Innovative learners at work

Results from the BRAIN project – the sub-project
'Training, skills and innovation'

Liv Anne Støren

Report 23/2015

NIFU

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Preface

This report constitutes a part of the BRAIN project where a central objective is the application of PIAAC data to conduct international comparisons on different aspects of adult learning. Four countries participating in the PIAAC survey were selected for in-depth studies: Denmark, Finland, The Netherlands and Norway. The PIAAC database is the main source for the analysis. The report brings the first empirical results from the BRAIN project. The full name of the project is ***B**arriers and drivers **r**egarding **a**dult education, skills acquisition and **in**novative activity.* The Norwegian Research Council, under the programme *Research and Innovation in the Educational Sector* (FINNUT) is funding the project.

The project is organized as four sub-projects: 1) Skills levels and skills acquisition, 2) Participation in adult learning, 3) Training, skills and innovation, and 4) Learning processes in enterprises – 'virtuous-circle' organisations. In addition, a PhD-project 'Drivers and barriers in adult education: How and why are there differences among workers in various industries?' is connected to the project.

Previously, an article relating to the fourth sub-project, has been published (Olsen 2015). The current report provides the first findings from the third sub-project. The main purpose is to examine the occurrence of innovative strategic learners in the four selected countries, and to analyse which factors enhance the probability of being such a worker. A purpose of this report is to present a broad documentation of findings which will later also be used as a basis for other forms of scientific and popular scientific dissemination. The further development of the project includes ongoing work on issues such as how motivational factors for training and drivers linked to the national institutional frameworks interact and affect the differences in training rates and skills levels between different countries.

The project involves participation by different institutions and international scholars, and as regards this report, previous drafts have been discussed at workshops where these international scholars have given fruitful comments and contributions. They, as well as the total BRAIN research group, cannot be thanked enough. The international partners to the projects are Professor Rolf van der Velden, The University of Maastricht; Professor (Associate) Richard Desjardins, UCLA Graduate School of Education and Information Studies; and Senior Researcher Jouni Nurmi / Professor Osmo Kivinen at the University of Turku. Associated with the project as an adviser is also Professor Edward Lorenz at the University of Nice Sophia-Antipolis. The project also has a national partner at the University of Stavanger, Norwegian Reading Centre, represented by Associate Professors Kjersti Lundetræ and Egil Gabrielsen. The latter two, are responsible for the first of the sub-projects mentioned above, i.e. 'Skills levels and skills acquisition'. All the persons mentioned have participated in the BRAIN workshops and are contributing in the development of the project. The same applies to the BRAIN research group at NIFU, i.e. Dorothy Sutherland Olsen, Asgeir Skålholt, Vibeke Opheim, Pål Børing and Kari Vea Salvanes. Research professor Liv Anne Støren, NIFU is the project manager for BRAIN, and the author of this report. The author would especially like to thank Rolf van der Velden, Richard Desjardins and Asgeir Skålholt for thorough and useful comments on previous versions of the report. The author is, however, the only person responsible for possible errors.

Oslo, August 2015

Sveinung Skule Director	Nicoline Frølich Head of Research

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Summary

Main findings

- About 15 per cent of the workers in the four countries studied (Denmark, Finland, the Netherlands and Norway) meet the criteria used in this report for being innovative strategic learners at work. The percentage is highest in Finland (21 per cent).

- The individuals' work profiles, i.e. variables which cover the extent to which the worker can be characterized as *brokering, championing, independent* and/or is *sharing information*, have very large impacts on the likelihood of being an innovative strategic learner at work.

- The individuals' work profiles are more decisive than their educational and skills levels.

- Type of job in terms of 'occupational level' also has a very large impact.

- Work-related training – if this training is *of own interest* – increases the probability of being an innovative strategic learner at work, although this is found largely to be moderated by the person's work profile.

Background

Though debated, the repeating low Norwegian scores year after year on the Innovation Union Scoreboard (IUS) and Community Innovation Surveys (CIS) have been a concern in Norwegian public debate. The OECD Skill Strategy Action report for Norway highlights (among other things) under-use of skills for entrepreneurship and innovation, and states that in the context of declining oil production, Norway should adjust for a boost in its non-oil economy.

Following the decline in oil prices during the autumn and winter of 2014/2015, followed by a marked increase in unemployment, this challenge has been accentuated and perceived even more important. The expression 'need for renewal, restructuring and innovation' is increasingly heard in Norwegian public debate. This happens partly independently of, and in addition to requests for restructuring of other political causes. For example, the threat of climate change requires Norway to invest in industries other than the oil sector. This backdrop makes it interesting to compare Norway with other quite similar countries concerning questions related to the innovativeness of the workforce.

This report constitutes a part of the BRAIN[1] project where a central objective is the application of PIAAC[2] data to conduct international comparisons. Four countries participating in the PIAAC survey were selected for in-depth studies: Denmark, Finland, The Netherlands and Norway. The PIAAC database is the main source for the analysis.

These four countries are also compared with other countries participating in PIAAC on a number of parameters. However regarding the in-depth analyses, the focus is on these four countries. The Nordic countries and the Netherlands are similar in many ways. All are welfare states with a highly educated workforce. They all have high scores on adult skills in different surveys, and have high participation rates in adult and lifelong learning. On the other hand, there are important differences in key aspects such as adult learning institutions and policies, and labour market regimes. They are also quite different in key outcomes at the aggregate level such as labour market performance and innovation scores.

Definition

In this report 'innovativeness' is defined in terms of workers who are actively seeking and utilizing new knowledge. We consider that the worker possesses a high degree of innovativeness if

- his/her job largely involves *keeping up to date with new products or services*, and
- to a large extent involves *learning-by-doing from the tasks he/she performs*; and if the respondent
- scores high on a set of *active and creative learning strategies*.

The active learning strategies refer to these items: 'When I come across something new, I try to relate it to what I already know'; 'I like to get to the bottom of difficult things', and 'I like to figure out how different ideas fit together'.

As an additional criterion, we have included information on the extent to which the worker *solves complex problems at work*. Here, we have excluded those who seldom solve complex problems.

Another way of describing this worker is that he/she is an *innovative strategic learner at work*.

Research design

Based on a literature review, several factors are identified that may impact the likelihood of innovativeness. These factors are used as independent (explanatory) variables in the analyses in this report, and some important results concerning the impacts of such variables are outlined below.

The report examines how frequently the worker who is here characterized as being an innovative strategic learner occurs in the four selected countries (Denmark, Finland, the Netherlands and Norway), and which factors enhance the probability of being such a worker. Of particular interest when examining this is the occurrence of discretionary work forms such as flexibility and autonomy. Also included is the work profile of the workers such as being brokering, independent, sharing work-related information etc., as well as the workers' level of educational, skills and occupation. In addition, a control is made for the industrial sector and weekly working hours as well as demographic variables.

The situation in the four countries is compared including those factors within each country which have the greatest impact on innovativeness. Consideration is also made of those factors which may contribute to explaining country differences.

Finland has most innovative learners

About 15 per cent of the workers in the four countries studied (Denmark, Finland, the Netherlands and Norway) meet the criteria mentioned above (see Definition). However, this varies from 9 per cent in

[1] BRAIN is an acronym for the project 'Barriers and Drivers regarding Adult Education, Skills Acquisition and Innovative Activity', financed by the Norwegian Research Council.
[2] Programme for International Assessment of Adult Competencies, OECD. In most participating countries, data collection for **the Survey** of Adult Skills (**PIAAC**) took place between 1 August **2011** and 31 March 2012(.

the Netherlands to 21 per cent in Finland. The Netherlands scores at the same level as neighbouring countries such as Belgium and Germany, while Norway and Denmark score at the same level as the neighbouring country Sweden, around 15– 16 per cent.

Country differences in the likelihood of being an innovative strategic learner at work are robust when controlling for a number of independent variables. Therefore, it is not the distribution of characteristics in a country sample that is decisive for the country differences. The effects of the same characteristics vary between the countries, but neither is this variation decisive for the country differences.

All the analyses confirm the findings in previous studies showing that Finland is a leading innovation country. However, the dependent variable in the current study concerns the properties of individuals in the workforce, while other studies mainly refer to composite indicators at the country level (Innovation Union Scoreboard, IUS) or to surveys among firms (Community Innovation Surveys, CIS). Denmark is also a leading innovation country in most studies, but is more in the 'middle' according to the analyses in this report. For Norway, also found to be 'in the middle' in this report, the results differ from the findings in studies that refer to composite innovation indicators at the country level (IUS). In these studies Norway ranks very much lower than Finland and Denmark, and also lower than the Netherlands. Although the Netherlands ranks above the EU average on IUS, concerning the Dutch workforce we find that a lower proportion can be characterised as being innovative strategic learners at work than in the other three countries.

The different aspects of being an innovative strategic learner

The definition of an 'innovative strategic learner at work' embodies many dimensions. As mentioned above, one such dimension is 'keeping-up-to-date with new products and services'; another is 'learning-by-doing from the tasks one performs'. A third dimension refers to learning strategies. When Finland ranks highest of the four countries on the merged variable 'innovative strategic learner at work' it is because Finland ranks high on *all* the individual variables that are merged and constitute this construct. Further, when the Netherlands ranks lowest, it is because Netherlands ranks lowest or second lowest on *all* the individual variables that constitute being an 'innovative strategic learner at work'.

When the results for Norway appear as equally positive as those for Denmark, this is largely due to Norway's high score on 'learning-by-doing from the tasks one performs', and *not* by the scores on 'keeping-up-to-date with new products and services', where Norway scores low. An implication is that *if* the Norwegian workforce score more positively on the variable 'keeping-up-to-date with new products and services', the total innovativeness in workforces could have been greater. Also; if the Danish score more positively on the variable 'learning-by-doing-from the tasks one performs', the total innovativeness in the workforce could have been greater.

Work profiles and work environment

The variables indicating that people have different roles at work, i.e. variables which cover the extent to which the worker can be characterized as being *brokering, championing, independent* and/or is *sharing information*, have large impacts on the likelihood of being an innovative strategic learner at work, and appear as more decisive than education levels and skills. The variables for work profiles are based on the response to questions that concern skills used at work.

- 'Championing' refers to (the frequency of) influencing and advising people.
- 'Brokering' refers to negotiating with people inside or outside the organisation.
- 'Independent' refers to (the frequency of) organising own time and planning own activities.
- 'Information exchange' refers to the response concerning (how often) the respondent is sharing work-related information with co-workers

The positive effect of all these factors applies to all dimensions that constitute being an innovative strategic learner at work.

Work environment measured by flexibility and autonomy – frequently referred to in the literature as discretionary work forms – also has a large impact. 'Flexibility and autonomy' refers to the response to questions concerning the extent to which the employed persons choose or change the sequence of work tasks, how they do their work, the speed or rate at which they work, and working hours. High scores on flexibility and autonomy increase the likelihood of being an innovative strategic learner. This applies to all the underlying dimensions for being an innovative strategic learner, but in particular to the active learning strategies and 'learning by doing from the tasks one performs'. High scores on autonomy and flexibility increase the likelihood that the worker exhibits active learning strategies and to a large extent learns from the tasks he/she performs – in total that he/she is an innovative strategic learner at work.

Work-related training

Work-related training – if this training is *of own interest* – increases the probability of being an innovative strategic learner, although this is found largely to be mediated by the person's work profile. The effects of work-related training are reduced when controlling for work profiles. This indicates that if not taking the roles at work into account, the effects of training can be exaggerated. The request for work-related training varies between different types of workers. When employees with higher scores on variables covering work profiles and with higher education frequently request training, i.e. people whom we can assume basically have a more innovative orientation, it is natural that a (statistical) effect of training on innovation activity is found in many studies. But a large part of the 'real' effect of training on innovativeness is probably largely caused by the individual's work profile. However, this does not mean that training does not matter. Our findings indicate that it has particular impact in Norway, thereafter in the Netherlands (if it has long duration), and then in Denmark. Moreover, the *availability* of training in an organisation may be of great importance, and can explain the relationship between training and innovation at the aggregate level found in many studies. Here, the analyses is on the individual level, and not at the institutional/organisational level.

Level and type of education, and occupational level

The likelihood of being an innovative learner increases with increasing education level. But overall, we have not found significant effects of fields of study when also controlling for economic sector. The effect of education level differs broadly between the countries. The effects are smallest in Finland, i.e. the country with the overall highest level of innovativeness as is measured here, as well as in the Netherlands, when controls for all other variables are undertaken. The first-mentioned result (Finland) could indicate that *if* innovative learning at work in other countries was more evenly distributed related to education levels – as seems to be the case in Finland – the total amount of innovative learning at work in the other countries could have been higher. However, such a conclusion is not supported by the results for the Netherlands, where the effects of education levels are insignificant as well, and where the likelihood of being an innovative strategic learner is quite low.

Compared with the strong emphasis on human capital as is generally found in the literature on innovative activities and capabilities, we may conclude that the (isolated) effects of education levels found in this report are quite small. Education level correlates with occupational level, – also controlled for here – and which reduces the effect of education level (especially the effects of having the highest education level). However, it appears that when controlling for work profiles, this has the largest impact on the effects of education levels because the person's work profiles' also correlate to some extent with education level. This is in line with arguments in some previous studies where human capital in itself is not sufficient to increase the likelihood to engage in innovation, since this may correlate with other variables. Here, we have shown that these other variables concern the role the individual has at work.

In our analyses we have *not* found positive effects of increased skills (numeracy, literacy and problem-solving skills in technology-rich environments) when controlling for other variables. Compared to the large amount of literature concerning 'skills for innovation' etc., this is somewhat surprising. However, we *have* found indications that increased skills have a positive effect on the likelihood of being an innovative learner at work among workers who belong to the groups with the lowest scores on some of the work profiles described above. Among others, the skills level in itself does not seem to have any impact ('all other things equal').

However, type of job, i.e. the classification of jobs according to their skills level (in this report labelled as 'occupational level') has a very large impact. In some countries (particularly Norway and Denmark) varying educational levels within a certain occupational level, seems to be of great importance as well.

Challenges

The results of the study indicate different challenges for the four countries. These are discussed in the last chapter of the report. A brief summary concentrating on the possible challenges for Norway, is as follows:

High values on the work profile 'championing' has a particular positive impact in the Norwegian sample on the likelihood of being an innovative learner at work. Meanwhile, we found that the Norwegian sample does not manifest a high score frequently on this variable compared to Finland and Denmark.

For the Norwegian sample, increased score on the work environment variable 'autonomy and flexibility' increases the likelihood of being an innovative learner at work. The Norwegian sample score is lower than Denmark and Finland concerning the extent to which jobs involve the opportunity to be flexible and autonomous. Scoring high on the work profile 'independent', has positive effect in the Norwegian sample on the likelihood of being an innovative strategic learner at work. The proportion in Norway scoring high on 'independent' is below that of the other three countries.

The number of days with training is similar in Norway to the average for the other countries. The percentage participating in work-related training *of own interest* is also the same in Norway as the other three countries. In Norway, as well as in Denmark (in particular), the training of own interest has positive impact. What matters in Norway as well as in the Netherlands is the number of days of training. In total, these results indicate that increased efforts as regards work-related training will have positive effects in the Norwegian workforce.

In Norway, as opposed to Finland, no economic sector stands out as having particularly many innovative learners. The only significant effects of economic sector are the negative effects of working in the construction sector and within manufacturing. This might indicate that in these sectors in particular there much may be gained in encouraging innovative learning at work.

Further research

In the final chapter questions for further research are also outlined. In summary this comprises the following.

The robust and large effects of the different work profiles on the probability of being an innovative learner should be examined further. One question for further research should consider which factors act as barriers for workers in exerting such roles at work and those factors which encourage exerting such work profiles.

Future research should also examine the extent to which innovation activity is a gender issue. Not least do the results for Finland suggest that women's education and labour market behaviour have a special impact. Another interesting question refers to the fact that in Norway and the Netherlands there is a significant negative effect of increased age on innovativeness. Why is this so, and what could possibly be done in these countries to increase the innovativeness of older workers?

For further research it would be interesting to go deeper into the different economic sectors, for example in order to examine the reasons behind – and the possible implications of – the relative low rate of ‘innovative learners’ found in the construction sector in Norway. Another topic refers to the findings that indicate a lack of difference according to fields of study. This should also be followed up in future research with more detailed data on fields of study.

One question for further research relates to the need for more comprehensive data. Data from linked employer-employee datasets, i.e. nationwide and representative data at both the firm level and employee-level, would be very useful. Ideally, such data sets would combine information on corporate innovation investment and output/turnover as well individual data on workers’ training and education, their work profiles and work environment.

1 Introduction

1.1 Background and motivation

The importance of learning intensive work environment for a firm's innovative capability and activity has been addressed in many OECD publications in recent years. OECD (2010a) (*Innovative workplaces*) states that learning organisations are positively associated with innovation at the workplace, and that learning and interaction within an organisation, as well as learning through interaction with external agents, is essential for innovation. OECD (2010b) (*The OECD Innovation Strategy: Getting a Head Start on Tomorrow*) states that one of the key policy principles for innovation is to empower people to innovate, through education and training systems that equip people with the foundations to learn, and with the flexibility to upgrade skills. OECD (2011) (*Skills for innovation and Research*') suggests that there is a need for further work to better identify relationships between innovation and work organisation, and explore the strength and direction of these relationships as well as to identify the relationship between skills, competence and training and innovation.

In sum, the literature seems to suggest a reciprocal relationship between training and innovation, a 'good circle' where innovative activity provides incentives for work-related training which in turn promotes innovation. Workplace learning and employee innovation are mutually reinforcing (Ellström 2010; De Spiegelaere et al. 2012). Involvement in innovation brings about learning, and workplace learning gives workers capacity and opportunity for innovation. Some indicators also clearly show that investment in training is directly linked to the effort of stimulating new ideas and creativity among employees; in other words to stimulate innovative activity. In Norway it was observed that it is two to three times more likely that the activity 'training employees on how to develop new ideas or creativity' takes place in enterprises with product- or process (PP) innovation activity compared to enterprises without PP innovation activity (Wilhelmsen and Foyn 2012).

The main purpose in this report is to study variations in innovative*ness*, and not variations in actual innovation outputs. It is, however, of interest to present the definition of innovation and what this actually refers to. An official and also widely used definition of innovation is that presented in the so-called 'Oslo-manual':

An innovation is the implementation of a new or significantly improved product (a good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations (OECD and Eurostat, 2005: 46). t is about creating something new, whether it is a product, process, service, marketing or organizational method. Innovativeness is thus to be able to actively contribute to this.

One motivation for this report is to find a measure of *innovativeness* and the occurrence of what we in this report call 'being an innovative strategic learner at work'. The aim is to examine the extent to which this phenomenon varies between a selected group of countries and between workers within these countries, and which factors that seem to determine this variation. Linked to this is a purpose to examine the extent to which learning-intensive working environments vary between countries and groups of workers. In this report Denmark, Finland, the Netherlands and Norway will be particularly focused.

Another motivation for this report is what is called ‘the Norwegian puzzle’ (OECD 2007). A relatively low proportion of Norwegian companies report innovation activities (Wilhelmsen 2011; Statistics Norway 2012), according to the Community Innovation Survey (CIS). Furthermore, according to the Innovation Union Scoreboard (IUS) (EU 2012; 2014) Norway scores far below the Netherlands, Finland and Denmark. The latter two are referred to as innovation ‘leaders’, the Netherlands as an innovation ‘follower’ (the second best category) while Norway is among the ‘moderate innovators’ (the second poorest category). As pointed out by Wilhelmsen (2012), when referring to the Norwegian puzzle, ‘Norway does very well when it comes to core economic indicators such as a comparatively high GDP per capita growth, a high overall trade balance surplus, low unemployment etc. If we expect a direct causal relationship between a high score on innovation indicators and economic prosperity, this may seem like a paradox.’[3]

In Norwegian public debate the results of the Innovation Union Scoreboard is questioned, particularly by pointing to the kinds of indicators included in the scoreboard. For example, do innovation investments in the petroleum sector (resource production, which is especially important in Norway) have a low weighting on the IUS index. Other critics point to the fact that many of the indicators refer to percentage of GDP and where Norway’s high GDP makes it particularly difficult for Norway to achieve a high score. Other criticism concerns the fact that the Scoreboard does not measure the innovative capabilities of the workforce (employee-driven innovation), which could be decisive for the overall innovative activity in the workforce.

Critics and questions concerning the validity of CIS have also been presented. Wilhelmsen (2012) finds reasons to question the validity of benchmarking on indicators where Norway scores particularly poorly. Based on a new independent innovation survey in Norway, Wilhelmsen (2014) argues that one of the reasons behind the low scores for Norway in CIS is that unlike many other countries, Norway has integrated the R&D and Innovation surveys into a single combined survey, while most countries have separate R&D and Innovation surveys. In 2013, Statistics Norway conducted an independent innovation survey (similar to the CIS survey), and where the results differed widely from those reported in the 2012 CIS survey. In the new survey (2013), Norway performed as well as other Nordic countries such as Finland, Denmark and Sweden in the CIS 2012-survey. The results for Norway in the 2012 and 2013 surveys differed significantly. It should be added however, that Denmark has also undertaken combined surveys since 2007. We have seen a decline in the reported innovation activity since then (Wilhelmsen 2014) although this also indicates that the Norwegian and Danish results in CIS 2012 can be regarded as comparable. The Norwegian performance in that survey was considerably lower than the Danish on product-innovation and process-innovation as well as organisational and marketing innovation.

The discussion on the ‘Norwegian puzzle’, is also taken up by Asheim and Parrilli (2014). They point out that learning-by-doing and engineering-based activities such as the design of large process plants in oil refining or basic metals may not be captured in the question on CIS innovation expenditures. They argue that this measurement problem, together with the importance of learning organisation and DUI-mode[4] of innovation ‘may explain why the Norwegian “puzzle” is not at puzzle after all’ (Asheim and Parrilli, 2014, p. 14).

Other types of study than CIS and IUS have also presented international comparisons of innovation activity. When comparing the situation among graduates in thirteen European countries five years after

[3] OECD statistics for GDP is presented in the Appendix 2, Table A.2.
[4] Doing, Using and Interacting, see Section 1.5.

graduation, Paul (2011) found that Finland was at the top concerning the share of graduates working in organizations that are at the *forefront of innovation*. It was also found that Finland had the highest frequency of graduates *introducing* innovations at work (Bjørnåli and Støren 2012).

Though debated, the constantly low Norwegian scores in successive years on the IUS and CIS surveys have been a concern in Norwegian public debate regarding 'the need for innovation'. For Norway, low scores on innovation indicators are also challenging given the fact that one of the main challenges in the OECD Skills Strategy Diagnostic Report for Norway (OECD 2014a) highlights innovation. Challenge 8 in the OECD diagnostic report for Norway refers to innovation and entrepreneurship, and mentions the need for 'unlocking entrepreneurial and innovative potential'. The OECD Action Report (OECD 2014b) draws upon this report, and among other things highlights the underuse of skills for entrepreneurship and innovation, and states that within the context of declining oil production Norway should adjust for a boost in its non-oil economy.

After the decline in oil prices during the autumn and winter of 2014/ 2015 (followed by a notable increase in the unemployment level, which has nevertheless generally been lower in Norway than elsewhere in Europe),[5] this challenge is accentuated and perceived as becoming even more and the terms 'need for renewals, restructuring and innovation' is heard more and more frequently important in Norwegian public debate. This happens partly independent of, and in addition to, requests for restructuring of other political reasons, namely that the threat of climate change means that Norway must invest in industries other than the oil sector. We find that this backdrop makes it interesting to compare Norway with other, else quite similar, countries when it comes to questions about the innovativeness of the workforce.

1.2 The four countries

This report constitutes part of the BRAIN[6] project where a central purpose is to use PIAAC[7] data (OECD 2013) to conduct international comparisons on a variety of issues that concern adult learning. We have chosen four countries which participated in the PIAAC survey: Denmark, Finland, the Netherlands and Norway. The PIAAC database is the main source for our analyses.

The four countries are also compared with other countries participating in PIAAC on a number of parameters. Regarding in-depth analyses, the focus is on these four countries. The Nordic countries and the Netherlands are in many ways similar. All are welfare states with a highly educated work-force. They all had high scores (relative to other countries) in adult skills in the predecessors to PIAAC (IALS/ALL). The same applies to PIAAC (OECD 2013), and they are found to have high participation rates in adult and lifelong learning. (This is further developed below). On the other hand, there are important differences in key aspects that may influence the development of adult skills,[8] such as adult learning policies and -institutions, and labour market regimes. They are also somewhat different in key outcomes at the aggregate level, such as labour market performance and innovation scores. All in all, the Nordic countries and the Netherlands thus provide an interesting laboratory for comparative research.

1.3 Participation in training

Lundvall (2009) points to the fact that Denmark scores high on the Innovation Scoreboard and argues that some of the reasons for this are the strong commitment to lifelong learning as well as innovation activities in small- and medium-sized enterprises. He uses the Danish model ('the Danish innovation

[5] See Appendix 2, Table A.3, for international comparisons of the unemployment levels in 2011 (the time of the PIAAC survey) and 2014. From the first quarter of 2014 to the first quarter of 2015 unemployment in Norway increased by 0.7 percentage points (from 3.6 to 4.3 per cent) (Statistics Norway 2015).
[6] BRAIN is an acronym for the project '**B**arriers and drivers **r**egarding **a**dult education, skills acquisition and **in**novative activity', financed by the Norwegian Research Council.
[7] Programme for International Assessment of Adult Competencies, OECD. **The** data collection for **the Survey** of Adult Skills (**PIAAC**) took place from 1 August **2011** to 31 March 2012 (in most participating countries).
[8] The 'skills-issue' is studied in another part of the BRAIN project.

system' [9]) as an example for developing countries which can learn from Danish history. He argues that the secret behind the Danish success lies in the learning economy where the 'capability to learn are the key to success for individuals, organisations and regions'. Further, that 'it is crucial for economic performance that a broad segment of the population is engaged in the processes of change where they interact to develop, implement and utilize new ideas' (ibid; 7).

Lorenz and Lundvall (2011) argue that a broad competence-based system of education and training is essential regarding the extent to which the nation's workforce is a 'creative workforce' (this term is further explained below). The four countries which are the focused of this report are characterised by having such a system, although the participation rate in training and other forms of lifelong learning per country may vary somewhat over time and depending on the measurement tool. Lorenz and Lundvall (2011) use indicators of lifelong learning participation and participation in job-related training based on the Labour Force Survey 2003. Here, Denmark and Finland rank particularly high. The Netherlands, however, ranks much lower (Lorenz and Lundvall 2011: 280) (Norway was not included in Lorenz and Lundvall's study). Rubenson and Desjardins (2009) also show that Denmark, Finland and Norway rank particularly high on participation in lifelong learning, all three countries being close to or exceeding 50 per cent, while the Netherlands belongs to a 'second best' group of countries with participation rates between 35 and 50 per cent. Referring to participation rates in 2008, Desjardins and Rubenson (2013) found that Norway and Finland score very high (more than 50 per cent, most participating in non-formal learning), while the Netherlands and Denmark score about ten per cent lower.

The Labour Force Surveys (LFS) show the participation rate *during the last four weeks* prior to the survey, of the population aged 25 to 64, whereas the adult education survey (AES) shows the per cent of adults aged 25 to 64 participating in education and training *during the 12 months prior to the survey* (Eurostat 2013a). Obviously, the latter rates are much higher than in LFS, but there is also a tendency that the country differences are greater in LFS than in AES. In the 2011 Labour Force Survey, participation rates in the four countries differ considerably, with 17 and 18 per cent in the Netherlands and Norway, as against 24 and 32 per cent in Finland and Denmark respectively. However, all four countries score much higher than the EU 27 average of 9 per cent (Eurostat 2013a). Corresponding country differences were also reflected in the 2006 Labour Force Survey.

Although these surveys indicate lower participation rates in the Netherlands than in the other three countries (and also lower in Norway in the LFS survey), the AES surveys (Eurostat 2013a) show minor differences between the four countries. Here, the Netherlands ranks as high as the other three countries. According to AES 2011, the proportion of adults aged 25 to 64 participating in education and training during the 12 months prior to the survey was 60 per cent in Norway, 59 per cent in Netherlands and Denmark, and 56 per cent in Finland, compared to 40.3 per cent in the EU-27 (Eurostat 2013a). The majority participate in non-formal training (53 per cent in Denmark, 51 per cent in Finland, 55 per cent in Netherlands, 57 per cent in Norway, and 42.5 per cent in EU 27). In all the surveys mentioned, the four countries score much higher than the EU average, but it is hard to draw any conclusions about systematic differences between the four countries since this varies between the surveys. In this report, training rates based on the PIAAC data are presented in Chapter 3 (see Section 3.6).

The participation rates mentioned above are interesting in light of the emphasis placed in the innovation literature on lifelong learning in general and workplace learning in particular. This relates, for example, to innovation indicators and national innovation systems (Lundvall 2009; Lundvall et al. 2002). In previous studies it was found that training rates are positively correlated with investment in R&D and innovation (Bassanini et al. 2005; Cedefop 2012; Næss, Støren and Kaloudis 2009; OECD

[9] According to Lundvall (2009), *national systems of innovation* can be understood as the following: 'National systems of innovation differ in terms of what they do (industrial specialization), what they know (reflected in the patterns of patenting and publishing) and in how they work and learn (different institutions and different organizational forms). The most important dimensions of innovation systems are the patterns of interconnectedness and interaction among individuals and organizations' (Lundvall 2009, p. 3). See Lundvall et al. (2002) for an outline of the history of the use of the concept (national) innovation system, which was first introduced in Lundvall in (1985), then without the adjective 'national' added.

2011). Cedefop (2012) argues that the results of their analyses suggest that continuing vocational training might play a significant role with regard to innovation ability. Based on the Norwegian version of the Continuing Vocational Training 3 (CVTS3) in 2005, Kaloudis, Næss and Sandven (2008) found that the probability of participating in courses is very much higher in firms which had introduced new or significantly improved products or services, or improved methods for delivery of products or services, than in firms without such innovations. Also, the number of hours participating in courses was higher in the innovative firms than in other firms.

It is not certain from this study whether work-related training promotes innovative behaviour in organizations, or whether the reverse in the case. To our knowledge no such evidence exists and, as mentioned, most possibly there is a reciprocal relationship between participating in courses and innovative activity. This is in accordance with Ellström's theoretical work on practice-based learning (2010) where practice-based innovation is regarded as a cyclical process of learning.

This way of reasoning is followed up in a Belgian study by Spiegelaere et al. (2012), which particularly focuses on employee (driven) innovation defined as follows 'all employee behaviour directed at the generation, introduction and/or application (within a role, group or organization) of ideas, processes, products or procedures, new to the relevant unit of adoption that are meant to significantly benefit the relevant unit of adoption.'

One of their conclusions is that both formal and informal practice-based learning are closely related to employee innovativeness. This study showed, however, other interesting results. Although employee innovation was found to be quite widespread, most of the workers with such experience had been involved in activities where the management had taken the initiative and invited employees to contribute. Processes that the authors label as bottom-up innovation processes (initiated, developed and introduced on employee initiative) occurred more rarely, and even then mostly by 'higher level white collar' employees.

1.4 Education levels and skills

A high level of human capital is generally regarded as one of the key factors for innovation. This is also reflected in the composite indicators for the Innovation Scoreboard where 'New doctorate graduates per 1000 population aged 25– 34', 'Percentage population aged 30– 34 having completed tertiary education', and 'Percentage youth aged 20– 24 having attained at least upper secondary level education', are among the composite indicators for human resources. The relationship between human capital and innovation can be understood in different but complementary ways. One is that those who are higher educated are more creative (innovative). Another perspective refers to high skills being necessary so as to *utilize* new technologies for innovation. Toner (2011) points to the need for skilled workers in order to be able to introduce new technologies at the workplace. High levels of skill are necessary for the *absorptive capacity* and for adaptation. He argues that the capacity to engage in innovation has been shown to depend critically on the technological 'absorptive capacity' of the workforce, broadly conceived as the ability to adopt, adapt and diffuse new or improved products, production processes and organisational innovation. In turn it is generally argued that the increased rate of innovation across economies requires the workforce to possess both technical competence and what are termed 'generic skills' – problem solving, creativity, team work and communication skills (Toner 2011: 8).

The OECD reports referred to in the introduction point to the need for more knowledge about the relationship between competence and skills at work, and innovation. Regarding the impact of education level (human capital) on innovative activity, the OECD (2011) argues, that that human capital by *itself* is not sufficient to enhance the propensity to engage in product innovation, because of the potential correlation of human capital with other variables. This is based on Schneider et al. (2010) among others. Nevertheless, different studies have pointed to scientific skills, engineering skills, information technology skills, general business and marketing skills, depending on the type of industry (OECD 2011). Leiponen (2005) argues that firms benefit less from innovation if the employees do not possess sufficient skills, because they will not then have absorptive capacity. Leiponen uses data from a panel of Finnish manufacturing firms, and finds, among other things, that human capital and high technical skills can be seen as an enabling factor in profitable innovation. Based on the results, Leiponen argues that ‘policy implications suggest that investments in skills help expand the group of firms in the economy that have the potential to innovate successfully’.

Other studies, e.g. Danish surveys (Rasmussen 2009; 2012) point to the need for more generic skills, particularly in firms that have introduced new forms of organisation such as demand for employees who can work independently and co-operate with external partners, management and colleagues. Rasmussen refers to surveys showing that highly educated people are more creative and innovative than persons with lower levels of education, and that a higher proportion of the highly educated than those with low education report that they have learned to develop new ideas through education or continuing education.

Rasmussen (2009) also reports that most workers, irrespective of background, did *not* regard continuing education as important for their ability to engage in innovative thinking or as a source of creative and innovative competence. Such findings (as the last mentioned) may challenge the ruling view that there is a strong relationship between work-related training and innovation, at least that the relationship found at the aggregate level may depend on a variety of background factors. The relationship may be strong in a few cases and weak in most other cases. As mentioned above, about 60 per cent of the adult population in the four countries participate in training extending over one year according to AES. Probably, most do not experience that this participation in itself leads to innovations in the workplace. However, based on the results, Rasmussen argues that ‘there seems to be a pressing need for types of continuing education and in-service training that can develop and strengthen the creative and innovative competences of employees’ (2009, p. 7). Cedefop also stresses the importance of continuing vocational training for innovation, and argues that the role of VET – in a broad sense – might be underestimated as compared to higher education (Cedefop 2012:89).

Corresponding results to those of Cedefop concerning the importance of continuing vocational training is found by Lundvall and Lorenz (2012) when examining the (correlational) relationship between the level of vocational training in a country and the occurrence of discretionary learning forms[10] (see description of discretionary learning in Section 1.5). They found a fairly strong positive correlation between the frequency of discretionary learning forms and the firms’ investments in continuing vocational training. On the other hand, they found no correlation between the discretionary learning forms and the number of new science and engineering graduates, and only a modest correlation between the discretionary learning forms and the percentage of the population with third-level education (Lundvall and Lorenz 2012, p. 54).

The review about work-related training and the importance of education and skills, brings us to other key concepts which also encompass informal and non-formal learning, namely the terms ‘learning by doing’ and ‘learning societies’. Central economists (Arrow (1962; Dasgupta and Stiglitz 1988; Stiglitz and Greenwald 2014) are occupied with the economic returns to *learning-by-doing*, the importance of learning on the job and the close relationship to innovation, and the importance of that the society / the workplace promotes learning. A broad perspective on the relationship between learning and innovation (and on economic success or failure) is presented by Stiglitz and Greenvald (2014). The book deals with how societies learn, and what can be done to promote learning. One key argument is that learning determines economic success. Technical change should be understood as a process of learning. A starting point for their book is the classical paper of Arrov (1962) on Learning by doing. Stiglitz and Greenwald state;

[10] Such learning forms (Lundvall and Lorenz 2012, p. 51) are used here as indicators of innovation, by referring to Arundel et al. (2007), where it was found that the nations’s share of employees engaged in advanced learning forms in the workplace correlated positively with ‘the percentage of private sector enterprises engaged in more radical forms of innovation’.

We learn by doing. We learn how to produce more efficiently by producing – and as we produce, we observe how we can do it more efficiently. There is ample empirical evidence supporting this hypothesis at the micro-level, both before and after Arrow's classic work. [ ] Much of the formal analytics of this book is predicated on the assumption that much learning occurs by doing (p. 52).

It can be mentioned that a starting point for Arrow's complex modelling which shows 'the economic implications of learning by doing', is the statement: 'Learning is a product of experience. Learning can only take place through the attempt to solve a problem and therefore only takes place during activity' (Arrow 1962, p. 155). In another paper dealing with learning-by-doing (Dasgupta and Stiglitz 1988), the starting point (referring to the importance of learning) is: 'Productivity increases are realised not only as a result of the explicit allocation of resources to capital accumulation and research development, but also often as a by-product of the process of production; that is *learning-by-doing'* (p. 246).

One chapter in the book by Stiglitz and Greenvald (2014) concerns 'Creating a Learning Firm and a Learning Environment', which also refers to literature dealing with 'innovative firms'. However, as stated here (p. 90), most of the book is not concerned with maximizing learning in a firm; rather is it concerned with 'how *government* policy can affect the structure of the economy to maximize *societal* learning' (our italics).[11]

What is interesting in our context, is the thoughts mentioned above about the importance of learning-by-doing and the learning environments. This brings us to another central concept in the literature concerning learning and innovation. This is the concept of discretionary workplace learning, and what may be called innovation-friendly work forms which are frequently considered as promoting learning and innovative activity.

1.5 Work forms promoting innovation

In a number of reports, the OECD accentuates the strong relationship between learning and innovation. OECD (2010a) is concerned with the term *learning organisation* in relation to innovation, and states that a learning organisation is supporting innovation through the use of employee autonomy and discretion, promoted by learning and training opportunities. The nature and importance of learning intensive jobs is also studied by Skule (2004). He finds a positive relationship between having learning intensive jobs and participation in development of new products and services and high involvement of employees in product and process development.

Asheim and Pirralli (2012) also emphasise the role of 'the learning organisation' in relation to innovation. According to these authors, the learning organisation is the micro foundation of the DUI mode of innovation. The DUI-mode of innovation refers to one of the two forms of learning and innovation that are described by Jensen et al. (2006), among others. The DUI-mode is an experienced-based mode of learning based on 'Doing, Using and Interacting'. The STI-mode ('Science, Technology and Innovation') is based on the production and use of codified scientific and technical knowledge (Jensen et al. 2006, p. 680).[12] Asheim and Pirralli (2012, p. 14) describe the 'learning organisation' as "new forms of organizing work within a firm, such as self-determined and auto-organized work targets and work pace, continuous on-the-job training, and multi-function and multidisciplinary team work" (here, referring to Arundel et al. 2007, and Lorenz and Valeyre 2006).

[11] The references to Stiglitz and Greenvald (2014) presented here do not, of course, give justice to the book, which discusses thoroughly issues such as trade liberalisation, and the role of government in stimulating growth and welfare, as well as in promoting learning ('knowledge is a public good'). However, these issues fall outside the scope of our review here. Stiglitz and Greenwald state that the 'central thesis of this book is that every aspect of the market economy (and more broadly of our society) needs to be reexamined from the perspective of learning and innovation' (p. 166). When it comes to innovation, the book discusses (among other things) the two sides of intellectual property rights (IPR) (p. 168). It may enhance incentives to invest in research, but it may also impede the flow of knowledge that is essential to learning.

[12] Jensen et al. (2007) find that firms that combine STI learning and DUI learning are the most innovative.

Further, they argue that such forms of organising 'help to explain the innovation capacity of the firm and their productive systems' (ibid, p. 14).

The terms *discretionary learning forms of work organization* (discretionary learning/discretionary work forms) refer to autonomy, i.e. discretion in fixing work methods and work pace, learning new things at work, problem-solving activities and complexity of work tasks (OECD 2010a; Lorenz and Lundvall 2011). 'High levels of discretion in work provide scope for exploring new knowledge'. It is further argued that adhocracies (referring to flexible, adaptable, and informal organizational structures) 'tend to show a superior capacity for radical innovation' (OECD 2010a, p. 33).

In this report (OECD 2010a) it is stated that in the nations where work is organised to support high levels of employee discretion in solving complex problems, the evidence shows that firms tend to be more active in terms of innovations. This conclusion is based on the relationship between organizational learning and innovation explored at the *aggregate* level, and refers to *correlations* between findings in two different surveys, CIS and EWS (European Working Conditions Survey). A positive correlation was found at the national level between discretionary learning and innovation (Norway was not included in these analyses).

This OECD report (2010a) is very largely based on the EWCS and, finds, like other research based on the EWCS (Arundel et al. 2007; Lorenz and Lundvall 2011) that the Nordic countries as well as the Netherlands are in the forefront when it comes to innovation friendly and creative work forms. Further, they find that these work forms can be correlated with a number of characteristics of the education system and the labour market.

Arundel et al. (2007) emphasize the significance of mode of organisation of work for innovation, or rather – they emphasize that the mode of work organisation is necessary to understand the national systems of innovation. They use aggregated EU data.[13] The relationships that are reported are correlational and are not claimed to be causal. However, the authors argue that the way work is organised is highly nation-specific and that 'it co-evolves with equally highly nation-specific distributions of different forms of innovation' (ibid: 1200). Their main finding is that in countries where work is organised to support high levels of discretion in solving complex problems (Norway not included in the analyses), firms tend to be 'more active in terms of innovations developed by their own in-house creative efforts'.

In an examination of twenty-seven EU countries (where neither in this study is Norway included), Lorenz and Lundvall (2011) – find, among other things that 'the level of creative work activity is higher in nations with broad competence-based systems of education and training that place value on equality of access to life-long learning opportunities and the continuing acquisition of job-related skills'. Based on data from the EWCS 2005, Lorenz and Lundvall (2011) develop a measure of the 'creative work force',[14] which accounts for 51 per cent of the population (the rest – 24 per cent – are 'constrained problem-solvers', and 25 per cent are 'Taylorised workers'). The creative workers are characterised by high levels of problem-solving activities at work, learning new things at work, undertaking complex tasks, using one's own ideas in work, and ability to choose or change one's work methods and order of work tasks.

Denmark, the Netherlands and Finland score all very high, from 66 to 70 per cent, when it comes to the share of workers characterized as creative workers. As mentioned, Norway was not included in the Lorenz and Lundvall 2011 study. Otherwise, there are differences according to industry (business and financial services scoring highest; retail and other services lowest) and according to occupation (senior managers scoring highest; unskilled workers and skilled workers scoring lowest). Further, they find that the likelihood of an individual holding a creative job increases with increased education level, and

[13] EWS 2000 and CIS 2000.
[14] Lorenz and Lundvall mention that they draw inspiration from Florida's research on the Creative Class (e.g. Florida 2002).

that creative jobs are more likely at workplaces where work is organised to promote knowledge diversity.

Lorenz and Lundvall (2011) employ multilevel modelling (in addition to characteristics of the individuals) to examine which characteristics of the national institutional contexts promote creative work. These institutional characteristics cover the degree of labour market mobility in the country, the expenditures on active and passive labour market policies, participation in lifelong learning, participation in job-related training, and a measure of the equality of access to further education. One of their conclusions is that national differences in the likelihood of creative work activity are related to the further education and training systems, and to labour market structure. They find that higher levels of creative work are associated with education systems 'characterised by more equal access to further training for enhancing national skills as compared to academic knowledge'. They also find 'that labour markets that combine high mobility with ambitious labour market policy in terms of passive and active measures tend to be associated with higher levels of creative work' (Lorenz and Lundvall 2011, p. 290).

While the findings of OECD (2010a) and Lorenz and Lundvall (2011) show that creative work forms are reflected in high innovation activity in other Nordic countries, the opposite seems to be the case for Norway when using widely-used indicators of innovation such as CIS and the Innovation Scoreboard. Such findings make it interesting to explore the relationship between work profiles and roles at work, work forms in terms of discretionary learning, training and innovation. These are developed in this report using PIAAC data.

Cedefop (2012) has examined the relationships between innovation activity and learning-intensive forms of work organisation and workplace learning, at an aggregate level. Cedefop used data from EWCS, the CVTS (continuing vocational training survey) and IUS (the innovation union scoreboard). The results of the study confirmed that a correlation exists between innovation performance of countries, and the learning intensity of work organisations and workplace learning in addition to other, more formal modes of learning. Cedefop suggests two routes of effects:

> (a) effects at organisational level. Organisational forms with higher employee autonomy and more complex tasks seem to lead to more intensive cooperation, a more learning- and innovation-oriented corporate culture, higher propensity for organisational learning and, last but not least, higher absorptive capacity and therefore greater innovative ability of the organisation;
>
> (b) effects at individual level. Learning-intensive forms of work organisation seem to promote individual learning; this improves employees' capacity to initiate and take part in innovation processes and ultimately to contribute to the organisation's absorptive capacity, and therefore its innovative ability (Cedefop 2012: 88).

Research has also shown that certain *working roles and competency profiles* are strongly related to innovative behaviour. A brief summary of research on this topic indicates that an innovative role often involves *high levels of professional and creative competencies,* as well as *communicative and championing competencies* (Bjørnåli and Støren 2012). The role may also refer to the role of a technical innovator demanding a high degree of specialized knowledge and who recognizes opportunities. Further, the role may refer to a *knowledge broker,* who links information and knowledge and acquires information from outside organization and links it to information and knowledge within the organization or between different units in an organization (Zahra, Nielsen and Bogner, 1999; Block and MacMillan 1993; Maidique 1980; Hargadon 2002; Tushman and Nadler 1986; Bjørnåli and Støren 2012).

Having brokering skills can be expanded to having the ability to 'sell', in the broad sense. The importance of flexibility, training and 'selling', can be summarized as in this quote: 'To transform invention successfully into innovation requires a range of complementary activities, including organisational changes, firm-level training, testing, marketing and design' (OECD 2010b, p. 10).

1.6 The use of PIAAC data

Varying findings like those reported in the previous sections give reason to use micro-data to investigate the extent to which the workforce in different countries is characterized by being active learners and innovative at work and by discretionary work forms, and what factors that *promote* innovativeness.

Many questions in the PIAAC survey cover properties concerning learning strategies and activities, and work profiles which research has shown to be strongly related to innovative activity. Little is known from international comparable and representative data about what explains country differences concerning innovativeness among workers, and how – and the extent to which – training actually promotes innovative work profiles. Our aim is to use the PIAAC data to come a step further in examining such relationships.

No part of the PIAAC questionnaire included questions concerning innovation, innovative activity, intrapreneurship or entrepreneurship. We have no information from the survey data on the concrete output in terms of actually introducing or producing innovations. Thus, in our analyses we use proxies for what we consider as innovativeness based on many questions in the PIAAC survey, (see Section 1.7). This is explained in more detail in Chapter 2.

Our analyses follow several steps. In Chapter 2 the dependent variable(s) is outlined. Chapter 3 describes the independent variables used, i.e. factors that – based on the literature review above – may promote innovativeness. Chapter 4 includes regression analyses and concentrate on the four countries which are of main concern for the actual project (Denmark, Finland, the Netherlands and Norway). However, average values for the other (18) OECD countries are also presented in Chapters 2 and 3 for many of the focused variables in order to see whether the four countries differ markedly from other OECD countries.

The data are weighted according to the full sample weight used in PIAAC and found in the PIAAC database in order to secure representativity. In analyses including data for only four countries, a new weight based on the full sample weight is used in addition (see Appendix 1). This weight ensures that the *number of observations is the same for all the four countries*, here set to 5200 in each country (see Table A.1 in Appendix 1). This is done in order to ensure that all the country samples have the same influence on the results when the four countries are seen together and that the largest countries/samples will not have any particular influence on the results. The weighting of data is discussed in Appendix 1.

1.7 Research questions and design

The main purpose in this report is to examine what is broadly considered as essential for being innovative at work based on the literature overview above. Central to the definition of innovativeness in this report is that the worker actively *seeks new knowledge* and *utilizes* this new knowledge. This is based on the previous research emphasizing learning-by-doing, taking new knowledge into use and learning organisations.

When examining innovativeness, the respondents' learning activities and strategies are examined. We consider that the worker has an innovative work profile if the respondent's job

- to a large extent involves keeping up to date with new products or services, *and*
- to a large extent involves learning-by-doing from the tasks he/she performs; *and* if the respondent
- to a large extent likes to get to the bottom of difficult things, *and*
- relates it to what he/she already knows when coming across something new or likes to figure out how different ideas fit together, and
- is quite frequently confronted with complex problems at work.

Another way to describe this worker is that he/she is an *innovative strategic learner at work*.

We will examine how frequently the worker characterized as being an innovative strategic learner occurs in four selected countries (Denmark, Finland, the Netherlands and Norway), and which factors promote the probability of being such a worker. Of particular interest when examining this is the occurrence of discretionary work forms such as flexibility and autonomy, and the work profiles of the worker, such as *being brokering, independent, sharing work-related information* etc., as well as the workers' level of educational, skills and occupation. In addition, a control is made for industrial sector and weekly work hours as well as demographic variables. The situation in the four countries will be compared as well as those factors within the four countries respectively that have the greatest impact on innovativeness and which will possibly contribute to an explanation of country differences.

2 Measurement of innovativeness

In our strategy for defining innovative workers, we emphasize their orientations, for example their learning strategies, combined with information on what they actually do at work. The purpose is not to achieve an absolute measure of how many persons who can be characterized as performing innovatively at work. This proportion will vary by how many criteria are used and the strictness of the criteria. The purpose here is to reach a meaningful definition that can be used for comparisons between groups of workers and countries.

People learn and get new ideas from many sources and in many ways. One way is through keeping up to date with new products and services, which, according to previous research (see Chapter 1) is important for being innovative at work. One of the questions in the PIAAC survey covers the issue (how often) ‘keeping up to date with new products and services’. Another active way of learning is when *the job involves learning-by-doing from the tasks performed by the individual*. As also described in Chapter 1, learning by doing is a central feature of innovativeness. Learning-by-doing from the tasks one performs is also examined in the PIAAC survey and is among the questions that will be analysed below.

The response categories for both these variables are: 1 Never; 2 Less than once a month: 3 Less than once a week but at least once a month; 4 At least once a week but not every day; and 5 Every day. The mean proportion with value 4 or 5 on these two variables is shown in Table 2.1 (rows A and B), and the proportion with 4 and 5 on *both* these variables is shown in row G.

To acquire further evidence enabling us to ‘circle in’ innovative persons, we use additional information on whether the respondents *actively seek and use new knowledge*, and the extent to which they solve complex problems at work. Concerning whether the respondents actively seek and use new knowledge we employ a set of questions in the PIAAC questionnaire which deal with learning strategies, i.e. how the respondents assessed the way they dealt with problems and tasks they encounter. The response to such questions contributes to revealing the extent to which the respondent is an active and innovative learner. The respondents were presented with various statements and were asked to what extent they thought that these statements applied to them. The statements were:

A. When I hear or read about new ideas, I try to relate them to real life situations to which they might apply
B. I like learning new things
C. When I come across something new, I try to relate it to what I already know
D. I like to get to the bottom of difficult things
E. I like to figure out how different ideas fit together

F. If I don't understand something I look for additional information to make it clearer.

The response categories for all the items are: 1 Not at all; 2 Very little; 3 To some extent; 4 To a large extent; 5 To a very large extent.

We have selected three of the items covering learning strategies: items C, D, and E. These items correlated most, but are still complementary. Item C refers to being a strategic learner as well as to competency; D refers to being curious as well as thorough and deliberate; E refers to being creative and curious. Table 2.1 shows the mean proportion with values 4 or 5 on the different learning strategies (rows C, D and E) as well as a construct where the response to these three variables is merged (row H). We consider these learning strategies as particularly relevant when it comes to being innovative at work, especially when used *in combination* with the two first-mentioned variables 'keeping up to date' (which also relates to strategic learning) and 'learning by doing'.

A construct merging the G (referring to the first two variables, A and B), and H (learning strategies), is shown in row I.

Table 2.1. Mean distribution on dependent variables. Per cent.

	The four countries	The 18 other countries
A: Keeping Up to Date	41.7	39.9
B: Learning By Doing	58.1	56.9
Learning strategies		
C: When I come across something new, I try to relate it to what I already know	74.0	57.8
D: I like to get to the bottom of difficult things	64.4	54.8
E. I like to figure out how different ideas fit together	51.2	50.2
F: Solving complex problems	57.7	57.7
Constructed variables		
G: A + B Innovative learning	30.3	31.1
H: High C + D or High D+E (strategic learner)	57.8	49.1
I: G + H: Innovative strategic learner	20.5	19.6
J: I + F: Innovative strategic and problem-solving learner	15.4	14.8

Row F refers to 'solving complex problems at work'. Here, we use information based on the question in the PIAAC survey: 'How often are you usually confronted with more complex problems that take at least 30 minutes to find a good solution? (The 30 minutes only refers to the time needed to THINK of a solution, not the time needed to carry it out.).' The response categories were: 1 Never, 2 Less than once a month: 3 Less than once a week but at least once a month; 4 At least once a week but not every day; and 5 Every day. The question contains several dimensions which the respondents have to figure out simultaneously (for example 'how often usually'; 'at least 30 minutes', as well as the distinction between 'thinking' and 'carrying out'), and this *may* make the response somewhat uncertain and ambiguous. Further, very able persons (who perhaps usually do not need long time to figure out a solution) and less able people may react differently to the question. This indicates that the response to this question should not have *too* much influence on the dependent variable(s).

According to the literature (not at least the literature on learning-by-doing), solving complex problems is a central feature of innovativeness. Thus, this question should not be overlooked. People who answer that they only occasionally (response categories 1 and 2) solve complex problems should *not* be regarded as being 'innovative learners at work'. It should also be mentioned that the correlation between education level and solving complex problems is higher when including the response categories 3, 4 and 5 than if only categories 4 and 5 are included. Being innovative may also involve frequently solving simple problems. It should also be mentioned that the underlying data shows that among those who are included in row J, 93 per cent solve simple problems every day or at least once a week, compared with 70 per cent of the others (not included in row J), and 66 per cent solve simple problems every day, versus 37 per cent of those who are *not* included in row J.

Thus, our solution is that those who *quite frequently* solve complex (response categories 3, 4 and 5) is coded as 'yes, solving complex problems' in row **F**. In row **J** (Table 2.1), the variable **I** is merged with **F** (solving complex problems). When including the condition about solving complex problems, the percentage being an innovative strategic learner is reduced from 20.5 per cent in row **I** to 15 per cent in row **J**.

All estimates refer to employed persons. The variable in row J is the main dependent variable in this report, and the persons who fit all the criteria in row J will here be labelled 'innovative strategic learners at work', or sometimes the shorter term 'innovative learner'. These persons *keep themselves updated, they are curious, they are able to learn something new from the work they do, they use previous knowledge strategically, they like to get into bottom of difficult things, and in addition, they quite frequently solve complex problems at work*. We find it reasonable to label a person who scores high such aspects as an 'innovative strategic learner'.

Table 2.1 shows that many people may be classified according to *one* of the selected criteria, but only *15 per cent* applies to all criteria (row J).[15] The table shows mean values for the four countries taken together, as well as for the remaining 18 countries in the PIAAC data base, taken together. The different dependent variables will be further examined in Chapter 4 in regression analyses for the four countries to see which factors are significant for increased/decreased probability to possess these features of innovativeness.

Except for the learning strategies, the mean share for the four-countries group does not differ from the mean of the 18-countries group. There is a broad variation between the countries within the groups. The variation between countries in the percent 'innovative, strategic learner' (row J) is commented below and shown in Figure 2.1.

2.1 Rankings of countries – Innovation Union Scoreboard vs. 'innovativeness' derived from the PIAAC data

Based on row J in Table 2.1, we have no indication that the workforce in the four selected countries has a greater tendency of innovativeness than the 18-countries group taken together. However, there is a great variation within this group. The largest country (US) pulls up the average, together with another large country like Canada. Concerning row J, we find US at the top (23 per cent) and also United Kingdom and Canada score high (20 and 18 per cent respectively). But Spain and the Slovak republic also score particularly high (around 20 per cent), and may appear as outliers. Sweden is in the middle, with 15.5 per cent, similar to Norway and Denmark (15.5 and 16.5 per cent respectively). At the bottom we find Korea and Japan (3 per cent), Belgium and Germany (9 per cent) and Russia (11 per cent), as well as the Netherlands (9 per cent). The ranking of countries according to 'innovativeness' (being an innovative strategic learner) compared to the rankings on the Innovation Union Scoreboard (OECD 2014) is not the same (see Figure 2.1.)

In Figure 2.1 we compare results of the Innovation Union Scoreboard for the 17 countries for which we have information both in the PIAAC data and the scoreboard. USA, Canada, Russia, Japan and Korea are not included in the Scoreboard and thus not included in the graph. We use data for the summary innovation index (based on a set of composite indicators) of the Innovation Union Scoreboard 2014

[15] A question might be raised whether the criteria in row (variable) H should be stronger, for example. that the criterion should be 'high' on all the three variables C, D and E simultaneously. When using this stricter criterion the per cent in row J is only 11.6 per cent (and only 6.4 per cent in the Netherlands). We found that this restricted the group of interest too much. Further, the (relative) country differences, which will be examined later, were not reduced, but rather were increased.

(OECD 2014), which refer to the last year available (frequently 2010– 2012). We compare this with the percentage categorized as 'innovative, strategic learner' (ref. row J in Table 2.1) in the different countries. The left axis refers to the mean scores on the Innovation Scoreboard and the right axis to the per cent 'innovative, strategic learner' in row J in Table 2.1.

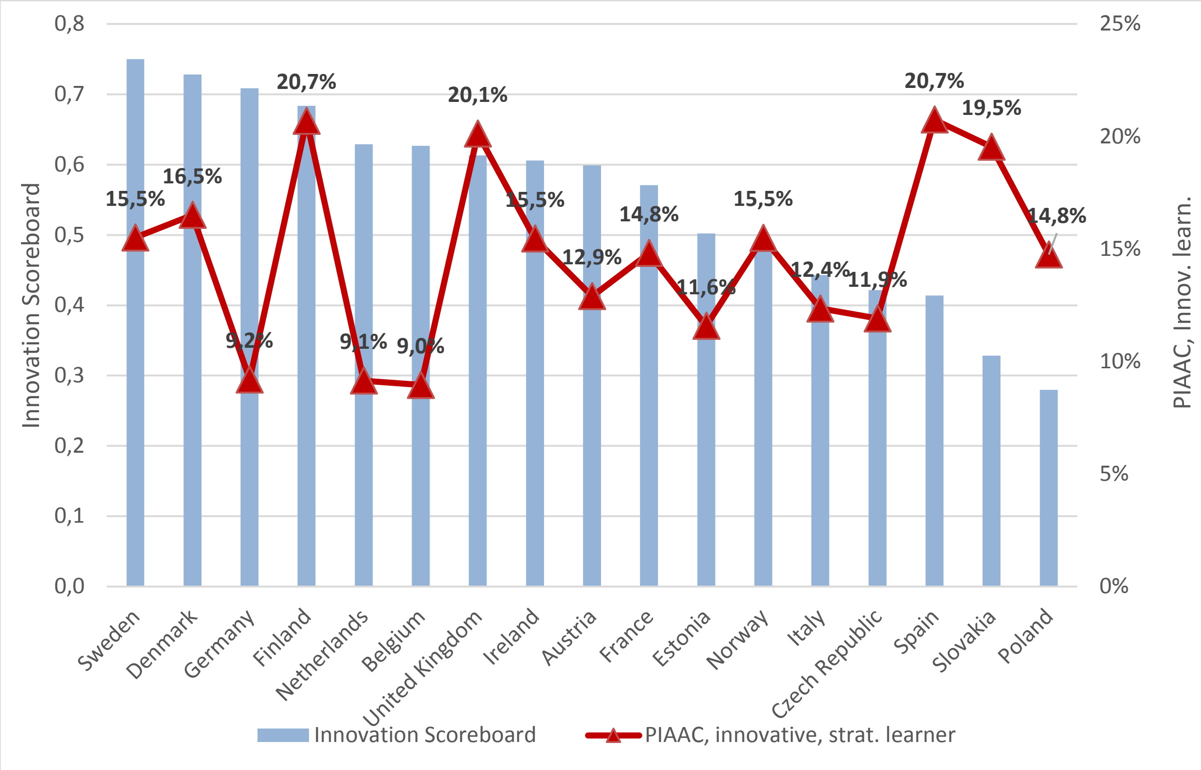

Figure 2.1. Rankings of countries according to the Innovation Union Scoreboard 2014 and the per cent 'innovative, strategic learner'

Of the four countries of particular interest here, the rankings differ markedly for the Netherlands. The best convergence is found for Finland. Denmark and Finland are among the highest performing countries according to the Innovation scoreboard, and they also score high on the variable 'innovative, strategic learner'. However, this applies particularly to Finland, so the correspondence is lower for Denmark. Concerning Norway, the rankings coincide only to a limited extent. Norway is average on 'innovative strategic learner', and a *below* the average on the Innovation Union Scoreboard. (The score for Norway is 0.480 on the IUS compared to 0.544 for the EU.) The Netherlands is among the countries scoring very high on the IUS 2014 (0.629), but scores particularly low on 'innovative, strategic learner'. The same applies to Germany and Belgium.

For some of the other countries, the two types of score do not coincide. Low performing countries according to the Innovation scoreboard such as Spain and Slovakia, score very high on our dependent variable 'innovative strategic learner'. For Sweden also, there is not a very good correspondence Sweden is in the middle of the ranking on 'innovative, strategic learner' (like Norway), while on the top on the Innovation scoreboard.

The variation illustrates that the measures are based on entirely different types of data and methods. The first thing is, of course, that being an 'innovative, strategic learner' does not imply that innovation actually or necessarily has taken place. This measure is based on the respondent's subjective self-evaluation, though it is a quite strict measure based on several indicators, and we consider it as a fairly good measure of innovativeness. The innovation scoreboard is based on objective indicators. Examples of indicators are: Business R&D expenditures as percentage of GDP; Non-R&D innovation expenditures as percentage of turnover; SMEs innovating in-house as percentage of SMEs, and

Innovative SMEs collaborating with others. Norway scores much lower than the Netherlands, Denmark and Finland on all the four indicators mentioned. These indicators are based on data from Eurostat/CIS, which also might have measurements problems, as mentioned in the introductory part.[16] It may also be mentioned that many of the ratios are based on the percentage of GDP and where Norway has a particularly high GDP per capita (see Appendix 2).

Though being ‘objective indicators’. the extent to which the Innovation scoreboard’s composite indicators measure the national workforce’s actual ability to innovate is questionable, as mentioned in the introductory part of Chapter 1. It should be mentioned that other comparisons also show a divergence between the ranking of the innovation scoreboard and the national workforces in terms of innovation. Based on the REFLEX survey, Paul (2011) compared the proportion of graduates in 13 European countries working in organisations at *the forefront of innovation* in the private sector five years after graduation with the ranking of countries according to the European Innovation Scoreboard 2006 (EIS).

Eight of the scoreboard indicators were selected for the comparison (Paul 2011): Business R&D expenditures (percentage of GDP); share of medium-high-tech and high-tech R&D (percentage of manufacturing, R&D expenditures); share of enterprises receiving public funding for innovation; SME’s using organisational innovation (percentage of all SMEs); sales of new-to-market products (percentage of total turnover); sales of new-to-firm products (percentage of total turnover), and employment in medium-high and high-tech manufacturing (percentage of total workforce).

Paul found that many of the 13 countries were ranked at a comparable level according to both two classifications. *Norway represented a strong exception*, ranking no. 13 (the lowest of the selected countries) on EIS, and no. 5 according to the REXLEX survey. Two other strong exceptions were Germany (no. 1 on EIS and no. 7 on REFLEX, and Belgium (no. 5 on EIS and no. 10 on REFLEX). The same discrepancy for Germany and Belgium is seen in Figure 2.1.

Finland and the Netherlands were among the countries scoring about the same level on the two rankings according to Paul , Finland no. 2 on EIS, and no. 1 on REFLEX, and Netherlands no. 10 and 9 respectively. (Denmark was not included in the REFLEX survey.) However, the Netherlands was ranked clearly below Norway in this study.

These results seem to confirm that regardless of type of measurement, Finland ranks very high. Further, we see that Norway ranks higher in both the surveys (PIAAC and REFLEX) than in the innovation scoreboards. The opposite is the case for countries like Germany and Belgium (ranking high on the scoreboards, but ranking low on the measurement in both surveys). Concerning the Netherlands, this country scores relatively low both in the REFLEX survey and according to the measure based on PIAAC data scores, but high on the latest innovation scoreboard. The rankings in the innovation scoreboards have varied for the Netherlands. The total score for the Netherlands on the innovation scoreboard was lower in 2006 (0.561) than in 2014 (0.629), thus there was a good correspondence between the REFLEX ranking and the EIS ranking (2006) for the Netherlands.

The results indicate that the survey data cover properties for innovativeness that the innovation scoreboards do not capture, nevertheless with great correspondence for some countries like Finland. For other countries (Germany, Belgium and the Netherlands, the scoreboard indicates high scores that do not seem to be reflected in the innovativeness of the workforce, as is measured here.

In Chapter 4, we will examine which factors which contribute to the variation between the four countries when it comes to innovativeness as measured by the PIAAC data. As mentioned, we concentrate on the four-countries group, and which will be examined separately. Corresponding

[16] Other examples are: Norway scores equally high as Denmark and the Netherlands on the composite indicator ‘Human resources’ (Finland ranking highest). And, Norway is scoring equally high as Denmark and the Netherlands (in fact Norway highest) on ‘Research systems’, where Finland is scoring lower than the other three countries according to the latest scoreboard. Still, in total Norway scores far below the other three countries.

analyses for the total 22 countries would be excessive. First (Chapter 3), we take a closer look at the distribution of independent variables that will be used in the regression analyses.

3 Factors which can promote ‘innovativeness’

As described in the literature review in Chapter 1, several factors may have impact on the likelihood of innovativeness. The objective of this chapter is to describe in detail the character and distribution of many such factors. All estimates refer to persons in the PIAAC survey who are employed.

The presentation of the different variables will also provide a description of many aspects of the four countries that are of particular interest for our study. If a country sample scores low on an independent variable that appears to be of great importance, this can be one of the reasons why the actual country scores low on the dependent variable. Further, the effects of the independent variables may differ between the countries. This will be examined in regression analyses for the four countries separately in Chapter 4.

The factors that are described, and which later (Chapter 4) are used as independent variables in the regression analyses, concern the following variables:

- skills, education levels, fields of study and occupational classification (skills level of the respondents’ occupation)
- lifelong learning and work-related training, and number of days training
- work profiles (type of skills used at work)
- discretionary work forms (opportunity to work flexibly and autonomously)
- weekly work hours
- economic sector
- demographic variable (age and gender).

In many cases, also the relationships between different independent variables are described below. These relationships are frequently essential when interpreting the results of the regression analyses in Chapter 4.

3.1 Skills

The four countries we are particularly interested in, are among those countries scoring highest on adult skills in the PIAAC survey (OECD 2013). We will include skills as independent variables in the logistic regression. The skills variables are based on so-called plausible values (see Appendix 3). Our examination of the data when using different measurements and tools indicates that our use of the skills variables does not encompass biased results (see Appendix 3, Tables A.4 and Appendix 4, Tables A.5).

Table 3.1 shows the average numeracy and literacy skills as well as problem-solving skills in technology-rich environment for the four countries. Table A.4 (in Appendix 3) shows the estimated means for the remaining 18 countries in addition to estimated standard deviations (using different tools). The four countries score higher than the 18-countries group on the different kinds of skills, with one exception. When it comes to literacy skills, Denmark does not score higher than the average for the 18-countries group.

There are small differences in average skills between the four countries, except that Finland scores particularly high on literacy skills and Denmark scores lower. The correlation between the three types of skills (literacy, numeracy and problem-solving) is very high (the correlation between numeracy and literacy skills is 0.9). Thus, because of multicollinearity, variables for all types of skills cannot be included in regression model(s) simultaneously. Preliminary analyses indicated that the effects of the three types of skills are quite similar (although not identical) on many of our dependent variables. We have created a new variable indicating the mean of literacy and numeracy skills taken together, and this combined measure is included as control variable in the regressions in Chapter 4. The main reason for this is that we considered that in some cases the two types of skills can be complementary (literacy skills might be as important as numeracy skills), and we found it difficult to choose one type of skill. The mean values on this combined measure is shown in the last row of Table 3.1, and is used in Figure 3.3 later in this chapter.

Information on problem-solving skills exists for fewer respondents than for numeracy and literacy skills (due to the fact that not all the respondents took the test). Controls for problem-solving skills are also included in the in the regression models in Chapter 4. Here, we use dummy-variables in order to include those with no information on problem-solving skills and to avoid multicollinearity. Four dummy-variables are included, no information on problem-solving skills, low (the lowest third among those where information on problem-solving skills exists) medium and high skills, see Table 3.2.

Table 3.1. Average skills. Employed persons

	Denmark	Finland	Netherlands	Norway
Numeracy skills	285.5	289.7	286.9	285.1
Literacy skills	276.6	294.5	289.8	283.4
Problem-solving	285.6	290.7	290.3	289.0
Numeracy and literacy combined	281.1	292.1	288.4	284.2

Table 3.2. Problem-solving skills in technology-rich environment. Per cent (vertical)

	Denmark	Finland	Netherlands	Norway
No information	10.5	13.6	7.7	10.8
Low	32.2	28.9	28.5	29.5
Medium	30.8	26.1	32.7	29.5
High	26.5	31.4	31.1	30.2

3.2 Education

The distribution according to educational levels is shown in Table 3.3. In the analyses in Chapter 4, education categories 3 and 4 (medium education level) are merged in the regression analyses. One reason for merging of these two categories is that the distribution between these two medium levels varies between the countries. ISCED 4 does not exist in all countries (for example the Netherlands), and the qualification of some persons at ISCED 3 in Netherlands may be the same as for those at ISCED 4 in another country. (It may also be the case that the qualifications for some persons at level 5B in one country can be the same as for persons with ISCED 4 in another country.) Whereas ten per cent are in the category ‘4 Post-secondary, non-tertiary (ISCED 4A-B-C)’ in Norway, this does not apply to any of the respondents in the Dutch sample and only 2– 4 per cent in the Danish and Finnish samples. Together, the categories ‘3 Upper secondary (ISCED 3A-B, C long)’ and category 4 constitute about 40 per cent in all the four samples.

Table 3.3. Distribution of education level in the four countries among employed persons. Per cent.

	Denmark	Finland	Netherlands	Norway	Total
1 Primary or less (ISCED 1 or less)	0.8	3.5	5.7	0.7	2.6
2 Lower secondary (ISCED 2, ISCED 3C short)	19.6	7.7	19.7	20.5	17.0
3 Upper secondary (ISCED 3A-B, C long)	38.1	39.6	39.7	28.7	36.4
4 Post-secondary, non-tertiary (ISCED 4A-B-C)	1.7	4.2	0	10.0	4.0
5 Tertiary – professional degree (ISCED 5B)	20.4	17.1	3.8	4.8	11.4
6 Tertiary – bachelor degree (ISCED 5A)	7.6	14.0	20.7	21.0	15.9
7 Tertiary – master/ research degree (ISCED 5A/6)	11.8	13.8	10.4	14.2	12.6
Total	100.0	100.0	100.0	100.0	100.0

A higher proportion of the Dutch sample has the lowest educational level (ISCED 1 or less). This is not due to a higher share of immigrants in the sample in the Netherlands than in the other countries. The relatively high proportion having the lowest educational level applies to persons born in Netherlands as well as to persons born outside Netherlands. Moreover, it is Norway, which has the highest share of people not born in the country.

The categories ‘5 Tertiary – professional degree (ISCED 5B)’ and ‘6 Tertiary – bachelor degree (ISCED 5A)’ are also merged in the analyses in Chapter 4. The distribution of these categories also differs in the four countries. Whereas Denmark and Finland have many in category 5 (ISCED 5B, professional degree); 20 and 17 per cent respectively, Norway and the Netherlands have only 4– 5 per cent. Whereas Norway and the Netherlands have many in category 6 (ISCED 5A) (21 per cent), Denmark and Finland have fewer (8 and 14 per cent respectively). This largely reflects differences in the educational systems. When these categories are merged, 27 per cent of the employed respondents in the four countries are in the combined category 5+6 (varying from about 25 per cent in Norway and the Netherlands to 28– 31 per cent in Denmark and Finland).

When adding category 7 (master and research degree graduates), the level of employed persons with tertiary education (ISCED 5 or higher) is 40 per cent (varying from 35 per cent in the Netherlands to 45 per cent in Finland). The corresponding estimate for the remaining 18-countries group is quite similar (42 per cent), where large countries such as Canada and Japan rank highest with 51 and 46 per cent respectively. At the other extreme, we find Italy, Austria, Czech Republic and Slovakia, with 17 – 26 per cent having tertiary education.

We may conclude that the four countries are well educated compared to most of the OECD countries, but many other countries rank similarly or higher (i.e. above 40 per cent with tertiary education among employed persons), including the U.S. South Korea, Ireland, UK, Belgium, Estonia, Japan and Canada, according to the PIAAC data. (We note that the estimates refer to employed persons. The percentages are about five percentage points lower when looking at the total groups of respondents.)

3.2.1 *Fields of study*

Among the employed persons in the four countries, information on fields of study is lacking for 16 per cent. The reason is that information on fields of study is not registered for persons at the lowest educational levels. This varies, however, considerably between the countries. Of the employed persons in the Dutch sample, information on fields of study is lacking for 25 per cent, but only to about 11.5 per cent in the Finish and Norwegian samples (Table 3. 4). In the Netherlands. the reason is that those at the lowest educational levels were not asked about fields of study. Tables 3.5 and 3.6 show the distribution of fields of study by educational level for the four countries respectively.

The information on fields of study refers to very broad fields. This means, for instance, that quite different groups are merged in the broad field 'Social sciences, business and law'. Thus, it is not possible to distinguish between business, social science and law and to examine whether the effects on the dependent variable possibly differ between these three more narrow fields. Table 3.4 shows that a particularly large share of the respondents in the Netherlands belong to this broad field. It would have been interesting to know whether this overrepresentation mainly refers to business and administration or to social science disciplines. The overrepresentation in this field in the Dutch sample is caused by the fact that many have an education level below tertiary level (see Table 3.6).

Table 3.4. Distribution of fields of study among employed persons. Per cent.

	Denmark	Finland	Netherlands	Norway
Unknown	15.5	11.4	25.3	11.5
General programmes	9.8	9.5	6.7	7.2
Teacher training and education science	8.4	4.5	5.2	6.8
Humanities, languages and arts	5.1	4.2	3.6	5.5
Social sciences, business, law	13.8	16.6	22.0	17.8
Science, mathematics, computing	7.6	2.4	5.2	6.5
Engineering, manufacturing, construction	16.9	26.6	12.5	24.2
Agriculture and veterinary	2.9	3.6	3.0	2.5
Health and welfare	10.0	13.1	13.4	14.4
Services	10.1	8.0	3.0	3.7
Total	100.0	100.0	100.0	100.0

It may also appear as somewhat unlikely that Norway the proportions being educated in the field of engineering, manufacturing and construction are so much higher than Denmark and the Netherlands. It should be added that for a majority of the persons within this field the educational level is below tertiary. This applies to all the four countries, but the proportion of this group with education level *below* tertiary varies from 62 per cent in Finland to 74 per cent in Norway (see Tables 3.5 and 3.6). This means that the reason why Norway has a higher proportion educated in engineering, manufacturing and construction is partly due to the fact that more persons with a lower education level are assigned codes for fields of study here than in the other countries.

Table 3.5. Denmark and Finland. Distribution of fields of study by education level. Employed persons. (Percent base: horizontally, within each country)

	1 Primary or less	2 Lower secondary or ISCED 3C, short	3 Upper secondary long	4 Post-secondary non-tertiary	5 Tertiary profess. degree	6 Tertiary bachelor degree	7 Tertiary master/ research degree
Denmark							
Unknown	4.9	95.1					
General programmes		10.7	81.5	1.1	6.2	0.5	
Teacher training and education science		1.9	5.7	1.6	69.8	17.0	4.1
Humanities, languages and arts		.5	24.5	.5	10.9	20.3	43.2
Social sciences, business, law		3.4	29.6	2.9	23.9	12.4	27.7
Science, mathematics, computing		1.7	33.0	2.8	23.3	8.7	30.6
Engineering, manufacturing, construction		2.3	65.0	1.1	13.7	8.7	9.2
Agriculture and veterinary		7.1	62.5	.9	15.2	3.6	10.7
Health and welfare		15.7	17.5	4.2	39.5	11.0	12.0
Services		8.6	71.8	2.1	16.4	0.5	0.5
Finland							
Unknown	30.7	67.6	0.2	.5	0.5		0.5
General programmes			99.1		0.3	0.3	0.3
Teacher training and education science			7.9	3.0	17.0	27.9	44.2
Humanities, languages and arts			14.9	3.2	9.7	29.2	42.9
Social sciences, business, law			16.7	4.0	39.1	18.7	21.5
Science, mathematics, computing			4.4	1.1	4.4	22.2	67.8
Engineering, manufacturing, construction			54.9	6.7	14.0	14.0	10.3
Agriculture and veterinary			54.2	4.6	18.3	13.7	9.2
Health and welfare			32.3	3.6	29.8	23.7	10.7
Services			70.0	10.0	12.1	5.9	2.1

Table 3.6. The Netherlands and Norway. Distribution of fields of study by education level. Employed persons. (Percent base: horizontally, within each country)

	1 Primary or less	2 Lower secondary or ISCED 3C short	3 Upper secondary long	4 Post-secondary on-tertiary	5 Tertiary profess. degree	6 Tertiary bachelor degree	7 Tertiary master/ research degree
The Netherlands							
Unknown	22.3	77.7					
General programmes			96.6		0.4	3.1	
Teacher training and education science			15.0		6.5	68.5	10.0
Humanities, languages and arts			24.8		1.4	33.3	40.4
Social sciences, business, law			43.4		6.9	30.2	19.5
Science, mathematics, computing			40.3		3.0	27.9	28.9
Engineering, manufacturing, construction			66.4		2.5	22.7	8.5
Agriculture and veterinary			69.8		2.6	16.4	11.2
Health and welfare			54.2		8.5	27.7	9.6
Services			71.8		6.8	21.4	
Norway							
Unknown	6.3	93.3	0.4				
General programmes		29.9	63.5	3.5	.3	1.7	1.0
Teacher training and education science		0.4	5.2	1.8	3.7	67.2	21.8
Humanities, languages and arts		6.0	18.3	8.3	5.0	35.3	27.1
Social sciences, business, law		12.1	20.0	6.9	11.4	24.3	25.3
Science, mathematics, computing		10.0	28.7	5.4	6.9	18.8	30.3
Engineering, manufacturing, construction		11.8	43.8	18.9	4.3	11.7	9.6
Agriculture and veterinary		12.1	36.4	32.3	3.0	8.1	8.1
Health and welfare		5.9	28.1	10.2	2.8	38.5	14.4
Services		13.3	47.3	20.7	7.3	8.7	2.7

In the regression models in Chapter 4, persons with educational level below 'ISCED, 3 long' are used as the reference category. In addition, persons with an unknown field or who are educated within general fields are included in the reference category. Tables 3.5 and 3.6 show that these groups a largely overlap.

3.3 Skills level of occupations

From the PIAAC data we have information on the occupational classification of the respondent's job and which are separated into four skill based categories. The distribution of these four categories in the four countries is presented in Table 3.7. We lack information on occupational level for about four per cent of the employed persons in the four countries. However, this varies widely between the countries. We want to include this group ('unknown' in the regression models on Chapter 4 Table 3.7. Five dummy-variables are created to be used in the regressions; Unknown, Skilled occupations, Semi-skilled white-collar occupations, Semi-skilled blue-collar occupations, and Elementary occupations, where the latter will be used as the reference category in the regression.

Table 3.7. Occupational classification of the respondent's job. The four countries. Per cent.

	Denmark	Finland	Netherlands	Norway	Total
Skilled occupations	47.0	42.6	52.1	42.1	46.0
Semi-skilled white-collar occupations	24.6	26.9	27.5	28.1	26.8
Semi-skilled blue-collar occupations	17.6	23.1	11.3	14.4	16.5
Elementary occupations	9.3	6.3	7.7	3.9	6.8
Unknown	1.4	1.0	1.3	11.4	3.9
Total	100.0	100.0	100.0	100.0	100.0

We see that the proportion with no information on occupational level is much higher in Norway than in the other three countries. This makes it important to include the group 'unknown' in the regressions in Chapter 4, something which is supported by the fact that many of these (39 per cent) have educational level at the tertiary level (the same as the total) (see Table 3.9). In Norway, this applies to 42 per cent of those with no information on occupation level.

The skills level of occupation is partly based on the respondent's educational level and the two variables correlate, as shown in Tables 3.9 and 3.10 below. Consequently, a question can be raised whether it makes sense to include controls for educational level and occupation level simultaneously in the regression model. However, checks of multicollinearity show that tolerance and variance inflation factors (VIF) are within acceptable levels. Table 3.8 shows that most persons at the highest educational levels have skilled occupations. However, Table 3.9 shows that among those in skilled occupations the educational level varies considerably; 32 per cent of these persons have education below tertiary education (most of them with the level 'Upper secondary ISCED 3A-B, C long').

Table 3.8. Education level by the occupational classification of the respondent's job

	Primary or less (ISCED 1 or less)	Lower secondary) y (ISCED 2. ISCED 3C short)	Upper secondary (ISCED 3A-B,C long)	Post-secondary. non-tertiary (ISCED 4A-B-C)	Tertiary – profess. degree (ISCED 5B)	Tertiary – bachelor degree (ISCED 5A)	Tertiary – master/ research degree (ISCED 5A/6	Total
Skilled occupations	9.6	17.3	27.5	35.8	67.5	78.2	89.2	46.0
Semi-skilled white-collar occupations	25.9	38.6	36.4	30.5	21.8	12.9	4.3	26.8
Semi-skilled blue-collar occupations	35.6	22.9	25.9	21.9	6.4	2.7	1.5	16.5
Elementary occupations	25.7	16.5	7.0	2.9	2.0	1.7	0.7	6.8
Unknown	3.2	4.7	3.2	8.9	2.4	4.5	4.4	3.9
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 3.9. The occupational classification of the respondent's job, by education level.

	Primary or less (ISCED 1 or less)	Lower secondary) y (ISCED 2. ISCED 3C short)	Upper secondary (ISCED 3A-B, C long)	Post-secondary. non-tertiary (ISCED 4A-B-C)	Tertiary – profess. degree (ISCED 5B)	Tertiary – bachelor degree (ISCED 5A)	Tertiary – master/ research degree (ISCED 5A/6	Total
Skilled occupations	0.6	6.4	21.8	3.2	16.7	27.1	24.4	100.0
Semi-skilled white-collar occupations	2.6	24.5	49.5	4.6	9.2	7.7	2.0	100.0
Semi-skilled blue-collar occupations	5.7	23.7	57.1	5.4	4.4	2.6	1.1	100.0
Elementary occupations	10.0	41.6	37.9	1.7	3.4	4.1	1.3	100.0
Unknown	2.2	20.4	29.2	9.1	6.8	18.4	13.9	100.0
Total	2.7	16.9	36.7	3.8	11.5	15.8	12.5	100.0

3.4 Work-related training

Of particular interest are variables that concern participating in work-related training (Table 3.10). In the PIAAC survey, the persons were asked whether they had participated in organised learning activities other than formal education during the last 12 months, including both work- and non-work related activities. The training activities were on-the-job training or training by supervisors or co-workers, and seminars or workshops, but could also include open or distance education and private courses or lessons.

Table 3.10. Mean sample values for training activities. Employed persons.

	Denmark	Finland	Nether-lands	Norway	Total, four countries	18 other countries
On-the-job training (per cent)	46.9	55.3	51.0	38.8	47.9	37.3
Participated in seminar / workshop (per cent)	35.0	24.9	31.8	36.9	32.2	25.6
Courses conducted through open or distance education	14.4	15.7	16.1	6.5	13.1	12.6
Courses or private lessons, not already reported	20.1	18.2	11.2	19.3	17.2	8.9
One of these types of training*	68.2	70.8	67.9	66.5	68.3	51.8
Obligatory job-related training (per cent)	12.0	14.8	10.6	10.1	11.8	7.1
Own interest job-related training (per cent)	49.3	47.0	49.4	48.9	48.7	29.4
Number of days participating in training, average all employed persons	8.7	6.8	10.6	7.9	8.5	9.3**
Persons participating in job-related training of own interest: Number of days participating in training,	12.9	9.2	14.8	12.4	12.4	15.8**
Persons who had participated in obligatory job-related training: Number of days participating in training	10.1	6.4	11.6	7.0	8.6	6.7**

* Percentage basis, persons who have responded to all the four questions .

** Average 17 countries (excluding Canada because of lack of information)

When all training forms are considered, about two-thirds of the workers in the four countries (compared to 52 per cent in the 18-countries group) had participated. There are small differences between the four countries. The country differences in training rates are smaller than what is found in some previous studies mentioned in Section 1.3 (Chapter 1), but the findings are very similar to what was found in the adult education survey 2011 (Eurostat 2013a). We see, for example, that the Dutch workers participate to the same extent as the workers in the other three countries.

It is also of interest to compare with the findings of CVTS (Continuing vocational training survey) particularly since the percentages reported in Table 3.10 refer to employed persons and non-formal training. According to CVTS 2010 (Eurostat 2013b) the percentage of employed persons participating in non-formal training was 47 in the twenty-seven EU countries , compared to 65 per cent in Norway and Denmark, and 66 per cent in Netherlands (Finland was not reported here), which are all very close to our estimates in Table 3.10.

When it comes to the category ‘organised on-the-job training’, there are quite large country differences where Norwegians are participating to a much lower degree than the Finish workers. Norwegians also participate less frequently in open or distance education, but more frequently in workshops and seminars. Regarding the total training rate, the high rate for Norwegians largely applies to workshops and seminars. Organised on-the-job training plays a great role also in Norway, but to a lesser extent than in the other three countries.

Those who had participated in training were also asked whether the training activity was mainly job related. If this activity was mainly job related, the persons were asked to specify more precisely the main reason for participating in this activity (referring to the last learning activity). Here (Table 3.10), the answers to this question are recoded so that those who responded ‘I was obliged to participate’ is coded ‘obligatory’; all others are coded ‘of own interest’ (e.g. ‘to increase my personal knowledge’ etc.), but still work-related. Based on this, two new dummy variables were created, referring to those who had participated in one of the (work-related) training forms, *obligatory* or of *own interest.*

There are no differences between the four countries concerning participation in job-related training of own interest, and the participation rate in the four countries is very much higher than the average rate in the 18-countries group. Obligatory training occurs somewhat more frequently in Finland than in the other three countries, and less frequently in the 18-countries group than in the four countries.

In the PIAAC questionnaire the respondents were also asked about the *total amount of time* they have spent in the past 12 months on *all* types of courses – training, private lessons, seminars or workshops. The answers could refer to weeks, days or hours. We have recalculated response referring to number of weeks into days (one week being five days), and we have recalculated the number of hours to the number of days (7 hours corresponds to one day).

The average results are seen in the last three rows of Table 3.10. Of the four countries, the Dutch sample report the longest duration of training. This is clear when calculated as the number of days among those who had participated in either obligatory training or training of own interest, as well as when measured as an average for all employed persons. Although the ‘18-countries group’ participate less frequently in training than the four-countries group, the number of days with training is equally high as in the four-countries group. The high number of training days reported in the group of 17 countries (Canada excluded) is due to the fact that a few large countries pull the average up. These countries are Korea, US and Spain. The Netherlands follow close behind these three countries. The remaining 14 countries (of the 17-countries group) score below the average for the four countries when calculated as the number of days participating in training.

Because there is a skewed distribution of the number of days training, this will be included as dummy-variables in the regressions in Chapter 4. The dummy variables used are shown in Table 3.11. We divided those with information on the amount of training in three groups of approximately equal size (about 20 per cent in each group in thee four countries). Preliminary analyses showed that the last group was very broad. Further, using such a broad category concealed the fact that that it was particularly significant to belong to the group with a very high number of training days. Thus, the last group was further divided to distinguish a group with a high number of training days.

Table 3.11. Distribution of number of days training. Employed persons

	Denmark	Finland	Nether-lands	Norway	Total, four countries	18 other countries
No training*	35.4	30.4	35.0	36.5	34.4	51.5
1 – 2 days	14.4	25.0	20.8	17.1	19.3	16.7
3 – 7 days	23.1	23.8	21.2	23.2	22.8	13.8
8 – 20 days	19.5	15.1	14.1	17.2	16.5	10.3
More than 20 days	7.6	5.7	8.9	5.9	7.0	7.7
Total	100.0	100.0	100.0	100.0	100.0	100.0

* Including a small group who have participated in training who gave no information on the duration of training.

Concerning the controls for number of days participating in training, it should be mentioned that we have no information on how much time was spent on the different types of activities (for instance work-related or not work-related, obligatory or of own interest, distance training or on-the-job training) in cases where the person has participated in more than one type of training. It is nevertheless interesting to see the extent to which increased levels of training have a positive effect on the dependent variable.

3.4.1 Who participates in work-related training?

It is not coincidental who participates in training. This varies with education level and types of work profiles. Many studies show that the training rate increases with increased education level (Eurostat 2013; Boeren et al. 2010; Desjardins and Rubenson 2011; Børing, Wiborg and Skule 2013). This is also the case here. Figure 4.3 shows that participation in work-related training *of own interest* increases with increased education level.[17] However, participation in *obligatory* training does not. (It is a tendency of a curvilinear relationship between obligatory training and education levels that those with the lowest and highest levels participate less frequently in obligatory training than those with middle educational level).

[17] Participation in training, and motivational factors for the participation as well as barriers to participation in training, is studied in another sub-project under the BRAIN project.

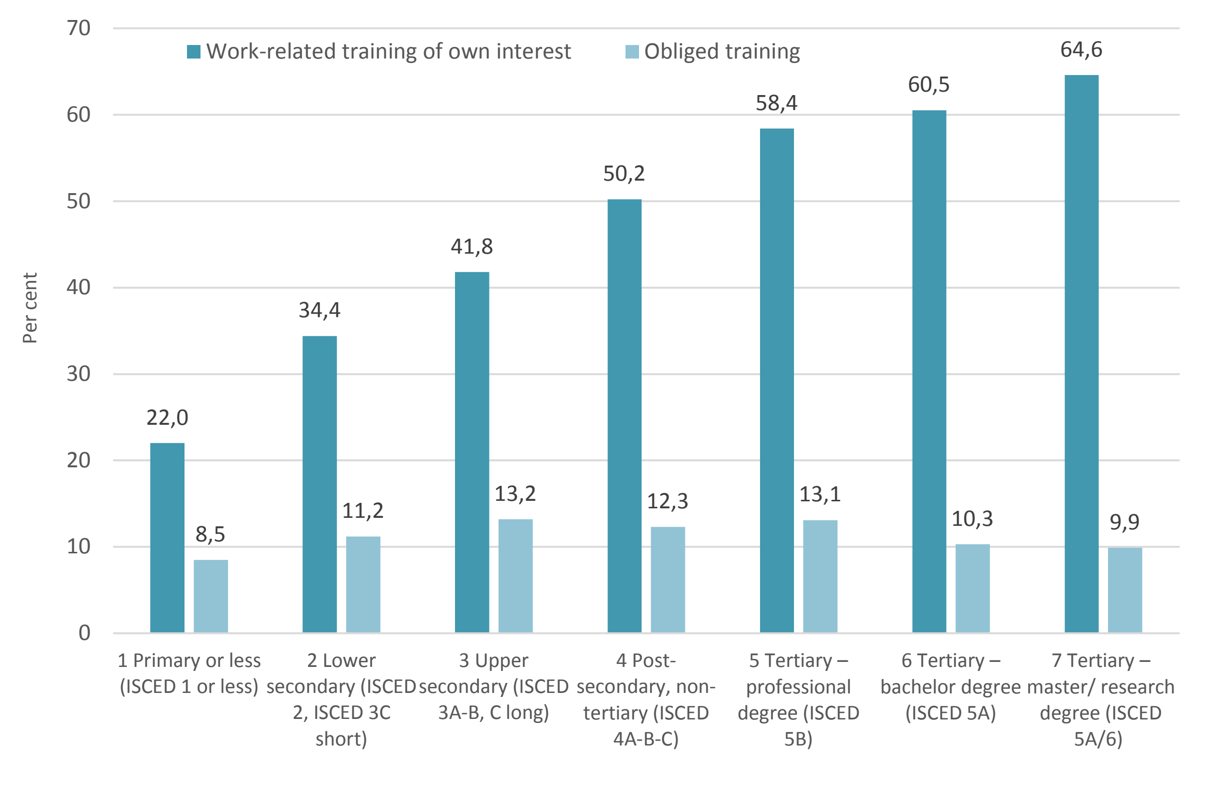

Figure 3.1. The relationship between participation in work-related training and education level. The four countries taken together

3.5 Work profiles

We expect an association to exist between the extent to which the worker exhibits innovativeness, and certain competency profiles and roles at work. Based on previous research (see Chapter 1) we expect that communicative and championing skills, and being a knowledge broker, increase the likelihood of being innovative at work (Zahra et al. 1999; Block and MacMillan 1993; Maidique 1980; Hargadon 2002; Tushman and Nadler 1986; Bjørnåli and Støren 2012). Further, being entrepreneurial, for example within a firm (*intra*preneurship/corporate entrepreneurship) embodies pro-activeness, risk-taking and discovering new opportunities (Zahra et al. 1999; Hayton and Kelly 2006), which presupposes the ability to work independently. Frequently mentioned in the innovation literature is also 'the innovation champion', 'the executive champion (Maidique, 1980) and 'corporate entrepreneurship champion' (Zahra et al 1999).

Such properties are covered in a section in the PIAAC questionnaire under the heading 'Skills used at work', from which we will use information based on these questions:

How often does the job usually involve …

- sharing work-related information with co-workers?
- advising people?
- persuading or influencing people?
- involve planning your own activities?
- organising your own time?
- negotiating with people either inside or outside your firm or organisation?

The response categories for all items are: 1 Never; 2 Less than once a month; 3 Less than once a week but at least once a month; 4 At least once a week but not every day; 5 Every day ('no response' is excluded).[18]

Based on the six questions above we created four new variables

- *Independent***.** Based on the items 'planning own activities' and 'organising own time', which were highly correlated (0.62).
- *Championing***.** Based on the items 'advising people' and 'persuading or influencing people' (which were also highly correlated, 0.56).
- *Information exchange.* Based on the item 'sharing work-related information with co-workers'
- *Brokering***.** Based on the item 'negotiating with people either inside or outside your firm or organisation'.

Each of these four variables is divided into three dummy-variables, for those with lowest, medium and highest scores (based on the distribution of the response with cut points for three equal groups, 33.3 percentiles). The distribution of the four variables varied and was skewed; mmore than half gave the highest score on some of the variables (see Table 3.12). For example, the medium values for Independent are in the range 4 – 4.5, but 2 – 3 for Brokering. Table 3.12 shows the distribution that comes closest when distinguishing groups of equal size scoring 'low', 'medium' and 'high'.

Table 3.12. Mean score and distribution of scores on work profiles

	Mean score	Per cent (horizontal)		
Independent		Low (values 1 – 3.5)	Medium (values 4 – 4.5)	High (value 5)
	4.1	27.1	19.2	54.7
Championing		Low (values 1 – 2.5)	Medium (value 3 – 4.5)	High (value 5)
	3.5	27.4	35.9	36.7
Information exchange		Low (value 1 – 3)	Medium (value 4)	High (value 5)
	4.2	18.9	22.7	58.3
Brokering		Low (value 1)	Medium (values 2 + 3)	High (values 4 + 5)
	2.8	32.9	28.4	38.7

The highest mean scores are found for being independent and for 'information exchange'. On both these variables more than half of the respondents have the highest score (5). (We recall that 'championing' as well as 'independent' are constructed variables, each being based on two variables, and this is the reason why many persons score 2.5, 3.5 etc.). The lowest score is found for 'brokering' (2.8), where approximately one third has the lowest possible value (value 1). Tables 3.13 and 3.14 show how the distributions vary by country.

[18] The many questions included in the question-battery about 'skills used at work' are as well very suited for factor analyses. When doing this, three clear factors for work profiles *(communicative/cooperative; independent, and brokering/selling)* are extracted. However, we have chosen not to include the results of the factor analysis (factor scores) in the regression analyses in Chapter 4, although preliminary analyses showed that they had a clear impact. (Still, the impact was not greater than the variables for work profiles that are included here.) The reason for not using the factor scores is partly that some of the underlying variables included in each factor hardly could be justified – based on previous research – as influencing innovativeness, and partly because a Cronbach's Alpha test revealed that the internal consistency between variables constituting a factor was not always reliable.

Table 3.13. Mean score work profiles by country.

	Denmark	Finland	Netherlands	Norway	Total, four countries	The rest 18 countries
Independent	4.3	4.2	4.0	3.9	4.1	3.8
Championing	3.6	3.6	3.3	3.6	3.5	3.2
Information exchange	4.2	4.1	4.1	4.4	4.2	4.0
Brokering	2.5	3.5	2.6	2.6	2.8	2.8

Table 3.14. Per cent high score on work profiles by country

	Denmark	Finland	Netherlands	Norway	Total, four countries	The rest 18 countries
Independent	63.3	51.2	57.9	42.8	53.7	46.2
Championing	40.3	38.5	32.9	34.7	36.5	33.4
Information exchange	59.9	51.0	57.6	63.7	58.2	57.8
Brokering	31.1	59.6	33.8	31.0	38.5	39.9

There is a clear difference between the average for the four countries and the average for the remaining 18 countries when it comes to the item 'Independent'. Otherwise, the differences are minor. However, there are differences between the four countries. Finland scores particularly high on brokering, whereas Denmark scores particularly high on Independent. The Norwegian respondents score high less frequently than the other three countries on the item 'Independent', but they score high more frequently on the item 'Information exchange'. The Dutch respondents (followed by the Norwegians) score lower on the item 'Championing'.

As mentioned in Chapter 1, work autonomy and flexibility are seen as central aspects of creative and discretionary work forms. Thus, it is of great interest to see whether these have a positive impact on the probability of being an innovative strategic learner. Indicators for' flexibility/autonomy' are based on the response to these questions in the PIAAC survey:

To what extent can you choose or change

- the sequence of your tasks?
- how you do your work?
- the speed or rate at which you work?
- your working hours?

The response categories for all the four questions are; 1 Not at all; 2 Very little; 3 To some extent; 4 To a high extent; 5 To a very high extent. A combined measure of 'autonomy and flexibility' based on the response to these four questions was constructed (the sum of the scores divided by 4). Based on the frequencies among the four countries scoring low (the lowest third), scoring medium, and scoring high (the highest third), three new dummy-variables were constructed. (Scoring *low* on autonomy/flexibility will serve as a reference group in the regressions in Chapter 4, which will include controls for scoring 'high' and in the 'middle'). Table 3.15 shows the percentage scoring 'high' in the four countries as well as the mean scores, compared to the 18-countries group.

Table 3.15. Per cent in the highest scoring group on ‘autonomy and flexibility’/ mean scores on ‘autonomy and flexibility’

	Per cent high, autonomy and flexibility	Mean scores (scale 1– 5).
Denmark	39.8	3.60
Finland	42.2	3.66
Netherlands	27.5	3.22
Norway	32.2	3.46
Total, four countries	35.3	3.48
The rest 18 countries	27.5	3.18

Among the four countries of particular interest here, the Netherlands scores lower than the three Nordic countries on autonomy/flexibility. However, Norway also scores low. Still, the four countries score higher than the 18-countries group, taken together. There is, however, a large variation within the 18-countries group.

The construct ‘autonomy and flexibility’ does not measure the same as ‘independent’ (Tables 3.12 – 3.14). The correlation between the variables ‘high, autonomy and flexibility’ and ‘high, independent’ is positive, but only 0.255.The variable ‘autonomy and flexibility’ does not capture exactly the same underlying features as the variable ‘independent’, and this makes it meaningful to include both variables in the regressions. Being ‘independent’ measures the extent to which the person organises his/her own time and plans own activities, based on his/her subjective experience. But the variable ‘autonomy and flexibility’ to a larger extent says something about the work environment; i.e. the degree to which the work situation makes it possible to decide how they work, the speed rate etc.

3.6 The relationship between work profiles and education levels, skills and participation in work-related training

The work profiles described in Section 3.5, as well as having the opportunity to be autonomous and flexible at work (Section 3.6) vary according to education level (and vice versa). This is important to bear in mind when we include education levels as well as work profiles in the regression model, since this relationship implies that the isolated (controlled) effects of education levels will be reduced. The relationship between the variables for work profiles and educational level among employed persons in the four-countries group is illustrated in Figure 3.2.

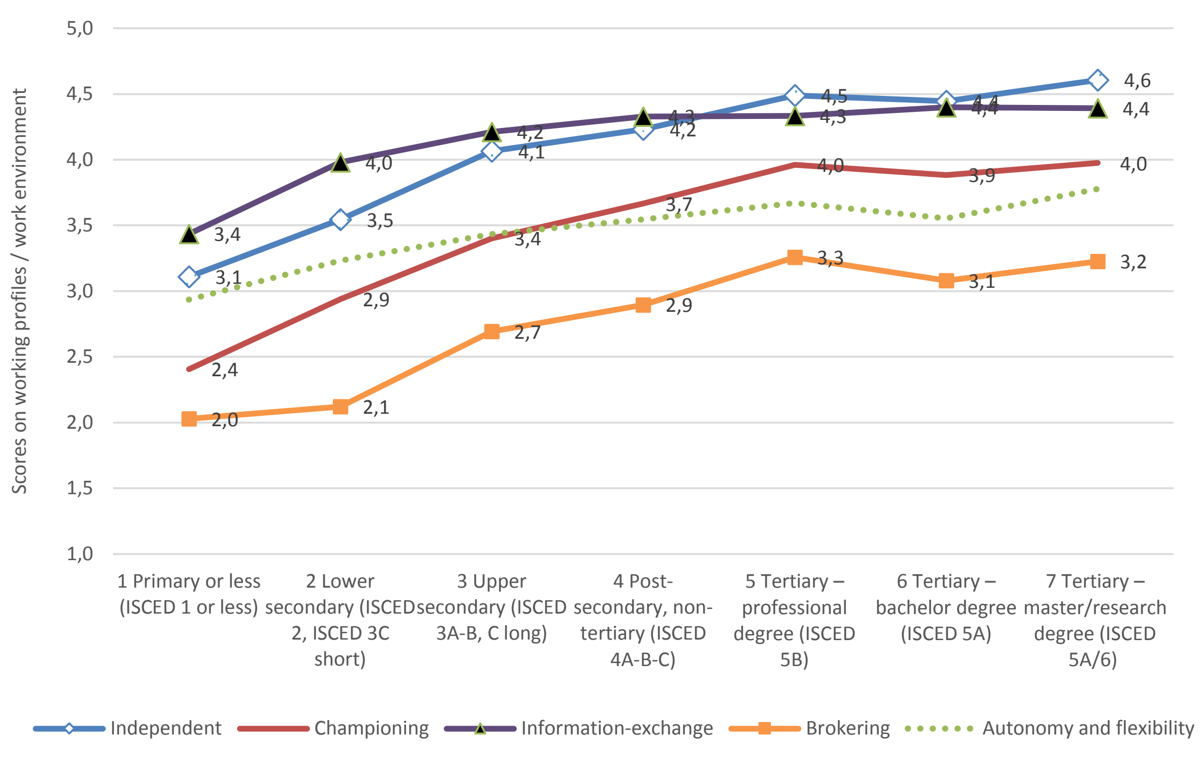

Figure 3.2. The relationship between work profiles and work environment, and education level

There is a clear relationship between the different work profiles and education level, with increased scores on the work-profiles variables when the education level increases. Among those with education level *above* ISCED 4, there is, however, no clear difference concerning the scores on the variables referring to work profiles and work environment. The curves tend to be steepest from ISCED 1 to ISCED 4. The strongest relationship with education level applies to 'championing', 'independent' and 'brokering'.

The work profiles described above, as well as having the opportunity to work autonomously and flexibly, also vary according to the skills level. The relationship between skills and the variables serving as measures of work profiles among employed persons in the four-countries group is illustrated in Figure 3.3.

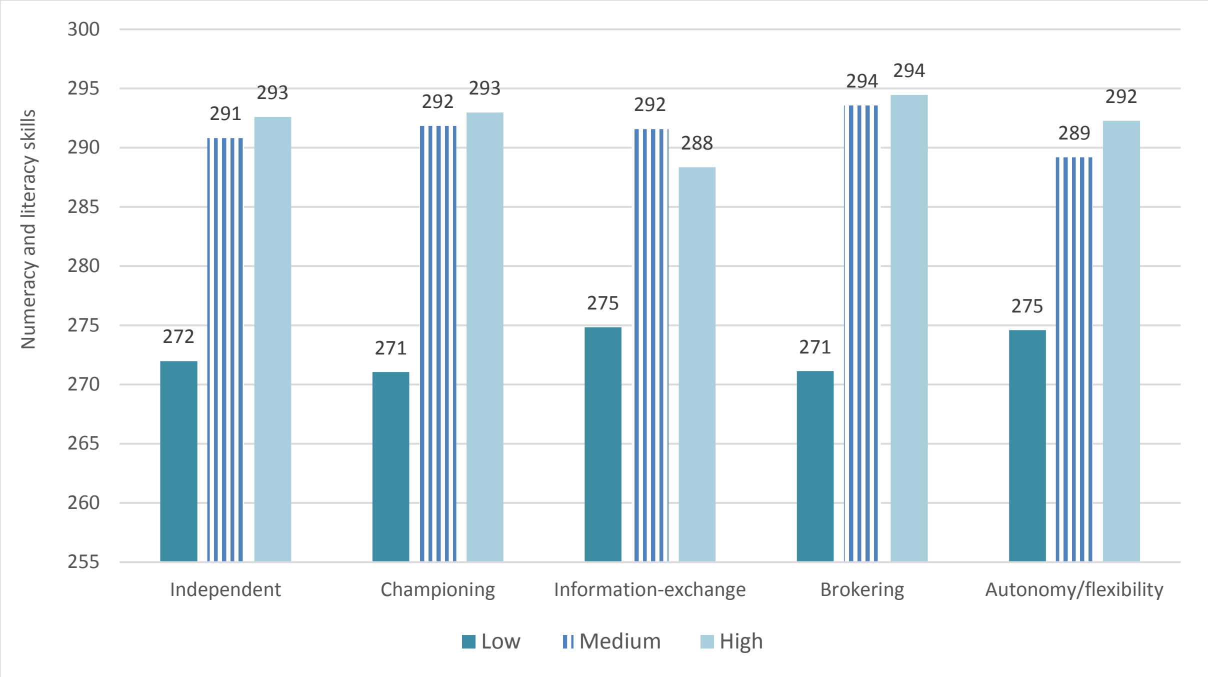

Figure 3.3. The relationship between work profiles and work environment, and skills level*

* Estimated average, numeracy and literacy skills combined.

The groups with lowest scores on the different variables referring to work profiles/work environment have remarkably lower skills than the other groups. (The groups with low scores are defined in Table 3.12.). Otherwise, the skills vary very little between the other groups.

It is also a fact that the mean scores for work profiles vary between those who participate in training, and those who do not. This is illustrated in Figure 3.4.

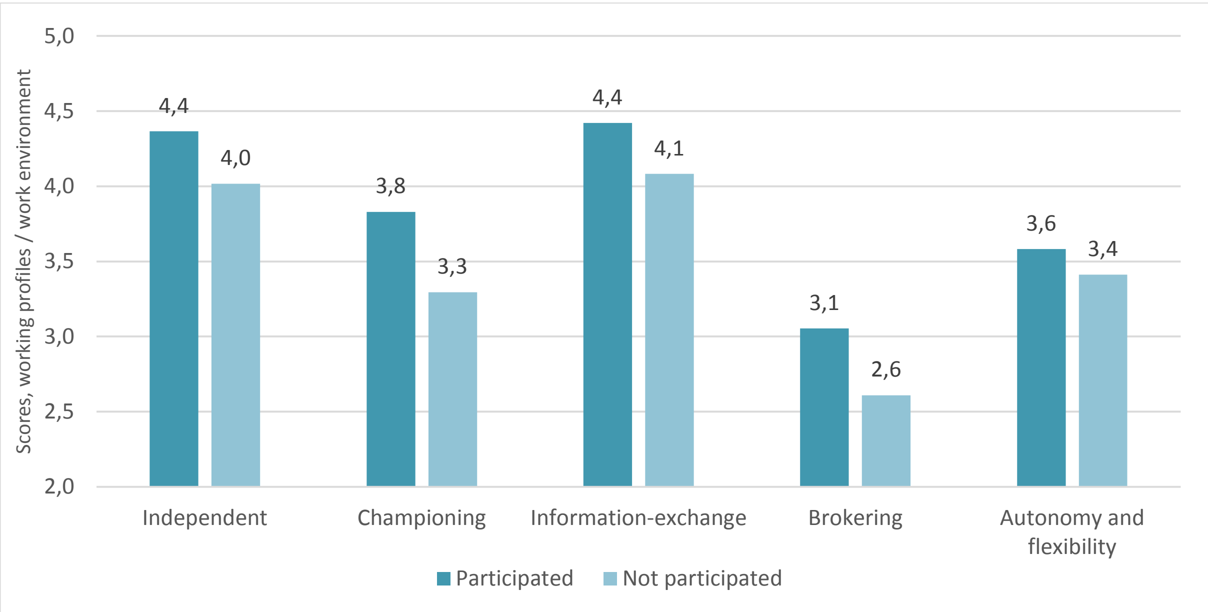

Figure 3.4. The relationship between work profiles and participating in training. Four countries

Figure 3.4 shows the (uncontrolled) relationship between participation in training (based on own interest) and the work profiles. Those who participate in training score higher on all the items compared to those who do not. The differences in mean scores between the two groups apply in particular to the items 'brokering' and 'championing',

3.7 Economic sector

The economic (industrial) sector where the person works may have a significant impact on the extent to which that person acts as an 'innovative, strategic learner' at work. Further, the distribution of the economic sector may vary between the four-country samples. Thus, controls for economic sector will be included in the regressions. We have used broad categories. This categorical variable is later converted into ten dummy-variables to be included in the regressions.

The distribution according to economic sector/industries is shown in Table 3.16, and it appears that the distribution does not vary much between the four countries. Neither does the distribution differ very much from the average distribution in the other 18 OECD countries, with one exception. The employed persons in the four countries work more frequently in the health and welfare sector whereas the proportion working within manufacturing, mining etc. is lower. Concerning the latter sector, the lowest share is found in Norway in the four-countries group, while Norway has the highest proportion working within the health and welfare sector. In fact, the Norwegian sample has the highest share working in the health and welfare sector of all the 22 countries, followed by the Netherlands and Denmark. (France comes thereafter, closely followed by Finland and Sweden.)

Table 3.16. The distribution of workers according economic sectors in the four countries.

	Denmark	Finland	Nether-lands	Norway	Total, four countries	Total, the rest 18 countries
Manufacturing, mining, electricity, supply	15.2	15.7	13.9	10.2	13.7	17.0
Construction	6.8	7.6	5.6	8.0	7.0	7.3
Sales, transport, support	25.9	26.7	27.5	28.2	27.1	29.1
Information, communication	4.5	3.4	3.9	3.6	3.8	3.6
Finance, estate	3.9	2.2	4.1	2.4	3.1	4.4
Professional / Scientific	5.4	6.4	5.6	5.4	5.7	4.9
Public adm. and defence	5.4	4.6	7.5	6.3	6.0	6.2
Education sector	8.6	7.8	7.6	10.1	8.5	8.1
Health and Social	18.0	15.6	18.7	20.7	18.3	11.4
Rest, used as reference category:						
Primary industries (agriculture, forestry and fishing)	2.2	3.5	0.9	2.0	2.1	2.4
Arts, entertainment and recreation	2.2	2.6	2.6	1.3	2.2	2.0
Other	2.0	4.1	2.1	1.8	2.5	3.6
Total	100	100	100	100	100	100

The main difference in Table 3.16 is between Norway and Finland and concerns the different proportions working in manufacturing etc., and the health and welfare and education sectors (when the latter two are taken together). Such differences can affect the initial uncontrolled country differences concerning innovativeness. In the regression analyses in Chapter 4, the three last-mentioned categories in Table 3.16 are merged and used as the reference group in the regressions. Each is rather small, and together these three groups have average score on the dependent variable and are thus convenient to use as reference category.

3.8 Work hours and demographic variables

Table 3.17 shows the mean values on the remaining independent variables. The percentage females among employed persons does not differ much between the countries, and neither does the average age. (The percentage of females in the *total* sample is 50 per cent or very close to 50 per cent in all countries.)

Weekly work hours differ more widely – the average is lower in the Netherlands than in the other countries. This applies however only to the females (see Table 3.18). A particularly high share of Dutch females work part-time. This may have influenced the lower proportion of innovative learners at work in the Netherlands (see Figure 2.1), and thus it is important to control for work hours as well as gender in the regression analyses. Further, we see that the number of weekly work hours per among women is significantly higher in Finland.

Table 3.17. Mean sample values for work hours, gender and age. Employed persons.

	Denmark	Finland	Nether-lands	Norway	Total, four countries	18 other countries
Per cent females	47.6	49.5	46.3	47.9	47.3	45.8
Average age	41.0	41.9	40.2	40.4	40.6	40.9*
Weekly work hours (PIAAC)	35.3	37.5	32.3	35.2	34.0	39.4
Males (work hours) (PIAAC)	38.1	39.9	38.0	38.3	38.3	42.6
Females (work hours) (PIAAC)	32.2	35.1	25.6	31.9	29.2	35.5
Official OECD figures, 2013, Average usual weekly hours worked on the main job**						
Males	35.7	39.0	34.8	36.8		
Females	31.1	34.7	24.4	31.4		

* Average age for 14 countries, excluding US, Canada, Germany and Austria, where information on age is lacking.
** Source: OECD Stat Extracts, URL:http://stats.oecd.org/Index.aspx?DatasetCode=AVE_HRS

To check whether the same pattern of gender differences was found in other statistics we have also included the 2013 official OECD figures in Table 3.17 referring to work hours among males and females in the four countries. The same pattern was found. The latter figures are lower for males than found in PIAAC, but this may refer to the condition that they apply to the 'main job'. (In addition, the weekly work hours among men has shown a minor decrease from 2011 to 2013.)

The varying gender differences in work hours within the four-countries group could possibly reflect that more women in Netherlands are employed than in the other countries. However, this appears not to be the case. Norway has the highest share of employed women. In Finland there is no gender difference in the percentage employed. Here, the employment level is 70 per cent for both men and women, and is lower than in the other three countries. Also in Norway the gender difference in the employment rate is small: 80 per cent of males are employed versus 77 per cent of the females according to the PIAAC data. In Denmark 76 per cent of the males are employed (70 per cent of females). Among the four countries, the largest difference is found in the Dutch sample, where 81 per cent of the males are employed versus, 71 per cent of the females. Still, all the four countries, also the Netherlands, have a higher employment rate among females than the average of the OECD countries.[19]

[19] These figures coincide quite well with estimates based on the Labour force survey 2013, where the employment level among women was 70 per cent in Denmark, 68 per cent in Finland, 70 per cent in the Netherlands and 74 per cent in

Gender differences may be important also in other respects, and particularly where these differences vary by country. In Table 3.18,, gender differences are shown by country concerning education levels, fields of study and economic sector. We find these figures important, as they may be helpful when interpreting the country differences that emerge in the analyses in the next chapter.

Table 3.18. Percentage of employed persons with tertiary education, by gender.

	Denmark	Finland	Netherlands	Norway
Males	33.8	36.4	34.6	36.0
Females	46.5	53.4	35.5	44.4
Total	39.8	44.9	35.0	40.1

As regards educational level, in all countries except the Netherlands more females than males have tertiary education (ISCED 5B or above). Among men, there are very small country differences, but among women there are large country differences in the percentage with tertiary level, ranking from 53 per cent of the employed Finish females to 35.5 per cent of the Dutch.

Table 3.19. Percentage of females within different fields of study, by country.

	Denmark	Finland	Netherlands	Norway
Unknown	42.2	39.8	46.4	42.9
General programmes	54.6	48.7	56.1	53.0
Teacher training and education science	73.0	73.3	68.0	73.2
Humanities, languages and arts	65.8	73.4	55.0	58.3
Social sciences, business, law	53.7	68.2	45.4	53.2
Science, mathematics, computing	36.9	52.8	17.9	40.5
Engineering, manufacturing, construction	11.8	12.3	6.4	16.9
Agriculture and veterinary	25.0	27.7	30.2	30.6
Health and welfare	86.4	86.0	84.4	85.4
Services	46.2	72.1	43.2	48.3
Total	47.6	49.5	46.3	47.9

Concerning fields of study, we see that in Finland more than half of the persons within the field science, mathematics and computing are females compared to only 18 per cent in the Netherlands. According to these data, the corresponding estimate concerning engineering, manufacturing and construction is 12 per cent in Finland (and only 6 per cent in the Dutch sample), and 17 per cent in Norway. Otherwise, in all the four countries we find the same pattern of gender segregation concerning the fields of Health and welfare and Teacher training – , which are extremely female dominated fields. The results so far leave an impression of greater gender equality in Finland than, for example, in the Netherlands. This is supported by the distribution according to economic sector, see Table 3.20.

Norway (EU 28: 50 per cent). Corresponding figures among men were 75 (Denmark), 70 (Finland), 79 (Netherlands) and 77 (Norway) per cent (EU-28: 69 per cent).

Table 3.20. The per cent females within different economic sectors, by country.

	Denmark	Finland	Netherlands	Norway
Manufacturing, mining, electricity, supply	29.1	27.8	26.0	25.1
Construction	12.5	10.5	6.5	8.7
Sales, transport, support	45.0	45.6	41.3	45.0
Information, communication	28.4	39.3	29.3	33.8
Finance, estate	48.3	65.0	39.5	45.6
Professional / Scientific	43.6	45.5	34.6	41.7
Public adm. and defence	55.7	53.3	39.7	48.3
Education sector	56.2	69.0	62.0	64.4
Health and Social	80.3	86.3	81.7	79.7
Primary industries (agriculture, forestry and fishing)	19.0	28.3	26.5	24.7
Arts, entertainment and recreation	55.6	55.3	56.1	36.0
Other	59.5	72.1	67.1	64.7

For most of the economic sectors, there are small country differences related to the share of females working in the sector. The most important exceptions refer to the fact that the sectors ‘Finance and estate’ and ‘Information and communication’ have higher shares of females in Finland than in the other three countries. Another example is that in the Netherlands, the percentage of females in the sectors ‘Professional/scientific’, ‘Public administration’, as well as in ‘Finance, estate’ is lower than in the other three countries. Again, although the differences should not be overstated, Finland and the Netherlands appear as the extremes among the four countries regarding education and the employment situation among women.

4 Analyses – thee probability of being an innovative strategic learner

This chapter includes results of regression analyses that employ the dependent variable(s) described in Chapter 2. The analyses include controls for a large set of independent variables which were described in detail in Chapter 3, and which are based on the literature review in Chapter 1. As shown in Chapter 3, there is a relationship between many of the independent variables. The independent variables are – however – not highly correlated.[20]

Before we present the results of the regression models, we start with an overview of descriptive results concerning the dependent variable(s).

4.1 Descriptive results

We return to the dependent variables depicted in Table 2.1. The descriptive variation by country is shown in Table 4.1, and results of regression analyses are shown in Tables 4.2 – 4.4.

[20] For variables used in the regressions below, these have been checked for multicollinearity. The values of Pearson correlations, tolerance and variance inflation factors are within acceptable levels.

Table 4.1. Mean distribution on dependent variables.

	Denmark	Finland	Nether-lands	Norway	Total. the four countries
A: Keeping Up to Date	43.0	49.5	38.6	36.4	41.7
B: Learning By Doing	52.2	63.8	51.7	64.9	58.1
Learning strategies					
C: When I come across something new. I try to relate it to what I already know	71.9	86.3	64.7	73.7	74.0
D: I like to get to the bottom of difficult things	69.6	76.8	38.1	73.4	64.4
E. I like to figure out how different ideas fit together	60.9	60.7	33.8	50.2	51.2
F: Solving complex problems	58.4	60.2	52.8	59.5	57.7
Constructed variables					
G: A + B Innovative learning	29.5	37.0	26.7	28.6	30.3
H: High C + D or High D+E (strategic learner)	62.3	72.6	33.4	63.7	57.8
I: G + H: Innovative strategic learner	21.3	28.8	12.2	20.4	20.5
J: I + F: Innovative strategic (and problem-solving) learner	16.5	20.7	9.1	15.5	15.4

Finland stands out when it comes to 'keeping up to date' (variable A). Also concerning 'learning by doing' (variable B) Finland has a high level, but this applies to Norway as well. When these two variables are merged (variable G), only Finland stands out. Otherwise there are only minor differences between the other three countries. Concerning learning strategies (variable H, merging variables C – E), the main difference is between the Netherlands on the one hand, and all the three other countries on the other. But again, Finland ranks highest and the Netherlands remarkably low.

Thus, when Finland ranks highest of the four countries on the last dependent variable (variable J), this is because Finland ranks high on *all* the variables which at merged in variable J. Vice versa, when the Netherlands ranks lowest, it is because Netherlands ranks lowest or second lowest on *all* the individual variables that are merged in variable J. The country differences exist also after controlling for a large set of independent variables of which several have significant impacts (See Tables 4.2 and 4.3 in the next section.)

4.2 Results of binomial logistic regressions – four countries taken together

Table 4.2 shows the main results of five regression analyses, i.e. when using five dependent variables. The independent variables that are included are the same in all the five regressions. In all tables that include logistic regressions the coefficient 'B' refers to the 'logit', i.e. the logarithm of the odds ratio.[21] These logits are used for estimating the probabilities illustrated in the graphs in this chapter.[22]

[21] The odds ratio represents the odds that an outcome will occur given a particular exposure (for instance having participated in training), divided by the odds that the outcome will occur in the *absence* of that exposure (for example no training).

[22] The estimated probabilities that are presented later in this chapter are calculated according to the formula: $P= e^z/ (1+ e^z)$ where P is the probability of being an innovative strategic learner and Z = the intercept plus the effects of the independent variables ($z = B_0 + B_1X_1 + B_2X_2$ ....).

Table 4.2. Results of binomial regressions. Dependent variables: different aspects of being an innovative learner at work.

	A: Keeping Up to Date		B: Learning By Doing		G: Innovative learning construct (A + B)		H: Learning strategies construct (C + D + E)		J: Innovative strategic learner (I* + F*)	
	B	S.E.	B	S.E.	B	S.E.	B	S.E.	B	S.E.
Denmark	*0.095*	0.054	-0.117	0.052	0.010	0.058	1.159	0.053	0.617	0.079
Finland	0.381	0.057	0.467	0.056	0.414	0.060	1.639	0.059	0.910	0.080
Norway	-0.183	0.056	0.485	0.055	0.022	0.059	1.247	0.055	0.619	0.081
Skills										
Numeracy and literacy skills	-0.005	0.001	-0.005	0.001	-0.006	0.001	0.002	0.001	-0.003	0.001
Problemsolv. skills, no information	-0.078	0.069	0.080	0.065	0.000	0.074	-0.059	0.066	-0.114	0.107
Medium problem-solv. skills	0.015	0.056	0.058	0.055	0.013	0.059	-0.032	0.056	-0.018	0.077
High problem solv. skills	-0.062	0.070	0.174	0.069	0.040	0.074	0.102	0.071	0.113	0.095
Edu. level and fields (ref. edcat 1+2, and unknown or general field)										
Edcat 3 and 4*	*0.122*	0.071	-0.042	0.068	0.119	0.076	0.139	0.068	0.288	0.107
Edcat 5 and 6	*0.144*	0.086	-0.045	0.084	0.087	0.092	0.212	0.084	0.261	0.125
Edcat 7 (master, hi.)	*0.165*	0.099	0.101	0.098	0.226	0.105	0.430	0.099	0.425	0.136
Pedagogy/ Teacher	-0.275	0.106	0.139	0.106	*-0.190*	0.112	-0.233	0.106	-0.326	0.144
Humanities	0.035	0.107	0.262	0.108	0.105	0.112	-0.052	0.108	0.071	0.140
Social science	-0.021	0.075	-0.205	0.074	-0.172	0.080	-0.107	0.075	-0.168	0.104
Science and mathematics	*0.164*	0.099	-0.150	0.098	0.017	0.105	0.087	0.101	0.164	0.128
Engineering	-0.044	0.075	-0.071	0.073	-0.107	0.079	0.047	0.074	-0.077	0.103
Agriculture and veterinary	0.117	0.122	*-0.231*	0.119	-0.052	0.132	-0.465	0.120	-0.451	0.187
Health and welfare	0.091	0.088	-0.093	0.086	-0.008	0.093	-0.105	0.087	-0.055	0.124
Services	0.011	0.092	*-0.161*	0.090	-0.155	0.098	-0.184	0.091	-0.331	0.131
Training										
Obligatory training	0.137	0.086	*-0.055*	0.084	0.104	0.093	-0.064	0.086	0.032	0.121
Own interest training	0.335	0.072	0.110	0.071	0.314	0.078	0.029	0.072	0.267	0.099
1-2 days training	-0.218	0.084	-0.030	0.081	-0.221	0.091	0.041	0.083	-0.183	0.121
3 – 7 days training	-0.088	0.082	-0.011	0.080	-0.181	0.089	*0.150*	0.082	-0.072	0.115
8 – 20 days training	0.110	0.084	*0.150*	0.083	0.049	0.090	0.189	0.085	0.151	0.115
More than 20 days training	0.185	0.093	0.317	0.093	*0.175*	0.099	0.412	0.095	0.313	0.126

(Cont.)

Table 4.2 (cont.)

	A: Keeping Up to Date		B: Learning By Doing		G: Innovative learning construct (A + B)		H: Learning strategies construct (C + D + E)		J: Innovative strategic learner (I* + F*)	
	B	S.E.	B	S.E.	B	S.E.	B	S.E.	B	S.E.
Working roles and flexibility/autonomy										
Brokering, middle	0.134	0.052	0.028	0.050	0.093	0.057	0.105	0.051	*0.153*	0.081
Brokering, high	0.483	0.054	0.135	0.053	0.401	0.058	0.133	0.054	0.520	0.079
Championing middle	0.306	0.053	0.195	0.050	0.251	0.060	0.201	0.051	0.325	0.089
Championing high	0.700	0.058	0.522	0.057	0.686	0.064	0.392	0.058	0.781	0.092
Information exchange, middle	0.305	0.061	0.248	0.057	0.263	0.068	0.055	0.059	*0.168*	0.095
Information exchange, high	0.510	0.055	0.543	0.051	0.536	0.061	0.137	0.053	0.491	0.085
Independent, middle	*-0.116*	0.060	0.036	0.058	-0.062	0.066	0.010	0.059	0.130	0.093
Independent, high	*0.093*	0.053	0.196	0.051	0.194	0.057	0.141	0.052	0.461	0.082
Autonomy/ flexibility, middle	-0.045	0.051	0.068	0.049	-0.028	0.055	0.111	0.050	0.264	0.079
Autonomy/ flexibility, high	*0.096*	0.055	0.201	0.054	0.126	0.059	0.344	0.055	0.463	0.082
Occupational class. of job (skill based) (ref.= elementary)										
Skilled occupations	0.894	0.102	0.465	0.090	0.742	0.115	0.085	0.091	1.238	0.215
Semi-skilled white collar occupations	0.826	0.099	0.268	0.086	0.644	0.112	0.072	0.087	0.973	0.214
Semi-skilled blue collar occupations	0.554	0.105	0.453	0.092	0.482	0.119	0.086	0.093	0.907	0.221
Unknown	0.826	0.151	0.530	0.144	0.846	0.162	0.196	0.144	1.338	0.255
Constant	-1.219	0.218	0.742	0.208	-1.294	0.235	-1.887	0.212	-4.977	0.364
Nagelkerke R Square***	0.162		0.132		0.137		0.177		0.187	
N (weighted)	14206		14216		14192		14233		14233	
N (unweighted)	15939		15947		15923		15966		15966	

Also included: controls for industrial sector, work hours, age, and gender (female=1)

* ‘F’ refers to solving complex problems at work, see Tables 2.1 and 4.1. ‘I’ refers to merging G and H, see Table 4.1. The number of respondents is somewhat higher in column J than for A, B and C since a small group with no information on ‘A’ and/or ‘B’ is coded as 0 on variable J.

** See description of education levels in Table 3.3.

*** Coefficients in boldface are significant at level p<0.05. Coefficients in boldface and *italics* are significant at level p<0.1.

With a few exceptions, the central explanatory variables have significant effects in the same direction on all the dependent variables that constitute variable J. This confirms that this variable (J) is an expression of, and measures, certain underlying characteristics and properties, and gives good reason for further examination of the variable J. For example, has work-related training of own interest and/or long duration of training positive impact on all the dependent variables. The same applies to increasing education level, with an exception for the dependent variable B (learning-by-doing). Increased occupational level has, however, a positive effect on variable B. Otherwise, increased occupational level has no significant effect on the dependent variable H (learning strategies), whereas it has large significant impact on all the other dependent variables. On the other hand, the isolated effects of increasing education level are larger for the dependent variable H than for the preceding variables in Table 4.2.

High values on 'autonomy and flexibility' have a significant positive impact on all the dependent variables, in particular on variable H (learning strategies). The impact of the different work profiles overall is quite large. Of particular importance are high values on the items 'championing', 'brokering' and 'information exchange', though the effects of these variables are smaller on the dependent variable H (learning strategies) than on the other variables. High values on being 'independent' also have a positive impact on all dependent variables, but particularly on variable J. (We recall that value 1 ('yes') on the dependent variable J refers to a smaller and far more selected group than is the case for the other dependent variables.)

In brief, the results of the analyses of variable J tell us that people who work in organisations with a high degree of flexibility and autonomy, people who participate in work related training of own interest – and particular where it is of long duration, who score high on being brokering, independent and championing and on information exchange, are very likely to be innovative strategic learners at work. This fits quite well by what is stated by the OECD (2010b) as cited in Chapter 1, where organizational change (flexibility), work-related training and marketing were identified as essential features for successfully developing innovations. Further, the results show that high education levels, and having skilled or semiskilled occupations, increase the probability of innovativeness (all other things being equal), This is also is in accordance with assumptions and findings in the literature presented in Chapter 1. Concerning the effects of occupational level, we see that the effects of 'unknown occupational level' is of approximately the same size as the effects of skilled occupation (both compared to elementary occupations). As seen in Chapter 3, this group ('unknown') has the same education level as the average, and probably the actual skills level of their jobs are quite high.

The effects of numeracy and literacy skills as well as problem-solving skills in technology-rich environments are different from what we expected. When controlling for all other variables the only positive effect is found in column H (learning strategies) and refers to the positive effect of increasing numeracy and literacy skills. Otherwise, this effect is negative (when controlling for other variables). We return to the effects of skills later in this chapter.

The results of Table 4.2 imply that there are significant country differences that are not explained by the composition of the samples when it comes to work profiles and work environment (autonomy/flexibility), demographic variables, skills, education levels, work-related training, weekly work hours and distribution of economic sectors. Norway scores lower than the Netherlands on variable A ('keeping up to date') when including controls for a number of independent variables, but Norway together with Finland score highest on variable B ('learning-by-doing'). Finland has the highest rate on variable G, as in the descriptive statistics (Table 4.1), and there are no significant differences between the other three countries on variable G. Concerning learning strategies (variable H), the Netherlands scores very much lower than the other three countries, also when a number of control variables are employed.

The last variable (J), where the preceding variables are merged, and which will be analysed further in Tables 4.3 and 4.4, show that the Netherlands scores significantly lower than the other three countries, but also that Finland stands out when controlling for a number of independent variables as those shown in Table 4.2, and which are described in Chapter 3.

4.3 Being an innovative strategic learner – stepwise regressions

The results concerning the probability of being an innovative strategic learner (variable J) is shown in Table 4.3 by use of stepwise regression. One purpose of the step-wise models is to show whether the country differences are affected when new sets of variables are included. Another purpose is to examine – and illustrate – the extent to which the inclusion of an increasing number of variables has an impact on the effects of variables in the preceding models (for example, the impact on the effect of training, of including controls for work profiles). A third purpose is to compare the explanatory power of the different models (here measured by Nagelkerke's Pseudo R square).

In Model 1 only control variables are included, and in Models 2 to 6 several more explanatory variables are included. We see that the effects of belonging to the different country-samples do not change much from Model 1 to Model 6. Additional analyses also show that if controls of the economic sector were not included, as in Model 1, the positive effect for Finland, Denmark and Norway (compared to the Netherlands which serves as the reference category) is more or less the same. Model 1 shows significant effects of many economic sectors. These are, however, reduced when more variables are included, in particular when controlling for fields of study (Model 3). In Model 6, when a control for occupational level is also included, the effects of economic sector are very much reduced compared to Model 1. This implies that the initial difference between economic sectors is largely caused by characteristics of the individuals working in the different sectors. Nevertheless, there are positive effects in the last model ('all other things being equal') of working within the sectors 'information/communication', 'public administration', 'professional/scientific' and 'finance/estate', compared to the other sectors. The effect of gender is insignificant in all models, and the effect of increasing age is significantly negative in most models.[23]

In Model 2, skills levels are included as the first explanatory variable. Increasing numeracy and literacy skills, as well as increasing problem-solving skills, increases the likelihood of being an innovative, strategic learner. However, in Model 3 where controls for education level and fields of study are included, there is no longer a positive effect of numeracy and literacy skills. Model 3 shows positive effects of increased education level, and a few significant effects of fields of study. For example, there is no significant effect of the field 'science and mathematics' (though the sign of the coefficient is positive). It should be mentioned that in additional analyses without control for economic sector there is a significant positive effect of being educated in the field science and mathematics. Model 3 shows negative effects of being educated within Agriculture and veterinary science and within the field 'services' (negative effects that persist in Models 4 to 6). Otherwise there are no significant differences between thee other fields.

In Model 4 controls for training are included. Then, the effect of problem-solving skills is reduced. (The only significant effect of skills is the negative effect of no information on problem-solving skills, which refer to persons who did not take this test). Although somewhat reduced, the effects of educational level are still large. These changes are due to the relationship between skills and education level and participation in training, shown in Chapter 3. There is a positive effect of long duration of training, and a positive effect of training of *own interest,* the latter irrespective of the duration of training.

The explanatory power of the model increases when controls for training are included (Model 4), but what really increases the explanatory power is the inclusion of the controls for work profiles in Model 5. The control by these variables has impact on the effects of variables included in preceding models. The effects of training are reduced when controls for work profiles are included, and the same applies to the effects of educational level. Further, the effect of numeracy and literacy skilled is turned

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[23] The reason why the negative effect of age is not significant in Models 2 to 4 is probably that there is a negative correlation between age and numeracy/literacy skills, and a certain negative correlation between age and training, particularly training of long duration. When additional variables are included in Models 5 and 6, the negative effect of age again appears significant, though controls for skills and training tend to reduce the effect of age..

negative, and there is no longer any significant effect of problem-solving skills. These changes are due to the relationships between work profiles on the one hand, and education level, skills and training (respectively) on the other, as shown in Chapter 3. This also indicates that the effect of training to some extent is mediated through the person's work profile.

Table 4.3. Innovative strategic learner. Results of binomial regressions. Stepwise.

	Model 1		Model 2 + skills		Model 3 + level and type of education	
	B	S.E	B	S.E	B	S.E
Denmark	0.633	0.073	0.663	0.074	0.632	0.075
Finland	0.896	0.072	0.906	0.072	0.863	0.074
Norway	0.545	0.074	0.564	0.074	0.525	0.075
Female	0.006	0.053	0.022	0.053	-0.038	0.056
Age	-0.008	0.002	-0.001	0.002	-0.002	0.002
Economic sector and work hours						
Manufacturing, mining, electricity, supply	-0.031	0.120	-0.075	0.120	-0.126	0.125
Construction	-0.155	0.140	-0.117	0.140	-0.125	0.146
Sales, transport, support	0.153	0.110	0.139	0.110	0.129	0.113
Information, communication	0.956	0.138	0.787	0.140	0.581	0.144
Finance, estate	0.810	0.150	0.664	0.151	0.520	0.156
Professional / Scientific	0.698	0.130	0.532	0.131	0.334	0.136
Public administration and defence	0.707	0.131	0.580	0.132	0.444	0.135
Education sector	0.583	0.124	0.458	0.125	*0.250*	0.132
Health and Social	0.325	0.116	0.295	0.116	0.067	0.127
Work hours	0.034	0.002	0.033	0.002	0.032	0.002
Skills						
Numeracy and literacy skills			*0.002*	0.001	-0.001	0.001
, no information			-0.381	0.101	-0.339	0.102
Medium problem-solving skills			0.126	0.074	0.091	0.074
High problem-solving skills			0.287	0.092	0.203	0.092
Education level and fields of study (ref. edcat 1+2, and unknown or general field)						
Edcat 3 and 4					0.502	0.105
Edcat 5 and 6					0.732	0.120
Edcat 7 (master, hi.)					0.943	0.131
Pedagogy/Teacher					-0.185	0.140
Humanities					0.057	0.136
Social science					-0.042	0.101
Science and mathematics					0.159	0.125
Engineering					-0.095	0.100
Agriculture and vet.					-0.625	0.183
Health and welfare					0.121	0.120
Services					-0.274	0.127
Constant	-3.472	0.166	-4.262	0.279	0.502	0.105
Nagelkerke R Square	0.074		0.083		0.096	

Table 4.3 (cont.).

	Model 4 + training		Model 5 + work profiles		Model 6 + occupation level	
	B	S.E	B	S.E	B	S.E
Denmark	0.621	0.075	0.576	0.078	0.617	0.079
Finland	0.909	0.074	0.844	0.079	0.910	0.080
Norway	0.542	0.076	0.620	0.079	0.619	0.081
Female	-0.032	0.057	-0.009	0.058	0.000	0.059
Age	-0.002	0.002	-0.007	0.002	-0.008	0.002
Economic sector and work hours						
Manufacturing, mining, electricity, supply	-0.115	0.126	-0.159	0.130	-0.158	0.130
Construction	-0.056	0.146	-0.185	0.150	-0.117	0.153
Sales, transport, support	0.172	0.114	-0.010	0.117	0.037	0.118
Information, communication	0.579	0.145	0.407	0.149	0.363	0.150
Finance, estate	0.485	0.157	0.324	0.160	*0.302*	0.161
Professional / Scientific	0.362	0.136	0.350	0.140	0.304	0.140
Public administration and defence	0.371	0.136	0.368	0.139	0.322	0.141
Education sector	*0.234*	0.133	0.161	0.137	0.141	0.138
Health and Social	0.046	0.128	-0.112	0.132	-0.122	0.133
Work hours	0.029	0.002	0.017	0.002	0.016	0.002
Skills						
Numeracy and literacy skills	0.000	0.001	-0.002	0.001	-0.003	0.001
, no information	-0.290	0.103	-0.156	0.106	-0.114	0.107
Medium problem-solving skills	0.051	0.075	0.002	0.076	-0.018	0.077
High problem-solving skills	0.149	0.093	0.130	0.095	0.113	0.095
Education level and fields of study (ref. edcat 1+2, and unknown or general field)						
Edcat 3 and 4	0.486	0.105	0.326	0.107	0.288	0.107
Edcat 5 and 6	0.644	0.121	0.390	0.123	0.261	0.125
Edcat 7 (master, hi.)	0.825	0.131	0.569	0.134	0.425	0.136
Pedagogy/Teacher	-0.193	0.140	-0.303	0.144	-0.326	0.144
Humanities	0.055	0.136	0.071	0.140	0.071	0.140
Social science	-0.085	0.102	*-0.171*	0.104	-0.168	0.104
Science and mathematics	0.111	0.125	0.176	0.128	0.164	0.128
Engineering	-0.118	0.100	-0.087	0.103	-0.077	0.103
Agriculture and vet.	-0.617	0.183	-0.516	0.186	-0.451	0.187
Health and welfare	0.053	0.121	-0.038	0.124	-0.055	0.124
Services	-0.295	0.127	-0.366	0.130	-0.331	0.131
Training						
Obligatory training	0.020	0.117	0.042	0.120	0.032	0.121
Own interest training	0.365	0.096	0.290	0.099	0.267	0.099
1-2 days training	-0.181	0.117	-0.192	0.120	-0.183	0.121
3 – 7 days training	0.031	0.112	-0.065	0.115	-0.072	0.115
8 – 20 days training	0.306	0.112	0.165	0.115	0.151	0.115
More than 20 days training	0.405	0.122	0.321	0.126	0.313	0.126

(cont.)

Table 4.3 (cont.).

	Model 4		Model 5		Model 6	
	B	S.E	B	S.E	B	S.E
Working roles and flexibility/autonomy						
Brokering, middle			0.176	0.081	*0.153*	0.081
Brokering, high			0.552	0.079	0.520	0.079
Championing, middle			0.380	0.089	0.325	0.089
Championing, high			0.846	0.091	0.781	0.092
Information exchange, middle			*0.182*	0.095	*0.168*	0.095
Information exchange, high			0.500	0.085	0.491	0.085
Independent, middle			0.150	0.092	0.130	0.093
Independent, high			0.472	0.082	0.461	0.082
Autonomy/flexibility, middle			0.275	0.079	0.264	0.079
Autonomy/flexibility, high			0.486	0.082	0.463	0.082
Occupational class. of job (skill based) (ref.= elementary)						
Skilled occupations					1.238	0.215
Semi-skilled white collar occupations					0.973	0.214
Semi-skilled blue collar occupations					0.907	0.221
Unknown occup. level					1.338	0.255
Constant	-4.040	0.291	-4.328	0.312	-4.977	0.364
Nagelkerke R Square	0.111		0.181		0.187	

Unweighted observations: 15966; weighted observations 14233

* See description of education levels in Table 3.3.

** Coefficients in bold types are significant at level p<0.05. Coefficients in bold types and italics are significant at level p<0.1.

In Model 6 controls for occupational level (type of job, based on the skills level in the job) are included. As commented above, all the occupational levels, here included as dummy-variables (including unknown level), have positive effects compared to the reference group, which is ‘elementary occupations’. What is interesting is that the inclusion of controls for occupational level has only a minor impact on the variables included in the preceding models. Type of job has an additional impact and increases the explanatory power of the model. Naturally, since occupational level correlates with educational level, the effects of education level are somewhat reduced (Model 6), but still significant. The effects of work profiles are hardly affected by the inclusion of occupational level. Thus, the effects of these variables can be viewed as adding on each other, and not replacing each other.

4.3.1 The effects of skills

It seems counter-intuitive that the probability to be an innovative strategic learner at work decreases with increasing numeracy and literacy skills (see Model 5 and 6, Table 4.3) and that there is no significant effect of problem-solving skills on the probability to be an innovative strategic learner. It is important to be aware that in Model 2, prior to the inclusion of other control variables, the effect of skills is positive. According to the estimates in Model 2, the probability of being an innovative learner at work is 13 per cent if the person’s problem-solving skills are low and 17 per cent if these skills are high. This is estimated for persons who are assigned mean values on all other variables, including numeracy and literacy skills. When, in addition, to low problem-solving skills, the person has low numeracy and literacy skills as well (one standard deviation below the average), the estimated probability is 12 per cent (based on Model 2). If the person in addition to high problem-solving skills also has high numeracy and literacy skills (one standard deviation above the average) the corresponding estimate is 18 per cent.

Corresponding estimates for the effects of numeracy and literacy skills based on Model 2 for persons with mean values on all other variables than numeracy and literacy skills (including mean values on problem-solving skills) results in smaller differences between persons with low skills (one standard deviation lower than the average) and high skills (one standard deviation higher than the average), i.e. a difference of only two percentage points. However, if not controlling for economic sector and work-hours, which – as mentioned – is included in Model 2, the effect of numeracy and literacy skills is higher. Then the difference between those with low skills and high skills is about four percentage points (13 versus 17 per cent).

The differences mentioned may not appear to be large, although the relative differences are quite large. Four percentage increase (from 13 to 17 per cent) implies 30 per cent increased probability which is not trivial, but a fairly significant difference.

However, we see in Models 3 to 6 that the isolated effects of skills either disappear or change sign from positive to negative. The reason is that controls for education level and work profiles change the effects of skills. This implies that 'high skills' does not in itself have positive impact regardless of education level and work profiles. It seems that it is the education level that counts, while varying skills within an education level does not seem to matter much. Probably this is connected to the fact that the opportunity to be an innovative learner at work varies according to education level and the type of work one has.

It is also possible that an interaction between work profiles and skills exists. The reference group in Models 4 to 6 refers to persons who score low on all items for work profiles. It is possible that just for these groups, increasing skills have no (or negative) impact on being an innovative learner at work, but that increasing skills may have positive effects for those with high scores on these work profiles. We have examined this in additional analyses, and where the results are the opposite to that expected (see Table A.6 in the Appendix). There are no positive interaction effects of skills and the different variables that concern work profiles. In fact, only a few of these interaction terms are significant, and they are negative. For example is there a negative interaction effect for 'skills* high, brokering', and for 'skills * high, information exchange'.

On the other hand, the isolated effect of having these characteristics is even higher when controlling for the interaction terms. There is a positive sign for the effect of skills for those with low values on the variables measuring work profiles.[24] For those who score high, for example on 'information exchange', the (isolated) positive effect of skills is out-weighed by the negative interaction effect of 'skills * high, information exchange'. In fact, these analyses indicate that there are no effects of skills among those who score high on 'brokering' and 'information exchange'. But, for those who score low on these items, there is a certain positive effect of increasing skills on the probability of being an innovative strategic learner.

With the exception of Table A.6, we do not include all four interaction terms in addition to all the other variables depicted in Table 4.3 in the following analyses. The inclusion of these interaction terms has no or minor impact on the effects of country, educational level and fields of study, work-related training, work-hours, occupational level, economic sector, age and gender (cf. the effects of these variables in Table A. 6 compared to the effects of the same variables Model 6 in Table 4.3). Further, as seen in Table A.6, the analyses are rather difficult to comprehend when including four interaction terms, and for analyses on the individual four countries the number basis for many cells will be rather low when many additional variables are included.

The examples and reasoning above are however important to bear in mind when assessing the (seemingly) negative effects of skills shown in Models 5 and 6 (Table 4.3) as well as in Table 4.4. The main point is that skills do not matter much compared to the effects of other variables. Further, the effect of skills may interact with other variables. Increasing skills seem to have a positive effect only for

[24] This effects is though not significant in a full model (see Table .5), but significant when not including controls for the variables for occupational level.

those with low scores on the variables for work profiles. We also find it interesting that the effect of skills in general is so small, which is contrary to what could be expected based on the literature overview (see Chapter 1).

4.3.2 The effects of work profiles

As mentioned, the variables for work profiles have the largest impact on the dependent variable. They also appear as very robust. This is found in additional analyses where we added new variables in another order than what is seen in Table 4.3. It appears that the inclusion of controls for education level etc. has little impact on the effects of work profiles. This indicates that individual properties expressed in the work profiles are of very high importance. Later, we will examine the extent to which this affects the country differences and whether the variables have similar or different impacts in the four countries.

The substantial, marginal effects of the different work profiles are illustrated in Figure 4.1. The estimates refer to theoretical average persons with mean values on all other variables included in Model 6 (Table 4. 3), except for the variables measuring work profiles, and work environment, the latter referring to the extent to which the person has the opportunity to do his/her job autonomously and flexibly. For example, the estimates for persons scoring low, respectively high, on ‘championing’ (Figure 4.1) refer to persons with average values on all other variables (including being ‘independent’ and ‘brokering’, gender and age etc.) than ‘championing’.

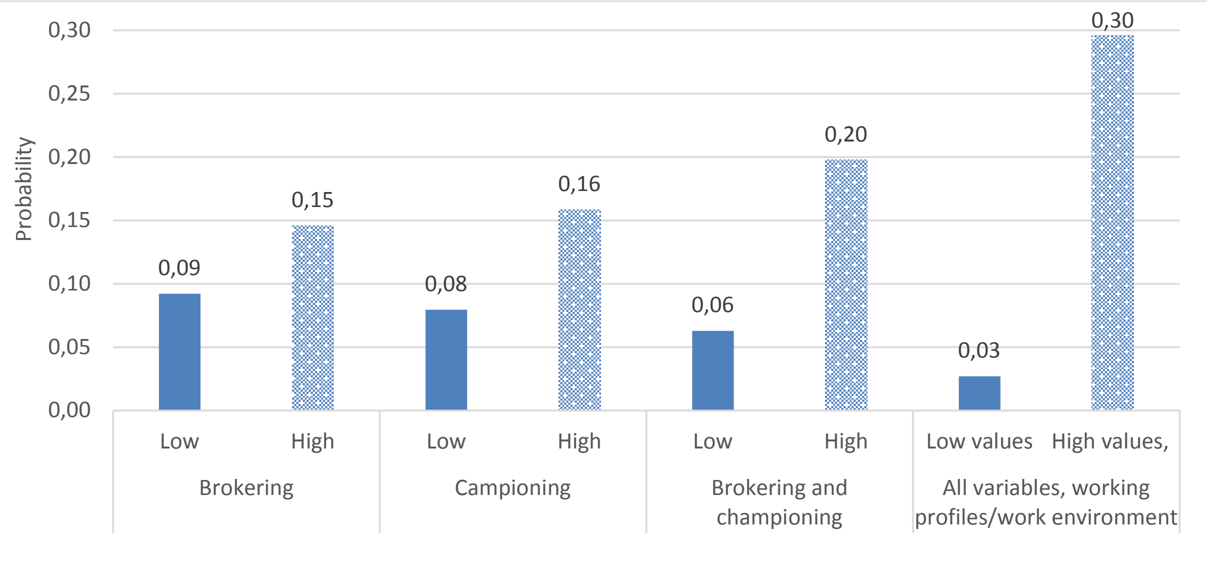

Figure 4.1. The probability of being an innovative strategic learner by work profiles and autonomy/flexibility. Four countries taken together

The first four columns illustrate the difference between those with low, respectively high, values on ‘brokering’ and championing’ (‘all other things being equal’). Regarding the two other work profiles, ‘independent’ and ‘information exchange’, the differences between the estimated probabilities is fairly similar to those depicted in Figure 4.1 for ‘brokering’ (the difference is one percentage point less).

In the next two columns in Figure 4.1 the persons have low, respectively high, values on *both* brokering and championing. In the last two columns, the estimates refer to respondents with high values on *all* the four variables referring to work profiles plus the variable autonomy/flexibility. There is a rather large difference between the two extremes shown in the last two column. The one extreme (3 per cent) refers to persons with low values on all the five variables in question (work profiles and autonomy/flexibility), but who at the same time are assigned mean values on all *other* variables such as education level, training, occupational level etc. The other extreme (30 per cent), refers to persons with high values on all the same five variables, and who (in the same way) are assigned mean values on all other variables. Many persons score high on more than two of the work profiles variables, but only a few persons score high (or low) on *all* the mentioned variables. These estimates are therefore made to illustrate the importance of the work profiles.

4.3.3 The association between work-related training and innovativeness

As mentioned in Section 1.3, previous studies indicate that training rates are positively correlated with investment in research and development and in innovation. Work-related training can promote innovative behaviour in organizations, but the causal sequence can also be the opposite. Most probably, there is a reciprocal relationship between participating in courses and innovative activity. Correlation caused by external factors exists as well. Some firms/organisation do – for different reasons – invest more than other firms/organisations in courses as well in developing new products, services and methods. This can result in a positive correlation at the individual level, as well, between participating in training and innovativeness and innovative activity. The PIAAC data do not allow for investigations at the firm level. Although the causal sequence cannot be stated with certainty, we find it interesting to examine the statistical effect of work-related training on our dependent variable measuring innovativeness at the individual level.

Based on previous research, we expected that the coefficients referring to training in our analyses would indicate a stronger relationship than what is actually found here. Participating in obligatory work-related training, does not seem to have any statistical effect. However, we do find a positive relationship if the person had participated in work-related training based on *own interest*. In additional analyses we have checked whether there is a difference in the statistical effect of 'on-the-job-training' and 'workshop'. However, it is whether the training was of own interest, and not whether it took place in workshops or as on-the-job-training, that is important. The underlying tendency reveals, however, that workshops are just as important as on-the-job-training.

When as much as half of the respondents have participated in work-related training based on own interest during the last 12 months, it is perhaps not surprising that the positive statistical effect of this training is not larger than what is seen in Table 4.3.Some of this training might have been very short, for others longer and more intensive. The regression model does, however, include controls for the duration of (total) training during the last twelve months (see Tables 3.10 and 3.11 for information on the duration of training). The results in Table 4.3 show a significant positive relationship between increased duration of training and innovativeness. However, the dummy-variable '8 – 20 days training' is significant only in Model 4, but once work profiles are added (Model 5) this variable is no longer significant. We also see that the positive effects of 'work-related training of own interest' and the dummy-variable 'More than 20 days training' are decreased in Models 5 and 6, compared to Model 4.

Combined with the statistical effect of long duration of training, the impact 'work-related training of own interest' is quite large. Based on Model 6, the estimated probability of an average person to be an innovative strategic learner is about 7 percentage points higher if he/she has participated in work-related training (of own interest) *of more than 20 days* than if he/she has not participated in training at all. If the duration of training is only 3– 7 days, the corresponding difference between the estimated probabilities is only about two percentage points.

Controls for education levels reduces the effect of work-related training of own interest. But what really reduced the effect of such training is the control for work profiles. These findings imply that when *not* taking different work profiles into account, the effect of work-related training could be somewhat exaggerated and overrated. The effect of work-related training is largely mediated through the work profile the employed persons exert.

4.3.4 The effects of type of education and occupational level

There are significant positive effects of increasing education level (Table 4.3, Model 3). These effects are somewhat reduced when including controls for training (Model 4), and clearly reduced when including controls for work profiles (Model 5), due to the relationship between the work profiles and education level (see Figure 3.2). The effects of education level are further reduced in Model 6 when including controls for occupation level. This was expected because the occupational level largely depends on education level. However, when comparing the effects of education level in Model 3 with Model 6, we see that the main decrease in the effects of education level when adding more control variables, is caused by the *control for work profiles*. When estimating the probability of being an innovative strategic learner for persons with different education levels (and mean values on all other variables than education levels) based on the effects in Model 6, the differences are quite small although significant. The difference between persons with medium education level (ISCED 3 + 4) and low education level (ISCED 1 + 2) is two percentage points. The same applies to the difference in estimated probability between those with low education level and those with tertiary education at the lowest level (ISCED 5A, professional degree and 5B, bachelor degree) (cf. that the coefficients for ISCED 5A + 5B, bachelor degree, and ISCED 3 + 4, are of the same size in Model 6, Table 4.3.) When comparing low education level with a master degree or higher, the estimated difference is higher – about 4 percentage points. The results are further illustrated in Figure 4.2.

Concerning the effects of fields of study, we expected a positive effect of being educated within science and mathematics, and engineering, manufacturing and construction. This is not found. In additional analyses we have added the control variables in a different order than that given in Table 4.3. We find a very large positive effects of the field science and mathematics, when not controlling for education level, economic sector etc.. When not controlling for education level, there is also a positive significant effect of being educated within engineering, manufacturing and construction, but even larger positive effects for humanities, social science, pedagogy, and health and welfare. All the latter effects are insignificant when controlling for education level. So these (initial) seemingly positive effects of fields of study are caused by the correlation between these fields and having higher education.

Neither is the effect of engineering, manufacturing and construction significant when controlling for education level (and the sign of the coefficient for engineering, manufacturing and construction changes from positive to negative). However, *the effect of being educated within science and mathematics is still significant* (and positive) *when controlling for education level*, although very much reduced. When controlling for skills, training, work profiles and occupation level, the picture remains the same, but when including controls for economic sector, the effect of science and mathematics is further reduced and no longer significant.

The main impression of the results of Table 4.3 is that educational level is more important than educational field; further, that the effects of fields are not robust when other variables are also included. A more surprising result is the lack of effect of being educated within engineering, manufacturing and construction, and the weak effect of science and mathematics. The fact that we find a certain positive effect for the field science and mathematics is in accordance with previous studies, but the results for the field engineering etc. differ in the results of these studies, for example those of Bjørnåli and Støren (2012), and Leiponen (2005). The different results may be due to the fact that the field is broad and in the PIAAC survey contains many persons educated within construction at levels below tertiary education. The different results may also be due to the fact that the dependent variables differ (being an 'innovative strategic learner', compared to 'introducing innovations' in Bjørnåli and Støren, and the 'complementarity between skills and innovation activities'[25] in Leiponen's study. They may also be due to fact that different populations are examined, for example *all* workers (PIAAC) versus *graduate* workers (Bjørnåli and Støren). Further, Leiponen referred to workers in

[25] In fact, the dependent variable in Leiponen's study is profitability where she studies the interactions between skills and innovation activities at the firm level and the effects on profitability.

manufacturing firms only, and where her study refers to *both* technical and natural science degrees (i.e. without a distinction between science and engineering).

The effects of occupation levels (included in Model 6) add to the effects of the other variables (although to some extent reducing the isolated effects of education level). These effects are strong. Holding a skilled occupation as well as semiskilled occupation (blue collar as well as white collar) increases the probability of being an innovative strategic learner. The results are illustrated in Figures 4.2 and 4.3.

When estimating the probability of being an innovative strategic learner for persons with different occupation levels (and mean values on all other variables than occupation levels), based on the effects in Model 6, the differences are quite large. The estimated difference between persons in elementary jobs and persons in semi-skilled blue collar jobs, is about six percentage points. The corresponding difference between persons in elementary jobs and persons in semi-skilled white collar jobs is about 7 percentage points, whereas the estimated difference in the probability of being an innovative strategic learner between persons in elementary jobs and *skilled* occupations is 10 percentage points. As mentioned, these estimates refer to persons who are assigned average values on all other variables (including education level), than occupational level. Figure 4.2 illustrates some of the (estimated) differences when we also take varying educational levels into account.

Figure 4.2 illustrates the marginal effects of occupation levels and education levels in terms of the difference in *the estimated probabilities of being an innovative strategic learner* dependent upon occupation and education levels. The estimates are based on Table 4.3, Model 6, and refer to theoretical persons with *mean values on all other variables than education and occupation level*. 'Low education level' refers to ISCED 1 or 2, 'medium' refers to ISCED 3 or 4, 'Master or higher' refers to ISCED 5a or ISCED 6, master or research degree**.**

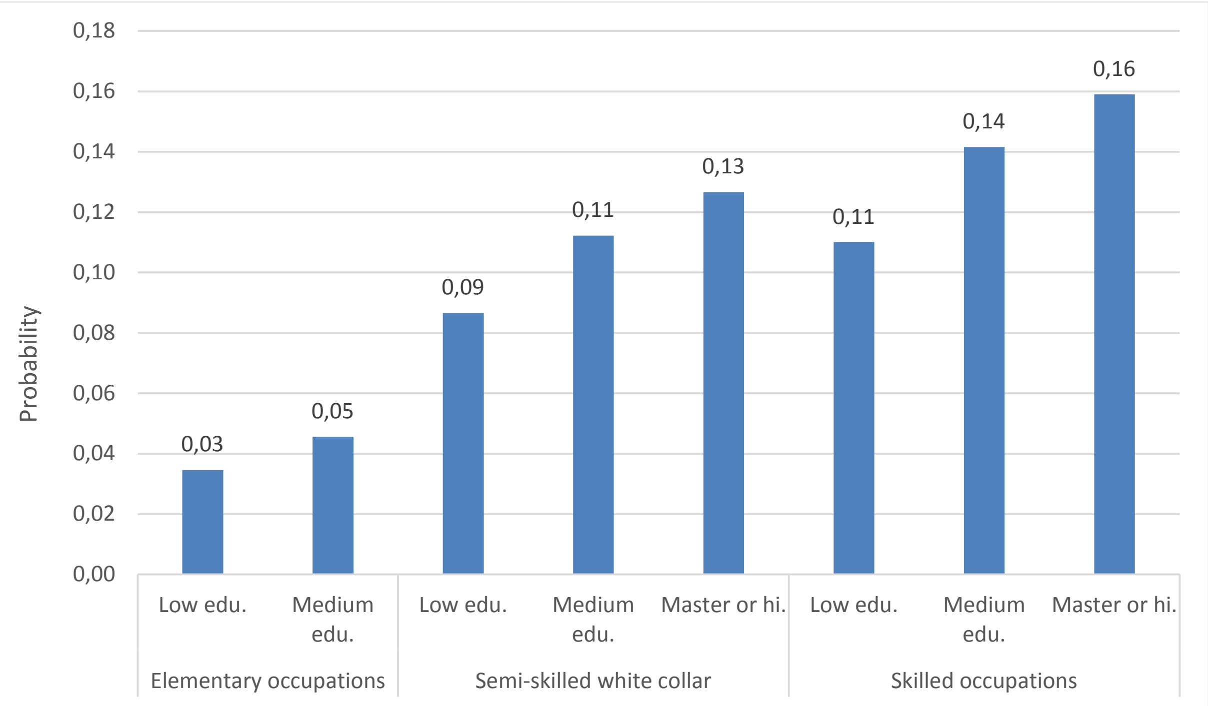

Figure 4.2. The probability of being an innovative strategic learner by education and occupational level.* Four countries taken together

* For elementary occupations, estimates for persons educated at master's degree are not included in the graph since this combination occurs rather infrequently.

4.4 What promotes being an innovative strategic learner at work in each of the four countries?

This section examines the extent to which the effects of the different independent variables vary between the four countries that is examined. The results of binary logistic analyses for each of the four countries – including all the variables that were included in the last model of Table 4.3 – are shown in Table 4.4.

Table 4.4. Being and innovative strategic learner. Results of binomial regressions in each of the four countries.

	Denmark		Finland		Netherlands		Norway	
	B	S.E.	B	S.E	B	S.E	B	S.E
Female	-0.148	0.114	0.300	0.114	*-0.281*	0.157	-0.014	0.117
Age	-0.008	0.005	-0.003	0.005	-0.016	0.006	-0.013	0.005
Economic sector and work hours								
Manufacturing, mining, electricity, supply	-0.315	0.262	0.152	0.221	-0.138	0.330	*-0.470*	0.281
Construction	-0.366	0.352	*0.425*	0.253	-0.339	0.394	*-0.579*	0.304
Sales, transport, support	-0.048	0.246	0.415	0.197	-0.503	0.315	-0.112	0.248
Information, communication	0.229	0.290	0.713	0.277	0.338	0.364	-0.051	0.318
Finance, estate	0.170	0.307	0.619	0.314	-0.027	0.375	0.180	0.349
Professional / Scientific	0.079	0.289	0.671	0.241	-0.063	0.360	0.166	0.290
Public administration and defence	0.282	0.290	0.297	0.278	0.324	0.333	0.038	0.293
Education sector	0.246	0.272	0.181	0.242	0.223	0.363	-0.130	0.289
Health and Social	-0.013	0.266	0.028	0.233	-0.292	0.340	-0.462	0.283
Work hours	0.017	0.005	0.010	0.005	0.019	0.006	0.011	0.005
Skills								
Numeracy and literacy skills	-0.004	0.002	-0.002	0.002	0.001	0.003	-0.004	0.002
, no information	-0.188	0.224	-0.116	0.173	-0.222	0.322	-0.128	0.217
Medium problem-solving skills	0.042	0.149	0.042	0.137	-0.287	0.197	0.073	0.158
High problem-solving skills	*0.313*	0.189	-0.018	0.174	-0.197	0.241	0.294	0.192
Education level and fields of study (ref. edcat 1+2, and unknown or general field)								
Edcat 3 and 4	0.523	0.215	-0.028	0.241	-0.009	0.300	*0.359*	0.190
Edcat 5 and 6	0.685	0.243	-0.174	0.284	-0.158	0.355	0.159	0.224
Edcat 7 (master, higher)	1.009	0.265	-0.239	0.313	0.161	0.381	*0.451*	0.238
Pedagogy/Teacher	-0.533	0.254	-0.271	0.299	-0.131	0.400	-0.210	0.300
Humanities	-0.209	0.261	0.202	0.278	0.313	0.389	0.180	0.276
Social science	*-0.346*	0.199	0.209	0.207	-0.337	0.288	-0.100	0.219
Science and mathematics	-0.064	0.226	0.229	0.319	0.090	0.337	0.308	0.254
Engineering	-0.166	0.202	0.155	0.198	-0.056	0.303	-0.074	0.211
Agriculture and vet.	-0.443	0.371	-0.328	0.354	-0.580	0.446	-0.197	0.392
Health and welfare	-0.202	0.236	0.206	0.242	-0.059	0.337	0.068	0.259
Services	-0.760	0.226	0.248	0.227	-0.555	0.500	-0.143	0.333

(cont.)

Table 4.4 (cont.)

	Denmark		Finland		Netherlands		Norway	
	B	S.E.	B	S.E	B	S.E	B	S.E
Training								
Obligatory training	0.421	0.264	-0.045	0.198	-0.045	0.319	-0.173	0.259
Own interest training	0.483	0.231	0.129	0.165	0.222	0.246	0.342	0.198
1-2 days training	-0.224	0.269	-0.245	0.201	-0.093	0.306	-0.194	0.241
3 – 7 days training	-0.323	0.257	-0.043	0.194	0.068	0.296	-0.066	0.227
8 – 20 days training	-0.100	0.259	0.276	0.197	0.307	0.292	0.109	0.229
More than 20 days training	-0.025	0.279	0.056	0.231	*0.525*	0.300	0.568	0.253
Working roles and flexibility/autonomy								
Brokering, middle	0.231	0.142	**0.532**	0.226	**-0.048**	0.197	0.007	0.146
Brokering, high	0.553	0.139	**0.951**	0.218	**0.370**	0.186	**0.400**	0.146
Championing, middle	0.771	0.200	0.204	0.154	0.174	0.205	0.287	0.189
Championing, high	1.017	0.203	**0.687**	0.162	**0.625**	0.211	**0.938**	0.194
Information exchange, middle	-0.036	0.189	0.195	0.158	**0.675**	0.239	-0.086	0.209
Information exchange, high	0.348	0.163	**0.531**	0.148	**0.651**	0.216	**0.374**	0.187
Independent, middle	0.428	0.216	0.027	0.157	-0.179	0.285	0.176	0.165
Independent, high	0.706	0.191	**0.365**	0.143	**0.422**	0.224	**0.491**	0.150
Autonomy/flexibility, middle	-0.287	0.160	***0.283***	0.151	**0.714**	0.185	**0.371**	0.155
Autonomy/flexibility, high	0.023	0.162	**0.500**	0.154	**0.673**	0.200	**0.669**	0.166
Occupational class. of job (skill based) (ref.= elementary)								
Skilled occupations	1.392	0.411	**1.002**	0.312	**1.669**	0.763	**1.962**	0.719
Semi-skilled white collar occupations	1.198	0.411	**0.764**	0.301	***1.313***	0.767	**1.421**	0.717
Semi-skilled blue collar occupations	*0.819*	0.424	**0.765**	0.319	***1.495***	0.785	**1.604**	0.730
Unknown occup. level	0.645	0.878	**2.082**	0.609	**3.280**	1.057	**1.944**	0.730
Constant	-4.166	0.716	**-4.519**	0.658	**-5.817**	1.091	**-4.037**	0.896
Nagelkerke R Square	0.210		0.163		0.196		0.199	
No. observations (un-weighted)	5030		3737		3692		3507	
No. observations (weighted)	3535		3488		3641		3569	

* See description of education levels in Table 3.3.

** Coefficients in bold types are significant at level p<0.05. Coefficients in bold types and italics are significant at level p<0.1.

The effects of the independent variables indicate many similarities in the four countries but also many differences concerning which have the largest impacts. Educational level has the greatest impact in Denmark, whereas economic sector has the greatest impact in Finland. The effects of the variables measuring the different work profiles have large impacts in all four countries.

4.4.1 Work profiles

Overall, high values on ‘championing’ have the largest positive effects and large impact in all countries but particularly large in Norway and Denmark (see also Figure 4.3). High values on ‘brokering’ have an especially large effect in Finland (though positive and significant in the other three countries as well). As seen in Chapter 3 (Tables 3.13 and 3.14), Finland scores very high on ‘brokering’, and in addition this variable has a particularly strong effect in Finland on the probability of being an innovative learner (Table 4.4).

The positive effect of having high values on ‘independent’ is notably large in Denmark (though positive and significant in the other three countries as well), and we see from Table 3.14 that in addition the Danish sample scores very high on this item. Information exchange is particularly important in the Netherlands (both middle and high values on this item), followed by Finland.

The item ‘autonomy/flexibility’ has a particularly large positive effect in the Netherlands and Norway, but has no significant effect in Denmark. We recall (cf. Table 3.14), that the Dutch sample scores lowest of the four countries on this item, and Norway the second lowest. This could indicate that in countries where the item occurs least frequently, we could find that the particular item has the greatest impact. We have, however, not found the existence of such a clear pattern for all the items (see for example above, the large effect of being ‘independent’ in Denmark, at the same time as the Danish workforce score high on this item).

The effects of having high (respectively low) values on the different items for work profiles in the different countries are illustrated in Figures 4.3 and 4.4. The estimates refer to persons with average values (average for the four countries taken together) on all other variables than the variables in question, which are work profiles and autonomy/flexibility. For example, the estimates for persons scoring low, respectively high, on ‘championing’ refer to persons with average values on all other variables, i.e. also average values on ‘independent’ and ‘brokering’ and ‘autonomy/flexibility’. The estimates are based on the effects for each country respectively, i.e. the coefficients shown in Table 4.4.

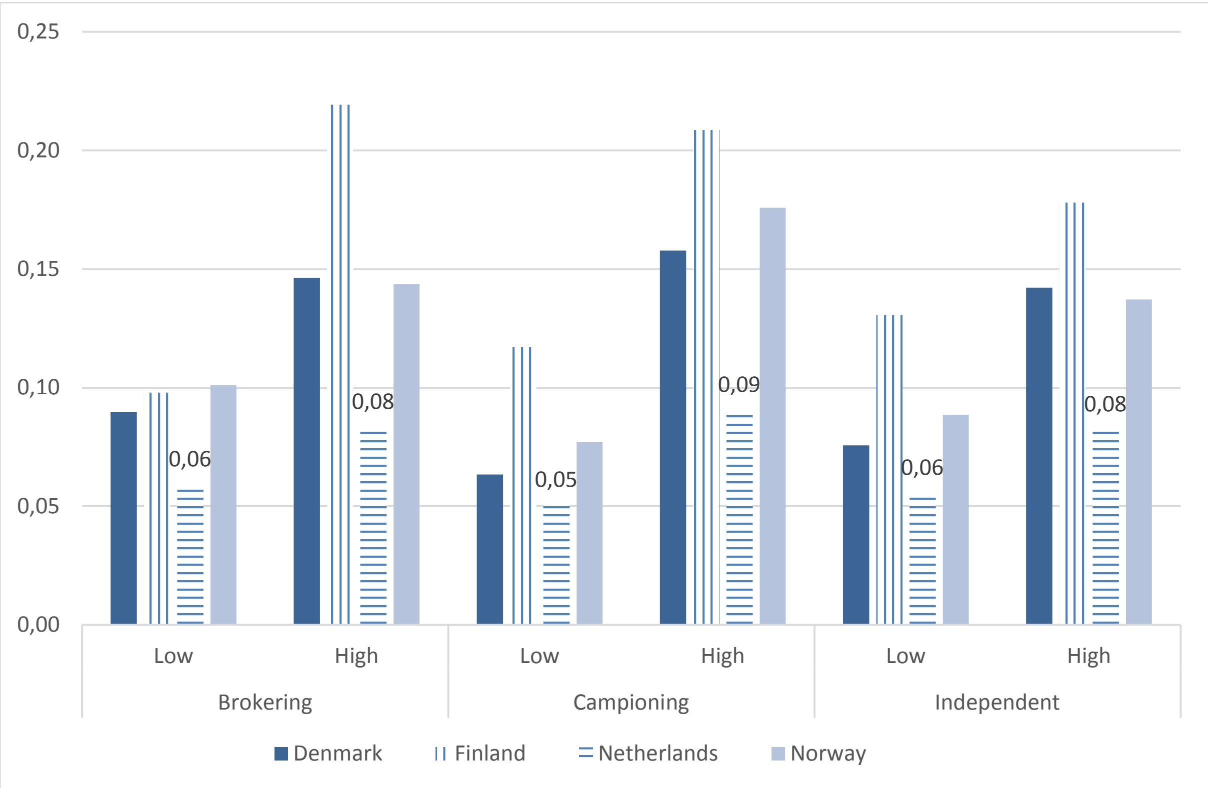

Figure 4.3. The effects of being ‘brokering’, ‘championing’ and ‘independent’. Estimated probability of being an innovative strategic learner in the four countries

In Finland, the estimated probability of being an innovative strategic learner when having high values on ‘championing’ and ‘brokering’ is very high. However, also when having *low* values on these items the estimated probability for the Finish sample is higher than for the Dutch respondents when the latter score high on 'championing' and 'brokering'.[26] Further, if the Finish workers have low values on 'independent' the estimated probability of being an innovative strategic learner is almost as high as in Norway and Denmark when these country samples are assigned high values on 'independent' (and much higher than when the Dutch sample has high values on 'independent'). Otherwise we see that for Norway and Denmark, the controlled results shown in Figure 4.4 are very similar.

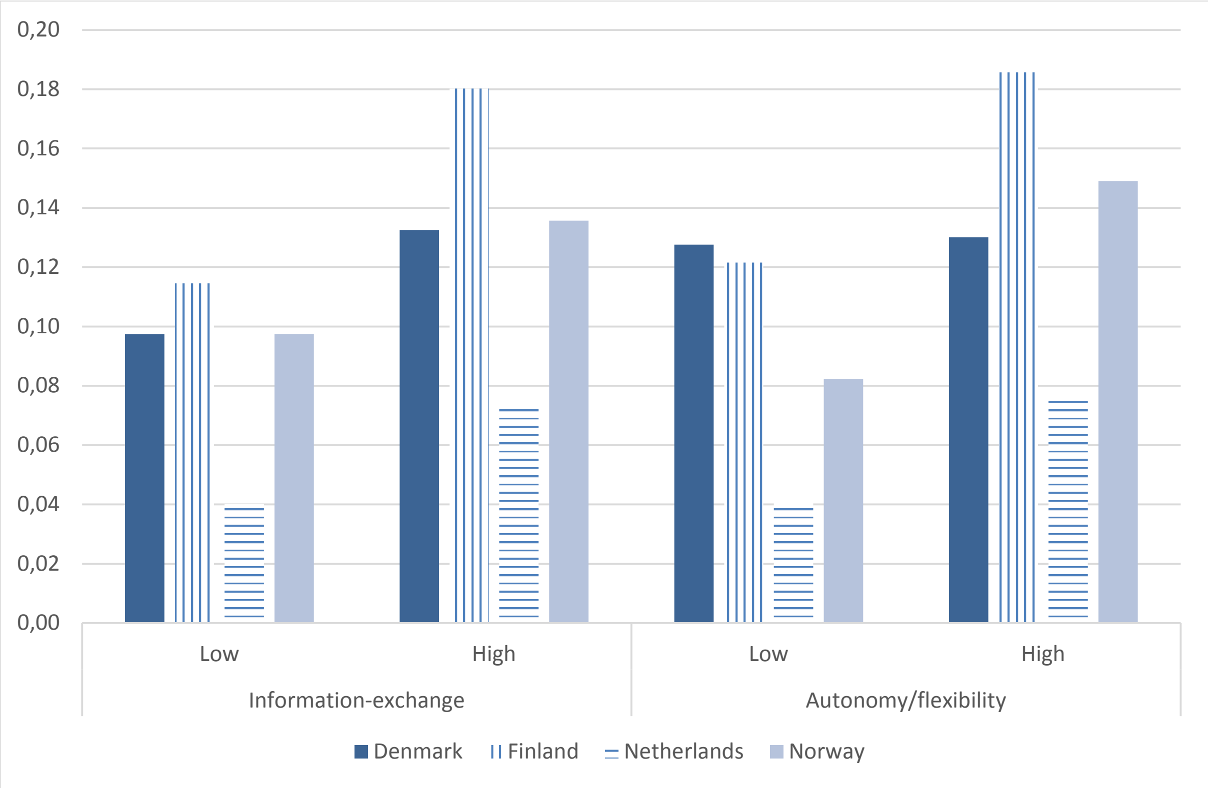

Figure 4.4*.* The effects of 'information exchange' and 'autonomy/flexibility'. Estimated probability of being an innovative strategic learner in the four countries

Figure 4.4 illustrates that in Denmark there is no effect of 'autonomy/flexibility', whereas high values on this item have large impact in the other three countries. Further, the graph illustrates that having high values on 'information exchange' has a particularly large impact in the Netherlands and in Finland.

4.4.2 Education and occupational level

Figure 4.5 illustrates that there is no effect of education level in Finland (when controls for all other variables are applied). Except for the highest educational level, the estimated probabilities for all groups are higher in Finland than in Denmark. (We recall that the seemingly negative effect of having the highest education level in Finland, is not significant.) For workers in semi-skilled white collar occupations in Demark, the difference between the educational groups is striking. *Occupational* level (skills level in the job) has, however, a large impact also in Finland, but even more so in Denmark.

[26] It should be mentioned that when assigning mean values on all the independent variables in the estimates, the estimated probabilities tend overall to be lower than that found for the uncontrolled averages, such as those depicted in Table 4.1.

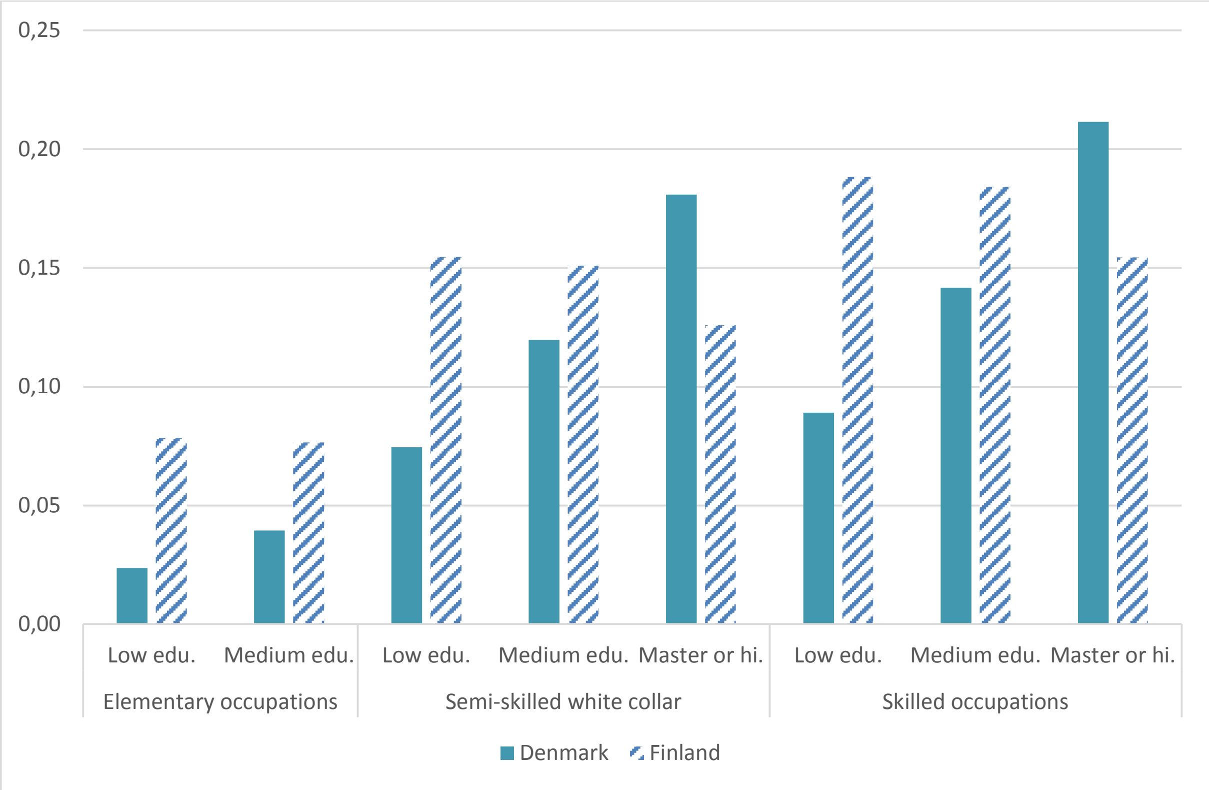

Figure 4.5. The effects of education and occupation level.* Estimated probability of being an innovative strategic learner in Denmark and Finland

* For elementary occupations, estimates for persons educated at master's degree level are not included in the graph because this combination occurs rather infrequently.

Figure 4.6 illustrates the corresponding patterns in the Netherlands and Norway. For the Netherlands, there is no significant effect of education level when including controls for other variables, but there are rather large (relative) differences according to occupational level. This refers mainly to the difference between elementary occupations and all types of skilled and semi-skilled occupations.

For Norway, the pattern is more or less as in Denmark (comparing Figures 4.4 and 4.5), although with some exceptions. In Norway, the estimated probability among persons in skilled occupations with low education level is at the same level as for persons with education at master's degree level in semi-skilled white collar occupations. In Denmark the opposite is found. Here, persons with education at master's degree level in semi-skilled white collar occupations are far more likely to be innovative strategic learners at work than persons in skilled occupations with low education level. This reflects the very large effect of increasing education level in Denmark, whereas in Norway type of job has greater impact. However, in both countries the effects of educational level add to the effect of occupational level.

For the low- and medium-educated persons in elementary occupations the estimated probability is quite low in all countries and, except for Finland, more or less the same. The situation among the workers in skilled occupations, and in particular among persons with the highest education level in these types of jobs, differs between the countries. The Netherlands does not follow the same pattern as Denmark and Norway. In the latter two countries there is a rather steep and quite steady increase in the estimated probability with increasing education and occupation level. In the Netherlands this increase is much shallower. Finland represents another type of exception, with much higher probabilities at low and medium education level than the other three countries, and overall a more equal distribution across education and occupation levels than in the other three countries.

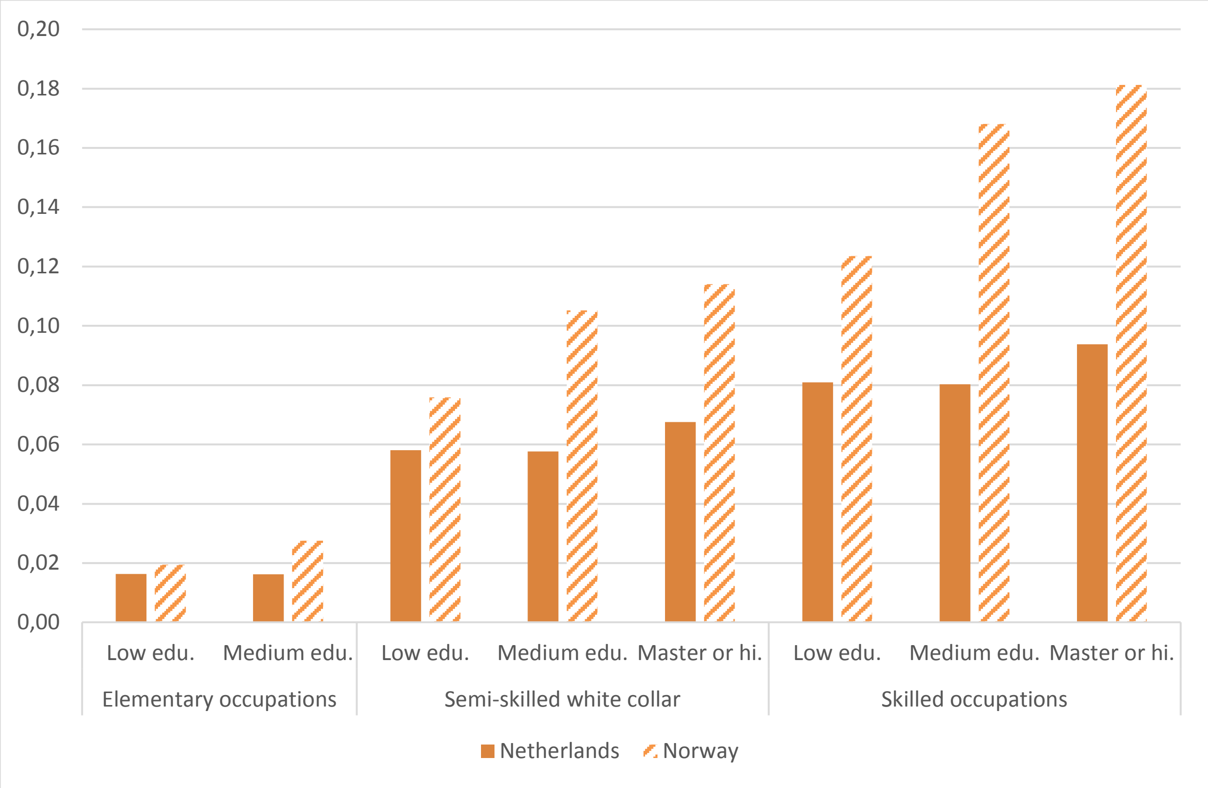

Figure 4.6*. The effects of education and occupation level.* Estimated probability of being an innovative strategic learner in the Netherlands and Norway*

* For elementary occupations, estimates for persons educated at master's degree level are not included in the graph since this combination occurs rather infrequently.

4.4.3 The effects of work-related training

Finland differs from the other countries regarding the effects of education level (see above), but this also applies to work-related training. Work-related training of own interest has a rather weak effect in Finland, whereas it seems to have larger effects in the other countries, particularly in Norway if it is of long duration. Such training is widespread in all countries, cf. Table 3.10.

Estimations of the probability of being an innovative learner among persons who have participated in work-related training of own interest and persons who have not participated in training are presented in Figure 4.6. This shows the controlled differences by country (based on Table 4.4). To capture the effect of having a large amount of training, the effect of 'training 20 days or more' is added to the effect of work-related training of own interest. The latter effects are significant only in Denmark and Norway, while the effect of 'training 20 days or more' is significant only in the Netherlands and Norway. This implies that the combined effects are particularly high in Norway, something which is clear in Figure 4.7. Reservation must be made concerning that none of the training variables are significant in Finland.

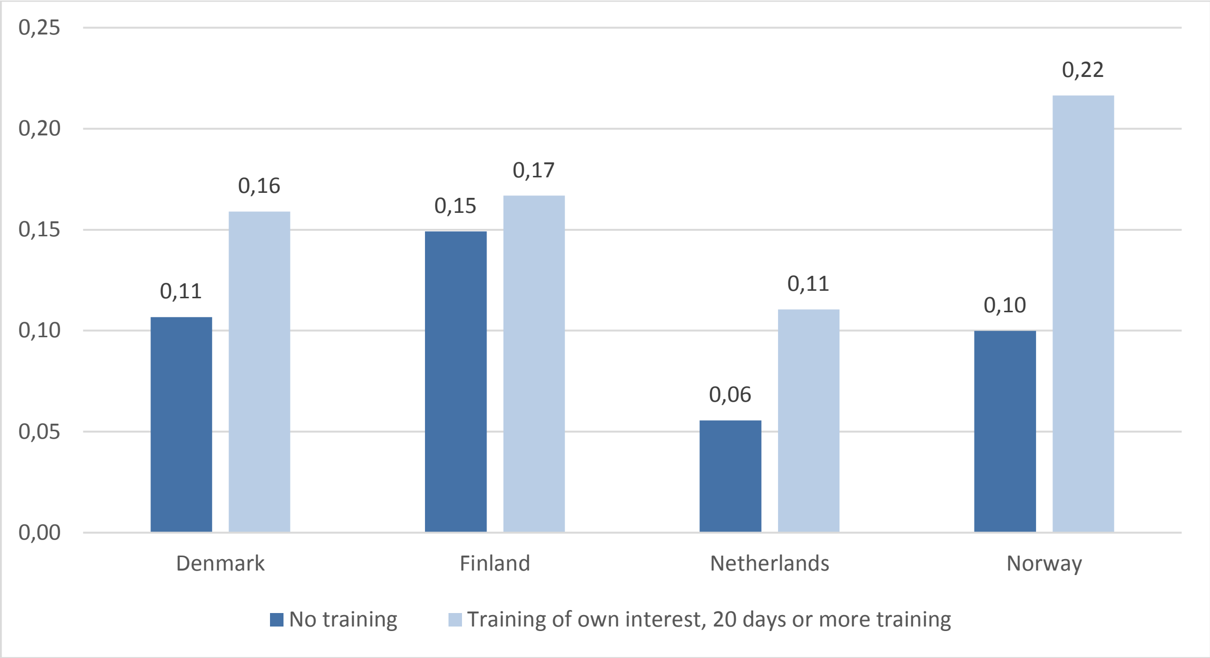

Figure 4.7. The effect of work-related training. Estimated probability of being an innovative strategic learner in the four countries

As in the preceding graphs, the estimates refer to persons who are assigned mean values on all the other variables (including educational level etc.) than the variable(s) in question, which here is training, in order to display the isolated effect of training.

Additional analyses show that the effects of work-related training in all countries are higher when controls for work profiles etc. are not included, but also that there are country differences in this respect, see Table 4.5.

Table 4.5. The effects of training in different models, separate countries. Results of binomial logistic regression models

	Model 1, including controls for econ. sector, workhours, and dem. variables		Model 2, plus controls for skills and level and type of education		Model 3, plus control for work profile/work environment		Modell 4, plus controls for occupation level	
Denmark	B	S.E.	B	S.E.	B	S.E.	B	S.E.
Obligatory training	0.360	0.249	0.379	0.252	*0.441*	0.263	0.421	0.264
Own interest training	0.644	0.219	0.591	0.221	0.517	0.230	0.483	0.231
1-2 days training	-0.257	0.255	-0.304	0.258	-0.243	0.268	-0.224	0.269
3 – 7 days training	-0.159	0.245	-0.271	0.248	-0.322	0.256	-0.323	0.257
8 – 20 days training	0.166	0.244	0.000	0.247	-0.100	0.258	-0.100	0.259
More than 20 days training	0.093	0.264	-0.044	0.267	-0.045	0.278	-0.025	0.279
Finland								
Obligatory training	0.023	0.190	-0.003	0.191	-0.038	0.197	-0.045	0.198
Own interest training	*0.294*	0.158	0.248	0.160	0.144	0.165	0.129	0.165
1-2 days training	-0.210	0.193	-0.228	0.194	-0.245	0.201	-0.245	0.201
3 – 7 days training	0.201	0.184	0.128	0.187	-0.021	0.193	-0.043	0.194
8 – 20 days training	0.590	0.185	0.497	0.189	0.304	0.196	0.276	0.197
More than 20 days training	0.341	0.220	0.261	0.222	0.096	0.229	0.056	0.231
Netherlands								
Obligatory training	-0.157	0.307	-0.098	0.310	-0.020	0.318	-0.045	0.319
Own interest training	0.348	0.237	0.373	0.239	0.281	0.246	0.222	0.246
1-2 days training	0.040	0.295	-0.031	0.298	-0.109	0.306	-0.093	0.306
3 – 7 days training	0.277	0.284	0.155	0.289	0.045	0.296	0.068	0.296
8 – 20 days training	0.569	0.280	0.425	0.286	0.295	0.292	0.307	0.292
More than 20 days training	0.778	0.285	0.704	0.289	*0.558*	0.297	*0.525*	0.300
Norway								
Obligatory training	-0.232	0.246	-0.191	0.248	-0.137	0.259	-0.173	0.259
Own interest training	0.384	0.188	0.388	0.190	*0.377*	0.197	*0.342*	0.198
1-2 days training	-0.111	0.229	-0.179	0.230	-0.230	0.240	-0.194	0.241
3 – 7 days training	0.145	0.215	0.026	0.218	-0.068	0.226	-0.066	0.227
8 – 20 days training	0.426	0.216	0.258	0.219	0.112	0.228	0.109	0.229
More than 20 days training	0.704	.239	0.622	0.241	0.555	0.251	0.568	0.253

In Denmark, the positive effect of work-related training of own interest is quite large in all models, but reduced when controls for work profiles are included (Model 3, Table 4.5). There is no effect of the amount of training in any models in Denmark. (Contrary to the other countries, there is also a tendency in Denmark that obligatory training has as positive effect.)

In Finland, there are no longer significant effects of the amount of training nor of training of own interest following the inclusion of controls for work profiles (Model 3). In the Netherlands the effect of work-related training of own interest is insignificant in all models, but the effects of large amounts of training are significant in Model 1 ('8 – 20 days' as well as 'more than 20 days'). In Model 3, after inclusion of controls for work profiles, only the latter effect is significant, but also this effect is reduced. In Norway, the effects of work-related training of own interest are only weakly affected by the inclusion of work profiles and other variables in the models. But, regarding the effects of amounts of training, the situation is the same as in the Netherlands; i.e. significant positive effects of large amounts of training in Model 1, but after the inclusion of controls for work profiles in Model 3, only one of the latter effects is significant ('more than 20 days'). But also this effect is somewhat reduced.

Although also the controls for education level (Model 2) contribute in reducing the effects training, and although the results differ between the countries concerning which of the training variables have the largest impact, the overall picture is the same. The effects of training in all countries are reduced when including controls for work profiles. Work-related training may increase the probability of being an 'innovative strategic learner', but to a certain extent this is moderated by the person's work profile.

4.4.4 The effects of age, gender and economic sector

Finally, we will comment the results concerning the effects of some of the control variables. In the regression where all the four countries were taken together (Table 4.3), we found a negative effect of increasing age. The separate regressions for the four countries (Table 4.4) reveals that this applies only to the Netherlands and Norway. There is a positive effect of being female in Finland. This does not imply that males in Finland less frequently than males in the other countries have characteristics of being innovative learners at work. Rather, estimates based on the results of Table 4.4 show that *females* in Finland more frequently do. In Norway and Denmark there is no significant effect of being female, but in in the Netherlands the effect is negative. Additional analyses show that in Norway and Denmark there is a certain negative effect of being female when not including controls for weekly work hours (while including controls for economic sector), but this negative effect disappears after including control for work hours (females work fewer hours per week).

In the Netherlands, the findings concerning the gender effect are more striking. When not including controls for weekly work hours (but including controls for economic sector), the negative effect of being female is very large in the Netherlands. However, once including controls for weekly work hours (females work fewer hours), this effect is very much reduced. There is nevertheless a significant negative effect of being female in the Netherlands in all models. When added to the effect of workhours, the combined effect of being female and working part-time is large.

The distribution of workers according to economic sector is quite similar in the four countries (see Table 3.16), but the *effects* of economic sector on innovativeness differ between the countries. In particular, the results for the Finish sample are characterised by large effects of economic sector, also when controlling for other variables. In the full model, including all the independent variables (Table 4.4) economic sector appears to have very little impact in Denmark, the Netherlands and Norway. In Norway, there are however, significant negative effects of working in the construction sector and within sales, transport and support.

The differences between the sectors are larger in Finland than in the other countries. This applies, for instance, to the difference between 'information and communication', 'finance and estate' and 'professional/scientific' on the one hand, and the health and welfare sector, manufacturing and agriculture etc. (the reference category in the regressions), on the other. This nevertheless does not imply that workers in Finland in the sectors where the likelihood of being an innovative learner is relatively low, such as within manufacturing and the health and welfare sector, are less likely to be innovative strategic learners at work than workers in the same sectors in, for example, Norway and Denmark. Rather, the main difference concerns the very high probability of the workers in Finland within 'information and communication', 'finance and estate' and 'professional/scientific' being innovative strategic learners. Also within sales and transport and construction, particularly the latter, the estimated probability of being an innovative strategic learner is much higher in Finland than in Denmark and Norway. (For the Dutch sample, the estimated probabilities are much lower than for all the three other countries regardless of economic sector.)

5 Summary and discussion

The definition of innovativeness in this report refers to a worker actively seeking new knowledge and utilizes the new knowledge. We consider that the worker possesses a high degree of innovativeness if his/her job to a large extent involves

- keeping up-to-date with new products or services, and to a large extent involves
- learning-by-doing from the tasks he/she performs; and if the respondent
- scores high on a set of active and creative learning strategies,[27] and in addition
- quite frequently solves complex problems at work.

Another way to describe this worker is that he/she is an innovative strategic learner at work.

About 15 per cent of the workers in the four countries we have studied (Denmark, Finland, the Netherlands and Norway) meet these criteria. However, this varies from 9 per cent in the Netherlands to 21 per cent in Finland. The Netherlands scores at the same level as neighbouring countries like Belgium and Germany, while Norway and Denmark score at the same level as the neighbouring country Sweden, around 15– 16 per cent.

Country differences in the likelihood of being an innovative strategic learner at work are robust when controlling for a number of independent variables. Therefore, it is probably not the possible unfortunate distribution of characteristics in a country sample that is decisive for the country differences. The effects of the same characteristics vary between the countries, but neither is this variation decisive for the country differences. This variation is not serving as a complete and satisfactory explanation for the country differences. This is illustrated in Figures 4.4 to 4.7. These figures illustrate the existence of country differences when country-dependent varying effects of the independent variables (as well as a constant distribution of the independent variables) are taken into account. Finland remains at the top, the Netherland remains at the bottom.

All the analyses confirm findings in previous studies showing that Finland is a leading innovation country. However, the dependent variable in this study concerns the properties of individuals in the workforce, while other studies mainly refer to composite indicators at the country level (IUS) or to surveys among firms (CIS). Denmark is also a leading innovation country in most studies, but is more in the ‘middle’ according to the analyses in this report. For Norway, also found to be ‘in the middle’ in this report, the results differ from those found in studies that refer to composite innovation indicators at the country level (IUS), where Norway ranks very much lower than Finland and Denmark, and also lower than the Netherlands. Although the Netherlands ranks above the EU average on IUS, we find

[27] As described in Chapter 2, the active learning strategies refer to these items: ‘When I come across something new, I try to relate it to what I already know’; ‘I like to get to the bottom of difficult things’, and ‘I like to figure out how different ideas fit together’.

that a lower proportion of the Dutch workforce than in the other three countries can be characterised as being innovative strategic learners at work. It is difficult to explain these country differences but are further discussed below.

5.1 The different aspects of being an innovative strategic learner

The definition of an 'innovative strategic learner at work' depends on many dimensions. As mentioned above, one of them is 'keeping-up-to-date with new products and services'; another is 'learning-by-doing from the tasks one performs'. A third dimension refers to learning strategies. As an additional criterion, we have included information on the extent to which the worker solves complex problems at work, where we excluded those who only seldom solve complex problems. When Finland ranks highest of the four countries on the merged variable 'innovative strategic learner at work' this is because Finland ranks high on *all* the individual variables that are merged and constitute this construct. On the contrary, when the Netherlands ranks lowest, this is because Netherlands ranks lowest or second lowest on *all* the individual variables that constitute being an 'innovative strategic learner at work'.

Further, when the results for Norway appear as equally positive as those for Denmark, this is largely due to Norway's high score on 'learning-by-doing from the tasks one performs', and *not* by the scores on 'keeping-up-to-date with new products and services', where Norway scores low. An implication is that *if* the Norwegian workforce scores positively on the variable on 'keeping-up-to-date with new products and services' to a greater extent, the total innovativeness in workforces could have been greater. Alternatively, if to a greater extent the Danish score positively on the variable 'learning-by-doing-from the tasks one performs', the total innovativeness in the workforces could have been greater. Later, we go deeper into the results for each of the four countries in order to summarize what seems to be the main challenges for each of the countries.

5.2 Work profiles and work environment

The variables indicating that people have different roles at work, i.e. variables that cover the extent to which the worker can be characterized as being *brokering, championing, independent* and/or exchanging information, have large impacts on the likelihood of being an innovative strategic learner at work, and appear as more decisive than education levels and skills. The variables for work profiles are based on the response concerning skills used at work. 'Championing' refers to (how often) influencing and advising people. 'Brokering' refers to negotiating with people either inside or outside the organisation. 'Independent' refers to (how often) organising own time and planning own activities. Information exchange' refers to the response concerning (how often) the respondent is sharing work-related information with co-workers The positive effect of all these factors applies to all dimensions that constitute being an innovative strategic learner at work.

Work environment measured by flexibility and autonomy – frequently in the literature referred to as discretionary work forms – also has large impact. 'Flexibility and autonomy' refers to the response to questions concerning the extent to which the employed persons could choose or change the sequence of work tasks, how they do their work, the speed or rate of work and working hours. High values on flexibility and autonomy increase the likelihood of being an innovative strategic learner. This applies to all the underlying dimensions for being an innovative strategic learner, but in particular to the active learning strategies and 'learning by doing from the tasks one performs'. High scores on autonomy and flexibility increase the likelihood that the worker exhibits active learning strategies and to a large extent learns from the tasks he/she performs, and in total that he/she is an innovative strategic learner at work (see Table 4.1).

5.3 Work-related training

Work-related training increases the probability of being an innovative strategic learner, but this is found largely to be mediated by the person's work profile. The effects of work-related training are reduced when controlling for work profiles. This indicates that if not taking the roles at work into account, the effects of training can be exaggerated. The request for work-related training varies between different types of workers. When people with higher scores on variables covering work profiles and with high education frequently request training, i.e. people whom we can assume basically have a more innovative orientation; it is natural that a statistical effect of training on innovation activity is found in many studies. But, a large part of the 'real' effect of training on innovativeness is probably largely caused by the persons' work profiles. However, this does not mean that training does not matter. Our findings indicate that it has particular impact in Norway, thereafter in the Netherlands (if it has long duration) and then in Denmark. Moreover, the *availability* of training in an organisation may be of great importance, and may explain the relationship between training and innovation at the aggregate level found in many studies. Here, the analyses is on the individual level, and not at the institutional/organisational level.

5.4 Level and type of education, and occupational level

The likelihood of being an innovative learner increases with increased education level, but overall we have not found significant effects of fields of study when controls for economic sector are also employed. The effect of education level differs very much between the countries. The effects are smallest in Finland, i.e. the country with the overall highest level of innovativeness, as measured here, as well as in the Netherlands, when controls for all other variables are employed. The first mentioned result (Finland) could indicate that *if* innovative learning at work in other countries was more evenly distributed according to education levels – as it seems to be in Finland – the total amount of innovative learning at work in the other countries could have been higher. However, such a conclusion is not supported by the results for the Netherlands, where the effects of education levels are insignificant as well, and where the likelihood of being an innovative strategic learner is quite low.

Compared to the strong emphasis on human capital as is generally found in the literature on innovative activities and capabilities, we may conclude that the (isolated) effects of education levels found in this report are quite small. Education level correlates with occupational level, which is also controlled for here, and which reduces the effect of education level (especially the effects of having the highest education level). However, it appears that the control for work profiles, which also correlates to some extent with education level, has larger impacts on the effects of education levels. This is in line with arguments in some previous studies mentioned in Chapter 1 (OECD 2011, Schneider et al. 2010) that human capital in itself is not sufficient to increase the likelihood to engage in innovation since it may correlate with other variables. Here, we have established that these other variables concern the role the persons has at work.

In our analyses we have *not* found positive effects of increased skills (numeracy and literacy skills and problem-solving skills in technology-rich environments) when also controlling for other variables. Compared to the large amount of literature concerning 'skills for innovation' etc. (see Chapter 1), this is somewhat surprising. However, we *have* found indications that increased skills have a positive effect on the likelihood of being an innovative learner at work among workers who belong to the groups with the lowest scores on some of the work profiles described above. Among others, the skills level in itself does not seem to have any impact ('all other things being equal').

However, type of job, i.e. the classification jobs according to their skills level (here labelled as occupational level) has very large impact. In some countries (particularly Norway and Denmark) varying educational levels within a certain occupational level, seem to be of great importance as well.

5.5 Challenges for the four countries

High values on the work profile 'championing' has a particular positive impact in the Norwegian sample on the likelihood of being an innovative learner at work. As mentioned, being 'championing' refers to skills used as work such as influencing and advising people. Meanwhile, we have found that the Norwegian sample does not frequently score high on this variable compared to Finland and Denmark.

One implication can be that if the workers in Norway develop and utilize such skills at work to a larger extent, then innovativeness would be increased.

This goes hand in hand with the findings concerning autonomy and flexibility. For the Norwegian sample, an increased score on the work environment variable 'autonomy and flexibility' increases the likelihood of being an innovative learner at work. The Norwegian sample scores lower than Denmark and Finland when it comes to the extent to which their jobs involve the opportunity to be flexible and autonomous (see Table 3.15). Thus, a possible interpretation is that if the degree of autonomy and flexibility at work were higher in Norway, the innovativeness of the workforce would probably be higher. As regards the percentage scoring high on the work profile 'independent', the proportion in Norway is below the other three countries (see Table 3.14). Also this variable has positive effect in the Norwegian sample on the likelihood of being an innovative strategic learner at work.

The number of days with training is more or less the same in Norway as the average for the four countries (see Table 3.10 and 3.11). The percentage participating in work-related training of own interest is also the same in Norway as in the other three countries. However in Norway, much of this training refers to workshops/seminars, and the Norwegians tend to participate in on-the-job training to a lesser extent than is the case for the other three countries. The high percentage participating in workshops/seminars and the relatively low percentage participating in on-the-job training, does however not reduce the positive effect of training in the Norwegian sample. What matters in Norway as well as in Denmark (in particular), is that the training is of own interest. Moreover, what matters particularly in Norway, as well as in the Netherlands, is the number of days of training. In total, these results indicate that increased efforts as regards work-related training will have positive effects in the Norwegian workforce.

Another challenge for Norway is that the Norwegian workforce scores quite low in one of the dimensions that constitutes the construct of being an innovative learner at work. This is the item 'keeping up to date with new products and services'. In order to increase the total innovativeness in the workforce, it is necessary that larger parts of the workforce are active in keeping up-to-date with new products and services. One way is by increased efforts in work-related training; another could be by increased use of the types of skills at work that we have labelled 'championing'.

A question can be raised concerning the fact that the results for Norway show that no industrial sector stands out as having more innovative learners than others when controlling for work profiles, education levels etc. In Finland this applies to the information and communication sector, and the sectors 'finance/estate', and 'professional/scientific', and to a certain extent also to the construction sector and 'sales, transport and support'. In Norway, the only significant effects of economic sector are the negative effects of working in the construction sector and within manufacturing. This could indicate that in these sectors in particular there is much to gain in encouraging innovative learning.

Although the challenges mentioned might be distinguished, the Norwegian workforce appears as having the same amount of innovative orientations/capabilities as for instance the Danish workforce, but still lower than in Finland. This brings us back to the benchmarking according to official innovation indicators mentioned in Chapters 1 and 2 where Norway ranks very much lower than Finland and Denmark. In this connection, an open seminar at the Research Council of Norway [28] after the release of the OECD Science, Technology and Industry Outlook 2014, is of interest. The topic 'Recent trends in science and innovation policy and performance: Are we on the right track in Norway?' was discussed. As found in other studies and as described in Chapters 1 and 2, Norway does not perform very well. One of the comments at the seminar was that Norway is too rich.[29] When an indicator is based on percentage of GDP, Norway falls behind because of Norway's high GDP per capita. One might say, this makes it 'impossible' to score as high as other countries on the Innovation Union

[28] January 28, 2015. The work was presented by Dominique Guellec from the OECD
[29] Cf. The magazine 3inn, http://www.3in.no/oecd-dere-er-rike-til-passe-inn/, retrieved 2. February 2015.

Scoreboard (IUS) indicators. According to IUS 2014, Norway scores as well (or higher) as the other three countries discussed here on indicators such as new doctorate graduates; percentage population aged 30– 34 having completed tertiary education, international scientific co-publications, non-domestic doctorate students, employment in knowledge-intensive activities, employment in fast-growing firms of innovative sectors, and knowledge-intensive services exports. The indicators where Norway performs weakly, and which result in Norway being categorized as a moderate innovator, refer to *shares of GDP* (for instance R&D expenditure, PCT patents applications, community trademarks or designs). Otherwise, indicators where Norway performs weakly are based on the Community Innovation Surveys (CIS), which – as mentioned in Chapter 1 – are found not to be fully representative for Norway (Wilhelmsen 2012; 2014). Still, while such arguments may be 'comforting', and that neither the results in this report indicate that the innovativeness in the Norwegian workforce is weak, the results here also show that the innovativeness of the Norwegian workforce certainly could be increased. Above, we have distinguished some of its potential.

For the *Danish* sample, increased score on the work environment variable 'autonomy and flexibility' has no significant effect on the likelihood of being an innovative learner at work. Possibly, and contrary to Norway, this variable does not distinguish Danish workers particularly, because the Danish sample scores overall very high on this variable. On the other hand, the effect of being 'championing' is very large in Denmark, and the Danish sample scores quite high on this item (see Table 3.14). The same picture is found for being independent where Denmark scores very high (see Table 3.14), and still the effect of having high values on 'independent' is strong in Denmark (see Table 4.4). However, the Danish sample scores below that of Finland on the work profile 'brokering', and we have seen that high values on this variable also increase the likelihood of being an innovative learner at work in Denmark, although not as much as being 'championing'. Overall, the results concerning work profiles indicate no clear challenges as regards Denmark.

A challenge for Denmark could, however, be the results that refer to the effects of *education level*. In the Danish sample, there are larger differences according to education level than in the other three countries regarding the probability of being innovative at work. For Denmark, it could be a challenge to increase the opportunity to be an innovative learner at work among the lower educated. At the same time, the innovativeness of the high educated in Denmark appear as an important resource.

The positive impact of work-related training of own interest found for the Danish sample, does not in itself represent a challenge; rather, an opportunity. Hhowever, a challenge may lie in the finding that increased amount of training participation has no effect. Another challenge is that participation in training is far from evenly distributed, not even in Denmark.

Finland scores high on most rankings relevant to economic activity (PISA, PIAAC, Innovation Union Scoreboard, the Community Innovation Survey) and also the kind of ranking that is presented in this report. Is it still possible to identify challenges? To ask whether it is possible to identify challenges in a situation (spring 2015) when Finland (the last couple of years) has faced major challenges to its economy (OECD 2014c; EC 2015; Focus Economics 2015),[30] may perhaps seem a bit odd. Nevertheless, here we are thinking especially about the possible challenges that Finland might have (compared to the other three countries) with regard to the extent to which the workforce is characterized as innovative strategic learners. The high education level and degree of innovation of the Finish workforce must still be seen as an advantage for Finland along with other measures implemented as regards the way out of a difficult economic situation.

[30] In 2014, OECD summarized concerning Finland: 'Strong growth, innovation and structural reforms in the decade preceding the global economic and financial crisis transformed Finland into one of the world's most competitive economies, ensuring a high level of well-being for its citizens. More recently, however, competitiveness has deteriorated and output has fallen, as electronics and forestry collapsed' (OECD 2014c).

One challenge with regard to enhancing the proportion innovative learners at work in Finland could be the positive gender effect. Finish females are frequently innovative learners at work. One could ask why this does not apply to male workers to the same extent.

One could also point to the fact that we find minor effects of training in the Finish sample. A relevant question is whether it is possible to improve the work-related training that is taking place. Neither are there any significant effects of education level. Possibly, other factors than training and education level contribute to the high innovativeness of the workforce in Finland. From one angle, the fact that there is no effect of education level may be considered as positive; the implication can be that also at lower education levels the workers in Finland pretty frequently are innovative strategic learners. However, also in Finland there are differences according the occupational level. Variation in the type of job one holds is very important for differences in the likelihood of being an innovative learner at work.

This also applies to the work profiles. The work profile ‘brokering’ has a large positive effect in Finland. However, Finland scores higher than the other countries on this item (see Table 3.14), hence this factor does not stand out as a particular challenge for Finland. The same applies to the work profile ‘championing’. In Finland, this work profile also has a large positive impact on our dependent variable referring to innovativeness, but Finland does *not* score low on this item. Overall, the results concerning work profiles indicate few clear challenges neither as regards Finland.

Nevertheless, one challenge based on our analyses can be identified for Finland. This lies in the fact that there are quite large differences according to economic sectors. In some economic sectors (information and communication, finance and estate, professional/scientific) the likelihood of being an innovative strategic learner at work is really very high in Finland. But, the results also imply that in sectors such as manufacturing, primary industries (agriculture etc.) and education there is a potential for increasing the innovativeness of the workers.

The results for the *Netherlands* are surprising, particularly when comparing these with the IUS ranking, where Netherlands is ranked as an ‘innovation follower’. According to IUS the Netherlands are perform above the EU average of most indicators.[31] What is surprising about the results in this report, is that the difference between the Netherlands and the other three countries is so large and consistent.

The low likelihood of being an innovative strategic learner at work is also found in the neighbouring countries Belgium and Germany. This opens up for an interpretation in the direction that the results refer to socio-cultural differences. In such case, these could be of two kinds. They might refer to differences in the way work tasks are organised in workplace. However, we cannot rule out the possibility that there also are country differences in the response pattern, for example regarding the questions about learning strategies. But as far as we can see, there is no evidence from the response pattern in other parts of PIAAC material that the Dutch sample has a ‘particular’ response pattern which distinguishes them from other nationalities.

The results indicate that the Dutch workforce is characterised by innovative learning at the workplace to a lesser extent than the workforces in the other three countries. This applies particularly to the part of the construct ‘being an innovative learner’ that refers to *active learning strategies*, and next to the item ‘learning-by-doing-from the tasks one performs’ (see Tables 4.1 and 4.2).

An implication of our results is that if the Dutch workforce had scored higher on the three dimensions (i.e. keeping up to data, learning by doing and active learning strategies), but particularly on the dimension covering learning strategies, the total proportion being innovative strategic learners would have been higher. It is, however important to note that we have no direct measure based on the PIAAC data of the innovative capability and/or innovative output.

[31] The Netherlands scores particularly high on IUS indicators such as international scientific co-publications and most cited scientific publications, indicators where also Norway’s score is quite high. What differs between Norway and the Netherlands on IUS, is mainly the indicators referring to per cent of GDP or to the Community Innovation Survey.

The Dutch workforce does not score much lower than the other three countries on the variables that *predict* being an innovative learner at work, such as work profiles, although they have lower scores on autonomy/flexibility which stand out as *one* challenge. This item has a particularly large impact in the Netherlands (see Table 4.4), and both medium and high values on this item increase the probability of being an innovative strategic learner in the Dutch sample.

However, also when controlling for such factors, Netherland scores lower than the other three countries. This is regardless of economic sector and educational level. In all economic sectors, Netherlands scores below the other three countries on the dependent variable, i.e. the likelihood being an innovative strategic learner at work.

The effect of training on being an innovative learner is positive and very clear in the Netherlands, but this applies largely to training of very long duration. The Dutch sample participate in training to the same extent as the other three countries; therefore, lack of training cannot be identified as a special challenge as regards the Dutch workforce.

Neither when it comes to economic sector, is it easy to identify clear challenges for the Netherlands. A similar question as was raised regarding the Norwegian result can also be raised for the Netherlands. This refers to the absence of effect of economic sector. No industrial sector stands out as having more innovative learners than others when controlling for work profiles, education levels etc. Further, the effect of weekly work hours might represent a special challenge for Netherlands. The low average work hours, particularly among women contributes to reducing the (average) proportion innovative strategic learners at work.

Finally, among the Dutch females the proportion of workers who can be characterized as innovative learners is lower than among male workers, while there is no effect of being female in Denmark and Norway, and a positive effect in Finland. This contributes to explaining the total results for Netherlands. Possibly, the gender issue represents a particular challenge for the Netherlands. This is further commented below.

5.6 A gender issue?

In this report, we have seen country differences in the likelihood of being an innovative learner at work that to some extent seem to rely on the fact that males and females adapt differently to the labour market in the four countries that we have studied. In the literature on innovation activity, gender is not a central issue. Yet, in the literature on *entrepreneurship,* gender is a recurrent issue. Women are found to be less entrepreneurial than men are; so, to the extent we had some expectations, we expected a negative effect of being female in our regressions. Entrepreneurship studies that examine gender differences (e.g. Spilling 2005; Berglann et al. 2011; Kelly et al. 2011; Xavier et al. 2013) usually look at entrepreneurship in terms of establishing new businesses, and it is found that women start new businesses less frequently than men. Being innovative is much broader than starting a new business, and it is not obvious that females in general are less innovative at work than men. However, Bjørnåli and Støren (2012) did find a negative effect of being female on the likelihood of introducing innovations at work when graduates in 12 European countries were examined.

In this report, when using the likelihood of being an innovative learner at work as the dependent variable, we find varying effects of being female. In Finland, where the work-hours among females are longer than in the other three countries, where the education level is higher and where the sex segregation according to economic sector tends to be somewhat less pronounced than in the other countries, there is a clear positive effect of being female. In Denmark and Norway, there is no significant difference between males and females, but in the Netherlands, there is a negative effect of being female. The Dutch females can seldom be characterized as innovative learners at work. The latter refers to both controlled and uncontrolled results. At the same time, we see that according to the PIAAC data Dutch females have lower education level than the females in the other three countries, and they work fewer hours per week. They also tend to be more traditional regarding their choices of economic sector than their Finish counterparts. In sum, the low likelihood of being an innovative learner at work in the Netherlands found in this report, seems to a certain extent to rely on the performance among Dutch females.

5.7 Questions for further research

Country differences in the likelihood of being an innovative strategic learner at work are robust when controlling for a number of independent variables. Thus, the country differences are far from explained by our data. Many other and unknown factors contribute to increase the probability of the Finnish sample to be innovative learners at work, whereas many unknown factors contribute to decrease the probability of the Dutch sample. It is hard to see that these factors could be related to industry/economic sector, as this is controlled for in our models. Still, it would be interesting for future research to go deeper into the different economic sectors, for example to examine the reasons behind – and the possible implications of – the relative low rate of ‘innovative learners’ found in the construction sector in Norway.

The unknown factors cannot be attributed to weekly work hours or education levels. Neither are they connected to the workers’ roles at work, variables that are derived from questions concerning the skills they use at work, as these variables are also controlled for. However, these work profiles, far from fully capture modes for organising work tasks at the work place. Probably, the unknown factors are largely connected to different ways of organising work tasks in the workplace. This may vary in the four countries as well as between economic sectors. We have little information on ways of organising, for example the degree of hierarchical organising, in the workplace.

However, we do have information on work environment in terms of the workers’ opportunity to work autonomously and flexibly. Variables that capture this are also included in our regression models and thus controlled for. These variables are also found to have significant and large impacts. Nevertheless, controlling for these factors does not remove the differences between the countries.

What is examined here, are factors that are commonly seen as important for employee-driven innovation. Probably, the Netherlands invests as much in innovation as the other countries (supported when looking at the Community Innovation Survey, CIS), i.e. innovation driven by the employers. This can make up for the situation whereby the Dutch workforce seems to show fewer innovative characteristics as we have been able to measure it here than the other three countries that we have studied.

OECD (2011) states that ‘Data from linked employer-employee datasets can provide valuable insights into the relationship between skills at work and firm-level innovation performance. However, relevant studies are still relatively scarce’ (OECD 2011, p. 90). The results in this report also point to the need for such kinds of data, in order to better understand why the results differ between countries, and also why different studies appear as having partly contrasting results. Ideally, such data should be nationwide and representative at both the firm- and employee-levels. Ideally, the research would combine information on corporate innovation investments and output/turnover as well individual data on workers’ training and education, their work profiles and work environment.

Future research should examine the extent to which innovation activity is (also) a gender issue. Not least do the results for Finland suggest that women’s education and labour market behaviour have special impacts. Another interesting question refers to the fact that in Norway and the Netherlands there is a significant negative effect of increased age. Why is this so, and what could possibly be done in these countries to increase the innovativeness of ‘older’ workers?

The findings indicating a lack of difference according to fields of study should also be followed up in future research with more detailed data on fields of study. Finally, the robust and large effects of the different work profiles on the probability of being an innovative learner should be examined further. A question for further research should be which factors that act as barriers for workers to exert such roles at work and what encourages exerting such work profiles.

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Appendix

Appendix.1 The weighting of data

The data are weighted according to the full sample weight used in PIAAC and found in the PIAAC database, in order to ensure representativity. In analyses including data for only four countries a new weight, based on the full sample weight, is used. In the new weight, the full sample weight is divided by the ratio of the weighted number of observations (which are several million persons, referring to the adult population in each country) and the number of persons in the actual samples – which varies between 5128 (Norway) and 7328 (Denmark). (See Table A.1 below.) This is done in order to avoid that 'everything becomes significant', which is the case in analyses using the full sample weight and which exaggerates the number of observations.

The analyses were carried out using SPSS, but several analyses are also run in STATA to check our estimates. If we do extra programming in STATA, this software provide correct estimates of standard errors and significance levels when using the full sample weight *in combination with 80 replicate weights in the PIAAC database*. (This is not possible when using SPSS). Extra analyses for the four countries (in STATA) show that there are *no differences* in the results referring to the size and significance level of the estimated coefficients compared to using our new weight, and minor differences in the standard errors. This option (using the 80 replicate weights) is also available when using the tool IDB analyser, developed by IEA (The International Association for the Evaluation of Educational Achievement). However, this tool does not allow logistic regression and factor analysis. Thus, for our analyses, this tool was not an option.

In our new weight, the data are also weighted in a way which provides that the *number of observations is the same for all the four countries*, here set to 5200 in each country (see Table A.1 below). This is done in order to secure that a*ll the country samples will have the same influence on the results* when the four countries are seen together and that the largest countries/samples will not have any particular influence on the results. The mean values per country on the different variables are exactly the same when using the full sample weight provided in the PIAAC data base and our new weight.

Table A.1. The construction of new weights.

	N 1 (Un-weighted)	N 2 (Weighted, using (full sample weight, SPFWT0)	N2 / N1
Denmark	7328	3629087	495.235671
Finland	5464	3496909	639.990666
Netherlands	5170	11160541	2158.71199
Norway	5128	3282755	640.162832
Total	23090	21569292	

5200 is divided with un-weighted N for each of the four countries:	
Denmark	0.70960699
Finland	0.95168375
Netherlands	1.00580271
Norway	1.01404056

For Denmark:	Newweight = (SPFWT0 / (495.2356714 / 0.709606987))
For Finland	Newweight = (SPFWT0 / (639.9906662 / 0.951683748))
For Netherlands	Newweight = (SPFWT0 / (2158.711992 / 1.005802708))
For Norway	Newweight = (SPFWT0/(640.1628315 / 1.014040562))

Appendix 2. GDP, and unemployment, in the four countries

Table A.2. OECD statistics of GDP per capita, 2009 and 2013.

	GDP Per capita		GDP Per hour worked		2009-2013, Average annual growth/change, per cent	
	2009	2013	2009	2013	GDP per capita, constant prices	GDP per hour worked, constant prices
Norway	47152	47246	62	63	0.1	0.2
Netherlands	38985	38498	51	52	-0.3	0.5
Denmark	32978	32976	45	47	0.0	1.2
Finland	31862	32165	41	43	0.2	1.0
OECD - Total	30322	31944	39	41	1.3	1.0

* US dollar, 2005 PPPs. Source: OECD (2015).

GDP per capita in Norway is extremely high compared to most other countries, mainly because of the oil sector. Productivity growth in Norway (in per cent) has been lower than the corresponding average for OECD during the period 2009– 2013 (OECD 2015), and this applies as well to the other three countries of particular interest here. (The OECD countries with the relatively highest growth during this period are Turkey, Chile, Estonia, Slovakia and Mexico, all with a much lower GDP per capita in 2009 than the OECD average, and still so in 2013 in spite of the growth.)

Norway is at the top also in 2013 (only Luxembourg ranks higher, and US close behind Norway). Of the other three countries that are of particular interest here, the Netherlands ranks highest and Finland lowest.

Below, the four countries are compared with regard to unemployment rate.

Table A.3. Eurostat statistics of the unemployment rate. 2011 and 2014.

	2011	2014
European Union (28 countries)	9.6	10.2
Denmark	6.7	6.6
Finland	7.8	8.7
Netherlands	4.4	6.8
Norway	3.2	3.5

Source: Eurostat (2015).

Appendix 3. Plausible skills and average skills

SFI – The Danish National Centre for Social Research, has developed guidelines for the PIAAC Nordic Database[32]. Below we cite a part of the text that refers to the use of the skills variables in the PIAAC database (SFI version: 22. January 2015.)

> In PIAAC, Cognitive Foundation Skills (CFS) are, as mentioned, measured in three domains: Literacy, Numeracy, and Problem Solving with ICT.
>
> Each PIAAC respondent solves a *sample* of tests in an adaptive testing design. The persons typically get diverse combinations of tests, although with some overlap of tests between categories of persons. For each PIAAC respondent with given traits is estimated a *distribution* of CFS within each domain - based on Item Response Theory and multiple imputation methods. From this distribution is randomly drawn 10 so-called *plausible values* (with a value range 0-500). Each PIAAC respondent thus has 30 plausible values (3 times 10) which have been calculated by The International PIAAC Consortium. Based on the plausible values, proficiency estimates (skills in a CFS domain) can be calculated for (larger) groups but, in principle, not for individuals. This design has been chosen to make the testing time short (about 1 hour) for economic and practical reasons - analogous with the reasons behind interviewing a sample of the population rather than the whole population.
>
> The average of the 10 plausible values for a *group* of persons represents an unbiased estimate of the proficiency for the group. This estimate is necessarily, due to the test-design, inflicted with a certain *measurement error,* which has to be estimated. Neither STATA nor other standard programming packages can handle measurements error AND errors due to sampling design and non-response (cf. above) simultaneously, in the same analysis, without additional coding/programming.
>
> Therefore, to analyse PIAAC data with plausible values, special programs are needed, cf. the following which includes programs to handle PISA and PIAAC data. PISA and PIAAC use much the same general methods.
>
> PISA and PIAAC surveys are complex: the samples are not simple random due to explicit design as in PISA, and/or non-response rate, which is high and biased in PIAAC. In PISA and PIAAC databases the complex survey design is indicated with population weights and replicate weights. Both types of surveys measure skills which are estimated with plausible values based on multiple imputation technique. For each respondent with given characteristics, a skills-distribution is estimated. From this distribution is randomly drawn a number of so-called plausible values (e.g. 10 in PIAAC), which are the information (variables) about the respondents' skills in the data from PIAAC. Present standard versions of SPSS, SAS, and STATA cannot, without further programming, calculate unbiased estimates of mean and variance in analyses including plausible values in the context of complex surveys.
>
> Therefore certain special kinds of programs have been developed to handle PISA and PIAAC types of data in the correct way; that is, in a way that ensures correct estimation of variance in particular.
>
> Perhaps the simplest program from a user point of view is The International Database (IDB) Analyzer, which can handle both PISA and PIAAC data. The program is available from International Association for the Evaluation of Educational Achievement (IEA) website.

Although it is recommended that special programs are utilised to analyse PIAAC data with plausible values, for example IDB analyzer, this is not done in this report. When using the tool IDB analyzer, logistic regressions cannot be run, and this report is mainly based on logistic regressions. We have

[32] In this project, the plan was originally to use the Nordic PIAAC database including register data for some of the analyses. This database has not (yet) been open for researchers, so therefore this database could not be used as a source in this report.

checked whether our regression results differ when using different methods/tools and programming, and found that they do not. The use of special programs to handle the plausible values to ensure correct estimates of standard errors and variance, is probably of particular importance when using skills as dependent variable. In this report we include skills as *in*dependent variable.

As mentioned, when using the tool IDB analyzer logistic regressions cannot be run. Through the use of the STATA software it is possible to do extra programming that includes plausible values of skills in the regression in a way that ensures correct estimates of the variance of the skills variables in the same way as IDB analyser. This is very time-consuming when running several regressions and testing different models which is the case for this report. Our tests showed that the differences in results were minor and of no significance (see examples in Table A.5). Consequently, we preferred to use SPSS and our new weight (see Appendix 1).

When it comes to the descriptive values of skills, there are no differences per country in the measurement of average skills when using plausible skills estimates in IDB analyser or STATA, and when calculating the average in SPSS. When using standard SPSS procedure, the standard deviations are, however, estimated too low (see Table A.4 below), compared to the estimates derived by IDB analyser.

Table A.4 shows the results when using plausible skills (the IDB analyzer tool) and calculating average skills by use of standard SPSS*. The mean values for each of the four countries are identical when using the different tools,* however, the standard deviations differ. For each of the four countries the difference in the estimated standard deviations are shown.

For aggregate estimates for groups of countries, we find that the estimated means as well as the standard deviation vary somewhat depending on which of the two methods that are used, see Table A. 3 below. For our purpose, where the individual four countries are of particular interest, and for which the estimates fit well, we find it justifiable to include skills as independent variable in the logistic regression, although the standard deviation on the variable is estimated too low, which might imply that an insignificant effect of skills appears as significant. Our tests when using extra programming in STATA confirm that the method used here gives reliable results (see Table A.5).

Table A.4 also shows the estimated means for the remaining 18 countries in addition to estimated standard deviations. The four countries score higher than the 18-countries group on the different kinds of skills, with one exception. Concerning literacy skills, Denmark does not score higher than the average for the 18-countries group.

Table A.4. Average skills. Employed persons.

	Denmark	Finland	Nether-lands	Norway	Total, four countries	Total, the rest 18 countries	
					New weight (SPSS)**	Full sample weight SPSS	Plausible values, IDB analyser
Numeracy skills*	285.5	289.7	286.9	285.1	286.0	269.0	272.7
Std.dev. SPSS (new weight**, full sample weight)	45.5	45.0	44.5	48.5	46.0	48.6	
Std. deviation. Plausible values for skills (IDB)	48.6	48.4	47.4	51.3			48.1
Literacy skills*	276.6	294.5	289.8	283.4	286.7	276.1	275.3
Std.dev. SPSS (new weight**, full sample weight)	42.1	43.6	42.9	42.6	43.3	43.9	
Std. deviation. Plausible values for skills (IDB)	44.8	46.6	45.5	45.1			44.2
Problem-solving*	285.6	290.7	290.3	289.0	288.9	282.4	282.6
Std.dev. SPSS (new weight**, full sample weight)	38.5	38.4	36.6	36.8	37.6	41.6	
Std. deviation. Plausible values for skills (IDB)	41.4	41.4	39.7	39.2			42.8
Numeracy and literacy combined	281.1	292.1	288.4	284.2	286.4	272.6	
Std. dev. SPSS (new weight** /full sample weight)	42.8	43.0	42.7	44.6	43.5	45.0	

** The new weight for the four countries is based on full sample weight, see Appendix 1, Table A.1.

The problem that the estimated standard deviation is estimated too low also applies to the new variable new variable used in the regression, i.e. a combined measure of numeracy and literacy skills. However, our tests indicate that the mentioned possible bias does not have any particular impact on the regression results (see Appendix 4).

Appendix 4. Comparing results when using different tools

Table A.5. Innovative strategic learner. Results of binomial regressions when using different tools. Finland and Norway used as examples.

Finland	1: Spss. New weight for four countries, based on full sample weight Numeracy literacy combined		2: STATA, full sample weight and 80 replicate weight Numeracy literacy combined		3: Spss. New weight for four countries, based on full sample weight *Only numeracy*		4: STATA, full sample weight and 80 replicate weights. Plausible values for numeracy skills *Only* numeracy	
	B	S.E.	B	S.E.	B	S.E.	B	S.E.
Female	0.300	0.114	0.300	0.116	0.293	0.114	0.296	0.118
Age	-0.003	0.005	-0.003	0.004	-0.003	0.005	-0.003	0.004
Economic sector and work hours								
Manufacturing, mining, electricity, supply	0.152	0.221	0.152	0.219	0.155	0.221	0.153	0.221
Construction	*0.425*	0.253	*0.425*	0.246	*0.429*	0.253	*0.426*	0.246
Sales, transport, support	0.415	0.197	0.415	0.205	0.417	0.197	*0.414*	0.210
Information, communication	0.713	0.277	0.713	0.273	0.713	0.277	0.711	0.278
Finance, estate	0.619	0.314	0.619	0.274	0.622	0.314	0.619	0.278
Professional / Scientific	0.671	0.241	0.671	0.208	0.674	0.241	0.669	0.210
Public administration and defence	0.297	0.278	0.297	0.304	0.297	0.278	0.293	0.306
Education sector	0.181	0.242	0.181	0.234	0.182	0.242	0.179	0.238
Health and Social	0.028	0.233	0.028	0.252	0.027	0.233	0.027	0.256
Work hours	0.010	0.005	0.010	0.005	0.010	0.005	0.010	0.005
Skills								
Numeracy and literacy skills	-0.002	0.002	-0.002	0.002	-0.002	0.002	-0.001	0.002
, no information	-0.116	0.173	-0.116	0.190	-0.132	0.172	-0.134	0.191
Medium problem-solving skills	0.042	0.137	0.042	0.122	0.038	0.134	0.022	0.122
High problem-solving skills	-0.018	0.174	-0.018	0.171	-0.022	0.169	-0.053	0.173
Education level and fields of study (ref. edcat 1+2, and unknown or general field)								
Edcat 3 and 4	-0.028	0.241	-0.028	0.254	-0.031	0.241	-0.037	0.256
Edcat 5 and 6	-0.174	0.284	-0.174	0.321	-0.177	0.284	-0.188	0.323
Edcat 7 (master, higher)	-0.239	0.313	-0.239	0.347	-0.238	0.313	-0.255	0.350
Pedagogy/Teacher	-0.271	0.299	-0.271	0.282	-0.271	0.299	-0.271	0.285
Humanities	0.202	0.278	0.202	0.267	0.192	0.279	0.200	0.267
Social science	0.209	0.207	0.209	0.214	0.208	0.207	0.213	0.215
Science and mathematics	0.229	0.319	0.229	0.336	0.232	0.319	0.233	0.338
Engineering	0.155	0.198	0.155	0.203	0.158	0.198	0.159	0.204
Agriculture and vet.	-0.328	0.354	-0.328	0.290	-0.323	0.354	-0.322	0.289
Health and welfare	0.206	0.242	0.206	0.257	0.203	0.242	0.208	0.260
Services	0.248	0.227	0.248	0.221	0.242	0.228	0.249	0.223

(cont.)

Finland (cont.)	1: Spss. New weight for four countries, based on full sample weight Numeracy literacy combined		2: STATA, full sample weight and 80 replicate weight Numeracy literacy combined		3: Spss. New weight for four countries, based on full sample weight *Only numeracy*		4: STATA, full sample weight and 80 replicate weights. Plausible values for numeracy skills *Only* numeracy	
	B	S.E.	B	S.E.	B	S.E.	B	S.E.
Training								
Obligatory training	-0.045	0.198	-0.045	0.186	-0.047	0.198	-0.044	0.190
Own interest training	0.129	0.165	0.129	0.149	0.126	0.166	0.129	0.150
1-2 days training	-0.245	0.201	-0.245	0.174	-0.241	0.201	-0.246	0.178
3 – 7 days training	-0.043	0.194	-0.043	0.176	-0.041	0.194	-0.046	0.180
8 – 20 days training	0.276	0.197	0.276	0.177	0.275	0.197	0.271	0.182
More than 20 days training	0.056	0.231	0.056	0.195	0.057	0.231	0.055	0.210
Work roles and flexibility/ autonomy								
Brokering, middle	0.532	0.226	0.532	0.217	0.533	0.226	0.530	0.221
Brokering, high	0.951	0.218	0.951	0.202	0.952	0.218	0.947	0.202
Championing, middle	0.204	0.154	0.204	0.142	0.204	0.154	0.203	0.147
Championing, high	0.687	0.162	0.687	0.167	0.686	0.162	0.687	0.169
Information exchange, middle	0.195	0.158	0.195	0.142	0.194	0.158	0.193	0.146
Information exchange, high	0.531	0.148	0.531	0.158	0.528	0.148	0.528	0.162
Independent, middle	0.027	0.157	0.027	0.149	0.025	0.157	0.025	0.149
Independent, high	0.365	0.143	0.365	0.145	0.363	0.143	0.362	0.145
Autonomy/flexibility, middle	*0.283*	0.151	*0.283*	0.168	*0.283*	0.151	*0.283*	0.168
Autonomy/flexibility, high	0.500	0.154	0.500	0.175	0.500	0.154	0.501	0.179
Occupational class. of job (skill based) (ref.= elementary)								
Skilled occupations	1.002	0.312	1.002	0.346	1.003	0.312	0.999	0.347
Semi-skilled white collar occupations	0.764	0.301	0.764	0.355	0.763	0.301	0.761	0.355
Semi-skilled blue collar occupations	0.765	0.319	0.765	0.349	0.763	0.319	0.762	0.349
Unknown	2.082	0.609	2.082	0.598	2.082	0.609	2.083	0.600
Constant	-4.519	0.658	-4.519	0.571	-4.533	0.639	-4.648	0.575
Nagelkerke R Square	0.163				0.163			
No. observations (un-weighted)	3737		3737		3737			
No. observations (weighted)	3488				3488			

(cont.)

Norway	1: Spss. New weight for four countries, based on full sample weight Numeracy literacy combined		2: STATA, full sample weight and 80 replicate weight Numeracy literacy combined		3: Spss. New weight for four countries, based on full sample weight *Only numeracy*		4: STATA, full sample weight and 80 replicate weights. Plausible values for numeracy skills *Only* numeracy	
	B	S.E.	B	S.E.	B	S.E.	B	S.E.
Female	-0.014	0.117	-0.014	0.110	-0.042	0.118	-0.029	0.111
Age	-0.013	0.005	-0.013	0.005	-0.012	0.005	-0.013	0.005
Economic sector and work hours								
Manufacturing, mining, electricity, supply	*-0.470*	0.281	-0.470	0.291	*-0.466*	0.282	-0.460	0.292
Construction	*-0.579*	0.304	*-0.579*	0.318	*-0.561*	0.304	*-0.561*	0.321
Sales, transport, support	-0.112	0.248	-0.112	0.271	-0.104	0.248	-0.101	0.272
Information, communication	-0.051	0.318	-0.051	0.366	-0.032	0.319	-0.040	0.369
Finance, estate	0.180	0.349	0.180	0.369	0.186	0.350	0.189	0.370
Professional / Scientific	0.166	0.290	0.166	0.316	0.179	0.290	0.178	0.318
Public administration and defence	0.038	0.293	0.038	0.321	0.049	0.293	0.045	0.324
Education sector	-0.130	0.289	-0.130	0.281	-0.129	0.289	-0.127	0.281
Health and Social	-0.462	0.283	*-0.462*	0.263	-0.464	0.283	*-0.460*	0.266
Work hours	0.011	0.005	0.011	0.004	0.011	0.005	0.011	0.004
Skills								
Numeracy and literacy skills	-0.004	0.002	-0.004	0.002	-0.005	0.002	-0.004	0.002
, no information	-0.128	0.217	-0.128	0.262	-0.166	0.218	-0.155	0.263
Medium problem-solving skills	0.073	0.158	0.073	0.145	0.122	0.157	0.070	0.149
High problem-solving skills	0.294	0.192	*0.294*	0.175	0.380	0.189	0.289	0.179
Education level and fields of study (ref. edcat 1+2, and unknown or general field)								
Edcat 3 and 4	*0.359*	0.190	*0.359*	0.190	0.375	0.190	*0.368*	0.190
Edcat 5 and 6	0.159	0.224	0.159	0.227	0.188	0.224	0.170	0.228
Edcat 7 (master, higher)	*0.451*	0.238	*0.451*	0.238	0.484	0.238	*0.463*	0.239
Pedagogy/Teacher	-0.210	0.300	-0.210	0.304	-0.206	0.300	-0.211	0.309
Humanities	0.180	0.276	0.180	0.284	0.165	0.276	0.163	0.287
Social science	-0.100	0.219	-0.100	0.225	-0.088	0.219	-0.099	0.226
Science and mathematics	0.308	0.254	0.308	0.246	0.325	0.255	0.311	0.248
Engineering	-0.074	0.211	-0.074	0.228	-0.062	0.212	-0.068	0.234
Agriculture and vet.	-0.197	0.392	-0.197	0.361	-0.190	0.393	-0.197	0.362
Health and welfare	0.068	0.259	0.068	0.285	0.070	0.259	0.068	0.290
Services	-0.143	0.333	-0.143	0.307	-0.155	0.333	-0.155	0.310

(cont.)

Norway (cont.)	1: Spss. New weight for four countries, based on full sample weight Numeracy literacy combined		2: STATA, full sample weight and 80 replicate weight Numeracy literacy combined		3: Spss. New weight for four countries, based on full sample weight *Only numeracy*		4: STATA, full sample weight and 80 replicate weights. Plausible values for numeracy skills *Only* numeracy	
	B	S.E.	B	S.E.	B	S.E.	B	S.E.
Training								
Obligatory training	-0.173	0.259	-0.173	0.300	-0.168	0.259	-0.169	0.301
Own interest training	*0.342*	0.198	0.342	0.233	*0.342*	0.197	0.345	0.233
1-2 days training	-0.194	0.241	-0.194	0.248	-0.200	0.241	-0.201	0.252
3 – 7 days training	-0.066	0.227	-0.066	0.233	-0.075	0.227	-0.073	0.235
8 – 20 days training	0.109	0.229	0.109	0.257	0.098	0.229	0.103	0.257
More than 20 days training	0.568	0.253	0.568	0.230	0.555	0.253	0.563	0.235
Work roles and flexibility/ autonomy								
Brokering, middle	0.007	0.146	0.007	0.132	0.018	0.146	0.011	0.133
Brokering, high	0.400	0.146	0.400	0.163	0.404	0.146	0.405	0.163
Championing, middle	0.287	0.189	0.287	0.221	0.294	0.189	0.283	0.221
Championing, high	0.938	0.194	0.938	0.230	0.939	0.194	0.931	0.231
Information exchange, middle	-0.086	0.209	-0.086	0.188	-0.099	0.210	-0.094	0.189
Information exchange, high	0.374	0.187	0.374	0.179	0.369	0.188	0.369	0.179
Independent, middle	0.176	0.165	0.176	0.161	0.181	0.165	0.178	0.162
Independent, high	0.491	0.150	0.491	0.131	0.502	0.150	0.494	0.131
Autonomy/flexibility, middle	0.371	0.155	0.371	0.147	0.363	0.155	0.365	0.152
Autonomy/flexibility, high	0.669	0.166	0.669	0.187	0.657	0.166	0.660	0.192
Occupational class. of job (skill based) (ref.= elementary)								
Skilled occupations	1.962	0.719	1.962	0.188	2.001	0.719	1.962	0.200
Semi-skilled white collar occupations	1.421	0.717	1.421	0.213	1.452	0.717	1.421	0.220
Semi-skilled blue collar occupations	1.604	0.730	1.604	0.228	1.638	0.731	1.609	0.234
Unknown occup. level	1.944	0.730	1.944	0.213	1.985	0.731	1.947	0.220
Constant	-4.037	0.896	-4.037	0.581	-3.876	0.875	-4.135	0.568
Nagelkerke R Square	0.199				0.201			
No. observations (un-weighted)	3507		3507		3507		3507	
No. observations (weighted)	3569				3569			

The main conclusion is that all the central explanatory variables appear as robust and with the same impact regardless of the tools that are used. Comparing Models 1 and 2 (Table A.5), where the difference refers to that different types of weights are employed, we see that all the coefficients are similar in Models 1 and 2*.* Standard errors differ somewhat, but not enough that the significance level is affected. For Finland, there are no differences. For Norway, *the same variables are significant* at level p<0.05, but there are a few examples where variables that are significant at level p<0.1 in Model 1 are not significant in Model 2, and a few examples of the opposite (in some cases S.E. is larger in Model 2 than in Model 1). The overall cobclusion is that the results are similar in Models 1 and 2, i.e. regardless of types of weights.

Comparing Models 1 and 3, where the only difference between the two models is: In Model 1 ‘numeracy and literacy skills’ is combined in one control variable, and in Model 3 we employ only *numeracy* skills. In Finland there is no difference at all between the results in the two models (1 and 3). In Norway there are minor differences. The isolated (negative) effect of numeracy skills (when controlling for all other variables) is larger in Model 3 than the (negative) effect of ‘literacy and numeracy skills combined (Model 1). This implies for example that the effects of having higher education is increased in Model 3 (for Norway) compared to Model 1. However, in total the results also for Norway are similar in Models 3 and 1.

Comparing Models 3 and 4: When using a model including *plausible values* for skills as a control variable, we had to use *one* of the three types of skills. Here, ‘numeracy skills’ is used (Model 4). In Model 3 ‘numeracy skills’ is used as well, but here run in SPSS as a calculated mean. The two different tools provide overall the same results, the differences are very small and of no practical significance.

Appendix 5. Interaction of skills and work profiles.

Table A.6. Logistic regression of the probability to be an innovative strategic learner, depending on skills and work profiles.*

	B	S.E.
Denmark	0.627	0.079
Finland	0.938	0.080
Norway	0.642	0.081
Female	-0.012	0.059
Age	-0.008	0.002
Manufacturing, mining, electricity, supply	-0.171	0.130
Construction	-0.109	0.153
Sales, transport, support	0.037	0.118
Information, communication	0.374	0.150
Finance, estate	*0.298*	0.161
Professional/ Scientific	0.286	0.140
Public adm. and defence	0.313	0.141
Education sector	0.130	0.138
Health and Social	-0.133	0.133
Work hours	0.016	0.002
Numeracy and literacy skills	0.003	0.002
Problemsolv. skills, no information	-0.104	0.107
Medium problem-solving skills	-0.005	0.077
High problem-solving skills	0.134	0.096
Edcat 3 and 4	0.285	0.107
Edcat 5 and 6	0.280	0.125
Edcat 7 (master, hi.)	0.452	0.137
Pedagogy/Teacher	-0.310	0.144
Humanities	0.060	0.140
Social science	-0.160	0.104
Science and mathematics	0.141	0.128
Engineering	-0.064	0.103
Agriculture and vet.	-0.455	0.187
Health and welfare	-0.049	0.124
Services	-0.320	0.131
Obligatory training	0.033	0.121
Own interest training	0.277	0.099
1-2 days training	-0.182	0.120
3 – 7 days training	-0.060	0.115
8 – 20 days training	0.176	0.115
More than 20 days training	0.321	0.126
High, brokering	2.118	0.398
Skills* High brokering	-0.006	0.001
Championing, high	0.411	0.409
Skills*championing high	0.000	0.001
Information exchange, high	1.264	0.406
Skills*Information exchange, high	-0.003	0.001
Independent, high	0.407	0.396
Skills* independent, high	0.000	0.001
Autonomy/flexibility, middle	0.294	0.078
Autonomy/flexibility, high	0.495	0.081
Skilled occupations	1.262	0.215
Semi-skilled white collar occupations	0.988	0.214
Semi-skilled blue collar occupations	0.880	0.222
Unknown occupation level	1.361	0.255

(cont.)

Table A.6 (cont.)

	B	S.E.
Constant	-6.110	0.517
N (weighted)	14233	
N (unweighted)	15966	
Nagelkerke R Square	0.187	

* Coefficients in bold types are significant at level p<0.05. Coefficients in bold types and italics are significant at level p<0.1.

** See description of education levels in Table 3.3.

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