The Importance of Employment and Training Policies for Lifelong Learning among Low- and High-Skilled VET Graduates: Evidence from PIAAC Cycle 2

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ABSTRACT

This working paper, part of Skills2Capabilities Work Package 6 (Task 6.5), investigates whether employment and training policies (ETP) help explain country disparities in lifelong learning (LLL) participation among vocational education and training (VET) graduates at the upper secondary level (ISCED 3). Using PIAAC Cycle 2 data from 23 OECD countries, we examine three policy domains—Active Labour Market Policies (ALMP), Strictness of Employment Protection (SEP), and Lifelong Guidance Legislation (LGL)—and analyse their associations with nonformal and informal LLL participation. We also assess whether these policies mitigate or reinforce differences in participation between individuals with high and low levels of adaptive problem solving (APS) and numeracy (NUM) skills. As such, it builds on the research of Unterweger & Markowitsch (2024) and Jacobs et al. (2025) that was delivered as part of Work Packages 2 and 6.

Examining direct relationships between policy domains and LLL, we find that higher ALMP training expenditure is associated with greater participation in both nonformal and informal LLL among VET graduates, while SEP and LGL show no clear overall effects. When considering heterogeneous relations by skill level, however, skill differences emerge as important. ALMP training expenditure is linked to higher nonformal LLL participation among higher-skilled graduates (NUM and APS), while SEP for regular contracts widens skill gaps for both skill types and SEP for temporary contracts does so for APS. LGL practitioner qualification requirements also increase nonformal participation among higher-skilled graduates.

Skills2Capabilities, a Horizon Europe study, is about understanding how skills systems need to develop if they are to assist people to make labour market transitions – i.e. between jobs, employers or sectors – and thereby reduce the level of skill mismatch which might otherwise arise.

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In contrast, ALMP training expenditure raises informal LLL mainly among lower-NUM graduates, while SEP for temporary contracts widens NUM-related disparities. Practitioner qualification requirements in LGL reduce APS-related disparities, as entitlement provisions also mitigate NUM-related gaps.

Overall, the findings highlight the need for skill-sensitive, inclusive policy designs to ensure equitable lifelong learning opportunities for all VET graduates.

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Introduction

The workplace is undergoing rapid transformation, driven by several converging megatrends. Automation and the rise of generative artificial intelligence (AI) are reshaping job tasks and skill requirements across sectors (Acemoglu, 2024). At the same time, increased flexibility in work arrangements, the green transition, and demographic shifts—particularly aging populations and migration—are altering the composition and needs of the labour force (André et al., 2024). These changes are not only redefining the nature of work but also intensifying the demand for continuous skill development and lifelong learning (LLL).

Vocational Education and Training (VET) graduates may be particularly exposed to the risks and opportunities posed by these developments. Unlike graduates from general academic tracks, VET graduates typically possess more occupation-specific skills (Brunello & Rocco, 2017). While these skills often provide a better initial match to job requirements and facilitate smoother school-to-work transitions (Hanushek et al., 2017), they are also more vulnerable to obsolescence. Technological change makes VET graduates' specific vocational skills depreciate more rapidly over time (Brunello & Rocco, 2017; Hanushek et al., 2017), and they must therefore retrain or update their skills more frequently to stay employable later in life (Dicks et al., 2024). In contrast, general skills are more transferable across contexts and support further learning (Golsteyn & Stenberg, 2017).

This dynamic places VET graduates at an interesting juncture. On the one hand, they must regularly update their skills to remain employable. On the other hand, empirical evidence consistently shows that VET graduates are among the least likely to participate in adult learning and training (Hanushek et al., 2017; Hornberg et al., 2021; Schwerdt et al., 2012). This paradox raises important questions about the potential policies that influence LLL participation among this group.

Furthermore, cross-country differences in LLL participation are often larger than differences between VET and non-VET graduates within the same country (Jacobs et al., 2025). This highlights the critical role of national employment and training policies (ETP) —such as Active Labor Market Policies (ALMPs), Strictness of Employment Protection (SEP) policies and Lifelong Guidance Legislation (LGL) —in shaping opportunities for skill development.

While targeted policies have been shown to increase participation among vulnerable groups more effectively than broad-based approaches (OECD, 2020a), disparities persist, particularly among VET graduates of differing skill levels (Kilpi-Jakonen et al., 2014). If employment and training policies disproportionately benefit already skilled or active learners, they risk reinforcing existing inequalities (Cunha & Heckman, 2007). Therefore, it is important to assess not only whether these policies promote overall LLL participation but also whether they help reduce skill-based gaps in LLL participation.

To fully understand these dynamics, it is also important to distinguish between nonformal and informal LLL participation. Much of the existing literature that relates ETP to LLL participation focuses on nonformal LLL, typically measured as participation in structured training activities over the past 12 months (e.g. Hornberg et al., 2024; Icardi, 2019). However, informal LLL participation, such as learning-by-doing at work, is also a critical component of skill development, especially for those who may not access nonformal training (De Grip, 2024). Informal learning can serve as a substitute or complement to nonformal training and may be particularly relevant for lower-skilled VET graduates who face barriers to formal participation (Richter et al., 2020). By including informal learning participation, we add to the existing literature.

This working paper addresses two central research questions:

- To what extent is LLL participation among VET graduates linked to differences in employment and training policies at the country level?
- To what extent does the association between employment and training policies and VET graduates' LLL participation vary by skill level?

To address the research questions, we use data from PIAAC Cycle 2 (2022–2023), covering adults aged 16–65 across 23 OECD countries (OECD, 2024). These data contain direct assessments of key information-processing skills (including numeracy and adaptive problem-solving), as well as background data on education, employment, nonformal voluntary job-related training participation, and informal learning participation. Country characteristics on training and employment policies are derived from existing indicators from the OECD and the European Commission (European Commission, 2020; OECD, 2021b, 2022b).

We contribute to the literature in four ways.[i] First, unlike previous studies, we focus on the type of study (VET) within the same educational level (ISCED 3). As Bol and Forster (2025) note, the distinction between study type and educational level is often overlooked, leading to misclassification and confounding effects.

Second, we expand the scope of analysis by including both nonformal voluntary job-training training participation and informal learning-by-doing at work, recognizing that much of workplace learning occurs through daily tasks, interactions, and problem-solving rather than structured programs (De Grip, 2024). Governmental policies are likely to have an indirect effect on informal learning, via an increase in the awareness of learning needs, learning motivation and learning cultures in organisations.

Third, we contribute to an emerging stream of literature looking at cross-national variation in LLL participation due to varying employment and training policies (e.g. Unterweger & Markowitsch, 2024). Desjardins and Ioannidou (2020) provide an overview of literature that links countries' LLL participation to institutional features, such as those related to education, labour market or welfare states. Moreover, they discuss institutional features that are more proximal to adult learning, like open and flexible education structures and active labour market policies. Desjardins and Ioannidou (2020) find that not all ALMPs seem to be equally effective in boosting LLL participation, especially among low educated workers. However, they acknowledge that not all ALMPs aim to actually foster LLL participation, and that the effectiveness of ALMPs is likely to depend on how open and flexible adult learning systems are. In this research, we extend their study by estimating multi-level linear probability regression model (on top of the correlations as presented by Desjardins and Ioannidou

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(2020)), and by also looking into measures related to employment protection and lifelong guidance legislation.

Fourth, we look at the differential role policies may play for LLL participation between VET graduates with different skill levels. Skill levels not only affect participation in LLL (Gauly & Lechner, 2019), but Van Nieuwenhove and De Wever (2021) also suggest that barriers to participation may be different. While targeted policies have been shown to increase participation among vulnerable groups more effectively than broad-based approaches (OECD, 2020b), disparities persist, especially among vocational education and training (VET) graduates of differing skill levels (Kilpi-Jakonen et al., 2014). If employment and training policies disproportionately benefit already skilled or active learners, they risk reinforcing existing inequalities (Cunha & Heckman, 2007).

The remainder of this paper is structured as follows: we begin with a literature overview, followed by a description of the data and methods. This is followed by a description of the results and conclusion and discussion.

Literature overview

Differences in LLL participation between VET and non-VET graduates

Vocational education and training (VET) graduates tend to participate less in training and adult learning activities compared to their generally educated peers (Fouarge et al., 2013; Golsteyn & Stenberg, 2017; Hanushek et al., 2017; Hornberg et al., 2021; Schwerdt et al., 2012; Woessmann, 2018). While earlier studies often conflated education type with level — comparing vocational upper secondary graduates to general tertiary graduates — more recent work isolates the effect of education type within the same level. Studies such as Woessmann (2018), Tobback et al. (2024) and Brunello and Rocco (2017) find that vocationally educated individuals participate less in LLL activities, including on-the-job training and work-related courses. These findings suggest that differences in LLL participation are not solely attributable to educational level, but also to the nature of the educational track itself.

Building on the literature that distinguishes between the type and level of education, cross-country analyses by Jacobs et al. (2025) show that variation in LLL participation among ISCED 3 program graduates is often greater between countries than between VET and non-VET graduates within countries. However, patterns emerge depending on the national prevalence of VET: in countries with a high share of VET graduates, VET graduates tend to participate less in LLL, while the opposite is observed in countries with fewer VET graduates (Jacobs et al., 2025, p. 24). These findings underscore that national context plays a substantial role in shaping outcomes for VET graduates.

How might policies affect individual differences in LLL participation?

National and firm-level employment and training policies can be designed to reduce barriers to LLL participation. Across major theoretical frameworks, barriers to adult learning are understood as multidimensional and mutually reinforcing (Mackeracher et al., 2006; Roosmaa & Saar, 2017). The Theory of Reasoned Action emphasizes that participation depends on behavioural intention, which is shaped by attitudes, social norms, and perceived control; yet intentions frequently fail to result in action because of intervening obstacles (Ajzen, 1980; Ajzen et al., 2018). Cross's Chain-of-Response Model frames these obstacles as a sequential interaction between self-perceptions and external conditions, distinguishing situational, institutional, and dispositional barriers (Cross, 1992; Rubenson & Desjardins, 2009).

Situational barriers stem from broad life circumstances that restrict access to learning opportunities, such as difficulties combining work and childcare, transportation or financial problems, job commitments, and limited support from others. Institutional barriers arise from employer or educational policies on the design, delivery, and administration of learning activities, including the complexity of financial support, lack of resources, negative attitudes toward lifelong learning, and the absence of recognition for prior learning or previously obtained credentials. Dispositional or attitudinal barriers concern individuals' perceptions of their ability to engage in and complete learning activities, including low self-efficacy, negative prior experiences, exam anxiety, and a perceived lack of need for further learning (Cross, 1992; Desjardins & Rubenson, 2013; Mackeracher et al., 2006; Roosmaa & Saar, 2017).

In the Psychosocial Interaction Model of Darkenwald and Merriam (1982), an informational dimension is added, highlighting how limited awareness of opportunities interacts with socio-economic background and childhood experiences to constrain participation, while motivation and social support can mitigate these effects. Rubenson and Desjardins' (2009) Bounded Agency Model further situates these barriers within social, economic, and policy contexts, emphasizing how structural conditions shape dispositions and decisions. Academic barriers, such as insufficient literacy, numeracy, digital competence, and critical thinking skills, might further restrict adults' ability to participate and succeed (Mackeracher et al., 2006).

Together, these perspectives underscore that effective interventions must address not only external conditions but also the attitudinal and skill-based factors that influence individuals' engagement with learning (Mackeracher et al., 2006). Barriers, whether situational, institutional, dispositional, informational, or academic, thus function as constraints on the substantive participation in lifelong learning (Roosmaa & Saar, 2017; Rubenson & Desjardins, 2009).

The development in research on barriers also reflects the reasons behind the implementation of employment and training policies on the governmental level. Traditionally, employment and training policy in industrialized economies emphasized economic returns through labour market alignment (Becker, 1962; OECD, 2019; Unterweger & Markowitsch, 2024), focusing on resolving skills mismatches — both shortages and overskilling (Cedefop, 2010, 2015, 2018). Moreover, their role in enabling civic participation and sustaining democratic societies is recognized (European Parliament and Council, 2006; Unterweger & Markowitsch, 2024). Lifelong learning, therefore, is a multidimensional concept, supporting, amongst others, economic adaptability, social inclusion, and human development.

However, the extent to which lifelong learning is embedded in governmental structures and supported through public policy varies across countries, as research suggests that they vary by the underlying characteristics of their welfare regimes (Roosmaa & Saar, 2017). For example, Lima and Guimarães (2024) distinguish three policy logics, each reflecting different ideological orientations and governance structures. The Democratic-Emancipatory Logic promotes bottom-up, participatory approaches aimed at social justice and empowerment. The Modernisation and State Control Logic relies on centralized state-led initiatives to support economic development and maintain social order. The Human Resources Management Logic treats LLL as a market commodity, focusing on individual responsibility, employability, and alignment with labour market needs (Lima & Guimarães, 2024, pp. 28-30). This suggests that skills should be seen as enhancing individuals' freedom to achieve goals, not merely to provide income, but that the extent to which this multidimensional perspective informs policy varies across countries.

What employment and training policies could influence LLL participation?

A frequently applied measure to increase participation is the introduction of vouchers or other financial incentives aimed at mitigating financial costs, thereby potentially taking away the situational barrier of financial restrictions. However, evidence suggests that the effect of these financial incentives on actual training participation is limited and often results in sizable deadweight loss (Fleuren et al., 2020; Hidalgo et al., 2014; Schwerdt et al., 2012). Another strand of research examines the impact of information provision, either like Wittich (2025), focusing on the general benefits of learning (reducing a dispositional barrier), or like Görlitz & Tamm (2016), specifically related to voucher schemes (reducing an institutional barrier).

Studies have also explored whether factors within the education system relate to differences in adult learning participation, particularly among graduates with varying educational backgrounds. Icardi (2019) shows that general educated graduates participate more in training than vocational educated graduates in the vocational-oriented education system of Germany. This difference was absent in the more general-oriented education system in England, pointing towards institutional differences and therefore also institutional barriers to learning. Moreover, prior research uses retention rates in foundational education, amongst others, as a proxy for early educational system design. Results suggest that systems characterized by early tracking and grade retention are associated with less positive learning attitudes, particularly among lower-achieving students (Lavrijsen & Nicaise, 2017) and may have implicit long-term effects on adult learning via lowering the dispositional barrier.

Both studies suggest that education system factors may contribute to differences in adult learning participation and imply that these differences might align with skill divides in the labour market. In this project, we focus on employment and training policy-related indicators structured by governments and social partners that are directly applicable to VET graduates, actionable, and closely related to training for individuals already in the labour market. Taking the lessons learnt from Icardi (2019) and Lavrijsen and Nicaise (2017), we examine whether there are differing effects by the workers' skill level.

How might policies influence LLL participation and LLL participation disparities by skill level?

Six policy domains are considered, each reflecting institutional, situational, or dispositional factors that may shape adult learning engagement. For each policy, we assess both its general expected effect on LLL participation and its potential to differentially affect individuals based on their skill level. More generally, governmental policies are likely to increase the awareness of learning needs and stimulate learning motivation and learning cultures in organisations. This in itself can already result in more participation in training and informal learning.

Active Labour Market Policies (ALMP)

Active Labour Market Policies (ALMPs) encompass social expenditures aimed at improving individuals' employment prospects and earning capacity, including labour market training and employment maintenance incentives (Kilpi-Jakonen et al., 2014; Lee, 2018). As the latter reduces the risk of layoffs, it creates a more stable environment in which employers might be more likely to invest in on-the-job training.

Training within ALMPs refers to publicly financed measures that improve employability and include a formal instructional component, encompassing institutional training, workplace training, and alternating training (OECD, 2022b). Such policies may reduce institutional barriers to participation by embedding learning within employment contexts (see for an discussion on their effectiveness Lee, 2018). However, the general nature of work-based training may disproportionately attract individuals who are already skilled, potentially reinforcing existing participation patterns (Cunha & Heckman, 2007; Kilpi-Jakonen et al., 2014; Lee, 2018).

Employment maintenance incentives, another ALMP category (OECD, 2022b), target individuals at risk of involuntary job loss due to economic restructuring. These measures may stimulate participation by mitigating situational barriers, such as the threat of unemployment, and alleviating dispositional barriers linked to job insecurity. If effectively targeted, such policies could narrow participation gaps between lower- and higher-skilled individuals, given the greater vulnerability of the former group to job loss (cf. OECD, 2020b).

Strictness of Employment Protection (SEP) policies

Strictness of employment protection (SEP) policies refer to legal and institutional safeguards that make it harder to dismiss employees, thereby encouraging employers to invest in long-term training and skill development (Dieckhoff et al., 2007). SEP policies can promote more equitable access to training, especially for workers on permanent contracts, but may also lead to polarization in LLL opportunities between permanent and temporary employees (Dieckhoff et al., 2007). While SEP policies may incentivize employer-led training, its overall impact on participation remains contested and varies across labour market contexts (Saar et al., 2013).

Employment protection legislation is assessed through two dimensions: protection against individual and collective dismissals, and regulation of temporary contracts (OECD, 2021b). Stricter dismissal protection may encourage employers to invest in the development of their existing workforce, thereby increasing LLL participation. For individuals, enhanced job security may reduce psychological barriers to engaging in learning. However, as protected employment is often associated with higher skill levels, such regulation may exacerbate participation disparities (Dieckhoff et al., 2007; Lee, 2018).

In contrast, stricter regulation of temporary contracts may include provisions for training rights (OECD, 2021b), thereby lowering both institutional and situational barriers to participation. Since lower-skilled individuals are more likely to hold temporary contracts (Ferreira Sequeda et al., 2018), such policies may promote more equitable participation across skill levels.

Lifelong Guidance Legislation (LGL)

Legislation regarding career guidance further structures access to learning and skill development opportunities (European Commission, 2020), possibly enabling more participation. Lifelong guidance legislation is considered in two respects: citizens' entitlement to career guidance and the legally defined qualifications of career practitioners (European Commission, 2020). Entitlement legislation can establish the scope and quality of guidance services, potentially reducing institutional barriers and enhancing motivation through improved awareness of training opportunities. However, if the legislation remains broad and non-specific, participation may continue to reflect existing disparities (European Commission, 2020, p. 9; OECD, 2020b).

In contrast, the formal qualification of career practitioners may improve service quality, thereby addressing dispositional and institutional barriers. If practitioners are equipped to tailor guidance to diverse learning needs, this may enhance participation among lower-skilled individuals and reduce skill-based disparities.

Data and methods

Data

This study utilizes cross-national data from the second cycle of the Programme for the International Assessment of Adult Competencies (PIAAC-II), the largest international survey on adult skills, conducted between 2022 and 2023. The dataset comprises a representative sample of adults aged 16 to 65 across 31 participating countries. Our final analytical sample is restricted to 23 countries due to data limitations. Specifically, Austria, Denmark, Italy, Norway, and Sweden were excluded due to access restrictions; Ireland and the United States are excluded from the analysis because at the upper secondary (ISCED 3) level there are no VET graduates[ii]; and Singapore lacked variation in nonformal voluntary job-training participation among ISCED 3-level VET graduates. The analysis focuses on employed individuals aged 25 and older, excluding those currently enrolled in formal education.

PIAAC-II assesses adult competencies in three domains: literacy, numeracy and adaptive problem-solving skills, of which we use the latter two. We used the comprehensive background questionnaire to include socio-demographic and educational characteristics. As noted before, the type (VET versus general) and level of education are often conflated, resulting in many studies that cannot clearly distinguish between vocational versus general education and upper secondary versus tertiary education (Bol & Forster, 2025). PIAAC-II offers a unique opportunity to disentangle these dimensions. In our main analyses, we focus on respondents who hold an upper secondary qualification, classified as ISCED level 3 in the UNESCO ISCED 2011 framework, and who graduated from a VET programme within this educational level.

To capture the employment and training policies, additional indicators were incorporated from external sources: Active Labour Market Policies and Employment Protection Legislation from the OECD database (OECD, 2021b, 2022b), and Lifelong Guidance Legislation from the European Commission (2020), supplemented with other sources for the Flemish Community (Belgium), Canada, Chile, Israel, Japan, South Korea, and New Zealand, which were not covered in the European Commission publication (see Measurements section and Appendix 1). Country-level controls include employment among ISCED 3 and 4 (sourced from the OECD database) and the share of VET graduates, derived from PIAAC-II itself (see also Measurements).

Measurements

LLL participation

To capture lifelong learning, we include indicators for both non-formal and informal LLL participation. Non-formal LLL participation is measured by respondents' participation in voluntary job-related training activities during the 12 months preceding the survey. Participants were instructed to consider a range of formats, including courses, webinars, workshops, lectures, and private lessons. By using a follow-up question on the reason for the training, we exclude obligatory training because the amount of obligatory training does not reflect intent, which could misattribute LLL participation to ETPs. Responses were coded dichotomously: participation (=1) or no participation (=0). Informal LLL is assessed through self-reported frequency of informal learning-by-doing at the workplace, of which the answer 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, 5) every day. We choose to indicate categories 4 and 5 as informal learning-by-doing (=1) and categories 1, 2 and 3 as not (=0). We provide descriptive statistics later in the paper (Table 2).

Employment and Training Policy Indicators

Active Labour Market Policies (ALMP)

We use indicators from the OECD on public spending on labour market programmes (OECD, 2022b), which measure government expenditure on policies designed to support jobseekers and improve labour market outcomes.

- We use the expenditure as a share of GDP on training and maintenance incentives (European Commission, 2018).
    - Training expenditure: captures the total intensity of publicly financed employability-enhancing training by summing institutional training, workplace training, and alternating training. It therefore reflects all measures that include a formal instructional component, regardless of whether they occur mainly in classrooms, in workplaces, or in mixed settings.

- Maintenance incentives expenditure: Employment maintenance incentives are measures providing incentives to maintain the employment of persons at risk of involuntary job loss due to restructuring or other economic difficulties.

Strictness of Employment Protection (SEP) policies

We look at two aspects of strictness of employment protection (OECD, 2021b) that are expressed on a 0–6 scale, where higher numbers indicate stricter regulation. This indicator only has data for 22 of the 23 countries: for Croatia, this information is lacking.

1. Employment Protection for Regular and Collective Dismissals. This is a composite measure that combines the rules for individual (EPR) and collective (EPC) dismissals, giving an overall score for protection in regular employment.
2. Employment Protection for Temporary Contracts. This is a regulation of temporary employment, including fixed-term and agency work contracts, reflecting how easily these contracts can be used.

Lifelong Guidance Legislation (LGL)

We use the characterisation of Lifelong Guidance Legislation across countries as published by the European Commission (2020). We look at two types of legislation: 1) citizens' entitlement to lifelong career guidance, and 2) legally defined qualifications of career practitioners. Whether countries belong to a type is based on a review of legislation and expert interviews (European Commission, 2020). However, it includes only 17 of the 23 countries we use in our analysis.

We extended the information from the European Commission (2020) based on additional information. In the Flemish Community (Belgium), Canada and Israel, there is no legal citizen entitlement to career guidance, but both have well-established practitioner qualification frameworks (Benjamin et al., 2011; Cedefop, 2020; OECD, 2022a). Chile and Japan lack both entitlement and qualification standards (OECD, 2015, 2021a; Ogawa, 2015). South Korea provides students with a legal entitlement under the Career Education Act, though practitioner standards are less formalized (OECD, 2020b). New Zealand combines student entitlement with structured practitioner standards embedded in legislation and national frameworks (Tertiary Education Commission, 2024).

Skill measures

PIAAC-II assesses adult skills in literacy, numeracy, and adaptive problem solving. We use numeracy and adaptive problem solving. While numeracy remains unchanged from the first cycle, adaptive problem solving was newly introduced to reflect evolving skill demands. Skills are measured on a scale from 0 to 500 using Item Response Theory. Each domain is represented by ten Plausible Values (PVs) per respondent. These skills are broadly applicable to both work and everyday life.

Control variables

Our analyses include the following control variables at the individual level: age group, sex, migration background, parental education, working hours, and contract type. Age is categorized into four groups: 25–34, 35–44, 45–54, and 55–65 years. Sex is coded as male (0) and female (1). Migration background is classified into four categories: first-generation immigrants, second-generation immigrants, individuals with no first- or second-generation background, and those with one foreign-born parent but not classified as immigrants. Working hours distinguish between part-time (<32 hours per week) and full-time (≥32 hours per week) employment. Contract type differentiates between permanent and fixed-term contracts.

Country-level control variables

Employment rate

We look at the employment shares at upper secondary vocational education and vocational upper secondary or post-secondary non-tertiary education, derived from OECD (2025). When the ALMP policies for the unemployed work, the pool of employed people is larger and more diverse by skill, making ALMP policies that focus on training workers applicable to more, and a wider range of workers. The employment data for ISCED 3 and 4 had better country coverage in the OECD database (2025). However, the employment rates for countries that covered both ISCED 3 and ISCED 3 and 4 rates did not differ substantively, leading us to choose rates with better country coverage.

Share of VET graduates at the ISCED3 level

We take into account the share of VET graduates at the country level. The education system – for example, the dual system in Germany or Switzerland combines classroom learning with work-based learning – determines the number of VET graduates (OECD, 2023). As mentioned earlier, the behaviour of VET graduates on their LLL participation does then vary due to the number of VET graduates and the country's education system (Jacobs et al., 2025). In all, we are able to distinguish the policy correlates of LLL participation from the education system correlates of LLL participation. We derive these percentages by aggregating the weighted PIAAC-II data to the country level.

Table 1 presents the descriptives of the country-level variables in our analyses. In Table 2, we describe the individual-level variables in our analysis.

Table 1. Values of the national employment and training policy indicators and country-level control variables

Country	ALMP		SEP		LGL			
	Training expenditure	Employment maintenance incentive expenditure	Regular contacts	Temporary contracts	Entitlement	Teacher qualifications	VET share	Employment rate
Flemish Community (Belgium)	0.155	0.059	2.71	1.89	No	Yes	79.15	75.62
Canada	0.047	0.001	1.68	0.44	No	Yes	14.28	82.19
Chile	0.027	0	2.34	2.07	No	No	43.03	74.68
Croatia	0.018	0	*	*	No	No	94.93	72.88
Czechia	0.003	0	3.03	2.01	No	Yes	93.54	83.14
Estonia	0.127	0	1.93	2.49	Yes	Yes	48.76	81.36
Finland	0.28	0	2.48	1.61	Yes	Yes	78.42	78.90
France	0.124	0	2.68	2.58	Yes	Yes	75.98	74.33
Germany	0.117	0	2.33	1.67	Yes	No	95.94	84.44
Hungary	0.003	0	1.89	1.62	No	No	82.36	84.83
Israel	0.045	0	2.83	1.48	No	Yes	31.85	81.14
Japan	0.012	0.184	2.08	1.35	No	No	36.68	82.28
Korea	0.067	0.032	2.35	2.19	Yes	No	40.78	72.47
Latvia	0.019	0	2.71	1.70	Yes	Yes	59.59	76.59
Lithuania	0.057	0	2.24	1.72	Yes	No	57.67	74.97
Netherlands	0.037	0.122	2.88	1.48	No	No	78.21	85.92
New Zealand	0.084	0.070	2.09	1.02	Yes	Yes	34.51	85.57
Poland	0.006	0	2.39	1.80	Yes	Yes	85.89	75.07
Portugal	0.155	0.050	2.87	2.29	Yes	Yes	28.48	85.64
Slovak Republic	0.006	0.001	2.33	2.24	No	No	94.25	80.63
Spain	0.105	0.032	2.43	2.47	Yes	No	42.78	74.96
Switzerland	0.123	0	1.61	1.16	Yes	Yes	85.13	84.34
United Kingdom	0.004	0	1.90	0.41	Yes	No	50.47	78.41

*Note: An * denotes that information was not available for that country.*

Table 2. Individual-level characteristics by country

	LLL participation		Skills		Gender		Age categories				Migration background			Parental education				Contract type		Working hours	
	Voluntary job-related training	Learning-by-doing	Adaptive problem solving	Numeracy	Women	Men	25-34	35-44	45-54	55 plus	1st	2nd	non	one foreign born parent	ISCED 0 to 2	At least one parents has ISCED3 or 4	At least one parent has ISCED 5 to 8	Temporary	Permanent	< 32 hours	>= 32 hours
Canada	36.51	63.64	254.75	265.26	37.64	62.36	26.34	25.84	22.94	24.87	3.49	0.97	90.86	4.69	32.48	41.27	26.25	9.94	90.06	0.00	100.00
Chile	31.56	67.77	213.54	214.98	44.08	55.92	29.96	35.41	21.77	12.85	5.79	0.04	93.33	0.85	49.87	40.51	9.63	19.25	80.75	23.60	76.40
Croatia	9.92	24.52	233.89	252.92	43.76	56.24	21.06	28.09	28.96	21.89	7.34	3.51	83.29	5.85	29.96	60.10	9.95	6.82	93.18	4.37	95.63
Czechia	25.08	46.30	244.83	264.33	40.41	59.59	17.09	26.42	35.15	21.34	2.68	1.18	88.72	7.42	3.54	84.73	11.74	15.28	84.72	12.38	87.62
Estonia	30.82	38.98	236.82	253.84	30.70	69.30	16.73	21.73	29.80	31.74	7.78	10.93	67.74	13.55	25.72	50.52	23.76	*	*	4.79	95.21
Finland	43.38	60.28	265.40	276.80	37.73	62.27	22.40	24.88	21.58	31.13	6.66	0.00	92.06	1.27	30.05	56.38	13.56	10.32	89.68	15.19	84.81
Flemish Community (Belgium)	34.14	52.24	251.86	264.76	37.19	62.81	24.75	26.09	27.61	21.56	7.96	2.62	85.79	3.63	35.54	47.65	16.80	6.62	93.38	18.57	81.43
France	23.57	55.87	234.52	242.80	41.65	58.35	19.65	27.90	30.57	21.88	8.27	7.34	76.44	7.95	45.17	43.65	11.18	11.76	88.24	14.44	85.56
Germany	27.49	48.89	253.39	263.86	43.92	56.08	16.24	24.28	28.33	31.15	14.56	6.23	66.76	12.45	10.99	64.21	24.80	*	*	10.18	89.82
Hungary	9.04	27.99	226.30	241.18	39.10	60.90	13.75	21.57	38.83	25.85	4.82	0.38	92.43	2.37	31.61	59.64	8.75	*	*	11.24	88.76
Israel	19.56	50.41	218.37	224.49	42.69	57.31	20.57	23.79	32.74	22.90	19.15	34.40	31.51	14.94	40.33	35.34	24.33	8.99	91.01	19.68	80.32
Japan	18.60	31.24	265.90	281.74	37.96	62.04	17.66	21.35	33.42	27.57	0.18	0.00	99.50	0.32	27.59	48.71	23.70	16.89	83.11	6.86	93.14
Korea	5.49	22.78	223.98	239.22	41.28	58.72	11.46	19.00	36.99	32.55	0.28	0.16	99.33	0.23	70.76	25.48	3.76	32.84	67.16	17.85	82.15
Latvia	24.49	37.54	229.50	249.92	39.23	60.77	16.36	21.10	32.19	30.36	6.80	9.08	65.65	18.47	20.03	62.33	17.64	7.08	92.92	7.51	92.49
Lithuania	13.75	14.75	224.86	236.01	36.41	63.59	23.49	23.59	31.28	21.64	2.59	2.11	86.99	8.32	26.58	50.58	22.85	3.76	96.24	7.69	92.31
Netherlands	37.49	54.68	262.07	275.18	44.84	55.16	23.97	25.07	29.29	21.67	9.41	3.01	83.55	4.03	43.84	40.36	15.81	17.09	82.91	33.88	66.12
New Zealand	49.81	63.65	260.50	263.83	48.67	51.33	25.71	28.88	26.87	18.54	25.46	12.20	51.10	11.24	31.62	31.35	37.03	6.71	93.29	27.84	72.16
Poland	9.87	12.08	225.47	235.82	34.56	65.44	21.11	28.26	29.74	20.89	0.24	0.29	99.06	0.41	20.41	77.09	2.51	9.19	90.81	2.45	97.55
Portugal	33.34	82.23	249.63	254.66	46.11	53.89	33.80	34.85	18.86	12.49	18.51	2.64	74.58	4.28	68.23	20.74	11.03	23.59	76.41	10.53	89.47
Slovak Republic	16.62	32.04	246.39	260.04	43.05	56.95	21.77	30.37	29.41	18.45	1.25	0.03	95.20	3.52	13.78	77.23	8.99	11.07	88.93	7.22	92.78
Spain	35.10	58.50	240.40	249.06	41.42	58.58	21.58	29.44	31.19	17.79	18.12	0.15	80.26	1.47	61.97	18.95	19.08	*	*	18.44	81.56
Switzerland	28.28	56.72	253.05	269.98	48.24	51.76	24.01	24.06	24.98	26.94	22.32	9.54	58.61	9.53	18.57	62.38	19.05	*	*	11.31	88.69
United Kingdom	41.41	59.49	253.56	260.38	51.08	48.92	23.09	22.90	27.23	26.78	6.40	3.38	85.66	4.56	29.64	53.85	16.50	5.15	94.85	10.91	89.09
Total	22.75	41.48	244.31	256.00	**41.35**	**58.65**	**19.12**	**25.21**	**30.37**	**25.30**	**6.88**	**3.24**	**84.56**	**5.32**	**28.57**	**56.03**	**15.40**	**13.53**	**86.47**	**11.09**	**88.91**

*Note: An * denotes that information was not available in PIAAC for that country. In further analyses, a missing dummy is included to take this into account.*

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Methods

First, we present correlations between employment and training policies at the country level and their association with participation in nonformal and informal LLL participation among VET graduates across OECD countries. Furthermore, we show figures in which we report differences in LLL participation by skill level for each country.

To assess whether these bivariate associations hold, we perform multi-level linear probability regression model (LPM) analyses. We estimate models separately for nonformal voluntary job-related training participation in the past 12 months as well as the informal learning-by-doing at the workplace indicator. After selections on countries and VET graduates, we are left with 19,062 VET graduates across 23 countries, except for the analyses with regular and temporary contracts, which are based on 17,647 VET graduates across 22 countries. After listwise deletion on the variables included in the analyses, 18,944 and 17,534 cases remain, respectively.

Following Jerrim et al. (2017), we use the first plausible value for simplicity in our multi-level models, given that relational inference analyses can validly use a single PV without compromising the accuracy of point estimates. In all multi-level analyses, we use restricted maximum likelihood (REML) estimations. REML yields less biased variance component estimates, particularly with relatively few level-2 clusters, i.e. countries (Elff et al., 2021). Note that this is cross-sectional data, meaning that strict causal interpretation is not possible.

In the first model, we explore the association between the employment and training policy and participation in LLL. In the second model, the skill is included, which is cross-level interacted with the employment and training policy measure in the third model. The fourth model runs this moderation with two country-level control variables: the share of VET graduates in a country and the percentage of employment among ISCED 3. Those models are shown in Appendix 3. In the main text, we present the fourth model for each policy-skill-LLL participation combination.

In the multi-level analyses, we applied mean-centring to the skill score and the policy indicators (for those that are continuous variables). This method involves subtracting the sample mean for each observation. As a result, the mean of these mean-centred variables is zero. As we assume that there is a linear relationship between the LLL participation, policy (if continuous), and skills, the coefficients can be interpreted as the percentage-point change in nonformal voluntary job-related training participation or informal learning-by-doing by each one-unit change of the policy indicator.

Results

1. **Association between training policy indicators and LLL participation**

In Table 3, the weighted correlations between the training policy indicators and LLL participation are shown. First, the correlations between the training policy indicators vary: between regular contract protection and temporary contract protection it is the highest (.696), while between the entitlement of lifelong guidance and temporary contract protection it is the lowest (.022). Second, only the ALMP employment maintenance expenditure seems to correlate negatively with the other policy indicators. For the rest of the indicators, it holds that if there is, for example, a high expenditure on training in that country, there is also more often better contract protection and lifelong guidance legislation among VET graduates.

Third, we find only small to moderate associations between the training policy indicators and the LLL participation of VET graduates. The highest association is observed between ALMP training expenditure and informal LLL participation (.189), while regular contract protection is not significantly associated with nonformal LLL participation. The same holds for temporary contract protection and informal LLL participation. The correlation between nonformal and informal LLL participation is significantly positive (.171) and indicates that both LLL participation types are complementary.

Table 3. Weighted pairwise correlations between the employment and training policies and LLL participation.

	Training expenditure (ALMP)	Employment maintenance expenditure (ALMP)	Regular contacts (SEP)	Temporary contracts (SEP)	Teacher Qualifications (LGL)	Entitlement (LGL)	Nonformal LLL participation
Employment maintenance (ALMP)	-0.325***						
Regular contacts (SEP)	0.233***	-0.249***					
Temporary contracts (SEP)	0.396***	-0.269***	0.696***				
Teacher Qualifications (LGL)	0.091***	-0.361***	0.459***	0.392***			
Entitlement (LGL)	0.519***	-0.616***	0.022***	0.176***	0.222***		
Nonformal LLL participation	0.088***	-0.025***	-0.005	-0.083***	-0.040***	0.019***	
Informal LLL participation	0.189***	-0.070***	0.043***	-0.007	-0.029***	0.033***	0.171***

Note: correlations are based on 19062 VET graduates across 23 countries, except for the correlations with regular and temporary contracts, which are based on 17647 VET graduates across 22 countries.

2. Skill disparities across countries

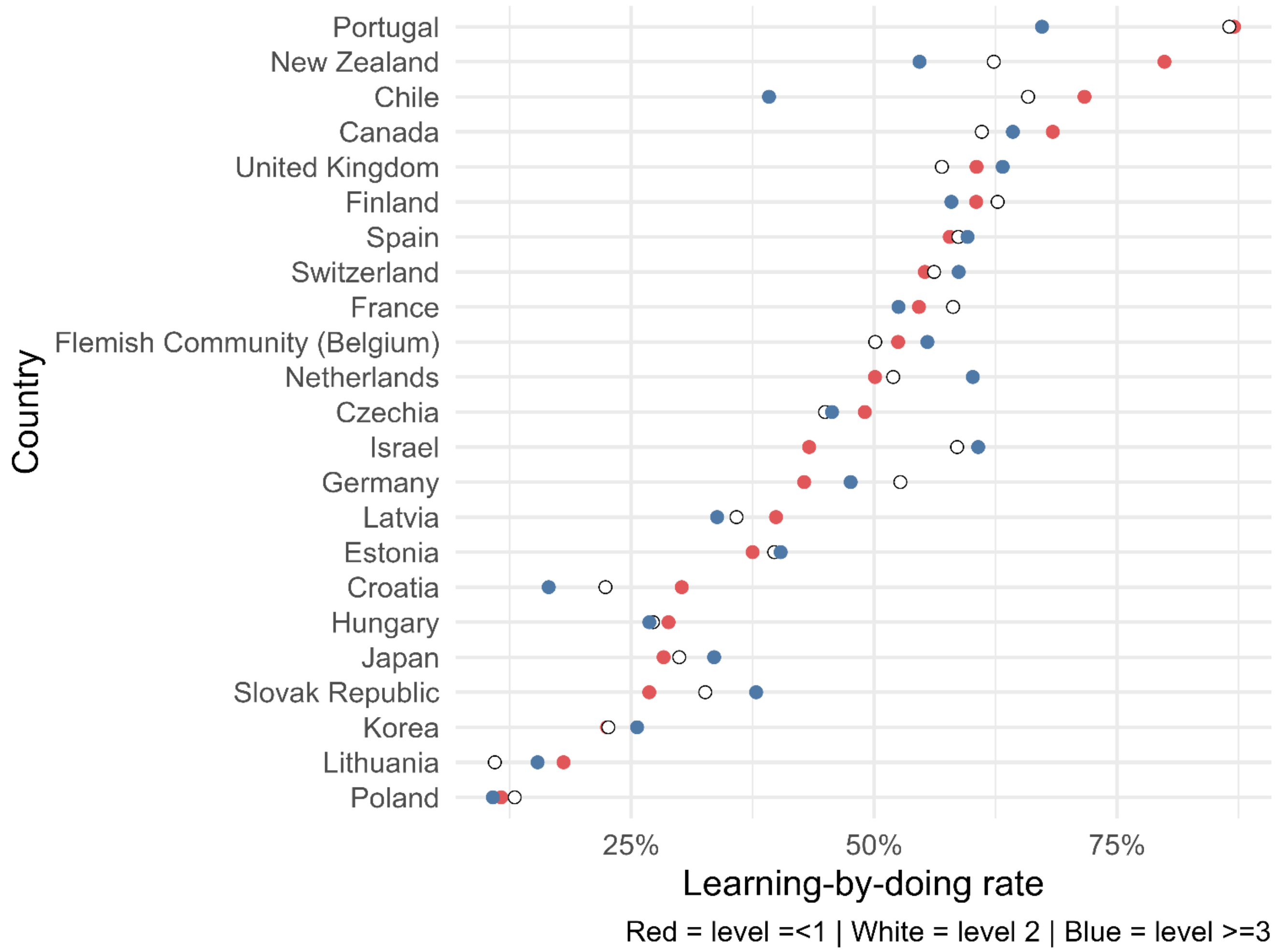
In Figure 1, the average nonformal voluntary job-related training participation rates (nonformal LLL participation) of VET graduates are plotted for each country by APS group. For ease of visualisation, we use the PIAAC proficiency skill groups. As we only look at ISCED 3 level VET graduates, the distribution over the PIAAC APS skill groups is skewed towards the middle categories; therefore, we take the "below level 1" and "level 1" together and the "level 3", "level 4" and "level 5" together. First, we observe that nonformal voluntary job-related training participation is most often higher for those VET graduates in skill group 3 or higher than those in group 1 or lower. Second, there is considerable variation in both the level of participation and the gaps between low- and high-skilled VET graduate groups. Compare, for example, France and Spain. Third, for most countries, the skills seem to be linearly related to LLL participation. Though not in all countries, the order of skill groups and nonformal voluntary job-related training participation is the same: in Croatia and Canada, the level 2 skill group has a slightly lower rate.

For informal learning-by-doing, we observe a less pronounced difference between skill groups (see Figure 2). However, more so than for nonformal voluntary job-related training participation, the higher skilled groups do not necessarily learn more in an informal way. Similarly to nonformal voluntary job-related training participation, there are considerable differences between countries in the skill groups' informal LLL participation rates.

The figures for numeracy skills can be found in Appendix 2 and show similar tendencies.

Figure 1. Nonformal voluntary job-related training participation for APS proficiency groups by country

Figure 2. Informal learning-by-doing for APS proficiency groups by country



3. Main model results: linear probability model

In this section, we investigate the associations between LLL participation, policy indicators, and adaptive problem solving (APS) skills by estimating multi-level Linear Probability Models (LPM). The results are presented as follows: first, we will present the results for nonformal voluntary job-related training participation in the last 12 months in Table 4. Second, we present the results for informal learning-by-doing in Table 5. In these tables, we only present interaction models; results of the associations between policy indicators and LLL participation, and between skill and LLL participation, are presented in Appendix 3. We also estimated the same models for numeracy skills; for reasons of brevity, these are presented in Appendix 3 too.

3.1 Nonformal voluntary job-related training participation

Before running our interaction models, we have estimated APS skills' associations with LLL participation (Model 2 in the tables in Appendix 3). In those models, regardless of policy indicator, we observe a significant association between APS skills and nonformal voluntary job-related training participation. An increase of the APS score of 50 points (one PIAAC skill level) is associated with a 5 percentage-point increase in nonformal voluntary job-related training participation (e.g.

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Model 2 in Panel B of Appendix Table A3.1). In all, this suggests that VET graduates at the ISCED3 level with, on average, higher APS skill levels compared to similar peers, participate more in nonformal training activities in the last 12 months, congruent with earlier research.

3.1.1 Active Labour Market Policies (ALMP)

Table 4 presents the associations between the policy indicators, skills, and nonformal training participation in the last 12 months for VET graduates at the ISCED 3 level. When interpreting the coefficients for the ALMP indicators, it is important to keep in mind that the range of GDP expenditures extends from 0.003 to 0.280% (de-meaned: -0.054 to 0.223%) for ALMP training expenditure and spans from 0 to 0.184% (de-meaned: -0.012 to 0.172%) for employment maintenance incentives expenditure.

We find a significant association between the percentage of GDP expenditure on ALMP training expenditure and nonformal voluntary job-related training participation: a 0.01 percentage point higher expenditure on training is associated with a 0.0086 percentage point higher nonformal voluntary job-related training participation rate (see Model 1 in both panels in Appendix Table A3.1). Moreover, we find a statistically significant positive interaction term of APS skills and ALMP training expenditure with nonformal training. This means that the ALMP training expenditure association with nonformal voluntary job-related training participation is stronger, the higher the APS skill level. We similarly find a statistically significant interaction term for numeracy and ALMP training expenditure (see Table A3.1 in Appendix 2, Panel A, Column 4).

Figure 3 shows the association between ALMP training expenditure and nonformal voluntary job-related training participation for different levels of APS: one standard deviation below the mean (-1SD) and one standard deviation above the mean (+1SD).[iii] It shows that for higher APS skill levels, the slope of the association between the percentage of GDP expenditure on ALMP training is steeper for those one standard deviation above the mean, than for those one standard deviation below the mean.

For spending on employment maintenance incentives expenditure, we do not find an effect on nonformal voluntary job-related training participation, nor a differential association by the VET graduates' skill level.

Table 4. Main model estimation results for nonformal voluntary job-related training participation

	ALMP		SEP		Typology	
	Training expenditure	Employment maintenance incentives expenditure	Regular contracts	Temporary contracts	Entitlement	Qualifications
Policy indicator	0.685**	-0.112	0.008	-0.030	0.051	0.041
	(0.269)	(0.512)	(0.059)	(0.043)	(0.043)	(0.043)
Adaptive problem solving score	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Policy indicator*Adaptive problem solving score	0.004***	-0.001	0.0005**	0.0003**	0.0002	0.001***
	(0.001)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	-0.287	-0.332	-0.211	-0.099	-0.411	-0.293
	(0.332)	(0.005)	(0.172)	(0.172)	(0.168)	(0.385)
var(_cons)	0.00733	0.0104	0.0105	0.0104	0.00959	0.00988
sd	0.00162	0.00162	0.00360	0.00358	0.00321	0.00162
var(Residual)	0.157	0.157	0.163	0.163	0.157	0.157
sd	0.00250	0.00347	0.00174	0.00174	0.00162	0.00331
Log Likelihood	-9469	-9478	-9094	-9095	-9482	-9477
ICC	0.0445	0.0618	0.0604	0.0601	0.0574	0.0591
Joint Significance	1.65e-05	0.752	0.0495	0.118	0.146	0.00176
Observations	18,944	18,944	17,534	17,534	18,944	18,944
Number of groups	23	23	22	22	23	23
Individual level control	YES	YES	YES	YES	YES	YES
Country level control	YES	YES	YES	YES	YES	YES

*Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.*

Controls include age categories, gender, migration background, parental education, working hours and contract type.

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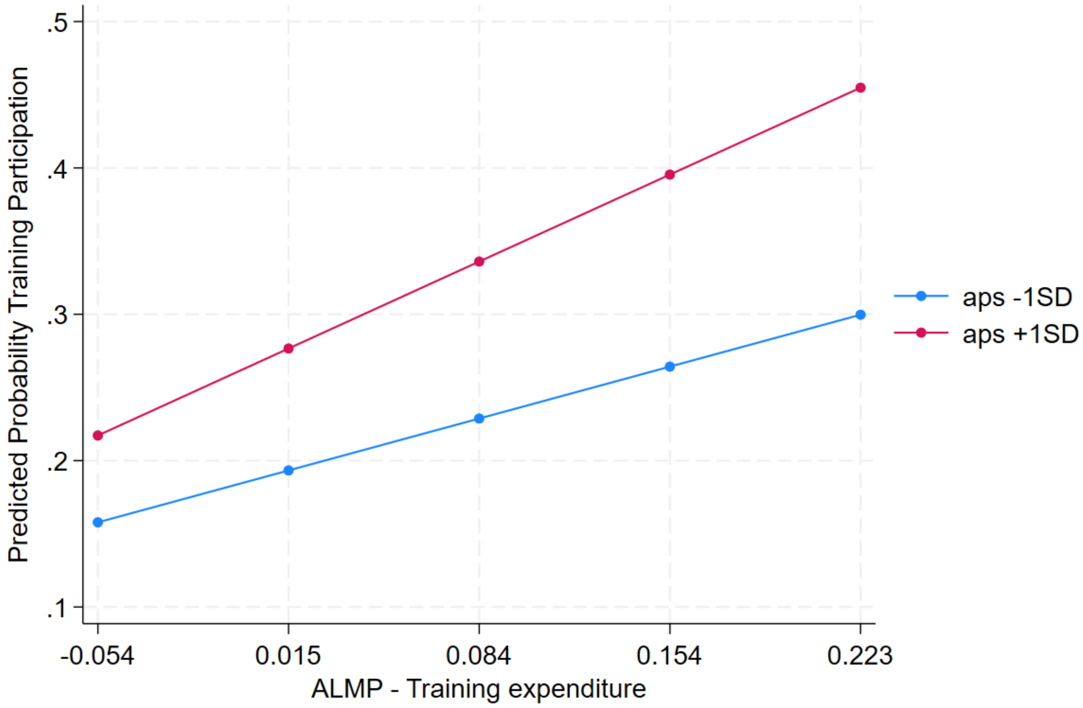
Figure 3. Margins plot nonformal voluntary job-related training – ALMP training expenditure



3.1.2 Strictness of Employment Protection (SEP) policies

The third and fourth column in Table 4 present the results for the employment protection legislation (SEP) scores. It should be noted that the SEP scores range from 0 to 6 and that the observed range spans from 1.61 to 3.03 (de-meaned: -0.76 to 0.66) for regular contracts and from 0.41 to 2.58 (de-meaned: -1.40 to 0.77) for temporary contracts. Also, it should be kept in mind that an increase of one score point is equivalent to 17% of the maximum score.

We find no significant main association between SEP and nonformal voluntary job-related training participation, neither for regular and collective dismissals nor for temporary contracts (see Column 1 and 5 in Panel B in Appendix Table A3.2). However, we see a significant and positive heterogeneous association between both SEP scores and nonformal LLL by APS skill level. We do find a similar association for numeracy and SEP for regular contracts-scores (see Table A3.2 in Appendix 2, Panel A, Column 4).

Figure 4a and 4b show the interaction effects with APS skill. For SEP for regular contracts, the results show a diverging pattern: there is a positive association between the stringency of the SEP for regular contracts and nonformal voluntary job-related training participation for VET graduates with a standard deviation above the APS skill mean, while it is negative association for the those whit a standard deviation below the APS skill mean (see Figure 4a). The results of SEP for temporary contracts imply that, for higher APS skilled VET graduates, the association between the protection of temporary contracts and nonformal voluntary job-related training participation is less negative than for lower APS skilled VET graduates (see Figure 4b).

Figure 4a. Margins plot nonformal voluntary job-related training – SEP for regular contracts

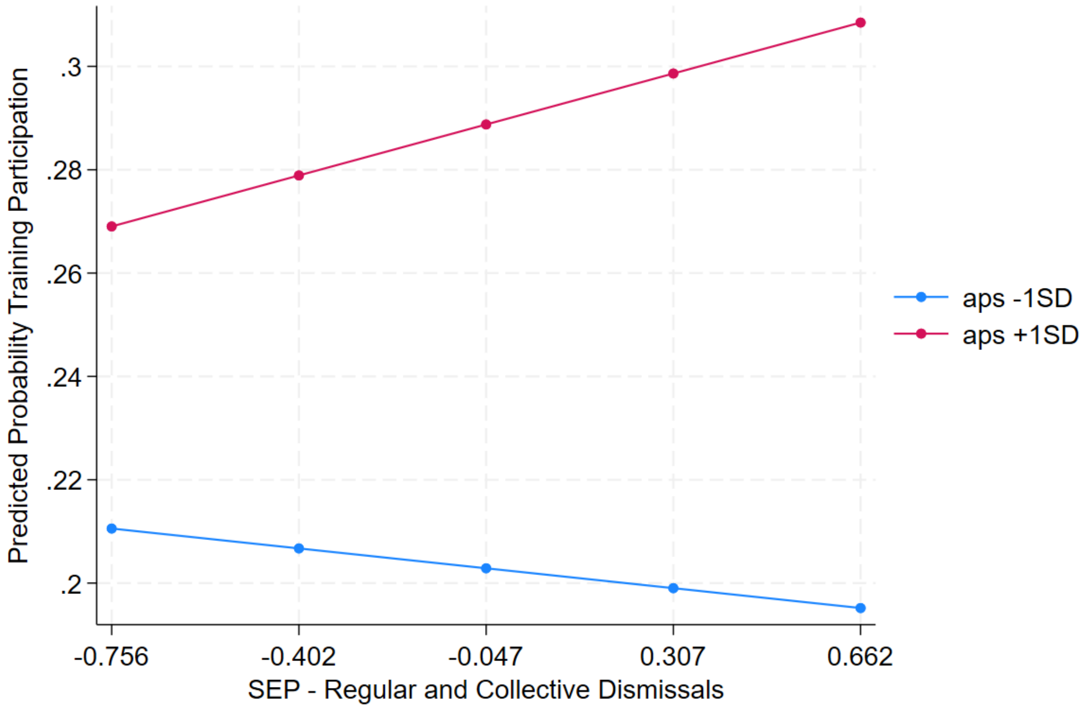
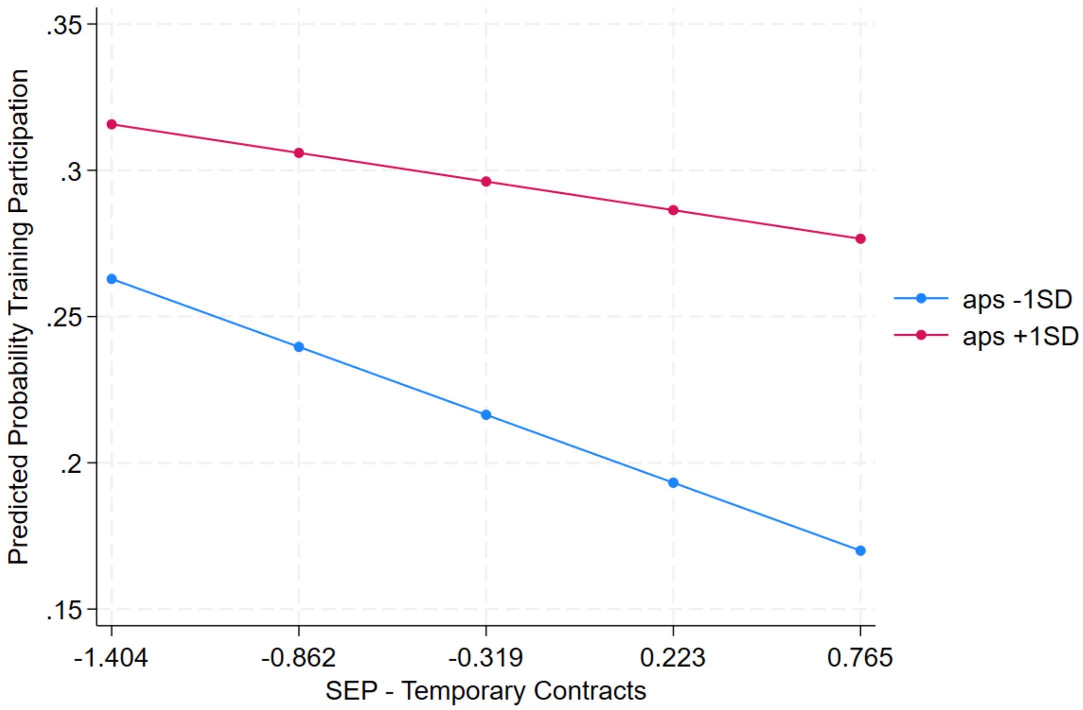


Figure 4b. Margins plot nonformal voluntary job-related training – SEP for temporary contracts

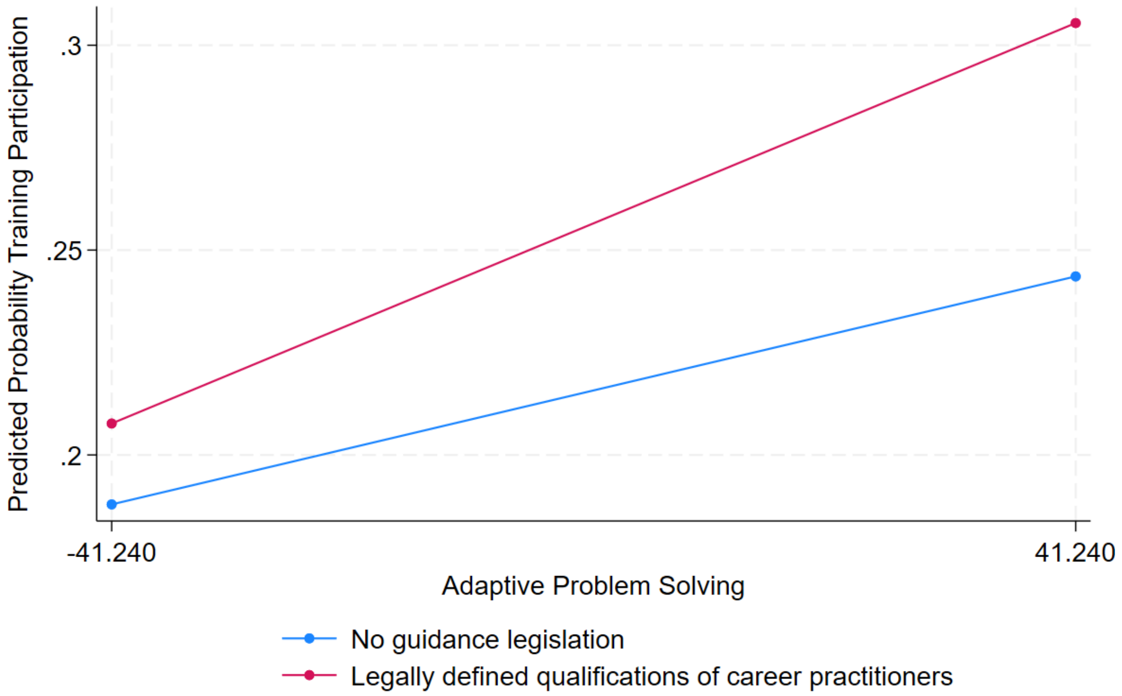


3.1.3. Lifelong Guidance Legislation (LGL)

The last 2 columns in Table 4 show the results for the typology of Lifelong Guidance Legislation (LGL). It should be noted that the interpretation of the results for the typologies differs from the previous policy indicators, as these are binary indicators instead of continuous indicators. The coefficients should therefore be interpreted as a comparison between countries with a certain legislation (1) and countries without that legislation (0).

The results of Model 4 indicate that there is no statistically significant association between having legislation setting out citizens' entitlement to career guidance and nonformal voluntary job-related training participation, which also holds for having legally defined qualifications of career practitioners (see Column 1 and 5, Panel B, Appendix Table A3.3). However, there is a positive and significant interaction term for the legally defined qualifications of career practitioners with APS skill, which visually depicted in Figure 5. The results indicate that, for VET graduates, a country's legislation has a stronger positive association with nonformal voluntary job-related training participation when individuals have higher APS skills. We do also find a statistically significant interaction term for numeracy and legally defined qualifications for career practitioners (see Table A3.3 in Appendix 2, Panel A, Column 8).

Figure 5. Margins plot nonformal voluntary job-related training – qualifications of career practitioners



3.2 Informal learning-by-doing

Again, before estimating our interaction models, we have estimated APS skills' associations with informal learning-by-doing (Model 2 in the tables in Appendix 3). In those models, regardless of the policy indicator, the association between APS and informal learning-by-doing is negative. Specifically, a 50 score point higher APS score (one PIAAC skill level) is associated with a 1 percentage point lower informal learning-by-doing rate. This is congruent with the descriptive informal learning-by-doing by skill level as depicted in Figure 2.

3.2.1 Active Labour Market Policies (ALMP)

There is a statistically significant and positive association between ALMP training expenditure and informal learning-by-doing engagement: a 0.01 percentage point higher ALMP expenditure on training is associated with a 0.012 percentage point higher informal learning-by-doing rate. There is no significant association between spending on employment maintenance incentives and informal learning-by-doing (see Column 5, Panel B, Appendix Table A3.4).

Table 5. Main model estimation results for informal learning-by-doing engagement

	ALMP		SEP		Typology	
	Training expenditure	Employment maintenance incentives expenditure	Regular contracts	Temporary contracts	Entitlement	Qualifications
Policy indicator	1.175***	-0.393	0.114	-0.003	0.026	0.084
	(0.447)	(0.829)	(0.093)	(0.071)	(0.072)	(0.069)
Adaptive problem solving score	-0.0002**	-0.0002**	-0.0002*	-0.0002*	-0.0002	-0.0001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Policy indicator* Adaptive problem solving score	-0.001	0.001	-0.0003	0.0002	-0.0001	-0.0003*
	(0.001)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	-0.555	-0.668	-0.636	-0.525	-0.651	-0.512
	(0.550)	(0.165)	(0.169)	(0.731)	(0.656)	(0.005)
var(_cons)	0.0206	0.0278	0.0271	0.0294	0.0280	0.0262
sd	0.00682	0.00217	0.00229	0.00994	0.00217	0.00217
var(Residual)	0.211	0.211	0.214	0.214	0.211	0.211
sd	0.00217	0.00914	0.00916	0.00229	0.00922	0.00863
Log Likelihood	-12164	-12166	-11401	-11402	-12171	-12169
ICC	0.0892	0.117	0.113	0.121	0.117	0.111
Joint Significance	0.0222	0.864	0.202	0.675	0.744	0.102
Observations	18,826	18,826	17,430	17,430	18,826	18,826
Number of groups	23	23	22	22	23	23
Individual level control	YES	YES	YES	YES	YES	YES
Country level control	YES	YES	YES	YES	YES	YES

*Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.*
Controls include age categories, gender, migration background, parental education, working hours and contract type.

Table 5 presents the associations between the policy indicators, APS skills, and informal learning-by-doing for VET graduates at the ISCED 3 level. We do not observe a differential association of the ALMP training expenditure with informal learning-by-doing by skill level. For numeracy we do find a negative interaction term, meaning that the effect of ALMP training expenditure is lower for higher skilled VET graduates, i.e. lower skilled VET graduates tend to learn more through learning-by-doing (see Column 4, Panel A, Appendix Table A3.4).

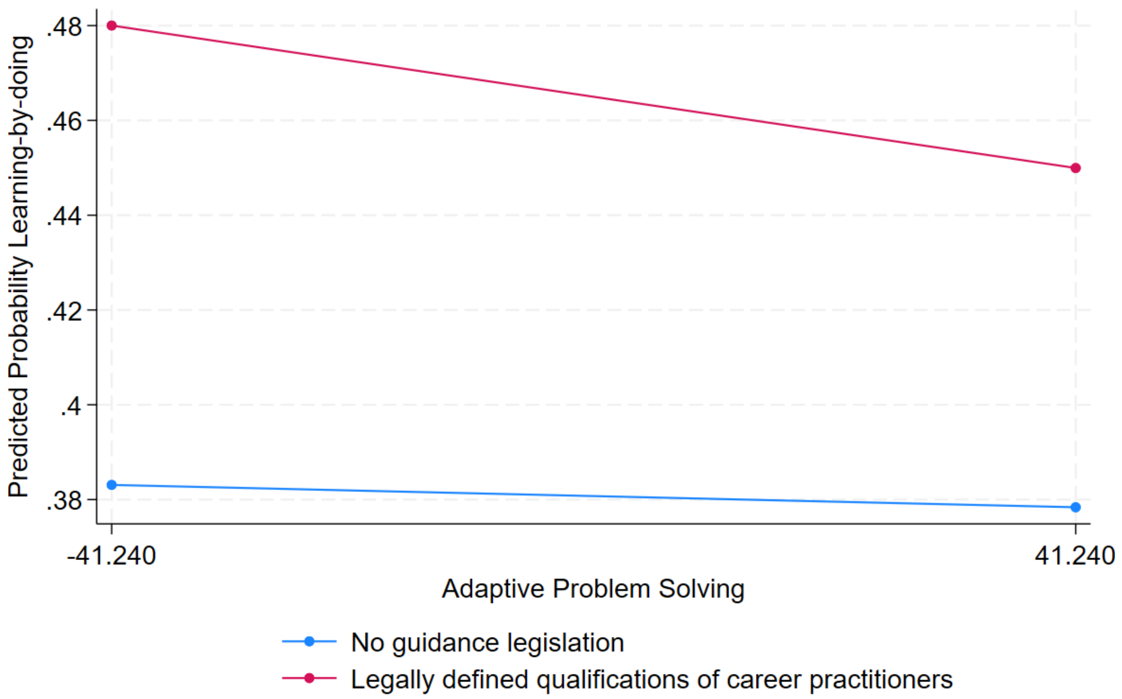
3.2.2. Strictness of Employment Protection (SEP) policies

Regarding SEP policies, there is no significant main association between the SEP scores and informal learning-by-doing, for both regular and temporary contracts (see Columns 1 and 5, Panel B, Appendix Table A3.5). In Table 5, we also do not find any significant interaction coefficients. For numeracy, the main coefficients between SEP for regular and temporary contracts are both non-significant. However, for temporary contracts, the results show that the higher the NUM scores, the albeit non-significant, negative association between the SEP for regular contracts and informal learning-by-doing participation is less negative (see, Column 8, Panel A, Table A3.5 in Appendix 2).

3.2.3. Lifelong Guidance Legislation (LGL)

The results in Appendix Table A3.6 indicate that informal learning-by-doing is not associated with either LGL types. In the last two columns of Table 5, the interaction results for the Lifelong Guidance Legislation are displayed. We find a significant negative coefficient (10%-level) for the APS and qualifications interaction term, which implies that the lower skilled the VET graduate is, the more they engage in informal learning-by-doing in countries with legally defined career practitioners. Figure 6 shows the interaction between the qualification of career practitioners and APS visually. Moreover, we do find a negative interaction term for entitlement to lifelong guidance and learning-by-doing by numeracy skills, meaning that in countries with an entitlement for lifelong guidance, lower skilled VET graduates participate more in learning-by-doing than higher skilled graduates.

Figure 6. Margins plot informal learning-by-doing – Qualifications of career practitioners



Conclusions and discussion

This working paper examined the relationship between Employment and Training Policies (ETP) and disparities in lifelong learning (LLL) engagement among vocational education and training (VET) graduates at ISCED level 3, using data from PIAAC Cycle 2 across 23 OECD countries (OECD, 2024). Specifically, we investigated how these policies relate to participation in nonformal voluntary job-related training and informal learning-by-doing, and whether these associations vary by skill level, focusing on adaptive problem solving and numeracy.

Compared to existing literature, we expand the analysis by estimating multi-level linear probability models, by incorporating indicators on employment protection and lifelong guidance legislation, and by looking into informal learning participation next to nonformal training participation. In doing so, we provide a more comprehensive assessment of structured employment and training policies that are directly relevant and actionable for VET graduates already participating in the labour market.

Our findings show that most employment and training policies do not exhibit a uniform association with either form of LLL participation. The exception is ALMP training expenditure, which shows both positive associations nonformal and informal LLL participation. Instead, their impact is often heterogeneous, depending on the skill level of VET graduates.

ALMP expenditure on training is associated with increased nonformal voluntary job-related training participation among both higher adaptive problem solving skilled and higher numeracy skilled VET graduates. At the same time, for numeracy it holds that ALMP training expenditure correlates with greater informal learning-by-doing among lower-skilled graduates. This differential effect may reflect a substitution or spill-over mechanism (e.g. Richter et al., 2020), where structured training is accessed primarily by higher-skilled individuals, and informal learning compensates for limited participation among lower-skilled workers, either by necessity or through knowledge transfer within the workplace.

Legal definitions of career practitioner qualifications also appear to support informal learning among lower adaptive problem solving skilled VET graduates, and nonformal voluntary job-related training among higher adaptive problem solving skilled VET graduates, suggesting that these professionalised guidance services may indirectly help foster learning-by-doing in case nonformal training is less evident. However, several employment and training policies, such as Strictness of Employment Protection (SEP) and Lifelong Guidance Legislation (LGL), are associated with increased disparities in nonformal voluntary job-related training participation across skill levels. SEP, for both regular and temporary contracts, tends to benefit higher adaptive problem solving skilled individuals more, while LGL entitlements narrow numeracy skill gaps in informal learning.

Since the analysis focuses on VET graduates *within* ISCED level 3, the results suggest that skill levels play a critical role in shaping LLL engagement beyond what formal education categories alone can explain. The findings underscore the importance of considering skill-level heterogeneity when designing and evaluating employment and training policies. Parts of our results align with findings from the skill-based disparity literature, while others diverge, highlighting cases in which expected patterns do not hold. Future research should investigate more in-depth the conditions under which skill-based disparities in LLL participation diminish. Policies that are not explicitly targeted may inadvertently reinforce existing inequalities by disproportionately benefiting those already equipped to engage in nonformal learning. Policymakers should consider designing tiered interventions that explicitly target lower-skilled VET graduates, particularly in contexts where nonformal training is less evident. For example, increasing informal learning opportunities through workplace mentoring, peer learning, or structured on-the-job development could help bridge gaps. Additionally, ensuring that career guidance services are not only legally defined but also accessible and tailored to diverse skill profiles of VET graduates may enhance engagement among those most at risk of exclusion from participation in LLL. Strengthening educational outreach among ISCED 3 level VET graduates, given their lower skill levels and weaker labour-market attachment, should be a central component of such efforts.

By focusing on VET graduates within the same educational level (ISCED 3), this study contributes to a more precise understanding of what influences lifelong learning outcomes for these graduates. Additionally, by incorporating both nonformal and informal learning measures, we provide a more comprehensive view of how individuals engage in LLL across diverse policy contexts. Our results pointed towards a possible synergy between the two measures, as policies targeting nonformal learning can also shape broader learning cultures and motivation within organisations, thereby indirectly fostering greater engagement in informal learning as well.

Several limitations should be acknowledged. First, while PIAAC Cycle 2 provides rich cross-country data, it remains cross-sectional, limiting causal inference. Second, informal learning may be interpreted differently across cultural and occupational contexts, i.e. how work is organised as well as interactions in the workplace (De Grip, 2024). Third, the training policy indicators are inevitably a rather crude measure of the policy itself. For example, similar ALMP expenditure on training does not mean similarity in the way the money is spent. Furthermore, the policy indicators are about the whole working population, while our population constitutes ISCED 3 VET graduates.

These findings should be interpreted within the broader context of labour market transformation. As automation and AI reshape job profiles, the ability to continuously learn and adapt becomes increasingly important. VET graduates, often trained for specific roles, may face greater challenges in navigating these shifts unless supported by inclusive and responsive policy frameworks. The observed heterogeneity between nonformal and informal learning for some of these policies also requires a strategic adaptation by individuals and workplaces, highlighting the need for policies that recognize and support diverse learning pathways.

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Appendix 1 – Lifelong Guidance Legislation sources

Table A1. Sources of extra countries in LGL

Country / Region	Citizen Entitlement	Practitioner Qualifications	Source
Flemish Community (Belgium)	No	Yes	(Cedefop, 2020)
Canada	No	Yes	(OECD, 2022a)
Chile	No	No	(OECD, 2021a)
Israel	No	Yes	(Benjamin et al., 2011)
Japan	No	No	(OECD, 2015; Ogawa, 2015)
South Korea	Yes	No	(OECD, 2020b)
New Zealand	Yes	Yes	(Tertiary Education Commission, 2024)

Appendix 2 – Skill disparities for numeracy skills

Figure A2.1. Nonformal voluntary job-related training participation by numeracy proficiency groups by country

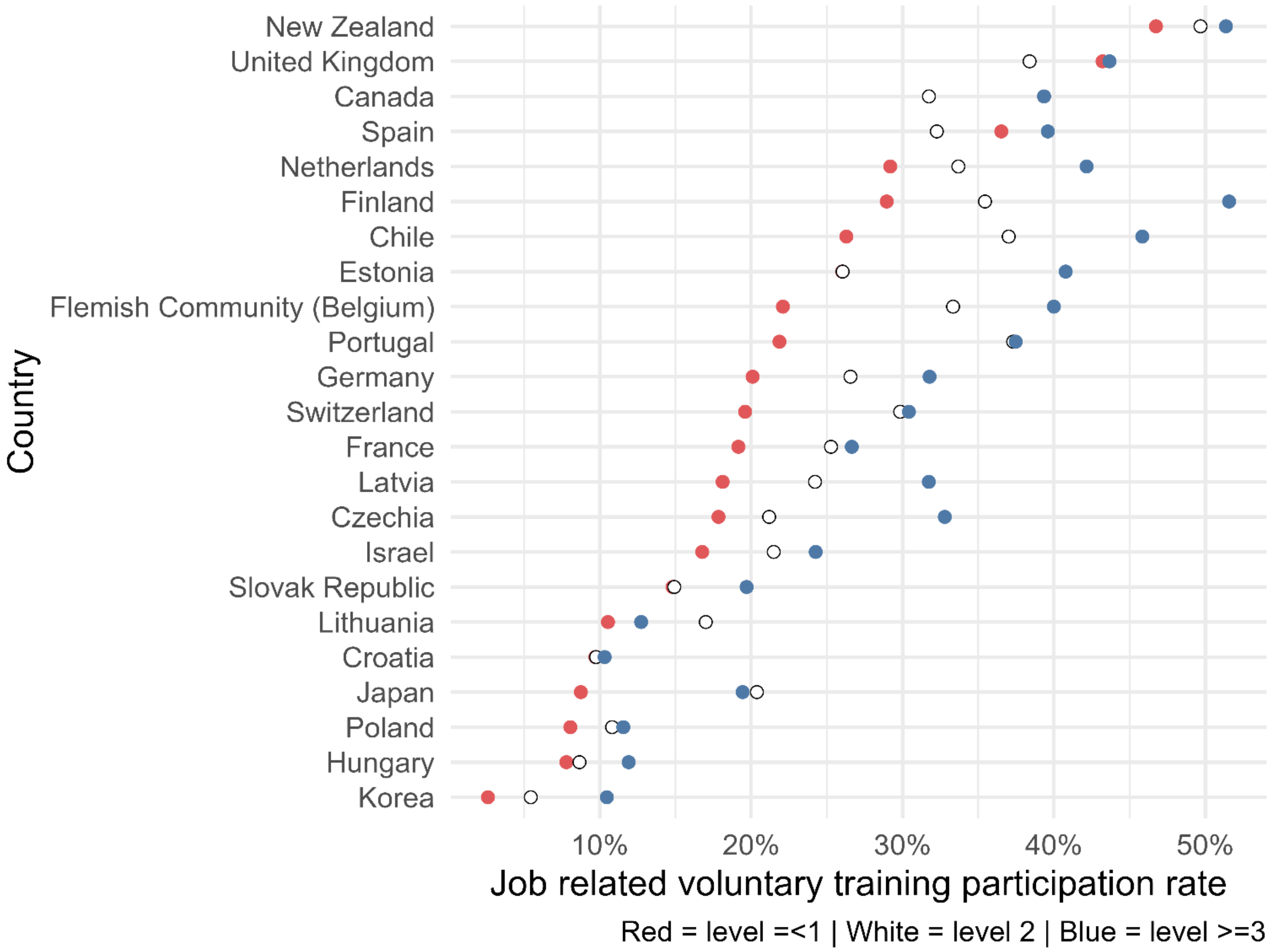
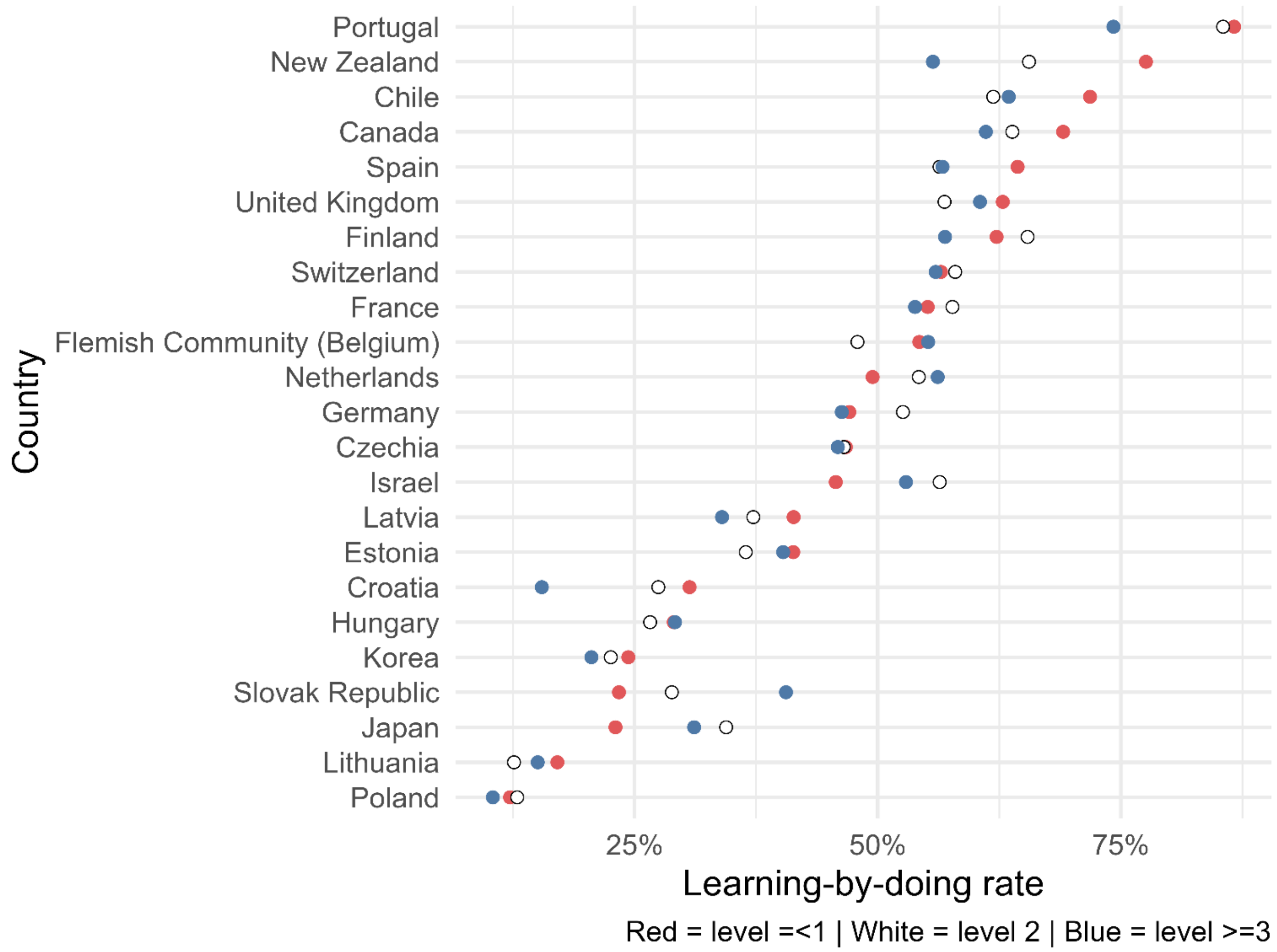


Figure A2.2. Informal Learning-by-doing by numeracy proficiency groups by country



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Appendix 3 – Main model results

Table A3.1 Estimation results for training – ALMP

	Workplace training				Employment maintenance incentives			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	M1	M2	M3	M4	M1	M2	M3	M4
Panel A: Numeracy								
Training expenditure	0.860***	0.794***	0.761**	0.738***				
	(0.314)	(0.303)	(0.304)	(0.275)				
NUM score		0.001***	0.001***	0.001***		0.001***	0.001***	0.001***
		(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)
Training expenditure*NUM			0.003***	0.003***				
			(0.001)	(0.001)				
Employment maintenance incentives expenditure					0.428	0.301	0.307	-0.127
					(0.535)	(0.514)	(0.515)	(0.527)
Employment maintenance incentives expenditure*NUM							-0.000	-0.000
							(0.002)	(0.002)
Constant	0.262***	0.261***	0.260***	-0.307	0.268***	0.268***	0.268***	-0.353
	(0.024)	(0.005)	(0.023)	(0.170)	(0.027)	(0.005)	(0.005)	(0.005)
var(_cons)	0.0101	0.00943	0.00946	0.00766	0.0135	0.0124	0.0124	0.0110
sd	0.00163	0.00302	0.00303	0.00162	0.00163	0.00394	0.00394	0.00162
var(Residual)	0.159	0.158	0.158	0.158	0.159	0.158	0.158	0.158
sd	0.00324	0.00162	0.00162	0.00261	0.00426	0.00162	0.00162	0.00368
Log Likelihood	-9531	-9475	-9477	-9485	-9534	-9477	-9482	-9491
ICC	0.0600	0.0565	0.0567	0.0464	0.0784	0.0732	0.0731	0.0654
Joint Significance			0.000783	0.000422			0.832	0.959
Panel B: Adaptive problem solving								
Training expenditure	0.860***	0.765***	0.707**	0.685**				
	(0.314)	(0.294)	(0.296)	(0.269)				
APS score		0.001***	0.001***	0.001***		0.001***	0.001***	0.001***
		(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)
Training expenditure*APS			0.004***	0.004***				
			(0.001)	(0.001)				
Employment maintenance incentives expenditure					0.428	0.272	0.302	-0.112
					(0.535)	(0.499)	(0.499)	(0.512)
Employment maintenance incentives expenditure *APS							-0.001	-0.001
							(0.002)	(0.002)
Constant	0.262***	0.257***	0.255***	-0.287	0.268***	0.263***	0.264***	-0.332
	(0.160)	(0.022)	(0.161)	(0.332)	(0.158)	(0.025)	(0.159)	(0.005)
var(_cons)	0.0101	0.00886	0.00896	0.00733	0.0135	0.0117	0.0116	0.0104
sd	0.00324	0.00285	0.00288	0.00162	0.00426	0.00371	0.00369	0.00162
var(Residual)	0.159	0.157	0.157	0.157	0.159	0.157	0.157	0.157
sd	0.00163	0.00162	0.00162	0.00250	0.00163	0.00162	0.00162	0.00347
Log Likelihood	-9531	-9463	-9461	-9469	-9534	-9465	-9470	-9478
ICC	0.0600	0.0533	0.0539	0.0445	0.0784	0.0691	0.0688	0.0618
Joint Significance			3.04e-05	1.65e-05			0.668	0.752
Observations	18,944	18,944	18,944	18,944	18,944	18,944	18,944	18,944
Number of groups	23	23	23	23	23	23	23	23
Individual level control	YES	YES	YES	YES	YES	YES	YES	YES
Country level control	NO	NO	NO	YES	NO	NO	NO	YES

*Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.*

Controls include age categories, gender, migration background, parental education, working hours and contract type.

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Table A3.2 Estimation results for training – SEP

Panel A: Numeracy								
	Regular contracts				Temporary contracts			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	M1	M2	M3	M4	M1	M2	M3	M4
EPL - Regular contracts	-0.015	-0.014	-0.016	0.008				
	(0.063)	(0.060)	(0.060)	(0.060)				
NUM score		0.001***	0.001***	0.001***		0.001***	0.001***	0.001***
		(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)
Regular contracts*NUM			0.0003*	0.0003**				
			(0.000)	(0.000)				
EPL - Temporary contracts					-0.060	-0.054	-0.054	-0.031
					(0.041)	(0.039)	(0.039)	(0.044)
Temporary contracts*NUM							0.0001	0.0001
							(0.000)	(0.000)
Constant	0.286***	0.285***	0.285***	-0.238	0.280***	0.279***	0.280***	-0.122
	(0.027)	(0.163)	(0.025)	(0.172)	(0.026)	(0.163)	(0.025)	(0.451)
var(_cons)	0.0131	0.0117	0.0117	0.0112	0.0118	0.0107	0.0107	0.0110
sd	0.00424	0.00382	0.00380	0.00175	0.00384	0.00175	0.00350	0.00378
var(Residual)	0.165	0.163	0.163	0.163	0.165	0.163	0.163	0.163
sd	0.00176	0.00175	0.00175	0.00384	0.00176	0.00349	0.00175	0.00175
Log Likelihood	-9154	-9098	-9104	-9113	-9154	-9098	-9105	-9115
ICC	0.0736	0.0669	0.0666	0.0641	0.0670	0.0614	0.0615	0.0632
Joint Significance			0.143	0.143			0.239	0.498
Panel B: Adaptive problem solving								
	M1	M2	M3	M4	M1	M2	M3	M4
EPL - Regular contracts	-0.015	-0.011	-0.014	0.008				
	(0.063)	(0.058)	(0.058)	(0.059)				
APS score		0.001***	0.001***	0.001***		0.001***	0.001***	0.001***
		(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)
Regular contracts*APS			0.0005**	0.0005**				
			(0.000)	(0.000)				
EPL - Temporary contracts					-0.060	-0.050	-0.053	-0.030
					(0.041)	(0.038)	(0.038)	(0.043)
Temporary contracts*APS							0.0003**	0.0003**
							(0.000)	(0.000)
Constant	0.286***	0.279***	0.279***	-0.211	0.280***	0.274***	0.275***	-0.099
	(0.162)	(0.005)	(0.005)	(0.172)	(0.005)	(0.024)	(0.024)	(0.172)
var(_cons)	0.0131	0.0109	0.0109	0.0105	0.0118	0.0100	0.0101	0.0104
sd	0.00176	0.00356	0.00355	0.00360	0.00176	0.00327	0.00330	0.00358
var(Residual)	0.165	0.163	0.163	0.163	0.165	0.163	0.163	0.163
sd	0.00424	0.00174	0.00174	0.00174	0.00384	0.00174	0.00174	0.00174
Log Likelihood	-9154	-9080	-9085	-9094	-9154	-9080	-9086	-9095
ICC	0.0736	0.0627	0.0625	0.0604	0.0670	0.0578	0.0582	0.0601
Joint Significance			0.0502	0.0495			0.0590	0.118
Observations	17,534	17,534	17,534	17,534	17,534	17,534	17,534	17,534
Number of groups	22	22	22	22	22	22	22	22
Individual level control	YES	YES	YES	YES	YES	YES	YES	YES
Country level control	NO	NO	NO	YES	NO	NO	NO	YES

*Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.*

Controls include age categories, gender, migration background, parental education, working hours and contract type.

Table A3.3 Estimation results for training – Lifelong Guidance Legislation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Numeracy								
	Entitlement				Qualifications			
	M1	M2	M3	M4	M1	M2	M3	M4
Citizen's entitlement to career guidance	0.046	0.046	0.046	0.054				
	(0.049)	(0.047)	(0.047)	(0.044)				
NUM score		0.001***	0.001***	0.001***		0.001***	0.001***	0.001***
		(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)
Entitlement *NUM			0.0000	0.0000				
			(0.000)	(0.000)				
Legally defined qualifications of career practitioners					0.060	0.059	0.059	0.041
					(0.048)	(0.046)	(0.046)	(0.044)
Qualifications *NUM							0.0002*	0.0002*
							(0.000)	(0.000)
Constant	0.247***	0.246***	0.246***	-0.440	0.242***	0.241***	0.241***	-0.306
	(0.005)	(0.158)	(0.036)	(0.167)	(0.158)	(0.159)	(0.034)	(0.005)
var(_cons)	0.0133	0.0121	0.0121	0.0102	0.0129	0.0117	0.0117	0.0105
sd	0.00163	0.00383	0.00383	0.00342	0.00163	0.00162	0.00162	0.00351
var(Residual)	0.159	0.158	0.158	0.158	0.159	0.158	0.158	0.158
sd	0.00422	0.00162	0.00162	0.00162	0.00409	0.00371	0.00371	0.00162
Log Likelihood	-9536	-9479	-9487	-9495	-9536	-9479	-9485	-9494
ICC	0.0776	0.0713	0.0712	0.0610	0.0753	0.0691	0.0690	0.0624
Joint Significance			0.614	0.468			0.0897	0.127
Panel B: Adaptive problem solving								
	M1	M2	M3	M4	M1	M2	M3	M4
Citizen's entitlement to career guidance	0.046	0.044	0.044	0.051				
	(0.049)	(0.045)	(0.045)	(0.043)				
APS score		0.001***	0.001***	0.001***		0.001***	0.001***	0.001***
		(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)
Entitlement *APS			0.0002	0.0002				
			(0.000)	(0.000)				
Legally defined qualifications of career practitioners					0.060	0.059	0.058	0.041
					(0.048)	(0.044)	(0.044)	(0.043)
Qualifications *APS							0.001***	0.001***
							(0.000)	(0.000)
Constant	0.247***	0.242***	0.242***	-0.411	0.242***	0.236***	0.236***	-0.293
	(0.158)	(0.035)	(0.035)	(0.168)	(0.158)	(0.033)	(0.033)	(0.385)
var(_cons)	0.0133	0.0113	0.0112	0.00959	0.0129	0.0109	0.0109	0.00988
sd	0.00163	0.00162	0.00162	0.00321	0.00163	0.00162	0.00162	0.00162
var(Residual)	0.159	0.157	0.157	0.157	0.159	0.157	0.157	0.157
sd	0.00422	0.00360	0.00357	0.00162	0.00409	0.00347	0.00348	0.00331
Log Likelihood	-9536	-9467	-9474	-9482	-9536	-9467	-9469	-9477
ICC	0.0776	0.0671	0.0666	0.0574	0.0753	0.0648	0.0650	0.0591
Joint Significance			0.192	0.146			0.00128	0.00176
Observations	18,944	18,944	18,944	18,944	18,944	18,944	18,944	18,944
Number of groups	23	23	23	23	23	23	23	23
Individual level control	YES	YES	YES	YES	YES	YES	YES	YES
Country level control	NO	NO	NO	YES	NO	NO	NO	YES

*Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.*

Controls include age categories, gender, migration background, parental education, working hours and contract type.

Table A3.4 Estimation results for informal learning-by-doing – ALMP

Panel A: Numeracy								
	Workplace training				Employment maintenance incentives			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	M1	M2	M3	M4	M1	M2	M3	M4
Training expenditure	1.181**	1.198**	1.234**	1.187***				
	(0.512)	(0.514)	(0.513)	(0.446)				
NUM score		-0.0002**	-0.0002**	-0.0002**		-0.0002**	-0.0002**	-0.0002**
		(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)
Training expenditure*NUM			-0.003**	-0.003**				
			(0.001)	(0.001)				
Employment maintenance incentives expenditure					0.431	0.462	0.457	-0.386
					(0.842)	(0.846)	(0.848)	(0.825)
Employment maintenance incentives expenditure *NUM							0.0003	0.0003
							(0.002)	(0.002)
Constant	0.453***	0.453***	0.454***	-0.549	0.463***	0.463***	0.463***	-0.665
	(0.037)	(0.157)	(0.037)	(0.005)	(0.157)	(0.005)	(0.005)	(0.005)
var(_cons)	0.0273	0.0275	0.0273	0.0205	0.0339	0.0342	0.0342	0.0276
sd	0.00217	0.00217	0.00859	0.00678	0.0106	0.0107	0.00217	0.00907
var(Residual)	0.211	0.211	0.211	0.211	0.211	0.211	0.211	0.211
sd	0.00857	0.00863	0.00217	0.00217	0.00217	0.00217	0.0107	0.00217
Log Likelihood	-12147	-12153	-12156	-12162	-12149	-12155	-12160	-12166
ICC	0.115	0.115	0.115	0.0888	0.139	0.140	0.140	0.116
Joint Significance			0.00363	0.00208			0.855	0.891
Panel B: Adaptive problem solving								
	M1	M2	M3	M4	M1	M2	M3	M4
Training expenditure	1.181**	1.204**	1.222**	1.175***				
	(0.512)	(0.515)	(0.515)	(0.447)				
APS score		-0.0002**	-0.0002**	-0.0002**		-0.0002**	-0.0002**	-0.0002**
		(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)
Training expenditure*APS			-0.001	-0.001				
			(0.001)	(0.001)				
Employment maintenance incentives expenditure					0.431	0.467	0.453	-0.393
					(0.842)	(0.850)	(0.852)	(0.829)
Employment maintenance incentives expenditure *APS							0.001	0.001
							(0.002)	(0.002)
Constant	0.453***	0.454***	0.454***	-0.555	0.463***	0.464***	0.464***	-0.668
	(0.037)	(0.037)	(0.157)	(0.550)	(0.157)	(0.005)	(0.005)	(0.165)
var(_cons)	0.0273	0.0277	0.0276	0.0206	0.0339	0.0345	0.0345	0.0278
sd	0.00857	0.00869	0.00217	0.00682	0.00217	0.0108	0.0108	0.00217
var(Residual)	0.211	0.211	0.211	0.211	0.211	0.211	0.211	0.211
sd	0.00217	0.00217	0.00867	0.00217	0.0106	0.00217	0.00217	0.00914
Log Likelihood	-12147	-12153	-12158	-12164	-12149	-12154	-12160	-12166
ICC	0.115	0.116	0.116	0.0892	0.139	0.141	0.141	0.117
Joint Significance			0.0405	0.0222			0.827	0.864
Observations	18,826	18,826	18,826	18,826	18,826	18,826	18,826	18,826
Number of groups	23	23	23	23	23	23	23	23
Individual level control	YES	YES	YES	YES	YES	YES	YES	YES
Country level control	NO	NO	NO	YES	NO	NO	NO	YES

*Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.*

Controls include age categories, gender, migration background, parental education, working hours and contract type.

Table A3.5 Estimation results for informal learning-by-doing – SEP

Panel A: Numeracy								
	Regular contracts				Temporary contracts			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	M1	M2	M3	M4	M1	M2	M3	M4
EPL - Regular contracts	0.056	0.056	0.056	0.112				
	(0.099)	(0.100)	(0.100)	(0.093)				
NUM score		-0.0001	-0.0001	-0.0001		-0.0001	-0.0001	-0.0001
		(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)
Regular contracts*NUM			-0.0000	-0.0000				
			(0.000)	(0.000)				
EPL - Temporary contracts					-0.063	-0.064	-0.065	-0.003
					(0.066)	(0.067)	(0.067)	(0.071)
Temporary contracts*NUM							0.0003**	0.0003**
							(0.000)	(0.000)
Constant	0.485***	0.485***	0.485***	-0.629	0.478***	0.478***	0.479***	-0.518
	(0.041)	(0.160)	(0.041)	(0.169)	(0.041)	(0.041)	(0.041)	(0.731)
var(_cons)	0.0329	0.0332	0.0331	0.0270	0.0319	0.0322	0.0323	0.0294
sd	0.0106	0.0106	0.00229	0.00912	0.0103	0.0103	0.0104	0.00994
var(Residual)	0.214	0.214	0.214	0.214	0.214	0.214	0.214	0.214
sd	0.00229	0.00229	0.0106	0.00229	0.00229	0.00229	0.00229	0.00229
Log Likelihood	-11381	-11388	-11396	-11402	-11381	-11388	-11394	-11401
ICC	0.133	0.134	0.134	0.112	0.130	0.131	0.131	0.121
Joint Significance			0.832	0.471			0.0589	0.0949
Panel B: Adaptive problem solving								
	M1	M2	M3	M4	M1	M2	M3	M4
EPL - Regular contracts	0.056	0.056	0.058	0.114				
	(0.099)	(0.100)	(0.100)	(0.093)				
APS score		-0.0002*	-0.0002*	-0.0002*		-0.0002*	-0.0002*	-0.0002*
		(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)
Regular contracts*APS			-0.0003	-0.0003				
			(0.000)	(0.000)				
EPL - Temporary contracts					-0.063	-0.064	-0.065	-0.003
					(0.066)	(0.067)	(0.067)	(0.071)
Temporary contracts*APS							0.0002	0.0002
							(0.000)	(0.000)
Constant	0.485***	0.486***	0.486***	-0.636	0.478***	0.479***	0.480***	-0.525
	(0.041)	(0.005)	(0.161)	(0.169)	(0.005)	(0.005)	(0.041)	(0.731)
var(_cons)	0.0329	0.0334	0.0333	0.0271	0.0319	0.0323	0.0324	0.0294
sd	0.00229	0.0107	0.0107	0.00229	0.00229	0.0104	0.00229	0.00994
var(Residual)	0.214	0.214	0.214	0.214	0.214	0.214	0.214	0.214
sd	0.0106	0.00229	0.00229	0.00916	0.0103	0.00229	0.0104	0.00229
Log Likelihood	-11381	-11388	-11394	-11401	-11381	-11388	-11395	-11402
ICC	0.133	0.135	0.135	0.113	0.130	0.131	0.132	0.121
Joint Significance			0.354	0.202			0.424	0.675
Observations	17,430	17,430	17,430	17,430	17,430	17,430	17,430	17,430
Number of groups	22	22	22	22	22	22	22	22
Individual level control	YES	YES	YES	YES	YES	YES	YES	YES
Country level control	NO	NO	NO	YES	NO	NO	NO	YES

*Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.*

Controls include age categories, gender, migration background, parental education, working hours and contract type.

Table A3.6 Estimation results for informal learning-by-doing – Lifelong Guidance Legislation

Panel A: Numeracy								
	Entitlement				Qualifications			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	M1	M2	M3	M4	M1	M2	M3	M4
Citizen's entitlement to career guidance	0.015	0.015	0.016	0.026				
	(0.078)	(0.079)	(0.079)	(0.072)				
NUM score		-0.0002**	-0.0000	-0.0000		-0.0002**	-0.0001	-0.0001
		(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)
Entitlement *NUM			-0.0003*	-0.0003*				
			(0.000)	(0.000)				
Legally defined qualifications of career practitioners					0.117	0.117	0.117	0.084
					(0.074)	(0.074)	(0.074)	(0.069)
Qualifications *NUM							-0.0002	-0.0002
							(0.000)	(0.000)
Constant	0.460***	0.460***	0.460***	-0.644	0.407***	0.407***	0.408***	-0.509
	(0.157)	(0.060)	(0.156)	(0.005)	(0.157)	(0.157)	(0.055)	(0.005)
var(_cons)	0.0342	0.0346	0.0349	0.0280	0.0306	0.0310	0.0311	0.0260
sd	0.0107	0.00217	0.0109	0.00217	0.00958	0.00970	0.00217	0.00217
var(Residual)	0.211	0.211	0.211	0.211	0.211	0.211	0.211	0.211
sd	0.00217	0.0108	0.00217	0.00921	0.00217	0.00217	0.00973	0.00857
Log Likelihood	-12152	-12157	-12164	-12170	-12151	-12156	-12163	-12170
ICC	0.140	0.141	0.142	0.117	0.127	0.128	0.129	0.110
Joint Significance			0.200	0.195			0.0761	0.134
Panel B: Adaptive problem solving								
	M1	M2	M3	M4	M1	M2	M3	M4
Citizen's entitlement to career guidance	0.015	0.016	0.016	0.026				
	(0.078)	(0.079)	(0.079)	(0.072)				
APS score		-0.0002**	-0.0002	-0.0002		-0.0002**	-0.0001	-0.0001
		(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)
Entitlement *APS			-0.0001	-0.0001				
			(0.000)	(0.000)				
Legally defined qualifications of career practitioners					0.117	0.117	0.118	0.084
					(0.074)	(0.074)	(0.074)	(0.069)
Qualifications *APS							-0.0003*	-0.0003*
							(0.000)	(0.000)
Constant	0.460***	0.461***	0.461***	-0.651	0.407***	0.409***	0.409***	-0.512
	(0.157)	(0.060)	(0.157)	(0.656)	(0.054)	(0.157)	(0.055)	(0.005)
var(_cons)	0.0342	0.0349	0.0351	0.0280	0.0306	0.0312	0.0313	0.0262
sd	0.0107	0.0109	0.0110	0.00217	0.00217	0.00979	0.00217	0.00217
var(Residual)	0.211	0.211	0.211	0.211	0.211	0.211	0.211	0.211
sd	0.00217	0.00217	0.00217	0.00922	0.00958	0.00217	0.00981	0.00863
Log Likelihood	-12152	-12157	-12165	-12171	-12151	-12156	-12162	-12169
ICC	0.140	0.142	0.143	0.117	0.127	0.129	0.129	0.111
Joint Significance			0.772	0.744			0.0583	0.102
Observations	18,826	18,826	18,826	18,826	18,826	18,826	18,826	18,826
Number of groups	23	23	23	23	23	23	23	23
Individual level control	YES	YES	YES	YES	YES	YES	YES	YES
Country level control	NO	NO	NO	YES	NO	NO	NO	YES

*Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.*

Controls include age categories, gender, migration background, parental education, working hours and contract type.

[i] Our paper builds forth on the research of Jacobs et al. (2025) and Unterweger & Markowitsch (2024) that were delivered as part of Work Package 2 and 6 of this S2C project.
[ii] We also keep congruence between Deliverable 6.6 and 6.7.
[iii] We do not show the confidence intervals of the predicted values in the margins plot, as the interaction in the regression analysis test differences in slopes using the full covariance structure, while the confidence intervals in our plots would merely reflect uncertainty around the individual predicted values. Whether or not confidence intervals of the predicted values on the line in the plot might overlap across levels of the policy indicator, does not contradict a significant interaction effect found in the regression analysis. This holds for all interaction plots in this working paper.

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