent with determinants of literacy and other cognitive skills reported in earlier studies (e.g., Desjardins, 2003; Desjardins & Ederer, 2015; Sulkunen & Malin, 2018). The independent role of age is in line with Sulkunen and Malin (2018), showing that age exerts a strong effect and exceeds even the role of a formal degree's recentness. Furthermore, parents' education had a positive association with literacy, as it has with other cognitive skills as well (Desjardins & Ederer, 2015). Notably, also in previous studies, informal literacy learning has played a small role in literacy, complementing other factors (Desjardins, 2003; Green & Riddell, 2012).

Previous research has shown that work provides more opportunities for literacy activities than leisure time (Smith, 2000; White et al., 2010), and that work-related reading activities have a stronger association with literacy proficiency than activities outside of work (Desjardins, 2003; Desjardins & Ederer, 2015). In light of these studies, we expected that reading at work would have a stronger association with reading proficiency than reading outside of work, but our results suggested the opposite. The differences between our findings and earlier research may result from different cultural contexts and different operationalisation of reading activities, but it is also worth noting that in our data, the respondents reported reading more frequently outside of work (mean 2.2) than at work (1.7). Here, the response scale was from 'never' (1) to 'every day' (5), offering fewer options than other studies. It is also noteworthy that cross-sectional and correlational studies do not reveal the direction of association causality between literacy proficiency and the factors in the model. For example, while we can assume that literacy activities during leisure time maintain and develop proficiency, the opposite likely also is true: Those who have high literacy proficiency find reading easy and enjoyable and, thus, read more (Guthrie & Wigfield, 2000).

Also, other types of lifelong learning opportunities were included in the study. Nonformal AET had a small positive relationship with literacy proficiency, albeit smaller than that of informal literacy learning, particularly outside of work. This is most likely due to the diverse nature of nonformal learning opportunities, which range from yoga classes to language courses, and have been measured as participation within 12 months prior to data collection. Participation in formal AET – measured in an equally simple way – elicited a small negative effect on the literacy proficiency of adults with similar backgrounds. One explanation may be that adults who participate in this type of education

have low skill levels and need more formal education (Sulkunen & Malin, 2014). As already pointed out, the current study cannot demonstrate any causal connections. Particularly with formal and nonformal adult education, the causal relationship is likely to be from literacy proficiency to participation (Desjardins, 2003), i.e., low-skilled adults participate in formal adult education, and highly skilled and educated adults participate in nonformal adult education (Sulkunen & Malin, 2014).

It appeared that all lifelong learning opportunities, i.e., informal learning, as well as nonformal and formal AET, play only a small role in maintaining and developing adults' literacy proficiency compared with other factors included in the study. Together they explained only 2 percent of the variation in adults' literacy proficiency, with other background variables controlled. The role of reading outside of work alone contributed most of this, emphasising the importance of reading outside of work among lifelong learning. However, comparisons should be made cautiously due to weak measures of nonformal and formal AET. After all, some studies show literacy gains in nonformal basic skill courses (de Greef, Segers & Verté, 2012; de Greef, Verté & Segers, 2015). Overall, this study confirms the results from previous research (e.g., Desjardins, 2003; Green & Riddell, 2012; OECD, 2013a), showing that informal literacy learning, particularly outside of work, complements initial education's effect on literacy proficiency, but does not outweigh its impact or that of other background variables.

This study has some methodological limitations due to data restrictions. First, the PIAAC data are correlational and, thus, do not warrant any causal interpretations. This is highlighted further in that many of the variables studied, such as reading at and outside of work, represent concepts that have a reciprocal relationship with literacy proficiency, i.e., proficient readers enjoy reading and, thus, engage in reading activities frequently, in which they develop their proficiency even further. Second, all measures in PIAAC data used in this study are not equally strong. While reading at and outside of work has been measured using indices summarising several (self-reported) items, measures of nonformal and formal AET merely include information about adults' recent participation in AET. This means that comparisons between informal and nonformal and formal education must be made cautiously. Third, PIAAC measures of reading at and outside of work lack data on time spent reading and the effort required for reading tasks, unlike many other studies (e.g., Smith, 2000; White et al. 2010). Since this information is missing from the PIAAC dataset, it is difficult to fully examine the effects from reading at and outside of work on literacy learning using these data.

Conclusions

The need for lifelong literacy learning currently is pronounced due to contextual changes, particularly the accelerating pace at which digital literacy has become ubiquitous (Leu et al., 2013). For example, in Finland, the most popular uses of the Internet include banking and searching for information on services (Statistics Finland, 2015), reflecting the trend of offering services primarily online. This trend is forcing all adults – including retired, unemployed and less-educated ones – to learn to master new literacy demands. Most adults have had to learn these new literacy skills in informal contexts (Leu et al., 2013; Herkman & Vainikka, 2012). For working adults, work supports and demands the acquisition of new literacies, but outside the workforce, leisure-time reading offers valuable learning opportunities as well. In our study, the less-educated and adults aged 60–65 had low literacy proficiency compared with other groups, reflecting a pronounced need for literacy learning. Lifelong learning also will support active aging, as elderly

adults are expected to live longer independently, which requires good literacy proficiency (Barabasch et al., 2012; WHO, 2002).

Our results suggest that opportunities for informal literacy learning outside of work in particular are associated positively with literacy proficiency. While we cannot draw any causal conclusions, literacy activities outside of work may offer meaningful opportunities for maintaining and developing literacy skills, particularly for adults who are not working, including unemployed (Cameron & Harrison, 2012) or retired adults, and for non-traditional participants in adult education, such as immigrants (Fragoso & Kurantowicz, 2016).

Although reading at work has a weaker association with literacy proficiency than reading outside of work, this study's results do not warrant underrating work-related literacy learning either, but rather indicate that opportunities for literacy learning at work are intertwined with occupation type. This is natural in light of literacy's situated nature (Barton, 2007; Reder, 1994). Different contexts – e.g., professions – offer a range of opportunities to engage in reading activities (Albaek et al., 2014). In some cases, reading activities at work may be frequent and demanding, while in other cases, they are routine, requiring little effort (Smith, 2000), thereby offering limited opportunities for informal learning. Another point to consider is that in many elementary occupations, employees have had low proficiency levels when entering the occupation. This may result in a cycle in which proficiency does not improve, even for those who are employed. Informal literacy activities outside of work also can offer these adults valuable learning opportunities.

Therefore, lifelong learning opportunities outside of work may offer all adults opportunities to complement literacy proficiency achieved earlier in life, but for many adults, a low proficiency level actually may hinder engagement in reading activities and, thus, limit opportunities for informal literacy learning. Thus, a need exists to develop innovative ways to initiate and support informal learning. For example, Schmidt-Hertha and Strobel-Dümer (2013) call for such support of learning processes for the elderly, but this could benefit all adult learners. Furthermore, self-directed informal learning (Schugurensky, 2000) in particular can be realised as self-organised groups for peer support.

Moreover, the boundaries between informal and other types of lifelong learning could be lowered to motivate adults – including non-traditional participants in adult education (Fragoso & Kurantowicz, 2016) – to engage in nonformal and formal learning. However, this also could be the other way around, as nonformal literacy programmes may motivate adults to engage in literacy activities in everyday contexts. For example, literacy programmes with the broader aim of social inclusion targeted at adults who are at risk of social exclusion (e.g., low-skilled workers, immigrants) offer basic skill training using authentic materials and content relevant to learners' daily lives. Studies on the results from these programmes show not only stronger mastery in reading and writing, but also engagement in literacy activities in everyday contexts relevant to adults (de Greef, Segers & Verté, 2012). This, in turn, encourages autonomous participation in social life, supporting the positive interplay between proficiency and engagement.

Digital technology and literacy not only have created the need for lifelong literacy learning (Leu et al., 2013), but also have provided a platform for new spaces and communities for learning (Wildemeersch & Jütte, 2017). Even educational institutions may develop more flexible and open structures to bring them closer to learners and their informal activities. They also could bring learners together and enable support from peers or literacy coaches. New types of structures and concepts that cross the boundaries of different types of lifelong learning would enhance literacy learning among all adults.

Acknowledgements

This research is part of the project ‘Skill acquisition, skill loss and age: A comparative study of cognitive foundation skills in Denmark, Finland, Norway and Sweden’. The project is funded by the NordForsk research programme ‘Education for tomorrow’ [Grant No. 54861].

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