



LLLight'in'Europe

Lifelong Learning Innovation Growth
& Human Capital Tracks in Europe

SYNTHESIS REPORT



IMPRESSUM

Copyright by LLLightinEurope Research Consortium

Coordinated by
Zeppelin University
Am Seemoserhorn 20
88045 Friedrichshafen
Germany

Graphics, Design and Layout:
Maren Sykora

Multimedia and Website:
Urs Boesswetter, Spooo Design

Video Production:
Sascha Kuriyama

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 290683.





LLIGHT'IN'EUROPE

Lifelong Learning Innovation Growth & Human Capital Tracks in Europe

Synthesis Report

Main author

Prof Dr Peer Ederer

With leading co-authors from the research consortium

China Center for Human Capital and Labour Market Research

China

Prof Dr Haizheng Li

Department of Education (DPU), Aarhus University

Denmark

Prof Dr Ulrik Brandi

Rosa Lisa Iannone

ifo Institute

Germany

Dr Simon Wiederhold

Prof Dr Ludger Woessmann

Innovation & Growth Academy

Netherlands

Dr Silvia Castellazzi

Institute of Forecasting of the Slovak Academy of Sciences

Slovakia

Dr Pavol Babos

Dr Ivana Studena

Leuphana University Lueneburg

Germany

Alexander Patt

University of Economics Bratislava

Slovakia

Dr Martina Lubyova

University of Luxembourg

Luxembourg

Prof Dr Samuel Greiff

Jakob Mainert

André Kretzschmar

University of Nottingham

United Kingdom

Prof Dr John Holford

Dr Susana Melo

Wageningen University

Netherlands

Dr Ir Thomas Lans

Dr Harm Biemans

Yvette Baggen

Zeppelin University

Germany

Dr Ljubica Nedelkoska

Brussels, September 22nd 2015



Acknowledgements

The LLLightinEurope project was only possible because many people have been generous with their time and knowledge to support our research. Participants to our various assessments and courses, interviewees and experts, number in the thousands. Below is but a brief excerpt of distinguished individuals who helped us in our efforts. We thank each one of them most sincerely, and can only hope that events of the world will return the favor to them.

Ackermann, Rolf | *Ministerium Baden
Württemberg*

Agagliate, Thierry | *Terre des hommes*

Aichert, Marion | *Zeppelin University*

Akker van den, Frans | *ISPT*

Álvarez, Guiomar | *Fade*

Auhagen, Ingo | *Leuphana Universität*

Aulmann, Peter | *Zeppelin University*

Beyer, Sebastian | *Klasmann-Deilmann*

Boer de, Remco | *Sous Fresh*

Brocklehurst, Tim | *IFR*

Butter, Annet | *Feyecon*

Cate ten, Andreas | *ISPT*

Cox, Hasse | *MARE Research*

Dekker, Edwin | *NEVAT*

Denis, Vanessa | *OECD*

Desjardings, Richard | *UCLA*

Deursen van, Sanne | *Wageningen University*

Diaz, Elena | *Abhal*

Dijk van, Onno | *VNO-NCW Midden*

Doebelt, Rene | *Landgut Nemt*

Doorneweert, Bart | *Tool Monk*

Eggers, Bernd | *Eggers&Partner*

Eisert, Ulrich | *SAP*

Elteren van, Henry | *SBB*

Englert, Michael | *ITK*

Fabian Zwicky, Jasna | *European Commission*

Fernandez-Matamorros, Asier | *Tecnalia*

Fier, Andreas | *Deutsche Telekom*

Flintholm, Nanna | *Aart*

Freije, Immaculada | *Deusto University – Bilbao*

Friedrich, Christian | *Leuphana Universität*

Garcia, Patricia | *FOREM*

Gill, Werner | *Audi*

Göbel, Jan | *DIW*

Gonzalez, Monica | *PFS Grupo*

Grobocopatel, Gustavo | *Los Grobo*

Hampf, Franziska | *Ifo Institute*

Hanushek, Eric A. | *Stanford University*

Hartinger, Katharina | *LMU Munich*

Hausmann, Ricardo | *Harvard University, CID*

Haydeyan, Mariam | *Leuphana Universität*

Heer, Oskar | *Daimler*

Heimisch, Alexandra | *Ifo Institute*

Hertel, Philipp | *Zeppelin University*

Herzig, Christine | *Zeppelin University*

Herzig, Sebastian | *Shire*

Hintzen, Gabriele | *Deutsche Telekom*

Hoesel van, Roger | *Food Valley Consortium*

Hofheinz, Paul | *Lisbon Council*

Iansiti, Marco | *Harvard Business School*

Ianson, Ken | *IFR*

Jahn, Alexander | *Candena*

Koers, Jellard | *Suplacon*

Kort, René | *Schut Papier*

Krauts, Robert | *DS Smit*

Leerling, Arnoud | *Regio Food Valley*

Lopez, Denise | *Leuphana University*

Maisterrana, Juan Pablo | *UPJ Argentina*

Mamedova, Saida | *NCES*

Marek, Radim | *Candena*

Matthée, Guido | *Food Valley NL*

Mazat, Andreas | *Ifo Institute*

McGrath, Daniel | *NCES*

Menapace, Monica | *European Commission*

Meyer, Ron | *C4SL*

Mulder, Martin | *Wageningen University*

Murray, Iain | *Trades Union Congress*

Oonk, Carla | *Wageningen University*


Oritz, Jugatx | *EARLALL*

Olsthoorn, Hans | *Sion*

Otto, Anne | *IAB*

Owen, Eugene | NCES
Parker, Marlon | Rlabs
Perry, Anja | GESIS
Pfeiffer, Rolf | Leadership Choices
Pickard, Martin Grantcraft | WRG Europe
Pille, Jan | VAPA
Prats-Monné, Xavier | European Commission
Reibold, Michael | Cosynus
Reijgersberg, Menno | Europe Retail Packing
Riess, Vincent | Yellowwood
Rippen, Lineke | AOC Oost
Sagasto Markina, Iker | Irontec
Santos, Jose | ADP Uruguay
Scalese, Claudio | European Commission
Schleicher, Andreas | OECD
Schleupen, Michael | Audicon
Schmidt, Philipp | MIT Media Lab
Schuller, Philipp | Deutschland Denken!
Schwerdt, Guido | University of Konstanz
Seifried, Luitgard | Winterhalter
Shrimpton, Mandy | Heart Capital

Shrimpton, Peter | Heart Capital
Slot, Martin | De Groot en Slot
Spaan, Joris | VAPA
Steinkamp, Helmut | DIL
Stumpe, Martin | Syngenta
Swart, Eleonara | RCT Rivierenland
Thorn, William | OECD
Veerman, Anneloes | My Business Media
Verhoeven, Piet | AGF
Vliet van, Stefan | BDO
Vonk, Edward | Banken Champignons
Wangler, Bernhard | ITK
Weisser, Hansjörg | Weisser
Wesselink, Renate | Wageningen University
Wilhelmi, Françoise | Buchinger
Willms, Stephan | Deutschland Denken!
Winterhalter, Ralph | Winterhalter
Wolters, Dirk Willem | Smeding
Yougang, Roger | European Commission
Zaat, Peter | Deliflor



*“The illiterate of the
21st century will not
be those who cannot
read and write, but
those who cannot learn,
unlearn, and relearn”*

Alvin Toffler

TABLE OF CONTENTS

I. Executive Summary	1
II. Summary of main Public Policy Recommendations.....	8
III. Publication suite table of all Policy Briefs and Thematic Reports of LLLightinEurope Research Project.....	12
Policy Briefs.....	12
Thematic Reports.....	14
IV. Core insights from the LLLightinEurope Project.....	15
1. Lifelong learning which increases skills of complex problem solving, raises lifelong incomes.....	15
2. The pathway between complexity resolution and income rise is to decrease the investment costs of innovation, which in due course leads to higher productivity.....	24
3. Complex problem solving skills are an important determinant of earnings.....	28
4. Modern knowledge-based labor markets value general cognitive skills highly.....	34
5. The skill of complex problem solving can be assessed reliably with a psychometric test.....	41
6. The skill of complex problem solving appears to be partially trainable.....	49
7. ICT skills are trainable through learning-by-doing.....	56
8. Skill mismatch affects lifelong earnings.....	60
9. Returns to part-time formal education while on the job are positive and worthwhile, but are lower than full time formal education.....	66
10. Language skills are critical for workers' human capital transferability among labor markets.....	73
11. Enterprises can foster skill creation by realizing pre-competitive cooperation and implement their corporate responsibility at the same time.....	78

12. Opportunity competence contributes to successfully leveraging ideas for entrepreneurship and innovativeness in enterprises.....	82
13. High levels of individual and feed forward learning, foster employee-driven entrepreneurship and innovativeness.....	87
14. Human capital of managerial leadership is related to innovativeness of the enterprise.....	91
15. Human resource strategies are the key to bolstering lifelong learning circumstances at the enterprise level.....	96
16. Incentives are the most effective resources to creating and sustaining lifelong learning strategies at the enterprise level.....	101
17. Punctuating routine work with something challenging is motivating and sharpens higher-order skills.....	106
18. Public policy impact on Lifelong Learning is most effective when it is implemented in close partnership with companies and stakeholders.....	111
19. Non-formal education dominates the circumstances of Lifelong Learning.....	119
20. Lifelong Learning is a growing factor in employability.....	124
V. Profiles of all consortium partners.....	128
VI. All participating researchers by alphabet.....	138
VII. Project Identity.....	139

„Learning is not compulsory but neither is survival.“

W.Edwards Deming

I EXECUTIVE SUMMARY

The skill of complex problem solving drives innovativeness, which drives higher productivity which drives higher incomes, higher profits and higher welfare. Complexity resolution therefore makes a particularly valuable target for lifelong learning activities. Skills in general are even more valued in the labor market than was suggested by previous empirical evidence. To be able to learn such skills not only in formal education during childhood and youth, but also to acquire skills in various circumstances of lifelong learning is therefore of growing importance. Fortunately, there is various evidence that these skills are learnable and trainable throughout a working life biography.

Enterprises play a central role in providing directly and indirectly the opportunities for lifelong learning. They are the organizers of the work place, and thus determine to a large degree the learning-by-doing opportunities of the job. Enterprises are also significant investors in skill investments of their employees in non-formal training or arrange the circumstances in which their employees can engage in lifelong learning. For those enterprises who understand their contribution well, the reward is a work force with strengthened capacity to be innovative and entrepreneurial.

The existence of large differences across countries in the circumstances and prevalence of lifelong learning suggests that policy frameworks play a major role in shaping the lifelong learning habits of their citizens. At the same time, their impact is felt mostly indirectly and remotely. A stronger engagement of the public sector in partnership with enterprises to work towards skill development via lifelong learning promises more effectiveness and efficiency in the future.

Chapter 1

LLLight research shows that persons who are more exposed to complexity, and have more capacity to solve this complexity, experience higher incomes. This should not be coincidence. The skill to solve complexity is critical for being more innovative, for increasing productivity, and for strengthening value creation. Individuals profit from this skill with higher income potential, companies achieve higher profitability, and regions increase the welfare of their residents. Using and strengthening complexity resolution skills should therefore be a vital component of any innovation and growth strategy.

Chapter 2

The pathway between complexity resolution and income rise is to decrease the investment costs of innovation. This leads to more frequent and more successful innovation, which in due course leads to higher productivity, which then permits higher income on the basis of stronger value creation.

Chapter 3

The returns to skills of complex problem solving (CPS) are estimated to be about 11% for every standard deviation of performance difference. This makes CPS an important measure of human capital, comparable in significance to the years of schooling or work experience for instance. Furthermore, the returns to CPS skills seem to be rising since several decades, and can be expected to continue to rise.

Chapter 4

OECD's PIAAC data shows that the returns to general numeracy and literacy skills are higher and longer lasting than suggested by previous evidence. On average, they are 18% for every one of the five proficiency levels in PIAAC. Returns to skills in a country seem to be negatively affected by high union density, strong employment protection legislation and a large size of the public sector.

Chapter 5

Complex problem solving skills can be reliably assessed with a psychometric instrument. The LLLight database now has benchmark data available for CPS for occupations, industries and companies.

Chapter 6

CPS skills are at least partially trainable. CPS incorporates a significant element of solution strategies. The selection and application of such strategies can be trained both formally and informally. The extent to which cognitive elements of reasoning can be trained or at least reinforced, requires further investigation of the constructs surrounding problem solving.

Chapter 7


OECD's PIAAC tested for Problem Solving in Technology Rich Environments (PSTRE). A careful comparison of these scores with national introduction rates of high-speed internet shows that the citizens of countries with earlier internet introduction score higher on PSTRE. Several pieces of evidence suggest that they acquired this skill in informal lifelong learning.

Chapter 8

To be changing occupations is a frequent occurrence in modern labor markets. Each such change is an opportunity to learn new skills. Occupational switchers who use this opportunity to upskill, shift to a new learning curve, acquire new skills, and over time earn more than before. On the other hand, those who decide to switch to occupations in which they are over-qualified (down-skilled), suffer earnings losses that on average are not recovered over the career lifetime. This skill mismatch investigation might be further evidence for the effective existence of lifelong learning.

Chapter 9

For special historical reasons, China's education system offered massive opportunities for working adults to obtain tertiary education degrees while remaining fully on-the-job during the 2000's. This created a unique dataset to compare the effectiveness of formal education before work with formal education while working. On-the-job formal education delivers positive returns, but much lower than before-the-job education. The difference cannot be attributed to student's aptitude, quality of the degrees or age of the students.



This suggests that lifelong learning activities are either perceived negatively by the labor market, or that institutional circumstances prevent the same returns to lifelong learning compared to before-job learning.

Chapter 10


Migration of the workers across national borders can have several positive effects for the individuals as well as the recipient labor market, because such a change can be a trigger for lifelong learning, and more optimal allocation of human capital resources. However, such migration necessitates the transfer of the migrant's human capital. US PSID data shows that language skills are a critical mediator for enabling the transfer of human capital. Every degree of language capacity improves the returns to human capital in the recipient labor market.

Chapter 11

Enterprises are a major investor in the lifelong learning market. They trigger and (co-)finance formal and non-formal education, and provide the work place arrangements for informal on-the-job learning. However, the full potential of enterprises as lifelong learning investor cannot be realized since unilateral action by the enterprises may strengthen the competition rather than oneself. This condition can be overcome with pre-competitive cooperation arrangements.

Chapter 12

Daily work at mature organizations is increasingly spiced with entrepreneurial challenges, which asks for employee-driven entrepreneurship and innovation. Nonetheless, Global Entrepreneurship Monitor data show that although entrepreneurial employee activity is highly needed, it is not present sufficiently among employees. LLLight results show that differences between high and low engagement in innovative behaviour by employees could be explained into more detail by specific human capital. For instance, those who engaged frequently in innovation related activities scored higher on opportunity competence (OC) (in particular opportunity identification, i.e. the ability to generate business ideas).



Moreover, CPS skills were an incremental predictor of such OC, and by extension thus appears to promote intrapreneurial success.

Chapter 13

Enterprises can be understood as multilevel learning organisations, with different feed forward and feedback learning cycles. The company data on organizational and workplace learning factors illustrate that there are differences between employees who successfully introduce many ideas to their management versus those who introduce only a few. Employees who experience high levels of individual and feed forward learning, get more innovative ideas adopted by the management. Also employees who face often complex problems and who have less detailed instructions in their work get more innovation ideas adopted by the higher management. Furthermore, two good practice cases show that flat hierarchies, high degrees of autonomy, and the explicit organization of informal learning activities contribute to innovativeness.

Chapter 14

Company data from China show that the more education, and the more tenure the general manager possesses, the more innovative is the company as measured by patents received. Thus there is a clear link between educatedness in formal education as well as lifelong learning through experience, and the achievement of innovativeness. Applying this insight to OECD's PIAAC data, it shows that the larger portion of this human capital is due to cognitive and non-cognitive skills, instead of the educational degree. This is further evidence that it is skills which promote innovativeness.

Chapter 15

Enterprises are a major investor in lifelong learning, both directly and indirectly. It is the human resources' function which is the primary actor within enterprises in this regard. Human resources' core role is to support and bolster access to knowledge and social communities where the know-where to find solutions on-demand has primacy over the know-what.

Chapter 16

The most effective tools for triggering lifelong learning in enterprises are incentive systems. These follow classic patterns: extrinsic incentive systems are important to have, but the intrinsic incentive play a more important role. Sizes of organizations leads to different degrees of systemization of incentive systems, but not necessarily to different effectiveness of outcomes.

Chapter 17


Work place design and work arrangements may very well be the most important creator and trigger of lifelong learning. Hierarchy, bureaucracy and status distinction pose challenges to lifelong learning; they can encroach on feelings of belonging and may stall performance. On the other hand, punctuating routine work with something different and/or challenging is motivating and sharpens higher-order skills.

Chapter 18

An integrated flexicurity approach is currently the dominant theme of the European employment strategy. Flexicurity at the EU level includes recognising the need to invest in lifelong learning for workers. With a focus on skilling, reskilling and upskilling, lifelong learning plays a key role in securing employment and ensuring companies adapt sufficiently to rapid change in their business environment. Public investment in educational and training programmes that encourage partnerships with companies, and build lifelong learning within companies, is strongly recommended. Companies' involvement with public educational institutions tends to generate mutually beneficial learning, but the state has an important role as regulator in such partnerships if the risk of particular business interests dominating these relations is to be avoided. Companies also benefit from engagement in NGOs and professional associations and networks.

Chapter 19

Empirical evidence on circumstances of lifelong learning documents dominance of non-formal learning activities. In the EU on average at least one in 3 adults undertook some non-formal learning in 2011 while only about 1 from 15 adults engaged in formal learning activity.



The lifelong learning activities are mostly job related and prevailingly sponsored by employers. At EU average, 6 out of ten adults undertakes learning that is related to the job and in most cases the education and training is paid by the employer. By country, the overall learning participation ranged from more than 60% in leading Sweden to less than 10 % in Romania. Informal learning by guidance on the job is a crucial element in the process of building adults competencies.

Chapter 20

There are strong links between employability, lifelong learning and social cohesion. Participation in lifelong learning in form of training is highly relevant directly for improved employability, as well as indirectly via contribution to skills upgrade. LLLight observes that most of the outcomes of non-formal trainings are recognized by the participants to have had positive effects on employability. Participants report in most cases that the non-formal education activities have resulted in finding a job or a new job or in improving their salary. If and how employability changes with learning depends on a range of factors but varies significantly across countries in relation to country educational, social and labor markets frameworks.

*„Learning is damaging
to ignorance“*

Unknown

II SUMMARY OF MAIN PUBLIC POLICY RECOMMENDATIONS

A. Promote the development of complex problem solving skills

The skill of resolving complexity is a key driver for higher innovativeness and higher productivity, leading to higher incomes for individuals, higher profits for companies and higher welfare in regions. It is moreover apparently a skill that can to some degree be acquired and trained in lifelong learning activities. Public policy should take the importance of this particular skill in its sights, and seek to promote the development of this skill in its programs and projects.

B. Encourage skill development in all biographic stages

Beyond the capacity to solve complexity, skills in general are even more valuable to economic value creation than suggested by previous evidence. Moreover, it is the skills of the population, and not the number of years spent in school, that drive economic development. Policy should therefore aim to encourage skill development in all stages of people's biography: in early childhood when learning foundations are laid, in formal child and youth education, and also in the many contexts of lifelong learning.

C. Carefully consider returns on human capital in labor market regulation

High union density, strong labor protection regulation and a large public sector are related to lower returns on skills. Policy needs to carefully weigh the intended benefits from these three labor market characteristics against the possibility of reducing returns to human capital investments.

D. If ICT competences are socially desired, then increase accessibility to internet

The ability to function in ICT technology rich environments can be promoted by providing access to this technology. To the degree that ICT competence enables socially desirable developments (overcoming digital divide, social inclusiveness, jobs of the future, etc), policy should aim to increase accessibility to internet infrastructure especially for those groups of society which are lacking access due to informational or financial reasons.



E. Promote upskilling during occupational switching

During occupation switches, voluntary or not, it is important to create access to new jobs for which an upskilling is required, as well as training opportunities which enable up-skilling, in order to maintain or increase income potential. Beyond securing a job at all, policies which promote upskilling during occupational switching are strongly preferred.

F. Reduce institutional restraints to lifelong learning where they can be identified

Formal education in lifelong learning circumstances may be suffering from reputational or institutional restraints, which reduce its returns, and therefore its comparative attractiveness to before-work formal education. Where such restraints can be identified, policy should work to reduce or eliminate them, in order to encourage more participation in formal lifelong learning activities.

G. In migration context, promote the learning of languages at all proficiency levels

If migration of work force across national borders is favored or accepted, then it becomes critical that the migrant's language skills for the recipient countries are present or fostered. Every degree of language proficiency increases the transfer rate of human capital from one labor market to the other. In migration scenarios, policy should strongly encourage and support the learning of languages at all proficiency levels.

H. Support enterprises in pre-competitive collective coordination on training

Enterprises are a significant investor in lifelong learning activities, both by (co-) financing directly in formal and non-formal education, and by providing indirectly informal learning at the work place. Policy can play a central role in supporting enterprises reach-out to employees and increase access to training and lifelong learning. Such policies should take into account the internal and external conditions and the interactions with different actors in the training market. To exploit the potential that enterprises can give to facilitate access to training, policies should target both HR function and key leadership roles in an enterprise because they all contribute to support access and reach out to employees. Moreover, policies should support the role that union and workers representatives can play by expanding their expertise and knowledge base on training issues. Finally, the creation of regional, local and industry-based training schemes among companies can help reduce the costs and risks that each single one bears and thus increase the overall investments and the inclusiveness of the initiatives.



I. In entrepreneurship context, support opportunity competences

Skills and learning are also positively related to employee-driven innovation and entrepreneurship, though some skills more than others. Where policy is focusing on fostering and encouraging entrepreneurship, its effort should be accompanied by highlighting these particular skills and work organizations which are beneficial to entrepreneurship. A particular noteworthy skill is opportunity competence, which also seems to be related to complex problem solving skills. In addition, the results confirm the importance of stimulating complex and demanding workplaces as they contribute to individual innovative performance.

J. Make human resource managers the contact partner for lifelong learning policies

The key decision makers in enterprises for lifelong learning activities are human resource specialists. HR management is therefore the contact partner for policy makers to engage with, particularly in co-creating and fostering the usage of measurement tools for transversal skills development. Enterprises currently lack the knowledge and tools to measure both the need and the development of their most valued skills.

K. Promote and support lifelong learning in the work place context

Lifelong learning in the workplace requires a context which can foster and champion it. There is a need for HR management to strengthen their business contexts by leveraging intrinsic motivational strategies, which directly contribute to value creation. There is equally a pivotal role for policy makers to collaborate in the development and promotion of such lifelong learning strategies.

L. Encourage partnership approaches among lifelong learning players

Lifelong learning matters for the impact of policies across many areas. When planning, it is important to be aware that encouraging lifelong learning among key groups may make the difference between success and failure. Public investment in educational and training programmes that encourage partnerships with companies and build lifelong learning within companies is recommended. The state has an important role as regulator of partnerships between public educational bodies and private companies to avoid the risk of specific business interests dominating these relations. Companies also benefit from engaging with NGOs and professional associations and networks.

M. Focus on increasing lifelong learning in countries with low participation rates

The pattern of participation in lifelong learning is very different across European countries. Participants to lifelong learning everywhere confirm that they engage in non-formal and informal lifelong learning in order to improve their employability. Given that lifelong learning appears to have substantial impact on incomes of individuals, enterprises and regions, there is substantial room for improvement in the institutional and socio-cultural context to increase participation in lifelong learning in many European countries. In particular, non-selective and administratively easily accessible programmes for the whole population are a key success factor to avoid market distortions and address risk of specific business interests. The dominating and increasing importance of SMEs in EU creates favorable conditions for such policy solutions.

N. Support more research on complex problem solving skills

While much could already be learned and measured about complex problem solving skills, there remain many unexplored angles around the construct. Encouraging and supporting more research on the construct family of problem solving are likely to yield important insights in how this skill can be developed, and how it contributes to economic and social value creation in society.

*„Everything should be made
as simple as possible, but
not simpler“*

Albert Einstein

III PUBLICATION SUITE TABLE OF ALL POLICY BRIEFS AND THEMATIC REPORTS OF LLLIGHTINEUROPE RESEARCH PROJECT

Policy Briefs

	PERSONS	ENTERPRISE	COUNTRY
01 Resources of society for learning	Human capital of managerial leadership is related to innovativeness of the enterprise	Incentives are highly effective resources for lifelong learning in enterprises	Public policies support lifelong learning among company employees
02 Institutions of learning	Returns to part-time formal education while on the job are positive and worthwhile, but are lower than full time formal education	Enterprises can leverage work arrangements for more effective lifelong learning	Partnerships and networks support lifelong learning in companies
03 Circumstances of learning	Non-formal education dominates the circumstances of lifelong learning	Human resource strategies are the key to bolstering lifelong learning circumstances at the enterprise level	Technology and business needs shape training and learning
04 Role of transversal skills	Complex problem solving: a promising candidate for facilitating the acquisition of job skills	Enterprises are greatly important for lifelong learning activities	ICT skills are highly valued in European labor markets

PERSONS

ENTERPRISE

COUNTRY

05 Role of job-specific skills

Skill mismatch affects life-long earnings

Enterprises can help increase access to training and lifelong learning: Opportunities and responsibility

Language skills are critical for workers' human capital transferability among labor markets

06 Productivity of skills

Income returns to complex problem solving skills are strongly significant

Opportunity competence contributes to successfully leveraging ideas for entrepreneurship and innovativeness in enterprises

European economies benefit greatly from a higher-skilled workforce

07 Outcomes of skills

Income growth is related to complexity

High levels of individual and feed forward learning foster employee-driven entrepreneurship and innovativeness

Lifelong Learning is a growing factor in employability

Thematic Reports

01 Learning to Lifelong Learn

02 Effective Lifelong Learning Strategies and Value Creation at the Enterprise Level

03 Job Complexity and Lifelong Learning

04 Links between Flexicurity and Lifelong Learning

05 Employee-driven Innovation/Entrepreneurship and Lifelong Learning

06 Macroeconomic Growth and Lifelong Learning

IV CORE INSIGHTS FROM THE LLLIGHTINEUROPE PROJECT

The LLLightinEurope research project proposed that high investments in lifelong learning of formal, nonformal and informal nature are required for European economies to be vibrant and for European citizens to enjoy high and growing quality of life. One of LLLight's main objectives was to understand to what extent the skill of complex problem solving should be targeted in lifelong learning. Chapter 1 explains the particular importance of the skill of solving complexity.

1. Lifelong learning which increases skills of complex problem solving, raises lifelong incomes


Skills to resolve complexity is related to higher income potential

LLLight research shows that persons who are more exposed to complexity, and have more capacity to solve this complexity, experience higher incomes. This should not be coincidence. The skill to solve complexity is critical for being more innovative, for increasing productivity, and for strengthening value creation. Individuals profit from this skill with higher income potential, companies achieve higher profitability, and regions increase the welfare of their residents. Using and strengthening complexity resolution skills should therefore be a vital component of any innovation and growth strategy.

This is true for individuals, for enterprises and for regions

LLLight observes that the skill to solve complexity may in many ways be acquired, learned or trained over the lifetime of a career, mostly in informal learning-by-doing circumstances. Learning to resolve complexity may therefore be a core component of lifelong learning. LLLight has good reason to believe that solving complexity can also be trained in formal learning conditions.

LLLight supposes that this relationship is the principal reason for why in Europe, incomes rise with increasing age and tenure on a job.



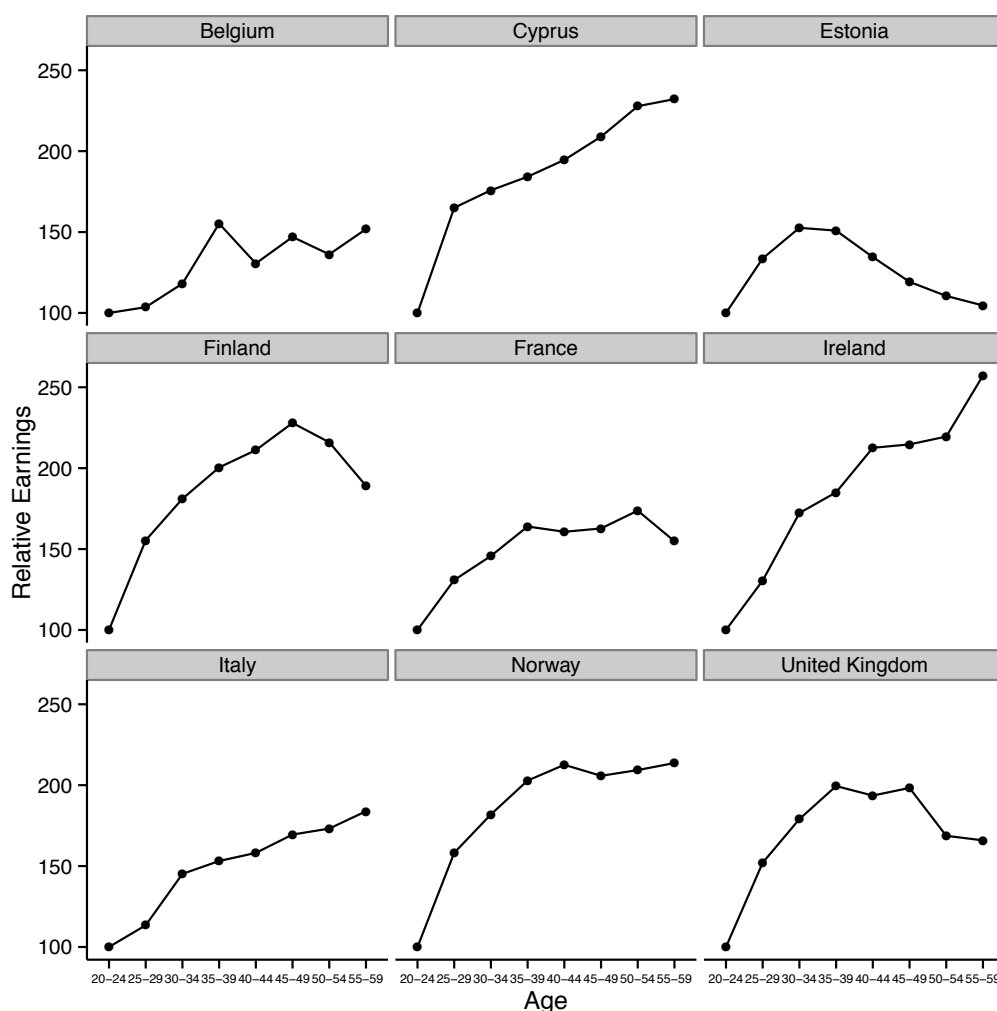
For a Europe which is changing towards longer lives and longer working biographies, this is a positive dynamic, because it shows that innovativeness and robust economic growth can be maintained also in the upcoming demographic conditions of the 2020's and 2030's.

Therefore, if the intention of engagement in lifelong learning is to increase income, then an efficient target of such learning should be to increase the competence to solve complex problems. This is true for individuals, for enterprises and also for regions.

In most of Europe, older workers are generally more productive than younger workers. Why?

In Europe, incomes generally rise with age and tenure. Figure 1.1 shows the average income curve by age groups for a selection of 9 EU countries. Even accounting for institutional arrangements whereby political or cultural institutions might be enforcing undue higher pay as workers grow older, this must mean overall, that workers become more productive as they become older.

Figure 1.1: Income by age groups for 9 selected EU countries



Notes: relative earnings are PPP-adjusted monthly earnings normalized by country average for 20-24 years old.

Source: LLLight analysis based on OECD PIAAC data

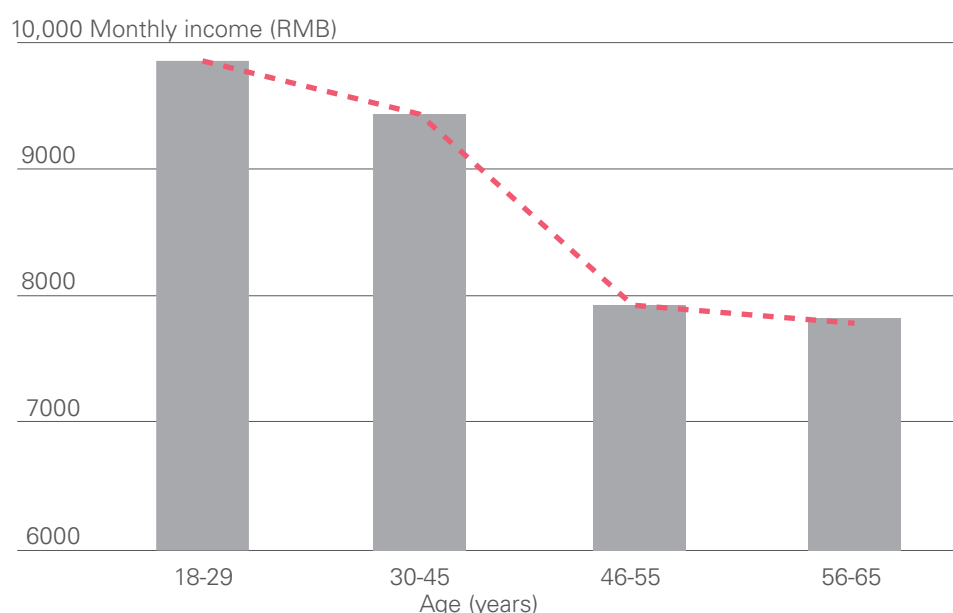
Why this should be the case is less obvious. At first sight, the younger should earn more than the older. The young are more intelligent than their older colleagues (intelligence peaks at around the age of 20), are on average healthier, are less burdened with family responsibilities and can therefore concentrate better on their job. Also their education is more recent and in most countries it is more extensive, which means that it probably was a better education to begin with, and that they will have forgotten less of it. Thus all primary indicators of human capital strength would favor the young over the old.

Scientists like Jacob Mincer claim that it is experience which makes the older more productive over the young, but that cannot be the complete story

Scientists have been advancing several reasons for this phenomenon, many of which in one way or the other mean that the older have more experience, and thus are more productive. This is captured in the famous Mincer earnings function, which is a single-equation model that explains earnings as a function of schooling and experience. The equation has been examined on thousands of datasets and is said to be one of the most widely used models in empirical economics. Typically the logarithm of earnings is modelled as the sum of years of education and a quadratic function of years of potential experience.

But this shifts the question only to: “What constitutes experience?” Furthermore, for the majority of the global work force the Mincer equation is misleading, (as figure 1.1 showed in some EU countries earnings drop with age). Despite the fact that these workers have accumulated more experience over time, their income relative to the average work population goes down with age, probably because their relative productivity is lower. Figure 1.2 on the income distribution by age in China for instance shows how:

Figure 1.2: Income by age groups for EU China



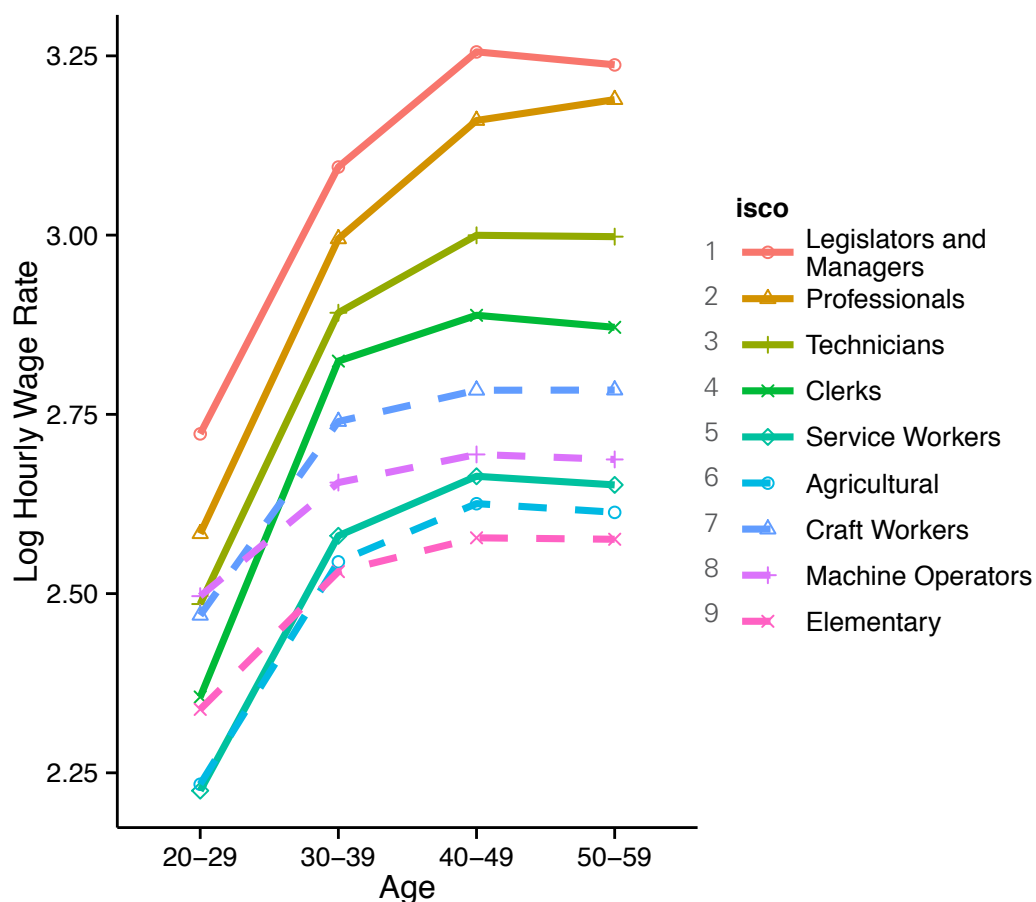
Source: Credit Suisse Emerging Countries Report

Looking at the income age curves in Europe by occupation, reveals that it is exposure to complexity which is related to income rises over a career

LLLight's analysis shows that it appears more explicitly to be the experience to resolve complexity, which is what increases productivity, and thus justifies higher incomes with age and tenure on a job.

Figure 1.3 splits the income age curves not by country but for the example of Germany, by the nine ISCO occupational groupings as specified by the ILO classification. While incomes rise with age for all occupational groups, the nine curves differ in two crucial ways: a) the lower income groupings experience a slower increase of income, and b) the lower income groupings plateau earlier from which incomes do not rise further regardless of tenure.

Figure 1.3: Income age curves by ISCO occupational groups in Germany



Source: LLLight analysis based on Eurostat SES

The skill of solving complexity is what is valued in the labor market and allows for higher incomes

If the difference between the ISCO groups would be only differing quality and quantity of initial education, then the curves should look different: they should begin at different levels and from then onwards have the same shape. Since the shapes of the curve are different, this suggests that the quality of the experience accumulated over a working lifetime, for instance a craftsmen (ISCO 7) is different from that of a technician (ISCO 3) and different from that of a professional engineer (ISCO 2).

We suggest that this difference is the amount of complexity encountered in these occupations, and the experience via lifelong learning, which is accumulated in solving this complexity. Alternative explanations are less convincing. For instance, organisational leverage in the sense of having leadership responsibility over a larger group of people and therefore being able to receive higher incomes, applies only to the ISCO 1 group, and can therefore not explain the other differences. The “difficulty” of job performance is also an unlikely candidate. There are many occupations in lower paid jobs, which are quite difficult to perform and require either high degrees of dexterity (watchmakers), stamina (construction workers), psychological stability (nurses) etc, without this being reflected in their income. A further explanation that the better paid ISCO groups would be receiving more training over their career lifetime, and will therefore experience longer and faster earnings growth due to more education received, is also neither proven nor plausible.

Using job content data of some 40,000 employed Germans from the BIBB/IAB and BIBB/BAuA Employment Surveys of 2006 and 2012, LLLight creates a measure of job complexity and shows that employees in more complex jobs have steeper wage curves than employees in less complex jobs. Figure 1.4 shows income age and income experience curves for different classes of complexity in the job content of occupations for both USA and selected EU countries. Clearly, the higher the task complexity of the job, the faster and longer does the income rise over a career.

Figure 1.4 a): Income age curves by classes of complexity for the combined countries of Belgium, Cyprus, France, Ireland, Italy, Norway and the UK

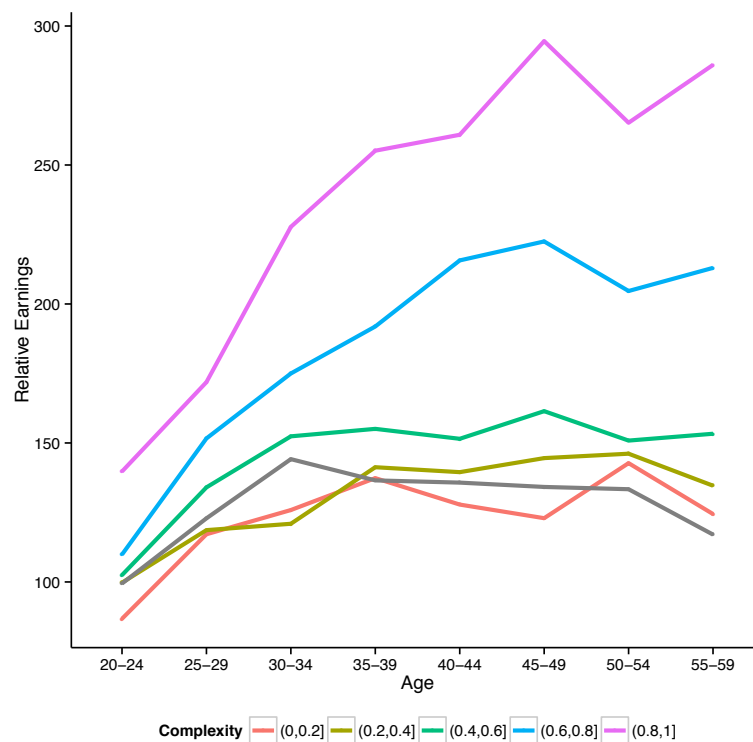
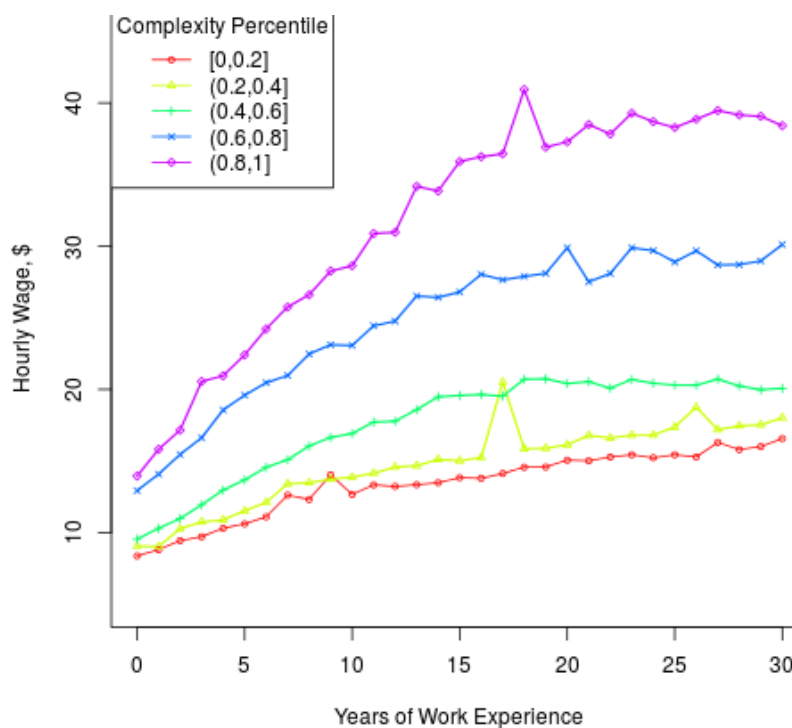


Figure 1.4 b): Income tenure curves by classes of complexity for USA



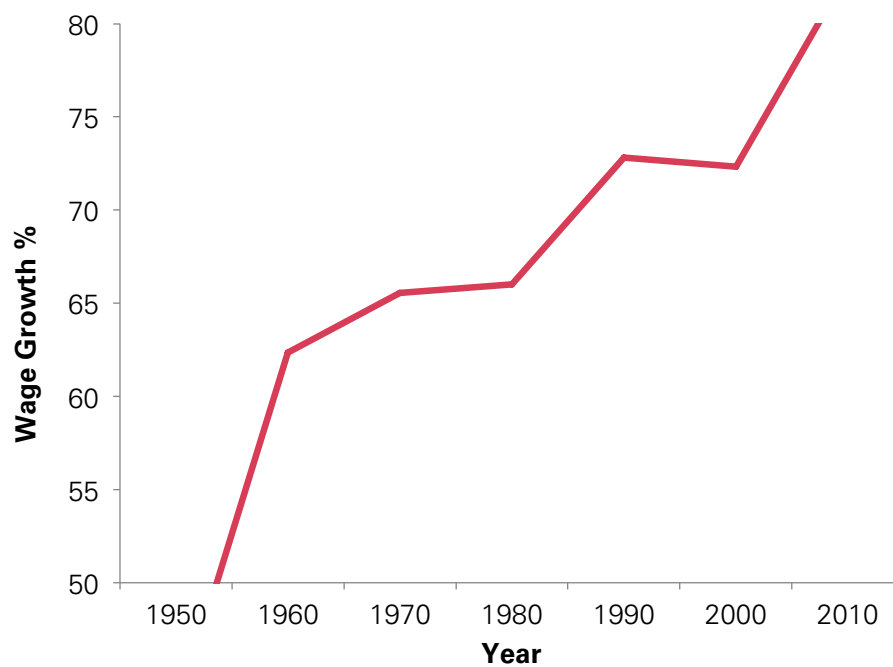
Note: complexity is measured in percentiles from 0 (least complex job) to 1 (most complex job).

Source: IPUMS and PIAAC and Nedelkoska et. al. (2014) for the complexity measure.

In past decades, jobs were less complex, and accordingly the Mincerian income age curves were also flatter

LLLight can also observe a historical relationship between the steepness of the income age curves and the complexity content of the jobs. Based on an analysis of the IPUMS database in USA, since 1950, the steepness of the overall Mincer curve for US occupations increased as is shown by Figure 1.5. At the same time, the amount of job complexity increased commensurately in the overall US labor market. These observations support the statement that it is complexity, and the skill to resolve such complexity, which is leading to higher incomes, higher profits and higher welfare. One important pathway between complexity resolution and value creation is explained in chapter 2.

Figure 1.5: Steepness of Mincer curves from 1950 to 2010



Notes: the numbers indicate estimated wage growth between 0 and 10 years of tenure. Estimation was done with the standard Mincer regression.

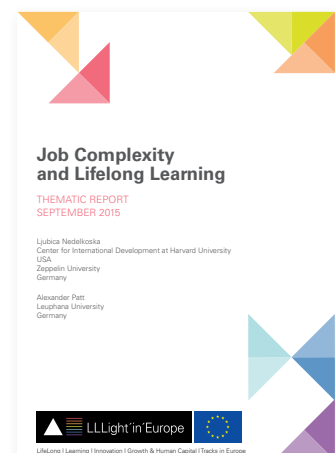
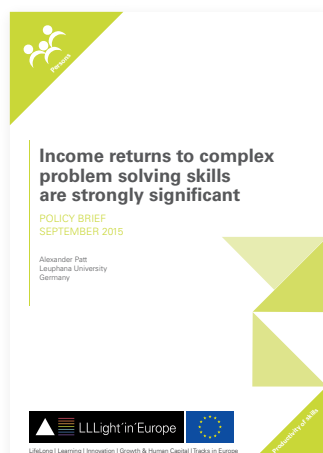
Source: IPUMS-USA, University of Minnesota

Lifelong learning
should target the skill
of complex problem
solving in order to
raise income potential

In conclusion, lifelong learning may have many targets and good uses for the welfare of individuals and societies. To the extent that the aim of lifelong learning is to increase income, LLLight recommends to focus learning efforts on the skill to solve complexity. LLLight bases this recommendation on the findings that a) the skill to solve complex problems attracts higher incomes, and b) that continuous exposure to complexity appear to train this skill of complex problem solving, and c) that there are elements of this skill of complex problem solving, which may be trainable also in formal learning environments.

For more details on this chapter, please find:

- LLLight Policy Briefs: “Income returns to complex problem solving skills are strongly significant” by Alexander Patt and “Income Growth is related to complexity” by Alexander Patt
- LLLight Thematic Report: “Job complexity and Lifelong Learning” by Ljubica Nedelkoska and Alexander Patt;
- Journal paper: Ederer, P., Nedelkoska L., Patt, A and Castellazzi, S. (in press) “What do employers pay for employees’ complex problem solving skills?” International Journal of Lifelong Education, Special Issue on Problem Solving Skills 2015.



Why might the skill of solving complexity be of prominent importance? Chapter 2 explains conceptually how complexity resolution skills increase innovativeness and in due course increases productivity – and thus lead to higher incomes.

2. The pathway between complexity resolution and income rise is to decrease the investment costs of innovation, which in due course leads to higher productivity

Being innovative is to a large degree an exercise in problem solving

Being innovative is to a large degree an exercise in problem solving. Innovation is defined as the successful introduction of either something new that will be bought by the public in the market place, or by producing the same thing in a new way. Such “*novae*” can be new products, new services, new processes, new organizational models or new business models in various guises. They are usually being introduced with the hope and promise to achieve “more or better” with the same or less amounts of workforce input – thus to increase productivity, and with it profitability and income.

However, there are two counteracting forces to these *novae*, which reduce productivity initially. First, the *novae* create conditions of complexity. Complexity is here defined as a state where for the workers involved in a task, the underlying cause and effect relationships of the constituent elements required for performing the task, are neither apparent nor accessible by random action. Under conditions of complexity, a worker is not going to succeed, because the task execution is not clear. Productivity will actually go down.

Before novae can unfold their proposed higher benefits, their impacts and relationships with the other elements in the system must first be understood and mastered. In other words, their complexity must first be resolved

Complex problem solving skill reduces the initial productivity loss of innovation, and in this becomes one of the determinants to the pace and depth of innovativeness of any given business, industry or region

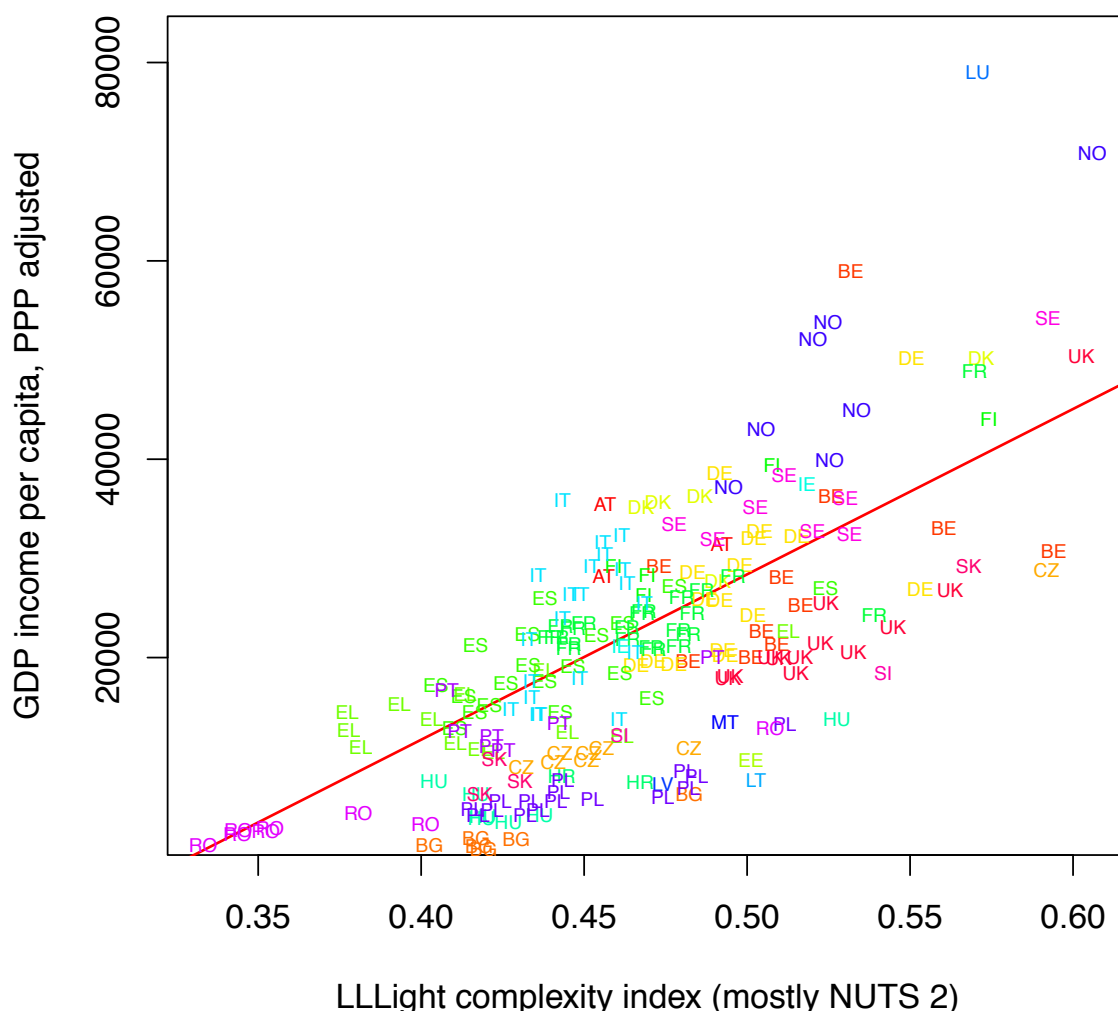
Therefore any activity with a recently introduced *novae* which caused complexity, is likely not going to profitable right away. Before the novae can unfold their proposed higher benefits, their impacts and relationships with the other elements in the system must first be understood and mastered. In other words, their complexity must first be resolved.

The second productivity-decreasing force is that once the relationships revealed themselves via complexity resolution, they then need to be translated into repeatable processes, which need to be trained to gain speed and quality.

Enterprise is thus faced with a Jekyll and Hyde situation of innovation: Jekyll promises to increase productivity with his *novae*, but Hyde will likely reduce productivity upon its introduction due to the complexity it creates at first. Unless the complexity is resolved, the promise of productivity increase will not materialize, and thus the innovation will not succeed.

In this way, complex problem solving competence of the work force or the customers becomes relevant: this skill reduces the effect of initial productivity decline upon introduction of an innovation. Its presence becomes one of the determinants to the pace and depth of innovativeness in any given business, industry or geographic region: the more of such competence is available, the more *novae* can be introduced, because the lower will be the initial productivity while being innovative.

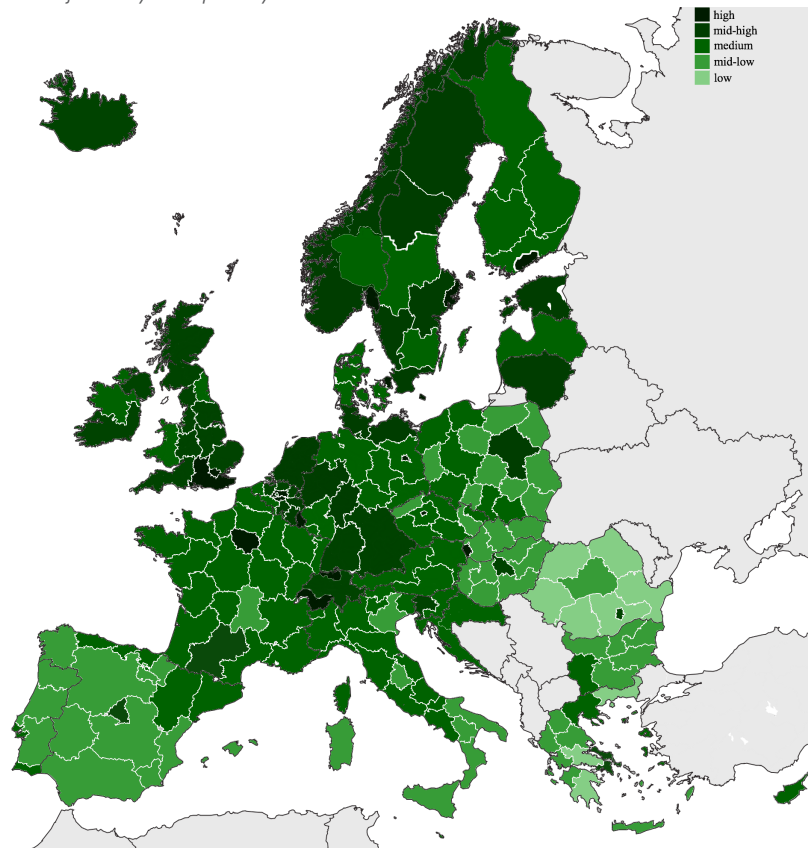
The relationship between degree of complexity encountered by the work force and productivity as measured by gdp income per capita for European regions is shown in figure 2.1, where wealth is the higher, the more complex a region's job contents are.



Source: LLLight'in'Europe

In a region, there are of course many factors that contribute towards solving complexity, besides the direct personal skill to solve complexity: general skills of the work force, companies with institutionalized capacity to manage complexity, industrial organization permitting complex supply chains, regional promotion of technology and innovation, or regional policy frameworks which allow complex systems to flourish. LLLights conceptual observation is, that the individual skills to solve complexity will likely augment or facilitate any of the institutional conditions which exist in a company or in a region to create value out of complex circumstances. Figure 2.2 shows a map of Europe where its regions (mostly Nuts II) are colored by degree of complexity, as indexed by LLLight analyses.

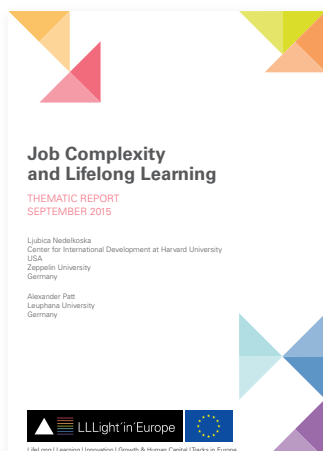
Figure 2.2: European rejects by complexity



Source: LLLight'in'Europe.

For more details on this chapter, please find:

- LLLight Thematic Report: "Job complexity and Lifelong Learning" by Ljubica Nedelkoska and Alexander Patt;
- Journal Paper: Ederer, P., Greiff, S., Patt, A.: "Distribution and Trainability of Complex Problem Solving as an Essential Skill for Innovativeness – Evidence from Occupation Testing"; European Journal of Education, Special Issue on Innovation (forthcoming).



What is the concrete evidence that the skill of complex problem solving leads to higher incomes? Chapter 3 presents the analyses from the LLLightinEurope proprietary datasets on CPS on the income returns to this skill.

3. Complex problem solving skills are an important determinant of earnings

Income returns to complex problem solving skills are about 11% higher for every standard deviation

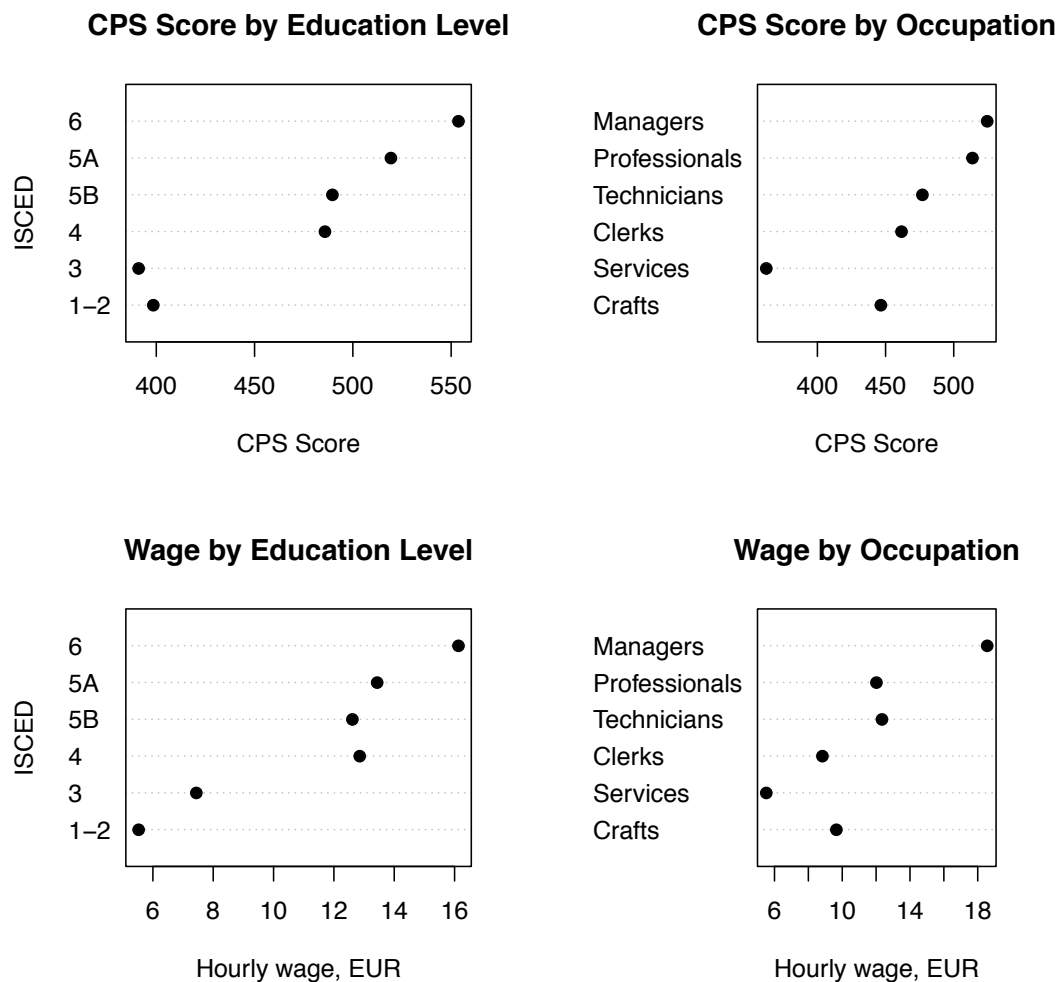
Education, work experience, on-the-job training, abilities and talents are all important determinants of labor market outcomes such as earnings and employability, albeit to varying degrees. How large are the returns to CPS skills and how do they compare to returns to other human capital measures? Based on analysis of 959 observations collected in the period 2012 – 2015 from employees from 12 countries in Europe, South America and Africa, LLLight estimates that for every standard deviation difference (one SD is 100 CPS points), employees receive 11% higher wages. This estimate takes into account possible differences in education, years of work experience and managerial responsibility. Thus for example an individual at the 85th percentile of the CPS skill distribution earns 20% more compared to a similar individual at the 15th percentile (the difference between 85th and 15th is approx. two standard deviations).

To provide a reference point for the relative size of this income return, the equivalent corresponding 85th-15th percentile difference is 6 (!) years of schooling, according to the PIAAC data provided by the OECD. Using 6% as an established estimate of the rate of return to one year of schooling, this translates roughly into a total of 36% earnings difference between 85th and 15th percentile. The 23% earnings difference for CPS thus has more than half of the magnitude as schooling does.


As for work experience, the corresponding number is 30 years, which according to our estimation translates into 41% difference in earnings. Again, CPS is roughly half of the magnitude of such earnings determinant as work experience is.

If one single measurable skill has ca half the impact and is half as valuable as all the different aspects that are compounded in measurements of school years or in working experience years, then this shows how significant this particular skill is. Needless to say, individuals who excel in the CPS assessment are also more likely to have a high level of education and be employed in an occupation that pays high wages (fig. 1).

Figure 3.1: Complex problem solving skills and wages by education and occupation



Source: LLLight'in'Europe.

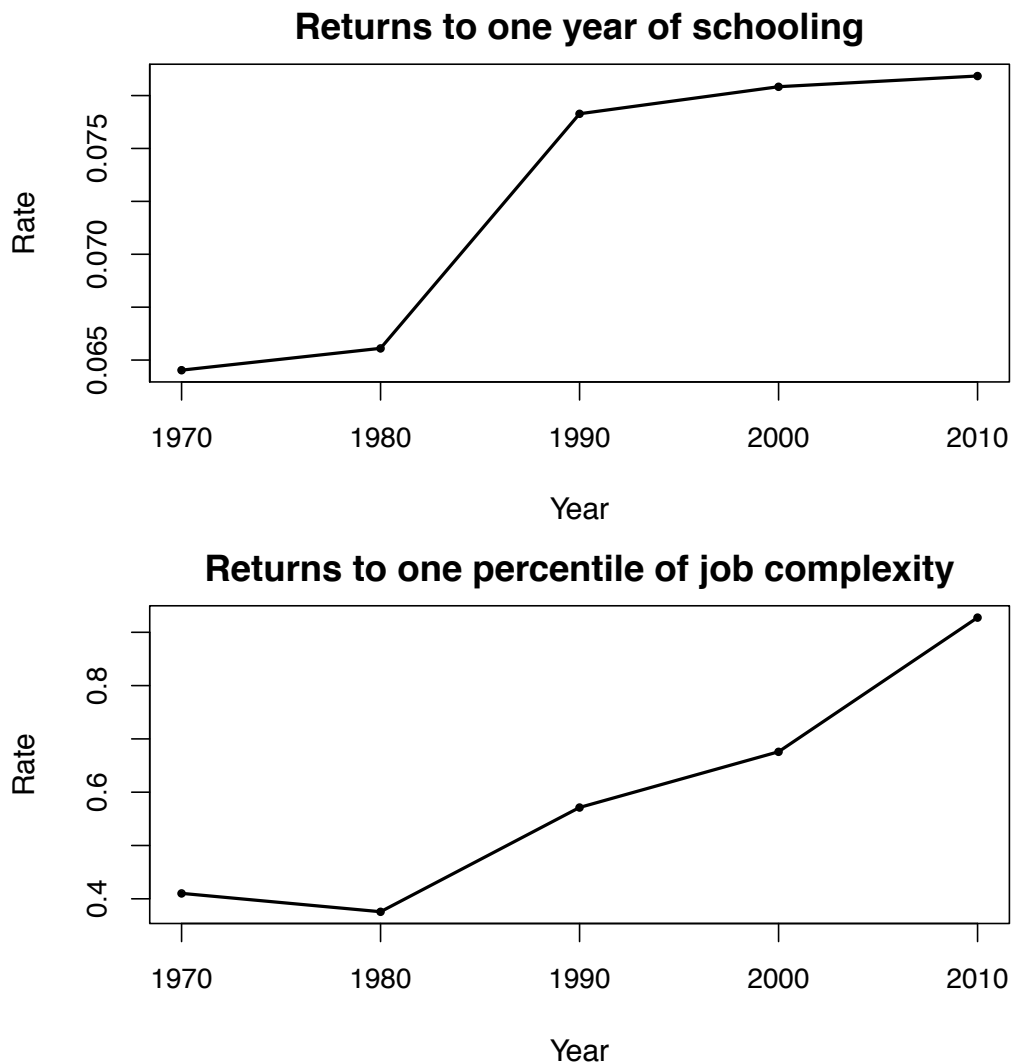


Returns to cognitive complexity of work has been increasing in the past 25 years

The importance of complex problem solving skills is furthermore highlighted by the fact that the share of employment in managerial and professional occupations has been increasing in a number of European countries in the past 20 years. Individuals employed in such occupations have high measured CPS skills that are statistically different from other occupations, in particular from service and crafts workers, whose CPS scores are more than one and a half standard deviations below. Such a large difference suggests that CPS skills may be intensively used in highly skilled occupations and that they are a precondition to obtain such jobs.

Not only are the returns to CPS skills high, they also seem to be rising. Based on the fact that CPS skills are strongly correlated with doing work tasks that are intensive in problem solving, acquiring knowledge, dealing with novelty and complexity, LLLight analysed the data on task utilisation in order to estimate historic returns to job complexity on occupational level. Using Integrated Public Use Microdata Series from the University of Minnesota, LLLight finds that market returns to problem solving skills have risen remarkably over the past quarter century (fig. 2). In 1990, an individual at 75th percentile of the job complexity distribution earned 24% more than an individual at the 25th percentile – all other factors being the same. By 2010 such earnings difference had become 35%, i.e. an increase by 46%. In comparison, the earnings difference between individuals with 75th-25th percentile of schooling increased little from 28% to 30%, because the returns to education hardly changed over that period of time. These findings suggest that the demand for complex problem solving skills has been rising strongly and that such skills have become increasingly more important for success at workplace.

Figure 3.2: Historical returns to job complexity and education




Source: estimated using IPUMS and O*NET data.

CPS skills explain
part of gender
inequality in earnings

Males on average perform better than females in the CPS assessment. Because of that CPS skills can explain part of the earnings gap between males and females. Once the difference in CPS skills is taken into account in addition to other determinants of wages, the gender gap is reduced from 18.5% to 13.3% in the data.

What are the factors that contribute to gender difference in CPS skills? In the collected data males and females have similar participation rates in tertiary education. Relatively more males completed vocational degrees and relatively more females have only upper and lower secondary education.

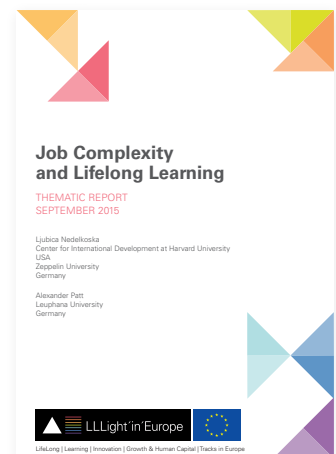
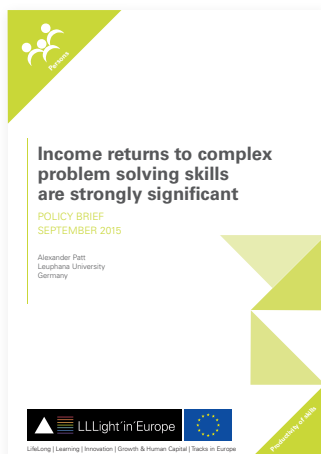


Males are considerably more likely to be employed as managers and less likely as service workers or clerks. Taking into account differences in education and employment, the gender difference in the CPS scores is reduced from 60 points to 44 points. In addition to that, personality traits also play a role, as males on average scored higher on the conscientiousness dimension of the Big 5 model, which helps to reduce the gender gap in the scores down to 36 points.

In conclusion, CPS skills play an important role in determining earnings and employment, therefore improving one's CPS skills is highly desirable. Investment in CPS skills may provide a way to increase earnings potential at the later stage of career, when other forms of human capital investment become less accessible. For this reason it is important to understand the mechanisms of improving one's CPS skills. LLLight finds that CPS skills are correlated with the level of education, intelligence, socio-demographic characteristics, personality traits and learning attitudes. While most of these factors are not easily changeable, improving the learning attitudes towards open-mindedness and learning new things may allow one to develop greater skills from interaction with daily problems. The relation between CPS skills and problem solving tasks at work suggests that choosing complex jobs which provide a favourable environment for learning and problem solving may be one venue to improve one's CPS skills.

For more details on this chapter, please find:

- LLLight Policy Briefs: “Income returns to complex problem solving skills are strongly significant” by Alexander Patt and “Income Growth is related to complexity” by Alexander Patt
- LLLight Thematic Report: “Job complexity and Lifelong Learning” by Ljubica Nedelkoska and Alexander Patt;
- Journal Paper: Ederer, P., Nedelkoska L., Patt, A and Castellazzi, S. (in press) “What do employers pay for employees’ complex problem solving skills?” International Journal of Lifelong Education, Special Issue on Problem Solving Skills 2015.



Not only Complex Problem Solving skills are valued in the labor market. Also the more general skills of numeracy and literacy as measured by OECD's PIAAC survey, achieve even higher returns and are longer lasting than was previously known. LLLight research explains in Chapter 4 how much skills are being valued in modern labor markets.

4. Modern knowledge-based labor markets value general cognitive skills highly


New international data on cognitive skills across 23 developed economies

Previous evidence on the returns to cognitive skills has had to rely on a small number of specialized data sets. While assessments of the achievement of students are common, tested students are seldom followed from school into the labor market where the impact of differential skills can be observed.

PIAAC, the new OECD study of adult skills, for the first time allows to quantify how different modern economies value cognitive skills. PIAAC was designed to measure key information processing skills that individuals need to advance in their jobs and participate in society. Drawing representative samples of adults in each country, the survey assessed skills in numeracy, literacy, and problem solving in technology-rich environments (similar to ICT skills).

Returns to skills are substantial everywhere, but differ widely across countries

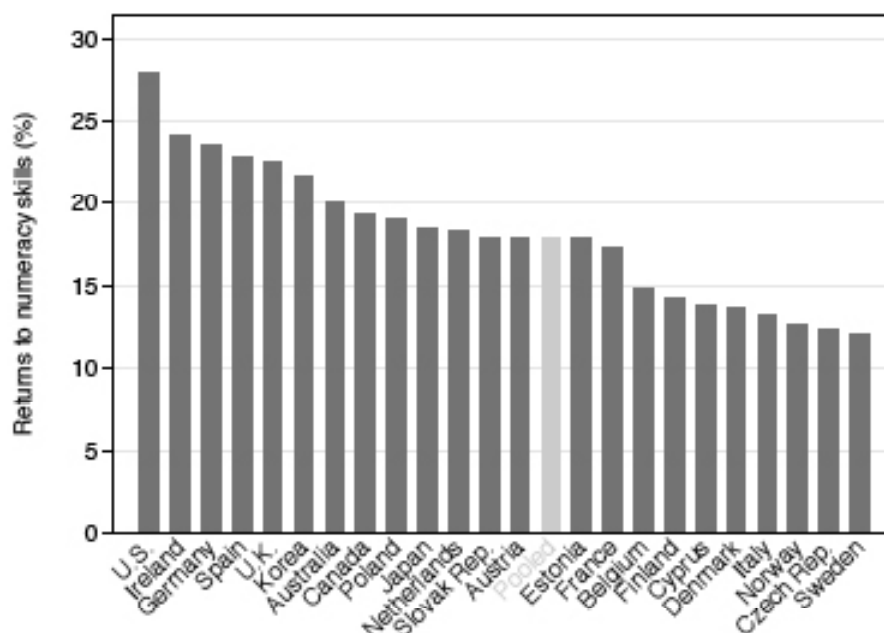
Higher cognitive skills are systematically related to higher wages in all 23 countries (see Figure 4.1). The effect size of the returns is economically important: on average, an increase in numeracy skills by one out of five proficiency levels in PIAAC is associated with an increase in wages by 18 percent across countries. Returns to literacy skills are of a very similar magnitude.



Perhaps the most striking finding from the international analysis is the substantial variation in returns to skills across countries. Estimated returns to skills in the countries with the highest returns (the United States, Ireland, and Germany) are roughly twice as large as in the countries with the lowest returns (Sweden, the Czech Republic, and Norway). Eight countries, including all Nordic countries, have returns between 12 and 15 percent, whereas six countries are above 21 percent with the largest return being 28 percent in the United States. These figures refer to the prime-aged population (individuals aged 35-54), which makes it a good approximation for the returns in terms of entire lifetime earnings.

The findings from Figure 4.1 pertain to individuals who are already employed. However, skills also positively affect the probability to be employed in the first place. When taking the employment effects of skills into account by including the non-employed in the sample and assign them a very low wage, estimated returns to skills increase from the baseline estimate of 18 percent to almost 32 percent. These results suggest that by ignoring employment effects, the results in Figure 4.1 even tend to underestimate the full returns to skills in the total population.

Figure 4.1: Returns to Skills Around the World



The graph depicts the percentage by which hourly wages increase on average with each standard deviation in numeracy skills, which is roughly one out of five proficiency levels in PIAAC. Estimates refer to prime-age full-time employees and control for gender and work experience. Returns to skills estimates are statistically significant at the 1 percent level in each country.

Source: Hanushek, Schwerdt, Wiederhold, and Woessmann (2015).

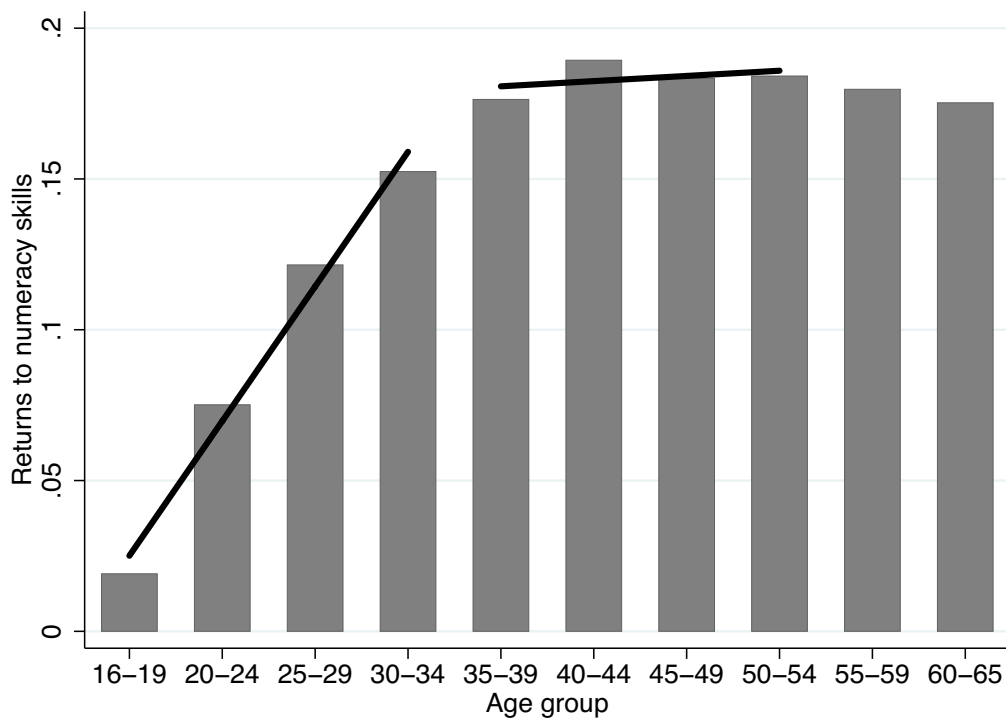
Returns to skills have a distinct age profile

Most previous evidence on the returns to skills has relied on U.S. panel data that permit observing the subsequent earnings of youth who can be followed into their initial jobs. However, estimates based on such early-career earnings are likely to suffer from downward lifecycle bias as people with higher lifetime earnings show systematically steeper earnings growth. Observing people across the entire work life, PIAAC allows an investigation of how much returns to skills differ by age group.

Prime-age workers considered in the main analysis have skill returns that are on average 4 percentage points higher than for labor-market entrants aged 25-34. By contrast, returns for workers aged 55-65 are close to the ones of prime-age workers (see Figure 4.2). This age pattern underscores the problem of previous studies that relied just on the experiences of younger workers in evaluating the economic role of skill differences.


Only the participating transition economies in Eastern Europe do not show this age pattern, probably reflecting the loss of human capital to older workers when their economies changed after the fall of the Iron Curtain.

Figure 4.2: Returns to Skills by Age Group



The graph shows returns to skills (for a one-standard-deviation increase in numeracy skills) for indicated 5-year age groups. Slopes of solid lines reflect average change in returns by age groups (separately estimated for ages 16-34 and 35-54). Estimates refer to full-time employees pooling all countries and control for gender, work experience, and country fixed effects.

Source: Hanushek, Schwerdt, Wiederhold, and Woessmann (2015).



Returns to skills are systematically lower in countries with higher union density, stricter employment protection, and larger public sectors

EU countries not among the top performers in the skill assessment

The cross-country dimension of the analysis can provide stylized facts about what accounts for differences in returns to skills across countries. Intriguingly, returns to skills are systematically lower in countries with higher union density, stricter employment protection legislation, and larger public sectors. By contrast, product-market regulations and the existence of a minimum wage are not systematically related to differences in skill returns across countries. Skill returns neither vary systematically with the level or distribution of skills in a country.

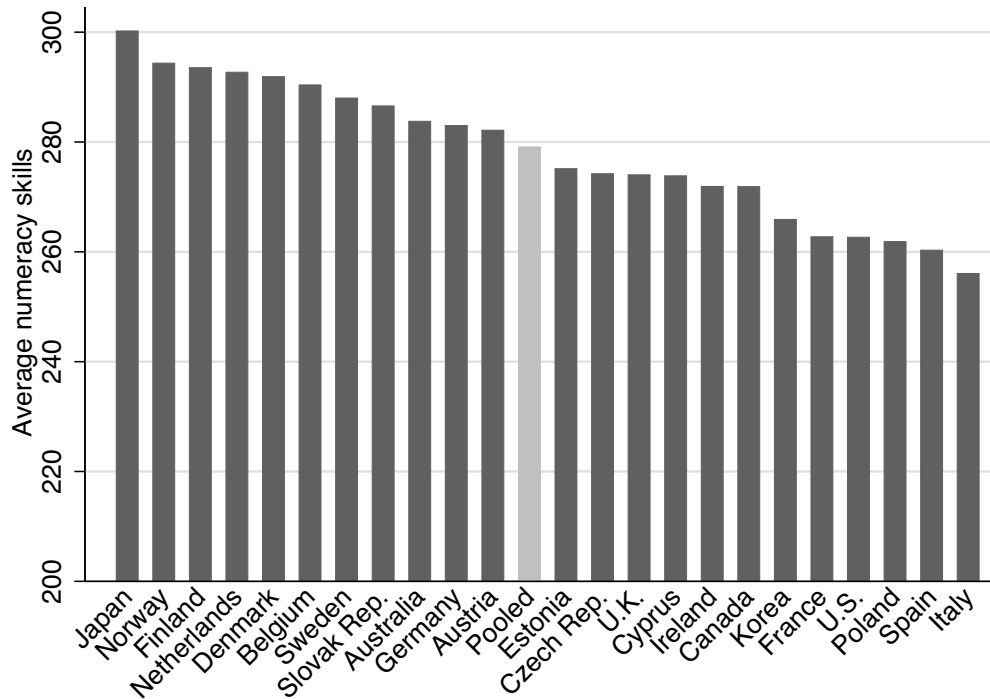
Much of the international discussion of educational policy is centered on school quality and student achievement. To understand the full economic implications of these discussions, it is necessary to go beyond labor-market analyses of the mere length of school attainment and directly investigate the role of acquired skills.

Overall, the results show that modern knowledge-based economies highly reward skills. Given the crucial importance of the skills of the population for economic prosperity, it is instructive to look at the skills of the EU population vis-à-vis other countries (Figure 4.3). Many EU countries perform close to the average of the OECD participants in PIAAC. But even the EU top performers of Finland and the Netherlands fall short of the international top performer Japan. At a worrying level, Italy and Spain, but also France, fall substantially short of the international performance and constitute the bottom of the international league tables. The rather poor performance of European adults on the PIAAC skill test signals a dire need for reforms if the European Union wants to prosper in the future.

This puts the focus on policies for skill development at all levels – from the education provided before and in school to lifelong learning opportunities on and off the job – and on policies that ensure that skills are effectively retained and used.

The new results emphasize that such policies are crucially important to secure the prosperity of European citizens in the future.

Figure 4.3: Numeracy Skills of the Adult Population

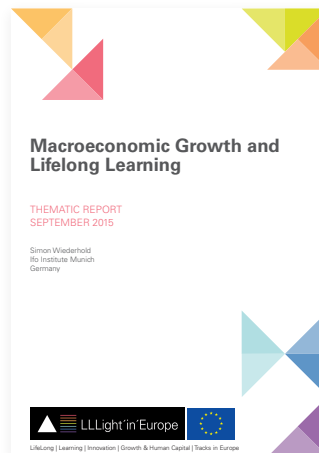
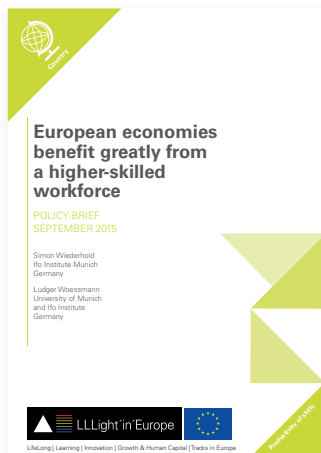


The graph shows average numeracy skills by country for full-time employees aged 35-54.

Source: LLLight calculations based on PIAAC

For more details on this chapter, please find:

- LLLight Policy Brief: “European economies benefit greatly from a higher-skilled workforce” by Simon Wiederhold and Ludger Woessmann
- LLLight Thematic Report: “Macroeconomic growth and Lifelong Learning” by Simon Wiederhold
- Journal Paper: Eric A. Hanushek, Guido Schwerdt, Simon Wiederhold, Ludger Woessmann (2015), “Returns to skills around the world: Evidence from PIAAC.” European Economic Review, Vol. 73(C), pp. 103-130.



The LLLight research on Complex Problem Solving skills was made possible by a novel and reliable assessment instrument for such a skill. LLLight research pioneered the deployment of this assessment among adults and in companies. Chapter 5 introduces the CPS assessment methodology.

5. The skill of complex problem solving can be assessed reliably with a psychometric test

LLLightinEurope
relies on sound
psychmetric tests

At the heart of the LLLight research lies a measurement device that provides a reliable assessment of complex problem solving. To this end, LLLight further developed and applied a fully computer-based approach with sound psychometric qualities from previous research, resulting in a psychometrically sound assessment with high reliability.

Current tests are of
better psychometric
quality and allow
more heterogeneous
tasks than previous
assessment

Early complex problem solving devices lacked such reliability and were not comparable with each other mainly because they differed in their understanding and design of complex tasks. This changed with the introduction of formal frameworks that allowed to better compare assessment scenarios. Formal frameworks enabled the researcher to sum scores across different scenarios, thereby to eliminate the scalability problem inherent in common single-task testing and finally to improve the accuracy of measuring complex problem solving. Since then, complex problem solving devices have been constantly improved to produce better psychometric quality and more heterogeneity in the scenarios than previous devices had shown.

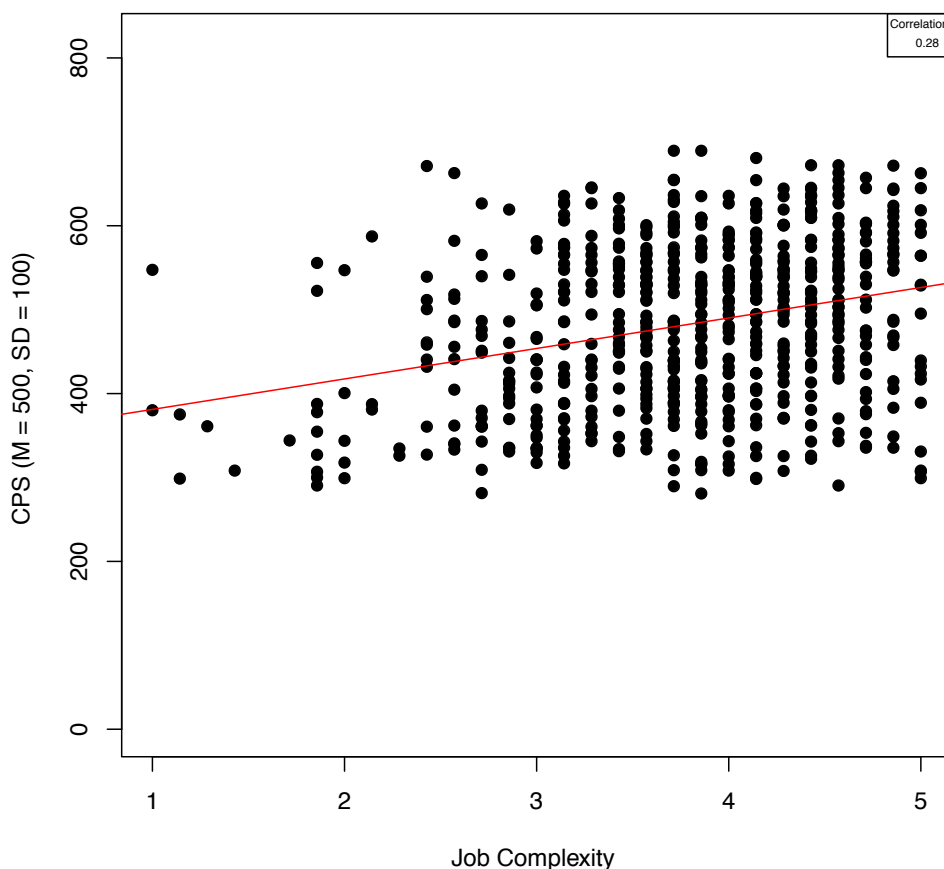
Dynamics between
complex problem
solving and
complexity at the
workplace

On the basis of this assessment approach, LLLight examined among other research questions the dynamics between complex problem solving and the complexity at the workplace. The findings build on a sample of 1129 working adults.

Complex problem solving is higher developed in complex jobs

Complex work environments may promote employees' complex problem solving skills. Figure 5.1 shows a statistical analysis of job complexity in relation to employees' complex problem solving score. Here, the graph reveals a positive, linear relationship between job complexity and complex problem solving. That means the more complex the job, the higher the complex problem solving level and vice versa.

Figure 5.1: Relationship between CPS and Job Complexity



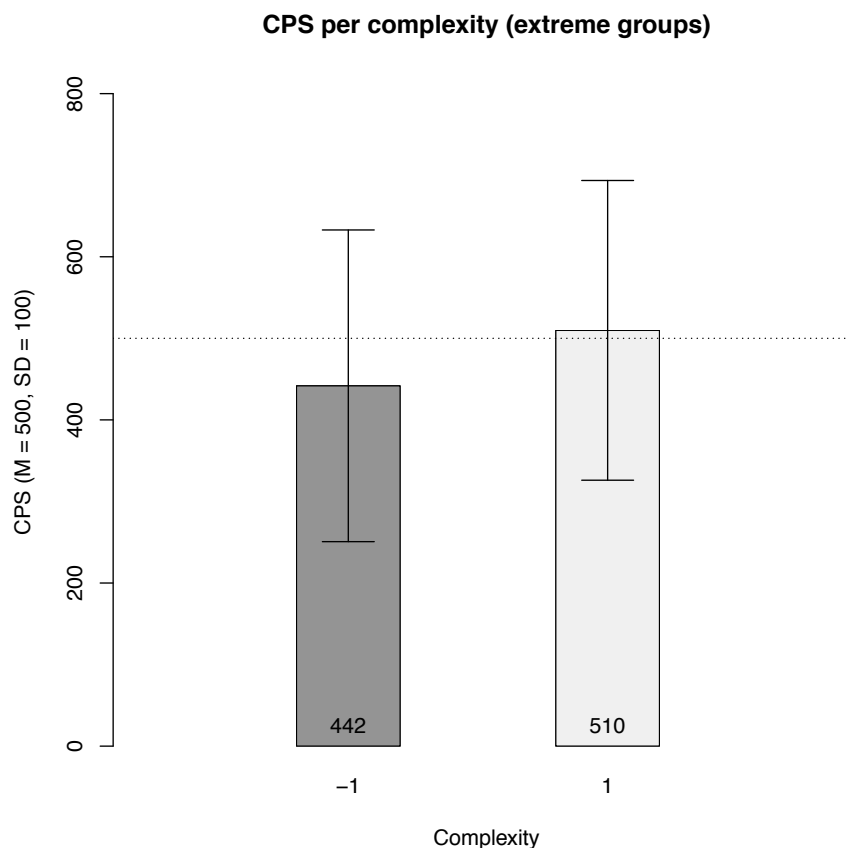
Note. The graph depicts the quantitative relationship between complex problem solving and job complexity. Complex problem solving had a standard-mean of 500 and a standard deviation (SD) of 100. The correlation was significant and on a low to moderate level. Without implications of causality, that means the higher the complexity of the job, the higher the complex problem solving level and vice versa.

Source: LLLight analysis of CPS database

The more complex the job, the higher the complex problem solving level and vice versa

Figure 5.2 depicts a similar relation for two extreme groups, which included either the group of people of the most complex, or the least complex jobs. This graph shows a difference between very high and very low levels of job complexity when looking at complex problem solving scores, furthering the claim that a high parameter value in complexity is associated with a high score in complex problem solving. However, the correlative nature of results made it impossible to draw conclusions about causality in either direction.

Figure 5.2: Relation between CPS and Job Complexity by examining extreme groups on the edges of the distribution of complex jobs.



Note. Relation between CPS and Job Complexity by examining Extreme Groups, which included either the group of people of the most complex, or the least complex jobs. For these groups we show the mean values.

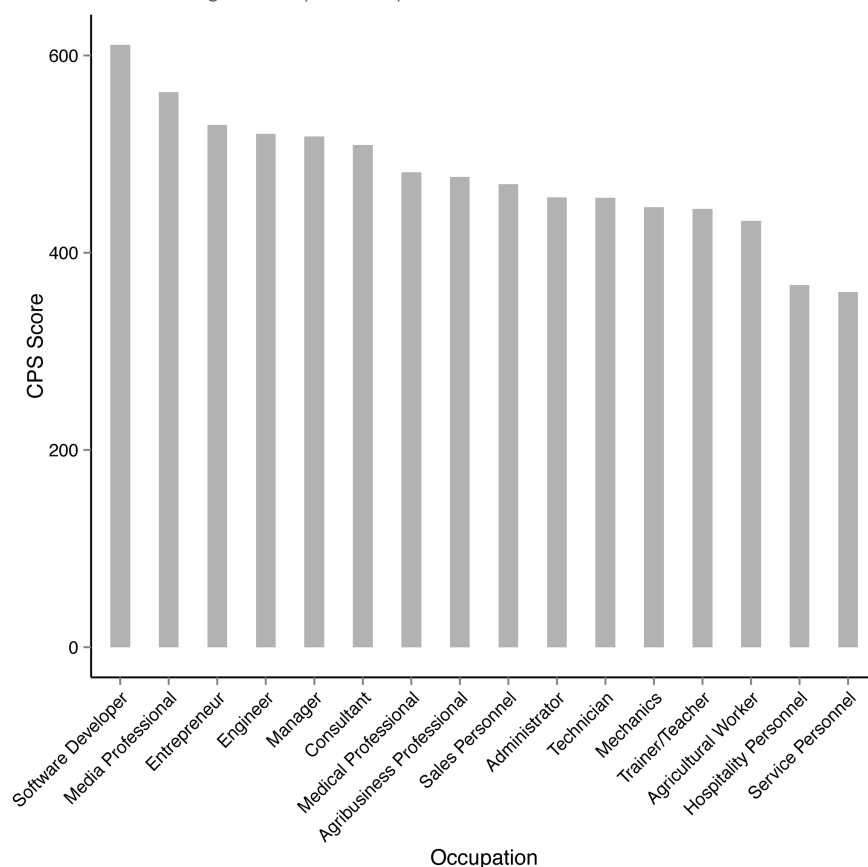
Source: LLLight analysis of CPS database

Complex jobs hold many challenges and also offer opportunities to learn

These results suggest that complex problem solving skills are more pronounced among individuals who work in more complex occupations that probably serve as more intense learning environments. Simultaneously, complex problem solving skills are also an important precondition for getting into these complex jobs and to successfully cope with difficult tasks that are part of complex jobs. The complexity of the job is based on many unique problems, which each pose a challenge and also offer an opportunity to learn. To some extent, these complex learning environments may promote complex problem solving and can thus be considered a source of lifelong learning. At the same time, complex problem solving skills are an advantage to successfully handle such complex learning environments.

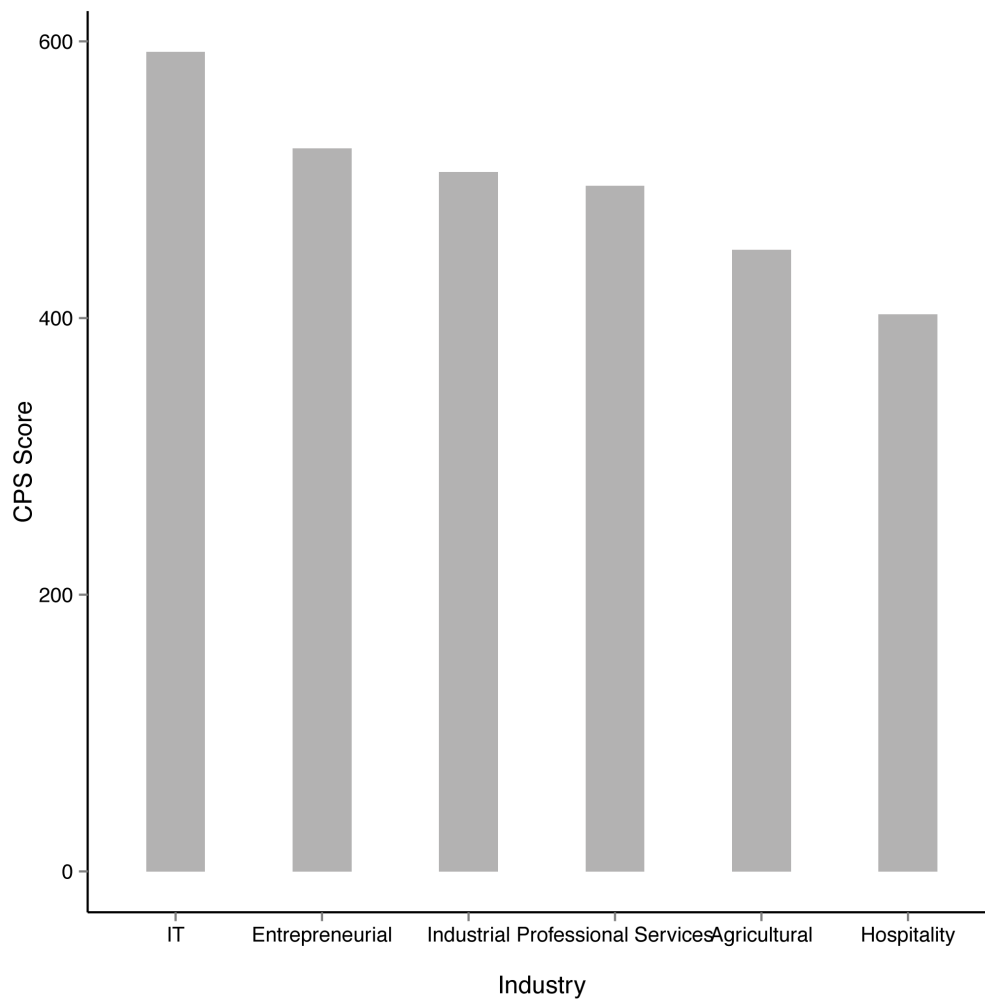
LLLight's research on CPS was conducted mostly in companies with working adults. This allowed to derive benchmark performance data for occupations, industries and companies (figure 5.3., 5.4., and 5.5.)

Figure 5.3: CPS benchmarking scores per occupation



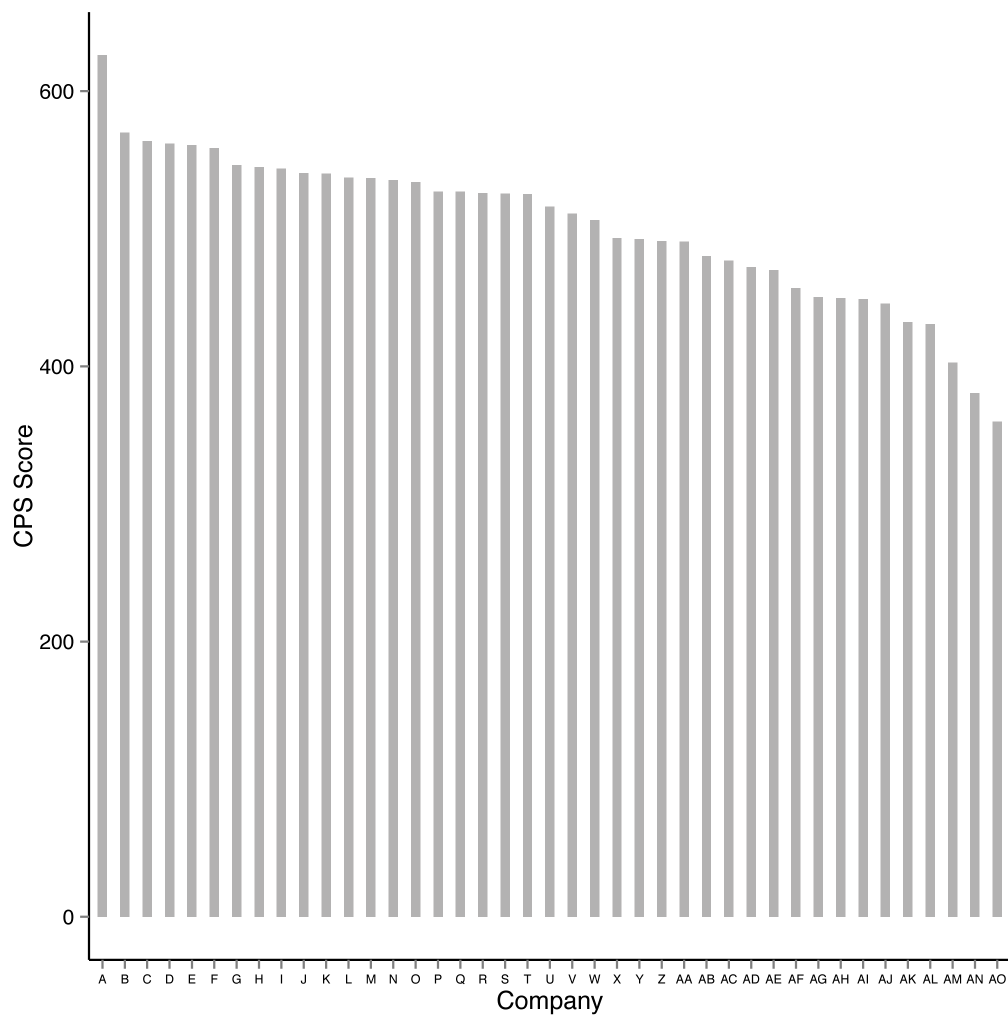
Source: LLLight database and analysis

Figure 5.4: CPS benchmarking scores per industry




Source: LLLight database and analysis

Figure 5.5: CPS benchmarking scores per company (anonymized)



Source: LLLight database and analysis



Complex problem solving is associated with higher chances to land a highly complex job

CPS assessment has proven to be reliable and meaningful. The approach should be deployed more frequently in human capital measurements, and should be further refined, including for instance also Collaborative Problem Solving.

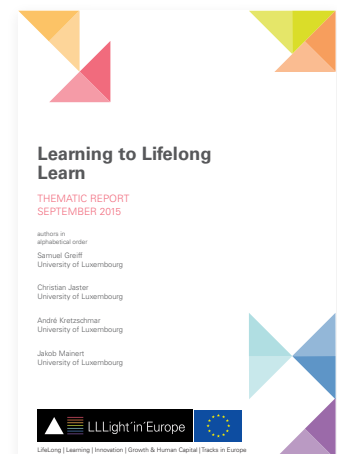
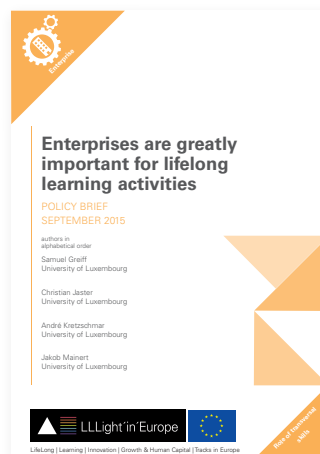
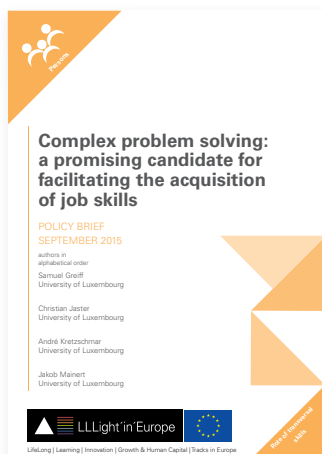
In conclusion, (1) high performance in complex problem solving is associated with increased chances to land a highly complex job and, vice versa, (2) working in a complex job that frequently exposes the employee to complex problems is associated with increased CPS performance.

To what degree complex problem solving can be seen as a precursor, aggregate measure, and outcome of lifelong learning, should be a matter of future research that to draw more differentiated conclusions about causality and pathways.

LLLight could establish that CPS assessments are reliable and meaningful. LLLight recommends that this instrument is more frequently deployed in human capital measurements. More data should be collected which will shine more light on causalities and pathways of skill transmission. Also, the methodology can be further refined to include other related types of problem solving skills, such as for instance collaborative problem solving skills.

For more details on this chapter, please find:

- LLLight Policy Briefs: „Complex problem solving: a promising candidate for facilitating the acquisition of job skills“ and „Enterprises are greatly important for lifelong learning activities“ by Samuel Greiff, Christian Jaster, Andre Kretzschmar and Jakob Mainert
- LLLight Thematic Report: “Learning to Lifelong Learn” by Samuel Greiff, Christian Jaster, Andre Kretzschmar and Jakob Mainert
- Journal Paper: Greiff, S., Fischer, A., Stadler, M., & Wüstenberg, S. (2015), „Assessing complex problem-solving skills with multiple complex systems, in Thinking & Reasoning. doi:10.1080/13546783.2014.989263



If CPS skills are such an important skill to promote income, productivity and welfare, then we need to know whether and how such skills can be fostered and created. Chapter 6 examines the available evidence which LLLight was able to collect.

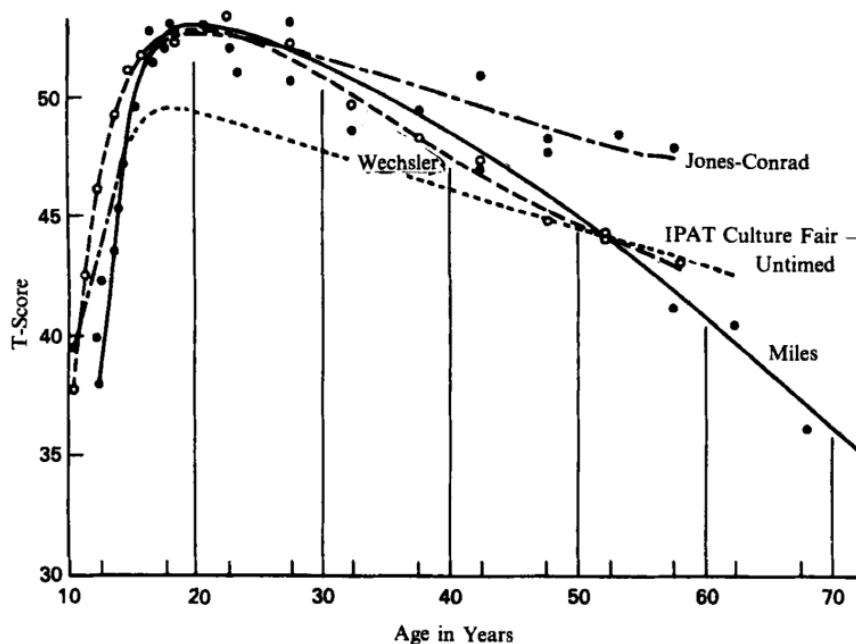
6.The skill of complex problem solving appears to be partially trainable

CPS is different from influent intelligence by the fact that learning strategies and specific behaviors can increase this competence

LLLlight research confirmed that Complex Problem Solving skills are a separate competence to general intelligence. At the same time, intelligence constructs such as mental reasoning capacity or working memory are helpful for high CPS competence levels, so these two are related. What sets CPS apart from “mere” intelligence, is that both learning strategies and specific behaviours can increase complexity resolution competence. A relatively simple strategy for some CPS resolution tasks is for instance “votat” = vary one thing at a time. Any participant can enhance their CPS competence by employing a votat strategy for those tasks where this strategy is helpful. There are also behaviours such as patience, using all available time resources, or not being shy to ask for precise instructions, which will enhance the CPS performance.

Whether general intelligence-related components of CPS can be trained or improved is questionable. The overall consensus in psychological sciences is that fluid intelligence is not trainable. Furthermore, intelligence is subject to a steady deterioration with aging. Absolute intelligence scores peak at around the age of 20, and by the age of 60, the person is back to the level of a 10 to 12 years old.

Figure 6.1: Life range curves of various fluid intelligence tests



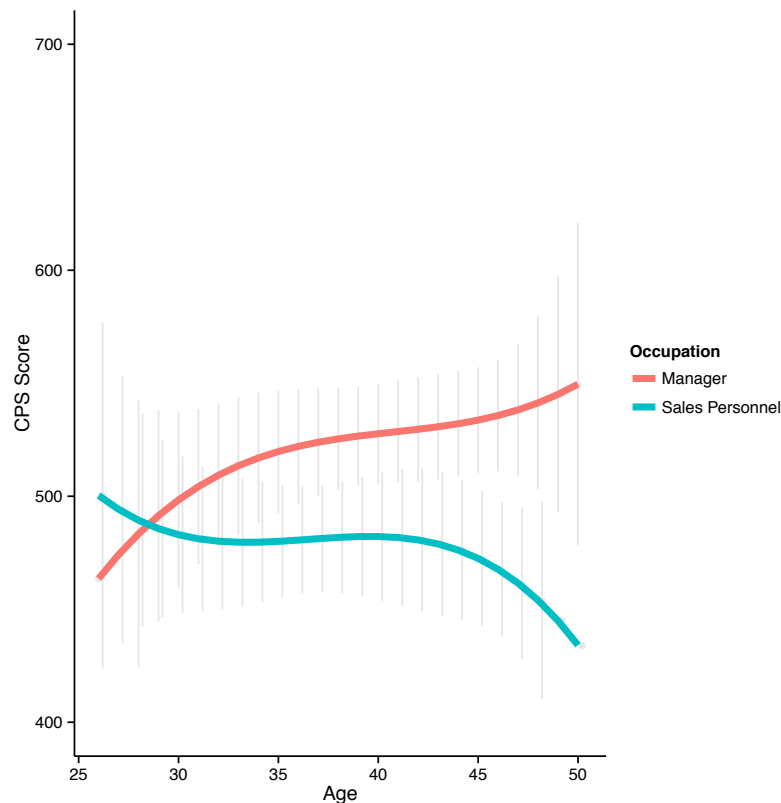
Source: R.B. Cattell 1934: *Your mind and mine*

Strategies and behaviours are trainable – so that CPS can be enhanced to the degree that these are captured in this construct

However, the strategies themselves, identifying which strategy is to be used, and helpful behaviours can be trained – and thus CPS competence can be enhanced to the degree that strategies and behaviours are captured in this construct. In Chapter 5, LLLight showed that in occupations with high degrees of complexity as defined by a task performance driven index, there exist also high degrees of CPS competence on average.

In the following, LLLight compares four occupations and their CPS scores as assessed by LLLight, this time including an age curve. The first comparison is sales personnel with managers. Both of them have an average CPS competence score of a similar 480 respectively at the time when they are 30 years old (500 being the average for the total sample). However, by the time they are 50 years old, the sales personnel will have dropped their competence to a score of around 450, whereas the managers went to 550.

Figure 6.2: Comparison of CPS skills by age for sales personnel and managers

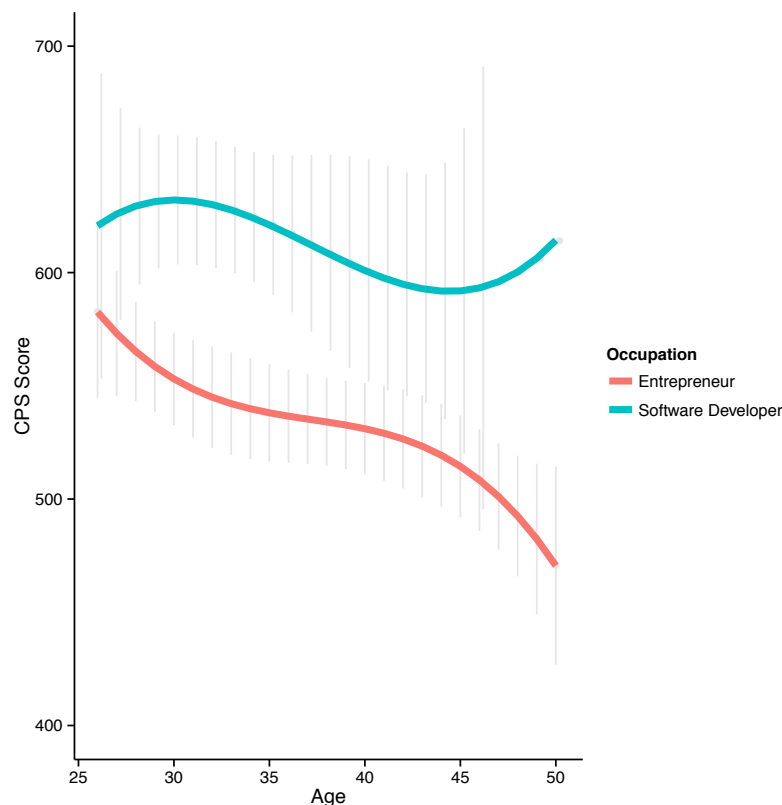


Source: LLLight analysis of CPS data


This is not a longitudinal observation. It is possible and to some degree probable, that there is a career sorting effect at play. For instance, the sales personnel which have high CPS scores when they are 30 years old and are possibly above average successful, might go on to become a manager, leaving the low performers to remain in sales and thus dropping their cohort average CPS performance over time. To the extent that CPS includes general intelligence, a certain inherent degree of age deterioration would be expected anyway. This age deterioration can be seen among the sales personnel, but not among the managers. This may be because the managers “arrive” at their occupation later in their career, having come down from occupations with even higher levels of CPS in previous jobs – or: and this is of interest here: because managers CPS skills keep on being relearned and therefore do not deteriorate.

It is instructive to observe another pairing of occupation. Both entrepreneurs and software developers start at a very high level of CPS competence of around 600 when they are 25-30 years old. But by the time they are 50, the entrepreneurs will have deteriorated to 510, while the software developers remained almost level. Here too, it is possible that the software developers which LLLight tested between the ages 40 and 50 were genial developers in their 20 and 30's and were thus found in their "deteriorated" stage by the age of 50. They would remain as programmers because they could still compete with the average youngster. Whereas the 30 year olds who had started "only" with a 600 score, lost their ability to keep up with programming over time and became ordinary managers (and thus keeping the average of the managers up).

Figure 6.3: Comparison of CPS skills by age for entrepreneurs and software developers



Source: LLLight analysis of CPS data



One possible explanation is that the job profiles of software programmers, engineers and managers throw up repeated exposure to demanding complexity resolution, and therefore provide a constant training environment for complex problem solving strategies and behaviours

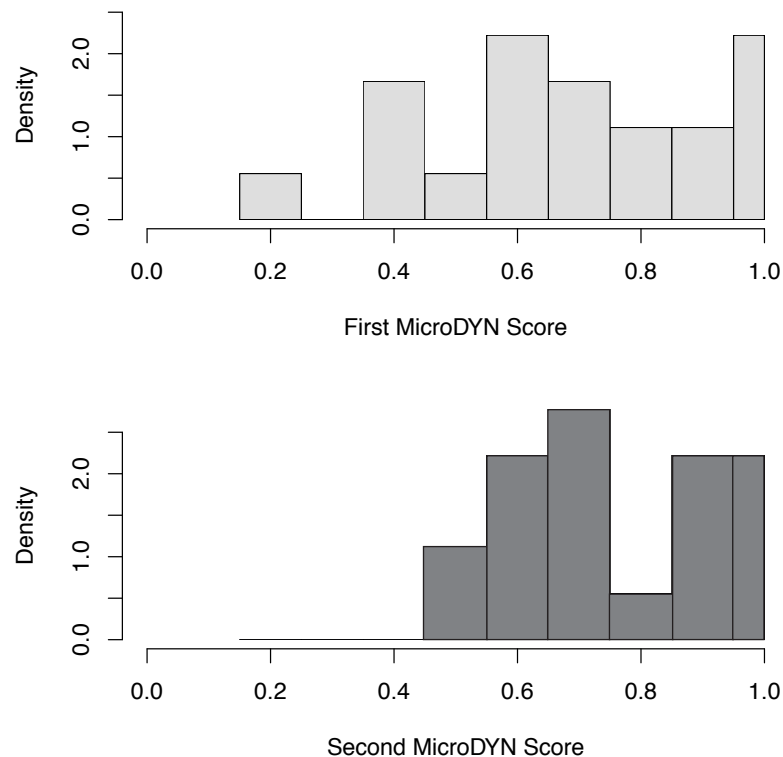
The restrictions of not having a longitudinal sample are obviously that the impact of cohort effects, career changes and other life impacts cannot be observed. However, one possible explanation is that the job profiles of software programmers and managers throw up repeated exposure to demanding complexity resolution, and therefore provide a constant training environment for complex problem solving strategies and behaviours. And vice versa, the job profiles of sales personnel and entrepreneurs may have high entry hurdles of CPS competence, but once these occupations are mastered, their execution become increasingly routine and thus the training effect from continuous complexity resolution diminishes, and with it also the skill of CPS deteriorates.

In the absence of a true longitudinal observation, LLLight conducted a limited experiment. Between September 2015 and December 2015, LLLight conducted a Mentored Open Online Course at Leuphana University Germany with the title "Solution and Innovation Skills". Among other things the subjects taught were strategies to reach complexity resolution. During the MOOC there was no explicit reference to strategies which are directly helpful for performing better in a Complex Problem Solving assessment.

In the MOOC there participated ca 800 persons from countries around the world in all age groups and occupational backgrounds. 160 of these persons participated in an online CPS assessment. Participants self-selected into this voluntary assessment, but otherwise their participation was random.

29 of these 160 persons participated in a comparable but not identical CPS assessment after the MOOC was completed in December. The distribution of their scores before and after the MOOC participation is shown in figure 6.4

Figure 6.4: Distribution of scores before and after MOOC participation



Source: LLLight analysis of CPS data

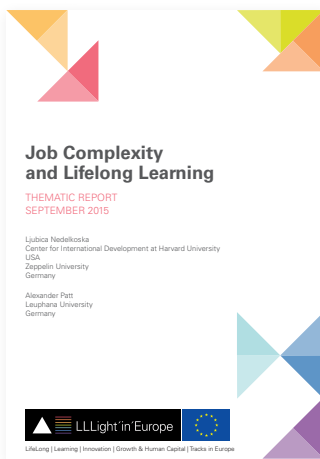
A test exercise shows that many participants with low CPS scores in the assessment before the course was taken, could significantly improve their CPS scores after the course

The test exercise shows that many participants with low CPS scores in the assessment before the course was taken, could significantly improve their CPS scores after the course. For those with high scores before the course, the course did not provide an improvement. These results can confirm the hypothesis that it is possible to teach strategies on how to achieve solutions, which even weak complexity resolution scorers can employ to improve their performance in this innovativeness-related skill.

Training of CPS strategies would thus improve the capacity to absorb and adopt innovations, and contribute to an increase of productivity, without having to rely on higher levels of intelligence.

For more details on this chapter, please find:

- LLLight Thematic Report: “Job complexity and Lifelong Learning” by Ljubica Nedelkoska and Alexander Patt;
- Journal Paper: Ederer, P., Greiff, S., Patt, A.: “Distribution and Trainability of Complex Problem Solving as an Essential Skill for Innovativeness – Evidence from Occupation Testing”; European Journal of Education, Special Issue on Innovation (forthcoming)



OECD PIAAC measured a similar skill to CPS, called Problem Solving Skills in Technology Rich Environments (PSTRE). LLLight research could establish that such ICT skills as PSTRE were at least partially learned via learning-by-doing.

7. ICT skills are trainable through learning-by-doing

Skills accumulate by regularly practicing them at home or at work

Given the crucial importance of the knowledge and skills of the population for economic prosperity, the question emerges how skills can be developed. One mechanism through which lifelong learning affects skills is learning-by-doing at home or on the job. Everyday economic activities often have side effects, and one of them is that people get better at what they are doing. LLLight analyses provide novel evidence for the existence of a learning-by-doing channel in skill accumulation.

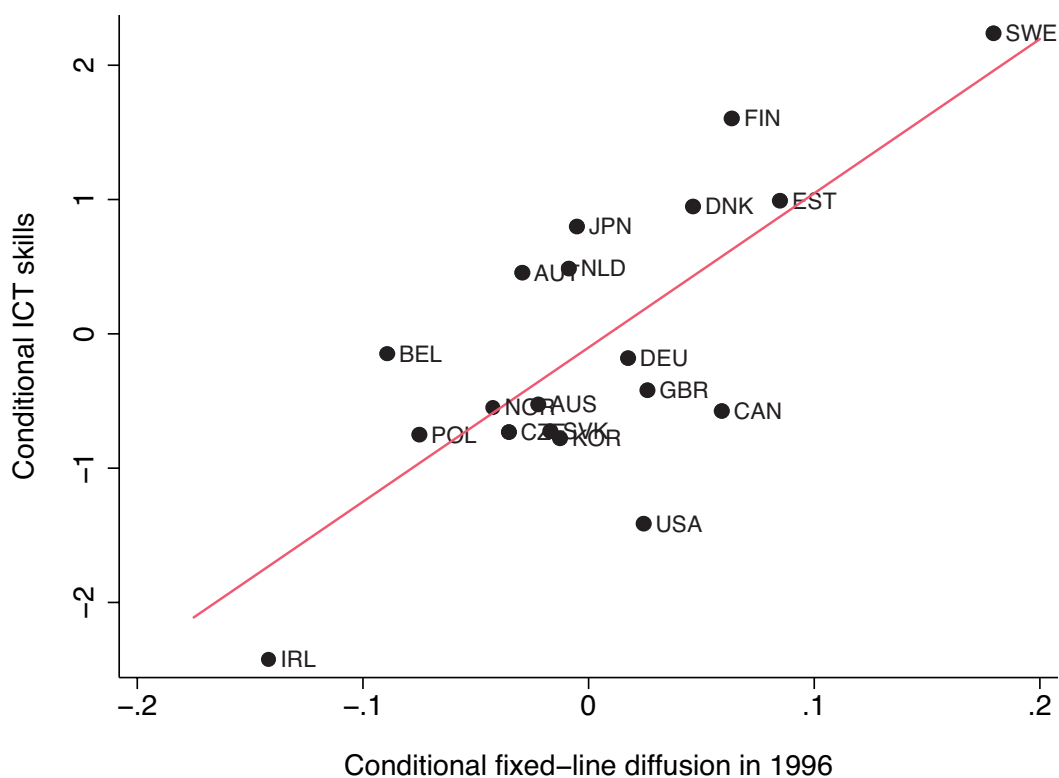
New evidence for learning-by-doing in the accumulation of ICT skills

One main innovation of the PIAAC survey is a richer measurement of various skills, both in the sense that a wider range of competencies is assessed within each skill domain and that a new skill domain was added. In particular, the PIAAC survey is the first-ever study that assessed individuals' ICT skills in an internationally comparable fashion. Using PIAAC, LLLight could show that individuals acquire ICT skills by performing ICT-related tasks. This learning-by-doing is facilitated, or rendered possible at all, when access to the Internet is available.

Specifically, LLLight exploited differences in the technologically determined probability of having internet access across countries. This variation stems from the extent of the pre-existing fixed-line voice-telephony network, which is upgraded in most countries to provide fast internet access by means of the so-called DSL technology.

Figure 7.1 provides graphical evidence that individuals living in countries with a farther-reaching voice-telephony network in 1996 have higher ICT skills today. In terms of magnitude, the estimates suggest that increasing the voice-telephony penetration rate from 17 percent (Poland) to 68 percent (Sweden) is associated with an increase in ICT skills of about 49 PIAAC points.

Figure 7.1: ICT Infrastructure matters for ICT skills



Added-variable plot of a regression of ICT skills (standardized to standard deviation 1 across countries) on fixed-line diffusion (in 1996) and the following control variables: GDP per capita (in 1996), average wage level in the country, quadratic polynomial in work experience, female indicator, and years of schooling. Except for fixed-line diffusion and GDP per capita, all variables are measured in 2011/12. "Conditional" refers to variation in ICT skills and fixed-line diffusion, respectively, purged for variation in the control variables. Sample: employees aged 20-49, no first-generation migrants.

Source: Falck, Heimisch, and Wiederhold (2015).

The learning-by-doing channel is robust to several validity checks

Since the extent of the traditional voice-telephony networks basically reflects a country's technological availability of broadband internet in the first decade of the 2000s, it should affect only the ICT skills of individuals who have used the internet during this decade in the respective country.

These encouraging findings on the success of adult skill creation, should stimulate more research towards understanding the best ways to nurture skills in adults

Reassuringly, the extent of a country's traditional voice telephony network is not related to the ICT skills of first-generation immigrants who are unlikely to have acquired ICT skills in the PIAAC test country.

Moreover, the predictive power of the traditional voice-telephony network for ICT skills is strongest for individuals aged 20-49, i.e., an age group in which individuals were old enough to use the internet in the first decade of the 2000s, but still young enough to be open to this new technology.

Finally, pre-existing fixed-line diffusion is associated with no appreciable changes in numeracy and literacy skills, suggesting that the empirical strategy isolates ICT skills (vis-à-vis generic skills or general ability).

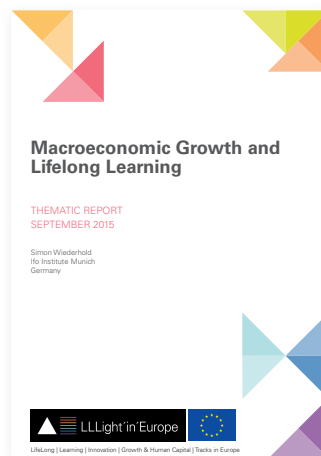
These LLLight results suggest that individuals' ICT skills accumulate by regularly practicing them at home or at work. Thus, ICT infrastructure policies may play an important role in determining a population's level of ICT skills.

However, policies aiming at fostering skill accumulation in general should consider that, by available evidence, much of the skill foundation is laid during youth. The fact that ICT skills, by the above evidence, could still be trained during adulthood should not lead policy-makers to disregard the importance of schooling or early childhood education. The above results of lifelong learning success in ICT skills may have been influenced by the foundations laid during childhood and youth educational achievements, which could not be tested for in the PIAAC data.

To find out the best ways to nurture the skills of adults, more research is needed to evaluate the outcomes and effectiveness of different adult education and training programs.

For more details on this chapter, please find:

- LLLight Policy Brief: “ICT skills are highly valued in European labor markets” by Oliver Falck and Simon Wiederhold
- LLLight Thematic Report: “Macroeconomic growth and Lifelong Learning” by Simon Wiederhold
- Scientific Paper: Oliver Falck, Alexandra Heimisch, and Simon Wiederhold (2015), “Returns to ICT skills.” Mimeo.



One way in which adults are forced to learn, is by changing occupations and having to adapt to new skill requirements. How their income responds to such forced learning situations can serve as evidence for on-the-job learning. Chapter 8 examines how skill mismatching due to occupation changes affects lifelong earnings.

8. Skill mismatch affects lifelong earnings

The decline of routine work and expansion of demand for complex jobs, causes skill mismatch in the labor market

Job-specific skills take years and sometimes decades to acquire, but there is never a guarantee that there will be a proper demand for them at each point of one's career. History offers ample evidence that skills, crafts, and even occupations were made technologically redundant or outsourced to different parts of the world in search of low-cost production.

In more recent history, a large body of literature shows that modern computers substituted human job tasks that are routine or machine-codifiable, and increased the demand for cognitive tasks that are not yet codifiable. In recent history as well, developed countries have witnessed a massive decline of the manufacturing sector employment and an unprecedented expansion of service employment. These epochal shifts in the labor markets of developed countries are fostering occupational changes among the work force, which in turn result in skill mismatches between the skills employed in the old job, and the skills required in the new one.

A definition of skill mismatch

When people change jobs, the work content of the new jobs will be at least in some respects different from the one of the jobs previously held. The extent to which the previously attained skills and knowledge (or human capital as economists like to say) can be used in the new job is referred to as *skill transferability*.

Skill mismatch
changes with
age and differs
by the type of
job switch

Part of the skills and knowledge may become redundant at the new job (*skill redundancy*). At the same time, this new job may require skills and knowledge that the worker does not yet possess (*skill shortage*). Sometimes these redundancies and shortages occur because the level of skills, e.g., the level of education, is higher (or in the case of redundancies lower) in the new job compared to the old job. However, redundancies and shortages can also arise because the job content changes, and with it the required skill set.

Hence job transitions between the old and the new occupation can be characterized by the type of skill mismatch resulting from job changes: *down-skilling* (e.g., a medical doctor working as a nurse), *up-skilling* (e.g., sales clerk becoming a store manager), and *re-skilling* (e.g., a car mechanic who is to become a chemical lab specialist).

Skill mismatch is very common on the labor market. For instance, 60% of German employees who change their employer also change their occupation. In the early stages of people's careers, workers seek new jobs where they initially have skill shortage, allowing them to learn on the job and to experience growth in their earnings.

This is depicted in Figure 8.1. It shows that when young employees switch occupations, they switch to jobs where they have larger skill shortage than redundancy. Among those who switch occupations voluntarily (direct job-to-job switches), skill shortage always dominates skill redundancy. Among those who switch occupations involuntarily (job-unemployment-job switches), skill redundancy starts dominating shortage after the age of 38.

Figure 8.1: Skill Mismatch by Age and by Type of Occupational Move



Note: The figure plots skill mismatch by age and type of occupational move. Skill mismatch is defined as the sum of skill shortage and skill redundancy. Since skill shortage by construction takes only negative values and skill redundancy takes only positive values, a negative sum means that a switch entails more shortage than redundancy. In contrast, a positive sum indicates a switch with excess redundancy. Voluntary (involuntary) moves are switches between occupations without (with) an unemployment spell between both employment spells.

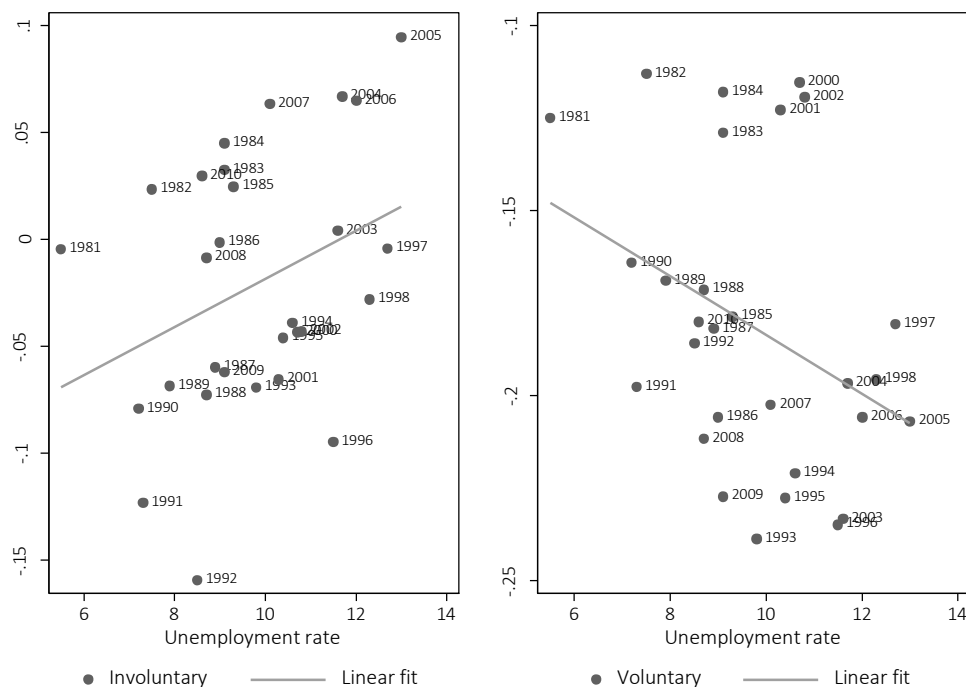
Source: Nedelkoska, Neffke & Wiederhold (2015).

These patterns suggest that skill redundancy at the new job is not desirable, but skill shortage is. Skill mismatch is further determined by the level and diversity of skills. The more skilled people are, (a) the more likely it is that they will incur skill redundancy if matched with another random job; and (b) the less likely they are to incur skill shortage when matched with a random job. This is one reason why skill shortage dominates among the young, less experienced, and hence less skilled employees.

Skill redundancy increases during economic recessions for those who are forced to change jobs


The correlation between the skill mismatch of involuntary occupational switchers and the unemployment rate is positive, while the one between the skill mismatch of voluntary occupational switchers and the unemployment rate is negative (see Figure 8.2). These findings suggest that unfavorable labor market conditions tend to worsen the skill match for those people who are not in a position to choose their next job optimally. In fact, excess supply of labor in recessions gives employers more choice of new hires. As a result, they may tend to hire workers with excess redundancy (i.e., workers who are overqualified for the job). At the same time, in recessions, people only make voluntary moves if they find a particularly favorable match (one with large skill shortage and low skill redundancy).

Figure 8.2: Skill Mismatch and the Business Cycle



Note: The grey lines show the linear fit between the national average annual unemployment rate in Germany and the average national skill mismatch of occupational switchers (the sum of skill shortage and skill redundancy).

Source: Nedelkoska, Neffke & Wiederhold (2015).



Occupational switchers who have the opportunity to upskill – i.e., to learn at the new job – do not experience income losses. Occupational switchers who downskill and therefore learn less, fail to catch up in their earnings with the occupational stayers. This evidence is consistent with the presence of lifelong learning

A substantial body of evidence suggests that workers being displaced from their jobs in the course of plant closures or mass layoffs endure large and persistent earnings losses. If skill mismatch affects individual earnings, then the earnings losses after job displacement should at least partly be attributed to the skill mismatch between the acquired skills up to the point of displacement and the skill requirements of the jobs chosen after displacement. To investigate whether this is indeed the case, LLLight estimated the earnings losses of displaced workers with different degrees of skill mismatch in Germany in the period 1975-2010.

The evidence shows that, conditional on being employed, job displacement leads to daily wage losses of about 3 Euro (3.7 percent of pre-displacement daily wages) for workers who stay in the same occupation after displacement. Workers who switch occupations after displacement suffer larger wage losses of 3.8 Euro per day (4.9 percent of pre-displacement daily wages).

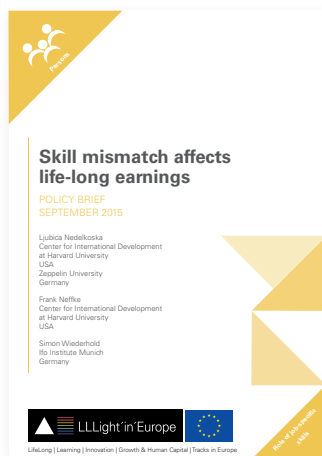
However, among the occupational switchers, upskilling workers quickly even out the wage losses relative to their non-displaced peers. Their average losses in the 15 years after displacement are in fact almost zero. In contrast, down-skilling switchers incur substantial wage losses immediately after displacement and never manage to catch up to their non-displaced peers. Down-skilling switchers also fare significantly worse than occupational stayers after displacement. On average, down-skilling workers lose 6.5 Euro per day after displacement compared to their non-displaced peers (8.3 percent of pre-displacement daily wages), which is more than twice as much as displaced occupational stayers lose.

Upskilling allows workers to shift to a new learning curve and acquire skills on the job

The LLLight results suggest that moving to up-skilling jobs is beneficial for individuals' careers. Such moves allow people to shift to a new learning curve, acquire skills on the job, and consequently enjoy the benefits of the returns to skills. In contrast, down-skilling switches are detrimental to earnings. Moving to jobs where a significant share of workers' previously acquired human capital is rendered redundant results in lower returns to acquired skills and hence lower pay.

For more details on this chapter, please find:

- LLLight Policy Brief: "Skill mismatch affects lifelong earnings" by Ljubica Nedelkoska, Frank Neffke and Simon Wiederhold
- Conference Paper: Nedelkoska, L., Neffke, F. & Wiederhold, S. (2015). „Skill mismatch and the cost of job displacement“, Conference Paper, American Economic Association



The previous chapters showed that there is solid evidence for informal and nonformal on-the-job or private lifelong learning activities which contribute significantly to income generation. How about formal education formats? Chapter 9 investigates whether lifelong learning in formal education can be effective.

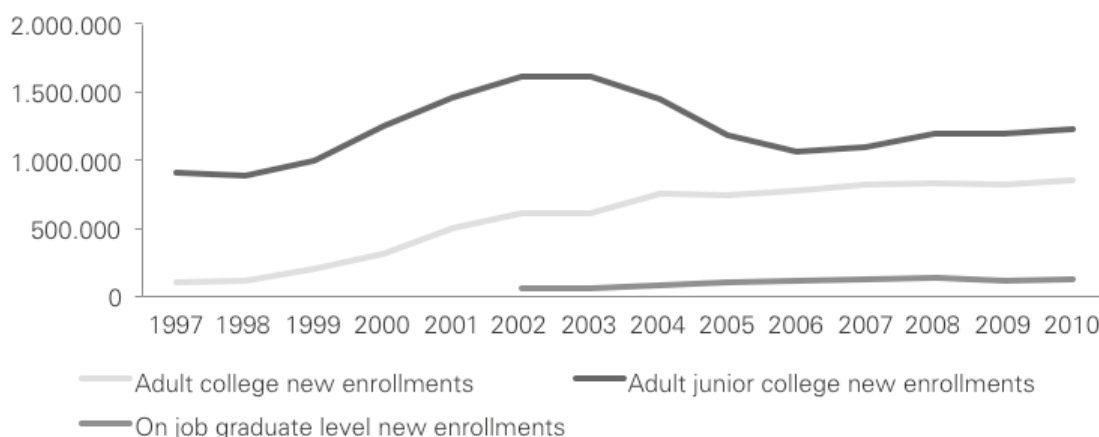
9. Returns to part-time formal education while on the job are positive and worthwhile, but are lower than full time formal education

Lifelong learning, especially on-job schooling provides adult workers with a new sequence of learning, receiving formal education while at work

Because of special historical backgrounds, China has a large population who received higher education degree through on-job schooling

Lifelong learning, especially on-job schooling provides adult workers with a new sequence of learning, receiving formal education while at work. China has a special historical background and features for the development of on-the-job formal schooling. At the beginning of the economic reforms in 1978, there was a severe lack of workers with tertiary education. A large number of adults had missed the chance of going to college during the Cultural Revolution. The Chinese government created a variety of continuing education programs to make it possible for these people to earn formal degrees. Colleges and universities have made their degree programs available for those who have full-time jobs. As a result, China has a large number of individuals who received their degrees while at work, and thus provides a particularly fertile database for investigating the performance of on-the-job formal education.

Figure 9.1: New Enrollments of On-job Students at Junior College or Above



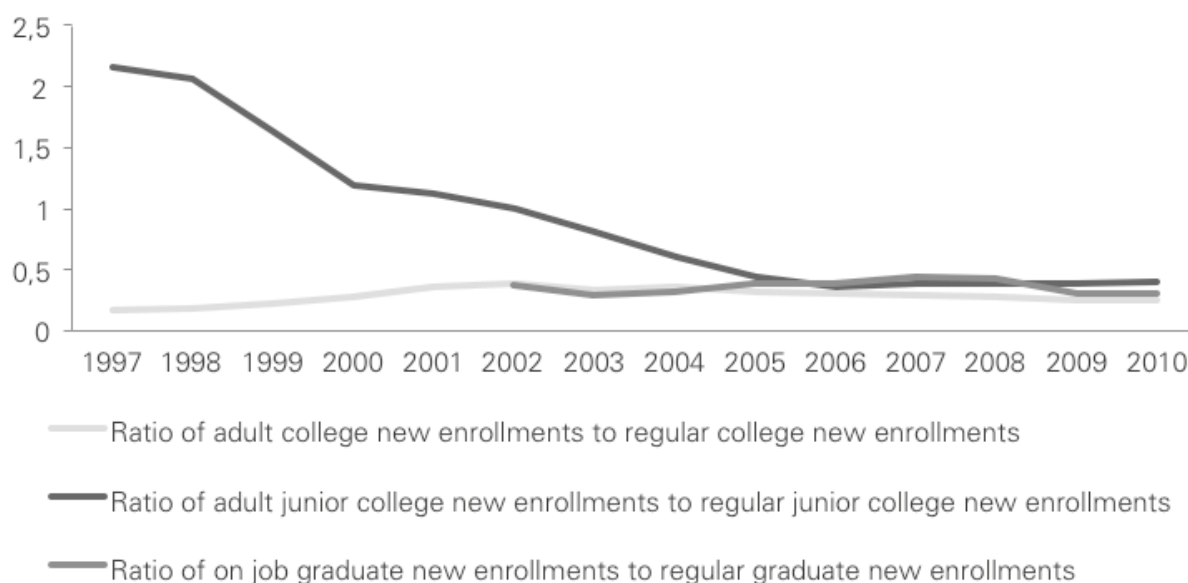
Notes: All the data are from the Statistical Yearbooks of Education for 1997–2010, Ministry of Education. For 2003, we cannot separate junior college and college from the original data and thus imputed the data (same for Graph 2).

Source: The Statistical Yearbooks of Education for 1997–2010, Ministry of Education

China's on-job education size develops fast, however, it shows a comparatively declining trend with the large enrollment expansion in regular higher education

Figure 9.1 shows that the new enrollments of on-job students at junior college level is the largest among the three education groups, followed by college students (4-year curriculum), and then by on-job graduate students.

Figure 9.2: Ratio of On-job New Enrollments to Regular New Enrollments



Sources: *The China Statistical Yearbooks of Education for 1997–2010*, Ministry of Education.

Figure 9.2 shows the relative trends of on-job students to regular students based on their new enrollments. Before 2002, the new enrollment of on-job students pursuing a junior college degree was more than that of regular (full-time) students. After that, its proportion declined rapidly to less than one half in 2005. The fast increase of new labor market entrants with college education when the first cohort of the large enrollment expansion graduated and entered the labor markets helps explain the relative decline of the ratio of on-job students to regular students.

Part-time learners experience lower returns on their investment than regular learners

LLLight finds that in the 1995, 2002, 2007 sampling periods, on the basis of analysis of 2216 valid multi-year cross-sectional datapoints from the Chinese Household Income Project, a significant proportion of working individuals received their tertiary degrees while at work. In 1995 and 2002, 36% and 32% of those with junior college education or higher earned their degrees while at work. The ratio fell to 18.5% in 2007. On-job students increasingly pursued higher education degrees in China. However, the overall trend appears to be declining.

Despite the gap in return, the on-job schooling is still an efficient investment option in tertiary education

The gap of returns to on-job degrees cannot be explained by the quality of the school/program

There exists a significant difference in the returns to education between regular students and on-job students. The gap in return increases with the education level, and it is quite sizeable. The rate of return for an on-job graduate degree is approximately 29–39 percentage points lower than that for a regular graduate degree. For a four-year college degree, the return to on-job learning is 9–11 percentage points lower than that for regular learning. There is no significant gap between returns to on-job and full-time schooling junior college degrees.

There is a trade-off for an individual to choose on-job tertiary education. On the one hand, a higher degree obtained while at work raises the earnings, and thus, the earlier a higher educational degree is obtained on-job, the higher life-time income would be. On the other hand, the on-job degree has a lower return relative to a regular degree.

Simple estimates show that the “income savings” due to non-forgone wages while maintaining a job throughout a study program can generally recover the life-time earnings gap caused by the differing returns on the college degree, though this is generally not the case for an on-job graduate degree. Thus the investment return is positive.

Why is the return on a degree earned while having a job lower than that earned as a regular student? LLLight tested several hypotheses:

Are institutions which offer on-job education programs relatively less prestigious or low quality?

LLLight listed the school ranking among different types of students. Overall there is no evidence that on-job students are more likely to attend lower ranking schools. The basic regression results show that the school ranking actually has no significant impact on the rate of return. Therefore, the gap of returns to on-job degrees cannot be explained by the quality of the school/program.

The gap of returns to on-job degrees cannot be explained by the quality of the student quality/skills

Were those individuals who took on-job schooling not able to get admitted as a regular student?

LLLight used grade ranking in high school to proxy student quality for 2002. Overall, on-job students are slightly more likely to have had lower high school grades, but the difference is small, and it occurs only at junior college and college levels.

At the graduate level, however, the proportion of on-job students with lower high school grades is actually much lower. The possible explanations are :

- Those who performed well according to their high school grades generally have good studying skills and thus it is easier for them to gain admittance and to complete an education program while maintaining a job;
- They have a greater appetite to study further and are thus more likely to join an education program with a job.

LLLight uses an individual's grade at the last school they graduated from to proxy the student quality in CHIP 2007. This shows a slightly better academic performance overall in the on-job group, because of a smaller proportion of students with lower grades, but this only happens at the college and junior college levels. Those with an on-job graduate degree did relatively better than their regular counterparts at high school studies but slightly worse in graduate studies.

LLLight found that at junior college and college levels, those with lower grades have a significantly lower return. More specifically:

- Compared with the results based on high school grades, lower grades at college reduce the return to schooling even more, which is consistent with the argument that college grades can represent both student quality levels and skills learned.

Aging has no significant effect on learning capacity as evidenced by the returns to junior college degree or college degree

- Lower grades at junior college reduce the return significantly. It is likely that the knowledge learned at the junior college level is more closely related to job requirements, and thus better grades also speak for improved job performance.

Differing from the high school grades, lower grades at graduate school seem to have insignificant effect on the returns, although the sign is negative.

- Grades obtained in graduate school, where there is a different focus, may not be emphasized as strongly as grades obtained in high school, and graduate school grades may not represent a student's quality as well as high school grades do, and/or that the graduate curriculum does not directly strengthen the individual's job performance.
- It may also indicate that graduate education, or its curriculum, may have low quality in China, and thus, the academic performance does not make a difference in the labor market outcome.

Because the on-job students are generally older than regular students, is it possible that aging lead to lower returns?

The majority of regular students begin their higher education at ages below 20 years, where most of the on-job students started after the age of 22 years. Older students dominated in the on-job student group. LLLight finds no significant effect of age on the returns to junior college degree or college degree.

Around 4–5% of regular students began junior college or college at age 22 or above, and they may be individuals who were employed and then quit their jobs to enroll in a regular education program. No different returns to the degree for those with working experience, whether earned via full-time study or via part-time study.

Are lower returns caused by career path differentials due to cost-sharing for study or signaling effect?

Two other possible explanations for the estimated earnings gap: career wage path differentials and the “signaling effect”

Policies should be implemented to reduce the cost of on-job schooling and ensure rigorous academic standards

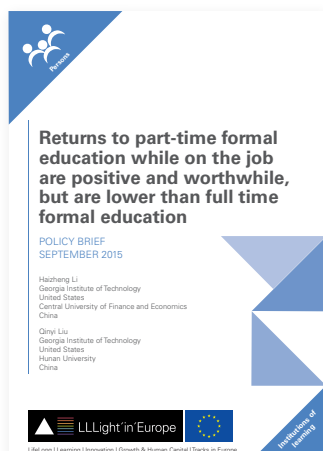
The cost-sharing outcome between the employer and employee can be viewed as a market mechanism that contributes to optimal resource allocation. The signaling effect in China is likely to be caused by the distorted learning effect at work and it is harmful to the lifelong learning system.

In order to improve the efficiency of lifelong learning in general, and schooling while at work in particular, policies should aim at:

- Reduce the implicit cost for employers to arrange for their employees to study while on the job
 - Provide more flexibility in the schooling
 - Encourage more transparency regarding
- Enforcement of the same rigorous academic standard that is applied for regular students.

For more details on this chapter, please find:

- LLLight Policy Brief: “Returns to part-time formal education while on the job are positive and worthwhile, but are lower than full time formal education” by Haizheng Li and Qinyi Liu
- Conference Paper: Li, H. Liu, Q., and Ederer, P. (2015): “Full Time versus Part Time Students - Does Regular Employment Lower Returns to Schooling?” *First World Congress of Comparative Economics*



Occupational change can be a source for Lifelong Learning. Changes in the course of life can similarly be a source of Lifelong Learning. For instance migration causes the need for skills to be transferred from one labor market to another. If the loss of this transfer is higher than the economic gains from migration, then migration would destroy human capital. Chapter 10 illuminates how important language skills are for the international skill transfers to function.

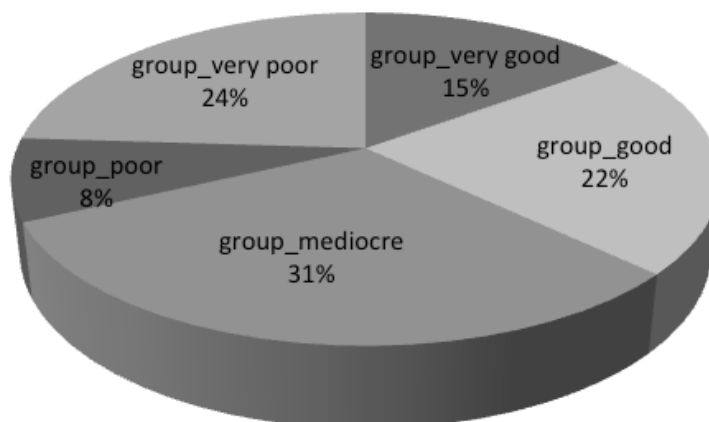
10. Language skills are critical for workers' human capital transferability among labor markets.

Language as human capital skills is related to the migrants' earnings potential

The issue whether human capital produced in one country is transferrable across regional or national boundaries is important for learning how migrants can transfer their skills across labor-market boundaries. LLLight research shows that immigrants' human capital accumulated in their home country is not equally productive in their adopted labor markets.

LLLight hypothesizes that an important barrier to human capital transferability arises when source and destination areas use different languages. Obviously, difficulty in communication through common language can seriously impact a migrant's labor market success. Thus, knowledge of the quantitative importance of language barriers in evaluating cross-country differences in worker productivity is critical in evaluating the causes of international differences in earnings.

Figure 10.1: Language skills distribution among US immigrants

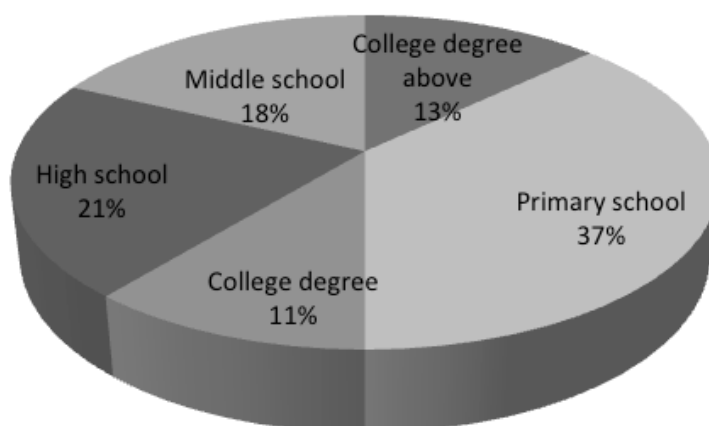


Source: Immigrants sample in Panel Study of Income Dynamics (PSID) 1997 micro dataset.

Human capital endowment, such as education and language skills, are critical for immigrants from non-English speaking Countries into the USA

Figure 10.1 shows that 15% of immigrants to the United States have the highest level of English proficiency and 24% have the lowest level. The percentages in the “intermediate” English language proficiency are 22%, 31% and 8% respectively.

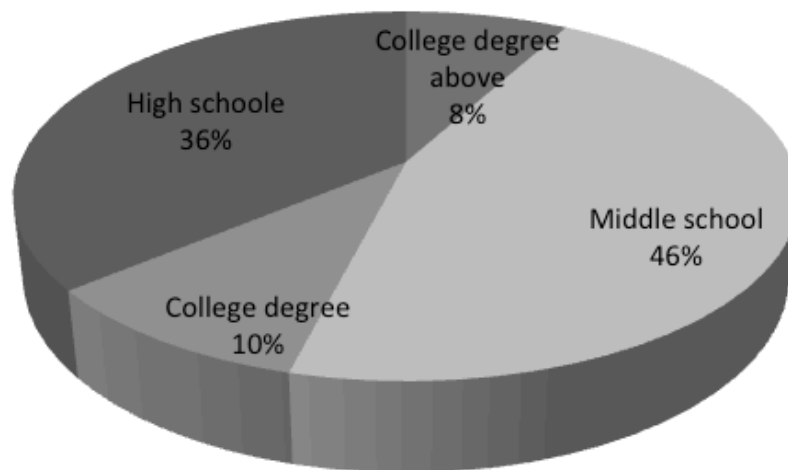
Figure 10.2: The distribution of education by migrants' home countries



Source: Immigrants sample in Panel Study of Income Dynamics (PSID) 1997 micro dataset.

Figure 10.2 shows that more than 90% of the sample received schooling outside of the United States, and of these, 37% completed at most primary school before emigration, approximately 18% middle school, 22% high school, and approximately 23% four or more years of college or university education.

Figure 10.3: The distribution of education attained outside the United States among immigrants




Source: Immigrants sample in Panel Study of Income Dynamics (PSID) 1997 micro dataset.

Figure 10.3 shows that approximately 20% of the immigrants obtained some education in the United States after arrival. Of these approximately 46% completed middle school in the United States, 36% completed high school, and approximately 18% completed four or more years of college or university education.

There exist earnings gap caused by language skills among immigrants

LLLight finds that language skills significantly influence labor market earnings. Higher destination language proficiency for immigrants will increase their earnings directly because they are more productive on the job.

The empirical results show that immigrants with the highest level of English language skills enjoy a significant 26.1% higher earnings gap over those with the lowest language skills. Immigrants with intermediate language skills earn similarly, immigrants with intermediate language skill levels earns 14.7%, 10% and 3% respectively more than those with the lowest proficiency level.



Language skill
impact earnings
indirectly through
the transferability of
human capital

Thus the LLLight analysis shows that English language skills affect the transferability of origin human capital for immigrants. The productivity of a higher pre-education degree increases with language skills improvement. The earning differentials between immigrants classified by their pre-immigration education degrees and those with no schooling increases significantly along with improved English-language skills.

The empirical results imply that there is a complementary relationship between language proficiency and pre-immigration human capital as measured by education accumulated before migration. For example, immigrants who earned college degrees in their origin countries earn 7.15%, 3.4%, 2.3% and 1.1%, respectively, more than those with lowest proficiency.

Language barriers are
critical in evaluating
cross-country
differences in both
worker productivity
and human capital
transferability

In conclusion, the LLLight research shows that English language proficiency is a key determinant of earnings among immigrants in the United States labor market. Studies that ignore English language skills will yield inconsistently estimated results. English language skill impacts labor market earnings by directly increasing worker's on-job productivity, other things equal. Moreover, there is complementary relationship between English language proficiency and the level of immigrant's education attainment. Higher proficiency in the destination country's language raises the return to schooling, which multiplies the payoff to destination language proficiency, raising the transferability of human capital to the destination labor market.

Policies should address languages skill of migrants within and into the EU

In order to improve the efficiency of human capital produced in one country to be transferrable across regional or national boundaries and increase immigrants' wealth beings in destination labor market. Policies should aim at:

- Encourage immigrants to increase the human capital investment to promote individual earnings, especially invest in language skills.
- Support language skill treatment in formal education institution in EU.
- Support to establish informal schooling that focus on improve language skill in EU.

For more details on this chapter, please find:

- LLLight Policy Brief: "Language skills are critical for workers' human capital transferability among labor markets" by Haizheng Li, Bo Li, Belton M. Fleisher.



Since lifelong learning, especially towards the creation of complex problem solving, has such beneficial effects on returns, companies should be enthusiastic investors in training. However, a company does not want to train the work force who then packs up and works for the competition. Similarly, a company does not want to be the only one to invest in innovative and potentially risky approaches to train elderly, low-qualified and other groups usually difficult to reach with learning. This situation leads to systematic underinvestment in training despite positive returns. Pre-competitive cooperation arrangements can overcome this barrier to lifelong learning investments.

11. Enterprises can foster skill creation by realizing pre-competitive cooperation and implement their corporate responsibility at the same time

Segmentation in
access to training
still high in the EU

Despite the overall consensus that training and lifelong learning are important and can represent a win-win for companies, individuals, and society at large, data show that much can still be done in expanding access to training opportunities and effective usage of adult education initiatives. Despite the increase in overall participation rate and expenditure, segmentation across different groups of employees is still remarkable and those who are at higher risk of exclusion (from the labor market; from society) are paradoxically those who participate the least.

To counteract such segmentation, it could straightforwardly be asked to companies as part of their corporate responsibility to support training, invest above demand, and in more difficult and learning-distant groups. However, such appeals are not bound to be effective as long as they are not supported by corresponding incentive structures which support companies.

To support training as part of corporate responsibility, companies need to receive incentive-compatible requests

Decisions on training provisions are diffuse and involve many actors

In particular, such incentive structures need to reduce the risk of a single company incurring competitive losses because of its responsible behaviour compared to other companies which do not behave responsibly (i.e., if one company is the only one investing in risky groups and innovative approaches, it might be worse off compared to other companies which do not do so.)

While purely moral appeals and requests to social responsibility might fall flat, a practice-effective approach requires analysing incentives and interactions among actors to deliver effective and implementable requests. Following the economic approach to ethics of scholar Andreas Suchanek, LLLight thus looked into what can be requested under market conditions to ensure implementability on the side of the companies.

In the approach we follow, the segmentation in the access is understood as the result of existing incentive-structures which are not able to counteract the formal legislation and the potential exclusion. The LLLight research thus aimed at clarifying why some investments in training (in certain groups; in certain skills) happen, and why others do not. Every training investment is conceptualized as the result of a (successful) interaction of different actors concerning a decision on training: companies, HR function, leadership, trade unions representatives, employees, training providers. LLLight reconstructed in two EU countries (Germany and Italy) interaction processes and existing incentive systems, agendas and preferences of the actors involved and the bearing these elements have on training decisions.

The following selection of key findings helps understand the structure of training decisions and interactions in mature training markets:

- Leadership and decisions about training participation are diffuse and not only limited to HR functions;

- HR is critical for organizational buy-in of training investments and innovative approaches;
- Involvement of management in HR and training decisions highly supports employees and their development;
- Several actors play a role in organizing training provision: in particular, the contribution of unions' representatives is often limited by lacking expertise;
- In low-competition training markets, quality of training offer can be improved.

Considering these elements help draft requests and schemes which are close to one company's reality and have high possibility of being received and implemented.

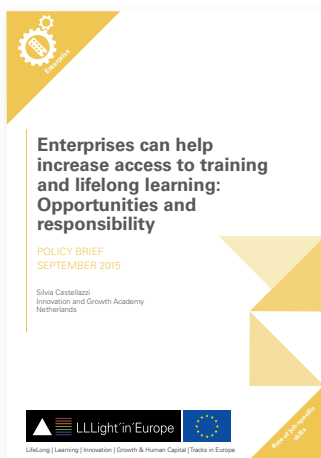
Pre-competitive cooperation can help companies support access to training without incurring in competitive losses

The market for training and the decision processes in organizations have become highly complex – any policy scheme which goes beyond regulating 'input' and thinks through the interactions and the incentives until the final outcome has much higher probabilities of being effective and of supporting higher-quality training provision.

In particular, building on the business-ethics implications and on the risk that companies might face when being the first and only to expand access, the research showed that cooperation among companies at pre-competitive level can remove disincentives which limit access to training. Therefore, it is recommended to support pre-competitive agreements at local, regional or sectoral level to increase the bar of quality and the inclusion in access to training. (For example, a group of companies in a certain region can develop a joint programme for elderly or for the development of a specific skills set).

For more details on this chapter, please find:

- LLLight Policy Brief: “Enterprises can help increase access to training and lifelong learning: Opportunities and responsibility” by Silvia Castellazzi;
- Monography: Castellazzi, S. (2015). Employability and further training. An economic-ethics contribution to the implementation of corporate responsibility in the labor market. (Doctoral Thesis, forthcoming).



Chapter 2 displayed a pathway by which complex problem solving skills specifically promote innovativeness and in due course raise productivity. Skills operate through several further pathways to increase value. One of such pathways is the opportunity competence which promotes entrepreneurship. Chapter 12 summarizes LLLight in Europe findings on the link between competencies and entrepreneurship.

12. Opportunity competence contributes to successfully leveraging ideas for entrepreneurship and innovativeness in enterprises

Complex problem solving skills and opportunity identification competence are linked, and contribute both to more entrepreneurship

LLLight investigated which specific competencies are effective to promote entrepreneurship and innovativeness in an enterprise. In particular, opportunity identification competence was investigated. A significant link between opportunity identification competence and complex problem solving skills could be established with results from a survey of 154 latent, early-stage entrepreneurs where the complex problem solving scores incrementally predicted the competencies needed to identify and evaluate business opportunities.

LLLight also used results from a survey of 234 employees in 12 companies from the agriculture, food and fibre industry to show that groups outperform individuals on evaluating opportunities. Hence, programs as well as organizations themselves should invest in team activities, such as activities in which opportunity identification and evaluation competence are being practiced. Also, by getting insight in the specific innovation abilities of teams, employers could get more insights on the strengths and weaknesses of their personnel and provide the right training to improve the organization's innovative capacity.

Groups outperform individuals in evaluating opportunities. Therefore team work is critical for innovativeness.

LLLight results from an additional survey of 247 latent, early-stage entrepreneurs confirmed the importance of team work. Generating business ideas and evaluating them for their potential success are separate abilities. For that reason, innovation teams should include team members that perform well on different abilities.

In the surveys conducted among employees, the engagement in innovative work behaviour was by far the strongest predictor of outcomes of employee-driven innovation and entrepreneurship. The latter was measured in terms of number of ideas of employees adopted by the management.

LLLight could identify which specific human capital factors are related to high engagement in innovative behavior.

Looking one level deeper, LLLight wanted to understand specifically what contributes to low or high engagement in innovative behaviour. Figures 12.1. through 12.4 illustrate that it is the number of ideas generated, a positive stance towards social networks, and self-efficacy, thus specific human capital which is related to high engagement in innovative behaviour. Typically this set of specific human capital is a result of socially mediated, informal, work-related learning activities, such as learning-by-doing, vicarious learning, experiential learning, and action learning.

Figure 12.1: Number of ideas generated by employees (opportunity identification) for low engagement (less than once a month) and high engagement (more than once a month) in innovative behaviour (differences are significant).

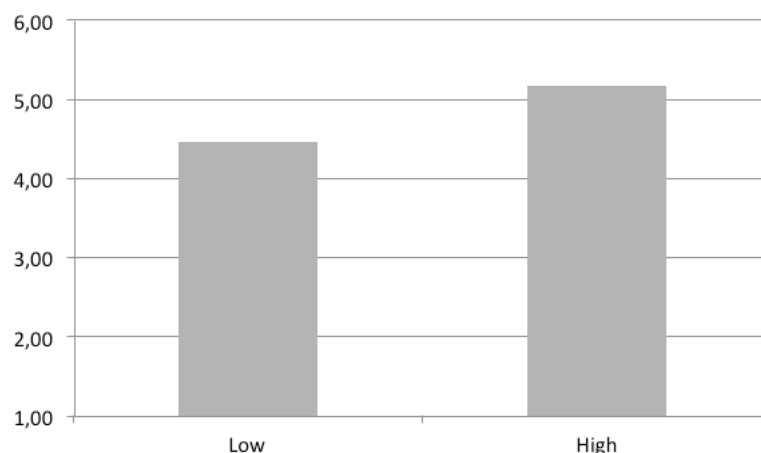


Figure 12.2: Idea evaluation by employees (opportunity evaluation) for low engagement (less than once a month) and high engagement (more than once a month) in innovative work behaviour (differences are not significant).

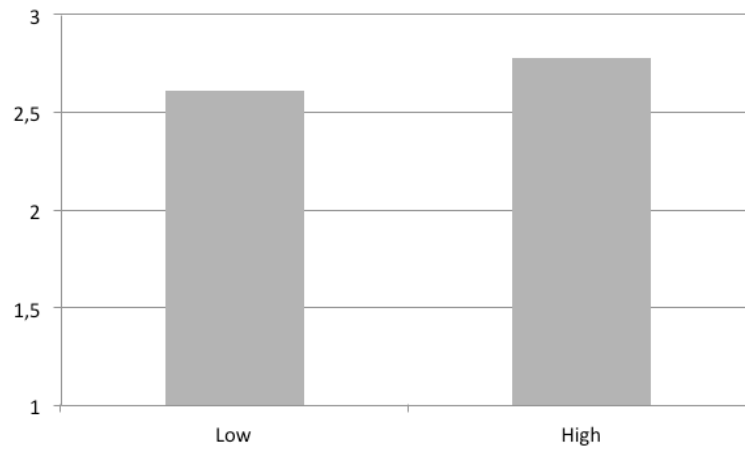


Figure 12.3: Importance of social networks scores for low engagement (less than once a month) and high engagement (more than once a month) in innovative work behaviour (differences are significant).

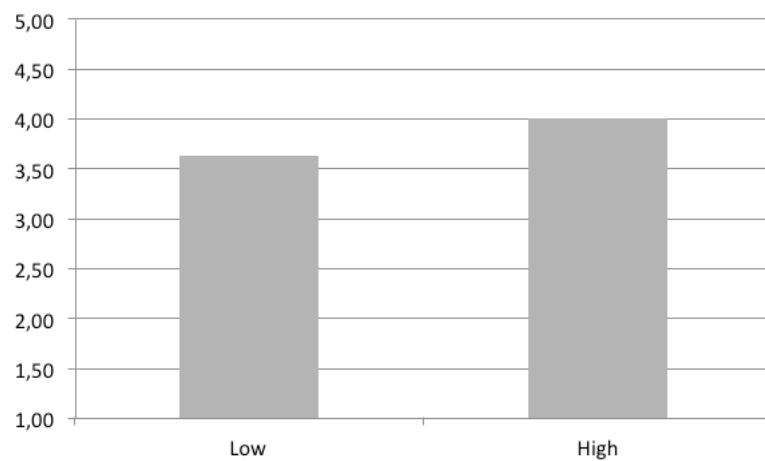
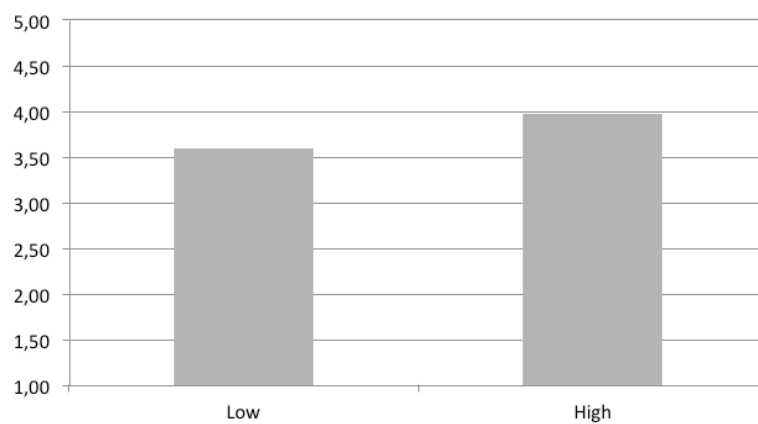


Figure 12.4: Self-assessed self-efficacy scores for low engagement (less than once a month) and high engagement (more than once a month) in innovative work behaviour (differences are significant).



Innovation performance can be influenced by investing in specific human capital and task-related activities

Opportunity competence and strength of teamwork are two essential ingredients to promote innovativeness and entrepreneurship in companies

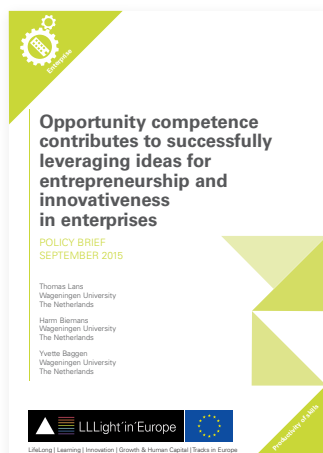
This finding supports the recommendation in the CEDEFOP study published in 2012 to invest in programmes that address organisational structures and processes with a focus on the workplace level. The key to get such programs running is in the hands of the management in small and medium sized firms. Thus, although human capital and task-related activities are often treated as an individual issue, in the context of innovation and entrepreneurship at any point of time they should be treated as a shared responsibility of the individual and his or her organization.

In conclusion, the LLLight results suggest that outcomes of employee-driven innovation and entrepreneurship (i.e. successfully leveraging an idea to the corporate level decision makers) depends on specific human capital and task-related activities (i.e. innovative work behaviour). Although focused, mostly, on one industry, the results of this study likely have broader applicability to wide variety of industries.

Specifically LLLight recommends to support the competencies to identify and evaluate business opportunities. Furthermore, special attention should be paid to the design of the workplace and tasks, in such a manner that employees are invited and challenged to be involved in innovation related activities such as idea generation, optimization, product development and strategic change. Finally, since groups outperform individuals in evaluating business opportunities' potential success, organizations should invest in team activities and incentives.

For more details on this chapter, please find:

- LLLight Policy Brief: “Opportunity identification competence contributes to to successfully leveraging ideas for entrepreneurship and innovativeness in enterprises” by Thomas Lans, Harm Biemans and Yvette Baggen;
- LLLight Thematic Report: “Employee-driven innovation/entrepreneurship and Lifelong Learning,” by Thomas Lans, Harm Biemans and Yvette Baggen
- Journal Paper: Baggen, Y., Mainert, J., Lans, T., Biemans, H. J. A., Greiff, S., & Mulder, M.: “Linking complex problem solving to opportunity identification competence within the context of entrepreneurship” International Journal of Lifelong Education, Special Issue on Problem Solving Skills 2015. Doi: 10.1080/02601370.2015.1060029.



Chapter 12 highlighted the importance of teams and groups in the innovation process. This suggests that organizational learning processes play an important role in fostering employee-driven innovativeness. Chapter 13 investigates the feed-forward learning processes in an organization.

13. High levels of individual feed forward learning foster employee-driven entrepreneurship and innovativeness

Employees who experience high levels of individual and feed forward learning, get more innovative ideas adopted by the management

In a LLLight survey, 234 employees from 12 companies responded to questions related to learning on the individual, group, and organizational level. The results show that employees scored significantly higher on individual learning, compared to group and organizational learning. Moreover, those who experienced a higher degree of individual learning in the organization were also able to get more ideas adopted by the management. Similarly, this was found for employees who perceived higher levels of feed forward (i.e. individual learning which moves to group and organizational learning in the company). By contrast, group and organization level learning were not directly related to employees' innovative performance.

Job control and problem demand are of significant importance for employees' innovative performance

According to academic literature, the work characteristics of job control and problem demand are important in the context of learning and innovation on the individual level. Job control refers to the extent to which employees have the freedom to do their job as they prefer to. Problem demand refers to the frequency and difficulty of task problems: for instance, if an employee has to deal with problems which are difficult to solve in his/her daily work. The results of the LLLight sample confirm that those employees who experience high levels of job control and problem demand, see more of their ideas adapted by the company's management.

Flat hierarchies, high degrees of autonomy and the explicit organization of informal learning activities promote innovativeness in companies


A direct route via task-related measures, or an indirect route via competence development programs can both stimulate innovative and entrepreneurial employee-driven behavior in companies

In order to understand deeper which organizational characteristics will encourage innovativeness, LLLight investigated two case studies in detail as good practice cases. Both companies (a middle-sized paper mill and a breeding company) scored high on learning and innovation, and both considered the following organizational characteristics in the context of innovation as important:

- A flat hierarchy (or almost no hierarchy) contributes to knowledge-sharing between employees fulfilling different roles and tasks.
- When recruiting new people, they look for teamplayers, a learning attitude, and pro-activeness.
- At both companies, employees are encouraged to take responsibility for their work and work with a high degree of autonomy.
- Organizing informal learning activities, such as joining colleagues in their work, organizing joint coffee-breaks on a structural (or even daily) basis, and visit employees to have a short chat on how their work is going, contributes to the sharing of knowledge and thoughts, and to their innovativeness.

In conclusion, the LLLight results show that those who experience higher levels of individual and feed forward learning (i.e. those who have the feeling that their ideas are being adapted by teams and the company as a whole), are more successful in getting more innovative ideas adopted by the management.

Secondly, the results indicate that to realize innovativeness on the employee-level, attention should be paid to specific task characteristics, such as: job control, problem demand, and high levels of autonomy and responsibility.



Thirdly, good practice examples illustrate that organizing informal learning activities (such as joining others in their job and stimulating contact between employees) contribute to the sharing of thoughts and knowledge, and innovativeness. Although focused, mostly on one industry, the results of this study likely have broader applicability to wide variety of industries.

Altogether, stimulating individual employee-driven entrepreneurship and innovation performance can follow at least two routes:

- a. directly via task-related measures, such as problem demand, as this chapter illustrates,
- b. or indirectly via stimulating innovative work behavior, via competence development programs focussing on human and social capital development as the previous chapter suggests.

For more details on this chapter, please find:

- LLLight Policy Brief: “High levels of individual feed forward learning foster employee-driven entrepreneurship and innovativeness,” by Thomas Lans, Harm Biemans and Yvette Baggen
- LLLight Thematic Report: “Employee-driven innovation/entrepreneurship and Lifelong Learning,” by Thomas Lans, Harm Biemans and Yvette Baggen
- Journal Paper: Lans, T., Van Galen, M. A., Verstegen, J. A. A. M., Biemans, H. J. A., & Mulder, M. (2014). Searching for entrepreneurs among small business owner-managers in agriculture. NJAS – Wageningen Journal of Life Sciences, 68, 41-51.



Chapter 12 and 13 show how organization has an important influence on how well individual skills can be utilized towards higher levels of innovativeness and entrepreneurship. This provokes the question whether the human capital endowment of the managerial leadership for shaping an organization is related to the innovativeness of the enterprise. Chapter 14 investigates this relationship.

14. Human capital of managerial leadership is related to innovativeness of the enterprise

More innovative companies are led by managers with more years of higher education

Besides R&D level, firm size and market structure, the human capital of managerial leadership might be one of the most important determinants of firm innovation. LLLight research confirms this statement.

Human capital has long been argued as a critical resource. Top executives have the discretion to control R&D expenditure in firms, and monitor R&D expenditure and adjust its level based on their preferences. Also, the top management team has the task of formulating and implementing the firm's strategy, and can also coordinate and control team behaviors. Thus, firms with higher managerial human capital should be more innovative.

In China, general managers have more than 14 years of schooling in both large cities and middle cities. 70% of the general managers have at least an undergraduate degree. The management team below the general managers have slightly fewer average years of schooling: 11.96 years in middle cities versus 12.07 years in large cities. The average age of management team in large cities is 36.03 and it is 36.36 in middle cities. In essence there is no difference by either age or educatedness in the management of companies between large and middle cities.

Firms do not differ between provincially middle cities and nationally large cities when it comes to general manager's education, tenure, and management team's average education and age

Firms with patents have higher managerial human capital than firms without patents

The general manager's education and tenure have positive effects on innovation

However, when measured by number of patents, companies with more patents have more highly educated workers, better educated general manager and management team, and younger management team than firms with less patents. For example, 27% firms with patents have general managers with postgraduate degree and only 11% firms without patents have general managers with postgraduate degree in more developed areas. Again there is significant difference when selecting by middle cities, where the two respective numbers are 31% and 14%.

Put differently, the LLLight research finds in an average company, when its GM has a postgraduate degree, its number of patents will increase by 0.0859 compared to having a GM without postgraduate degree. We also find that when its GM holds the position for one additional year, the number of patent applications will increase by 0.0458.

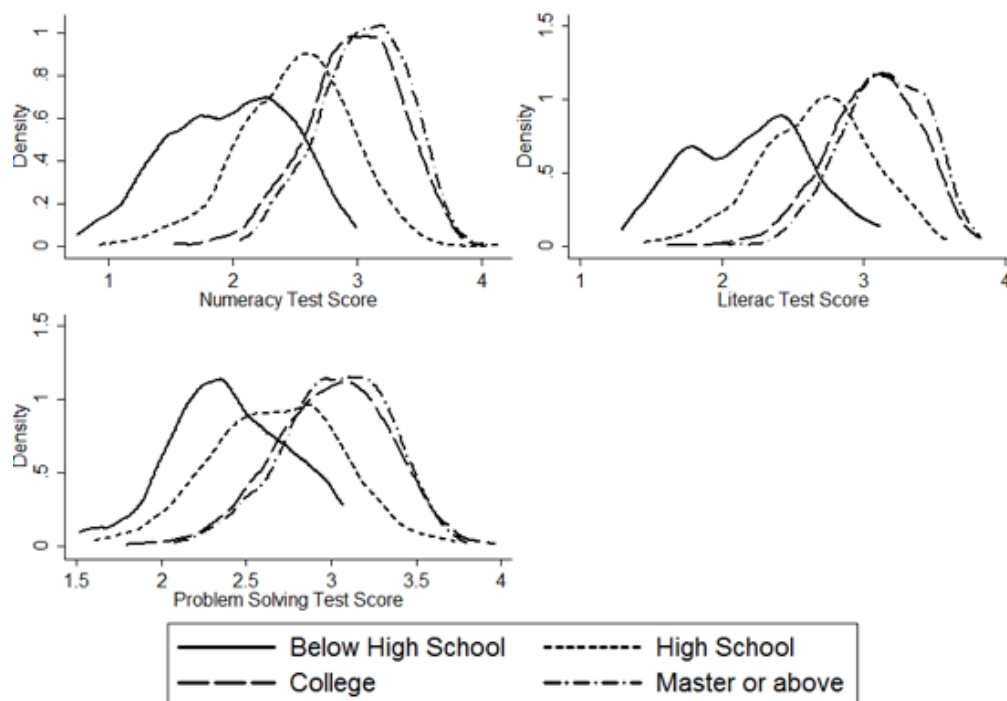
However, the GM tenure is positively related to company innovation only in nationally large cities but has no effect in middle cities; whereas the GM's postgraduate degree is positively related to company innovation in middle cities but has no effect in nationally large cities.

As an initial summary, LLLight research shows on Chinese data, that general manager's education and tenure have positive and significant effects on innovation. This implies that the managers Lifelong Learning is important to company innovation. Lifelong Learning can provide new knowledge and enhance the executive's ability to absorb new ideas, and therefore increase the appetite for innovations, as well as to make better innovation decision.

For understanding deeper how the manager's human capital promotes innovativeness, LLLight investigated the OECD PIAAC data. From PIAAC, LLLight constructed three measures of cognitive ability: numeracy, literacy, and problem-solving abilities—and three measures of noncognitive ability: perseverance, like to learn new things, and social trust.


As is well known, cognitive ability and education are positively related, as shown in Figure 1.

Figure 14.1: Kernel distribution of cognitive ability by schooling levels



Source: Programme for the International Assessment of Adult Competencies (PIAAC) survey, 2011-2012.

As education level increases, the mean ability level increase for all cognitive ability measures. Individuals with master's or Ph.D. degrees have the highest abilities and those with no high school diploma the lowest.



A third of the impact of education on leadership can be accounted for by cognitive abilities

As education increases, all non-cognitive abilities also increase. The largest increase happens for social trust. Perseverance and likeness to learn new things also increase significantly with education, which is easy to understand as steadfastness and the eager for new knowledge will help to achieve high levels of education.

Unsurprisingly, university degrees are important to becoming a leader. If an individual has a university degree, the probability of being a leader will increase by 10.2 percentage points, other things equal.

However, if numeracy or problem solving ability variables is controlled for, then the magnitude of college coefficients drop by 30% to 40%, which indicates that about a third of the impact of education can be attributed to cognitive abilities. Thus traditional estimation omitting the ability variables will overestimate the importance of education degrees.

Controlling for all cognitive abilities together, only problem-solving ability is positively significant. The importance of problem-solving ability, especially under technology-rich environment, has been emphasized by many studies.

Among the non-cognitive abilities, it is individuals with strong perseverance which are more likely to become leaders. Thus the ability to continue on and move forward is fundamental in effective leadership. There is no significant impact from “like to learn new things” and “social trust” on leadership.

In addition, problem solving ability remains significant after controlling for noncognitive abilities. However, there is less than 10% overlap between the impact from cognitive and noncognitive abilities on leadership.

After controlling for cognitive and noncognitive abilities, the impact of education drops further but remains significant.

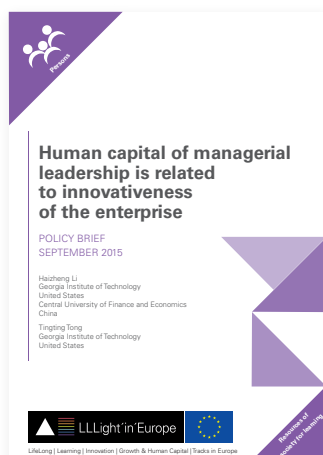
For successful leadership, specific abilities need to be promoted

Thus, a significant amount of the impact from education should be attributed to abilities.

This study provides evidence that cognitive and noncognitive skills, along with education, can significantly affect one's leadership and thus individuals' career outcomes. With regards to successful leadership of companies, it is therefore not just every education which is equally valuable, but specific cognitive and non-cognitive skills which need to be promoted.

For more details on this chapter, please find:

- LLLight Policy Brief: "Human capital of managerial leadership is related to innovativeness of the enterprise", by Tingting Tong, Haizheng Li.
- Conference Paper: "What makes a leader? The impact of cognitive and noncognitive abilities," presented by Tingting Tong at the CES 2015 North America Conference.
- Working Paper: "Firm-level human capital and Innovation: Evidence from China," by Xiuli Sun, Haizheng Li, and Vivek Ghosal.



In the chapters so far, the importance and relationships between skills, learning, innovativeness and growth was highlighted, and how critical and rewarding it should be to develop skills through lifelong learning activities. The following chapters 15, 16 and 17 take a closer look how the human resources function of enterprises can go about such skill development.

15. Human resource strategies are the key to bolstering lifelong learning circumstances at the enterprise level

Skills development is tied to how responsive human resource practices are in facilitating a flexible and need-based learning platform

In examining lifelong learning strategies for skill development in 194 enterprises, across 53 industries, LLLight has distinguished skills development as highly central. The focus is on human resource practices (HRPs), deployed by enterprise human resources (HR) and HR management (HRM) plans, that are explicitly interlinked with business goals, through learning objectives and productivity targets. There is evidence that indirect links between work and skills development (e.g. generic skills development) provide value that, although difficult to capture, contribute to business growth and important human development.

In the LLLight analysis of over 200 semi-structured qualitative and confirmatory interviews, findings in the skills development dimension of lifelong learning at an enterprise level show that the highest valued employee skills are soft skills.

Soft skills are the highest valued competences for enterprises, yet human resource management still explores how to optimise soft skills learning designs

When asked to highlight the most desired employee skill(s), the research participants named a mixture of hard and soft skills, with notable attention to soft, or transversal skills, as depicted in Figure 15.1 below (the larger the word, the more mentions it got). Irrespective of how technical the participants' work can be considered, and independent of how highly valued hard skills are (for example, in engineering, medical, accounting and aerospace enterprises), skills such as 'communication', 'creativity', 'customer service', 'interpersonal relations' and 'teamwork' came out as highest valued.

Figure 15.1: Highest valued employee skills



Yet for the most part, there is a focus on learning, training and developing skills that explicitly and directly relate to tasks, projects, and overall business goals; learning that visibly – rather than implicitly or indirectly – contributes to new business formation and financial bottom-lines, in ways that are also fast and on-demand. As for the main triggers for learning, LLLight found that triggers for learning were chiefly prompted by work-related, project-related and client-related needs.

The analysis of the interviews shows that learning is essentially managed by individuals who must be perceptive enough to uncover blind-spots in their knowledge, skills and competences and either bring that to the attention of management and/or take the initiative to up-skill themselves. Moreover, as an interviewed Chief Executive told, for such initiative to add value for the enterprise, it must relate to work demands directly or better, and fulfil learning gaps that can bridge onto new business opportunities.

Enterprise investment in learning therefore follows suit when linkages to work demands can clearly be perceived. The individual's role is tacitly understood as the catalyst for learning, with the exception of induction processes and industry standards or regulatory training and development.

Learning is triggered by work-related, project-related and client-related needs

A vital employee competence is that individuals must be able to uncover knowledge and skill gaps and prompt solutions

The most effective learning in workplaces occurs on demand

Human resources' core role is to support and bolster access to knowledge and social communities where the know where to find solutions on-demand has primacy over the know what

Analysis of the European Company Survey (2009, 2013) shows that enterprise size has a significant effect on provisions of learning opportunities and also, that there may be some country-specific trends that show a priority placed on lifelong learning such as in Germany, Ireland, Slovenia and the United Kingdom, where about 80% of all enterprises give employees time off for ongoing development.

The most successful types of learning reported by the participants relate to job-specific, learner-centred, in-house, classroom, group and one-to-one initiatives. Certificates and policy-mandated training are also noted as popular and effective, particularly since they target highly practical requirements of work, directly. In line with the premise that learning must be continually renewed, the most effective learning occurs on demand – as also noted through the examination of learning triggers.

LLL findings also show that having access to knowledge within an enterprise (e.g. knowledge repository, networks, etc.) as well as beyond the enterprise, to relevant communities of practice for instance, bolsters connectivism and also emphasises individuals' skills to know where to find solutions – quickly – rather than know the solutions first-hand. Being resourceful and problem-solving on-demand outrank knowing vast amounts of information, particularly since information is in a continual cycle of renewal and update.

The learning approaches which are thus highly linked to the dimension of skills development include action learning, connectivism, as well as learning that is on-demand and online. Communities of practice and social learning also serve to enhance learning in workplaces – however skills development most fundamentally addresses the cognitive dimension of learning. The implications of such findings reinforces past empirical work, depicting soft skills as the most desirable and valued employee skills, while investments in learning are low in addressing them in a targeted way.

Though soft skills are the highest valued employee skills, enterprise investment in developing them is lagging

Changes are needed in order to optimise lifelong learning strategies aimed at skills development

Investment in skills development is mixed, from our results, yet what is clear is that the responsibility of triggering learning and also fulfilling skills gaps chiefly rest on the capacity and initiative of individual employees. However championing skills development might not require huge investments from enterprises, given that the most advantageous and successful types of training reported are short, generally informal, online and on-the-job.

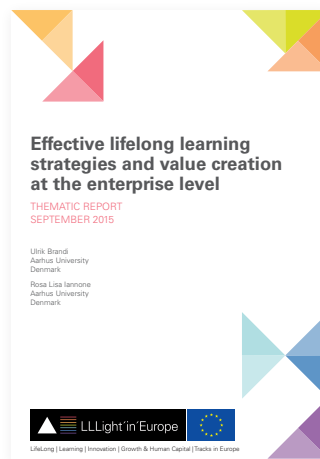
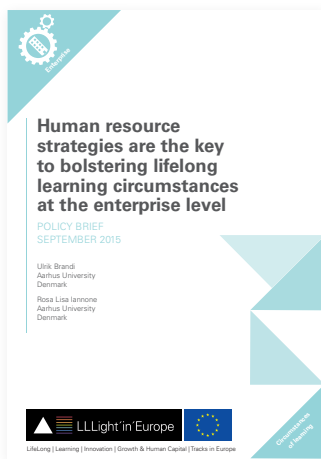
LLLight concludes from the above that there is much opportunity for deeper industry-wide collaboration, public-private partnerships, research-practice undertakings and government support for lifelong learning planning and deployment.

In order to reap the benefits from lifelong learning strategies mediated through HR and aimed at optimising skill development in European enterprises, LLLight recommends promoting policies that enhance learner-centred lifelong learning architectures, including: a) an explicit policy agenda that targets soft skills development and measurement; b) funding for soft skills development, which may also entail mobile courses so as to emphasise intercultural competence development; and c) social incentives through increased and more diverse public offerings in soft skills development.

In conclusion, LLLight finds that there are a variety of lifelong learning configurations that point to the need for learning that is responsive to a flexible, learner-centred workforce, in ways where a business case can be made for initiatives. Nevertheless, there is evidence that less formalised learning design and more generic learning and training is highly beneficial, the composition of which currently rests on both employee and enterprise needs as well as enterprise size.

For more details on this chapter, please find:

- LLLight Policy Brief: "Human resource strategies are the key to bolstering lifelong learning circumstances at the enterprise level" by Ulrik Brandi and Rosa Lisa Iannone
- LLLight Thematic Report: "Effective lifelong learning strategies and value creation at the enterprise level" by Ulrik Brandi and Rosa Lisa Iannone



Chapter 15 highlighted the central role of human resources management within an enterprise to promote lifelong learning and skills development. Chapter 16 illustrates that incentive structures are the major instrument through which the human resources function can promote skills development.

16. Incentives are the most effective resources to creating and sustaining lifelong learning strategies at the enterprise level

Incentive structures are the most effective resource to be employed in lifelong learning and enterprise value creation

In examining the enactment of lifelong learning strategies at the enterprise level, LLLight identified learning systems and incentives as highly central to choices in lifelong learning resource allocation. The focus is on human resource practices (HRPs), deployed by human resources (HR) and human resource management (HRM) plans, for learning systems and incentives that draw on both systematic and ad-hoc arrangements. Enterprise resources are being leveraged to address both extrinsic and intrinsic needs so as to achieve high-performance work system (HPWS) capacity.

According to the LLLight analysis of learning systems and incentives – the affective dimension of lifelong learning –enterprises are making use of a variety of creative methods of organising learning, with a trend of striking a balance between systematic and ad-hoc arrangements. Traditional compensation elements are much in place, particularly in larger enterprises, and are also desired aspects, on the part of employees, for satisfying extrinsic and fundamental needs.

Nevertheless, the key to attracting and keeping great staff is through the implementation of incentives that respond to intrinsic needs, such as offering interesting and challenging work, being flexible, setting up work organisation that is structured along teams and fostering a sense of belonging and ownership, also in a positive atmosphere.

The systematic organisation of learning increases with enterprise size

Systematised learning arrangements help in resource management for lifelong learning in enterprises, but a healthy level of ad-hoc approaches are needed to enable responsiveness to needs

Effective instruments that facilitate qualitative and quantitative measurements on investment in lifelong learning (both short-term and long-term) are in need

When asked about the systematisation of learning, training and development at their enterprises, our respondents strengthened the premise that the larger the enterprise, the more methodical and organised learning is, and that the smaller the enterprise, the more ad-hoc arrangements are.

The impact of having a balance between systematic learning arrangements and ad-hoc ones is that enterprises can strategically benefit from regular follow-ups with project and work demands, as well as employee requests, and at the same time, create a plan for flexible offerings in terms of training and development. As observed in the LLLight interviews, there is more demand for some types of training over others, and these demands, change over time. The key to both a systematic and ad-hoc approach to learning is that leaders and employees can be both responsive to change while planning for the year and years ahead. Systematic approaches do not necessarily need to be entirely top-down, as the interviewees expressed, even at large enterprises.

Complementing the planned provision of training and development are examinations of the effects of learning. However, in line with what all interviewees, without exception, emphasised is that measurements/calculations are difficult, if not doubtful, or impossible with respect to learning and development, particularly concerning soft skills. As a result, enterprises take on supportive, linked strategies to indirectly measure the benefits of learning by, for example, collecting experiential feedback from employees, clients, staff peer evaluations, self-evaluations and other general performance appraisal information.

LLLight also observed both extrinsic and intrinsic motivation factors that attract staff and ensure retention, as depicted in Figure 16.1 (the larger the word, the more mentions it got).

Figure 16.1: Appeal of the work environment, acquiring and keeping staff



After financial benefits, results show that employees rank 'people', 'teamwork', 'reputation', 'flexibility' and 'stability' as most desired incentives

Financial compensation was mentioned as the most attractive instrument, along with benefit packages, which include medical, retirement, vacation and other traditional compensation items. This satisfies the extrinsic motivational factors of having a job and earning enough to secure a livelihood and future.

Following this, however, respondents reported that 'people' and 'teamwork' as well as 'reputation', 'flexibility' and 'stability' are highly valued – all intrinsic motivators. In fact, there are mentions of many more intrinsic aspects of workplace environment than extrinsic in terms of what employees value. Several interview narratives tell of these positive motivators, strengthening the premise that intrinsic motivators, addressing higher-order needs, result in happiness in the workplace, and benefits to the enterprise.

Too much emphasis on exploitative (rather than explorative) lifelong learning strategies with a focus on financial incentives leads to an unhappy and potentially unhealthy workforce

Past empirical work informs that negative-motivators cannot be relied on for HPWS growth, and are therefore not long-term strategies to be used. Though as the LLLight empirical data echoes, socio-economic factors oblige employees to continue to work in less than favourable and unfulfilling conditions. Promisingly, LLLight discovered that although risk and mistakes are to be avoided, there is moderate tolerance to them in today's workplaces.

All participants report a relatively balanced approach to risk-tolerance and tolerance to mistakes

Stability and security are still relatively weak, with more than half our respondents telling they have only 'moderate' and lower anticipation' of being able to keep their jobs in the long-term

Incentives and learning systems are not only a means to satisfying standards, they are instruments through which the highest potential of a workforce can be derived

Research results on incentives at the enterprise level, suggest that flexibility plays to all the dimensions of learning; affective, structural and cognitive. Flexibility can affect motivation, performance, and freedom over work design among other aspects. Regarding risk-tolerance and tolerance to mistakes, results show that there is a general trend of having some flexibility for both, and this is the same pattern, irrespective of enterprise size.

There may be further insights gained by examining flexibility in relation to work tasks. For instance, there are some work scenarios that cannot afford much flexibility, such as in emergency services, security, monitoring, medical, assembly-line work, etc. And, flexibility might be something that can wax and wane, perhaps at various intervals in a fiscal year, such as in financial and audit services sectors. Nevertheless, it remains an important aspect of incentives, to be considered in HPWS.

As also accentuated in the analysis on appeal of the work environment and reasons for retention, the provision of stability and security are highly important to employees, addressing their intrinsic needs, as motivating factors. However, responses as to the current state of affairs tells, that stability and security are relatively weak – about half of all our respondents face the reality that they hold only moderate, slight or no anticipation to continue at their current jobs over an extended period of time. As noted by findings on past empirical work, employment security is one of the most basic, yet fundamental HRP that affects enterprise performance. Enterprise size, though, has an influence on some provisions, particularly with respect to stability and security.

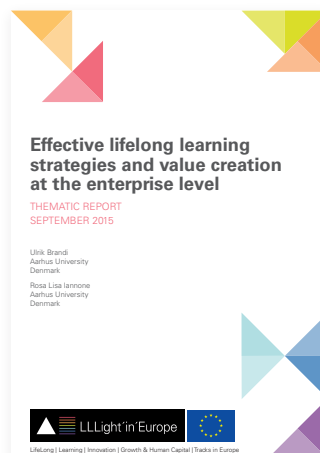
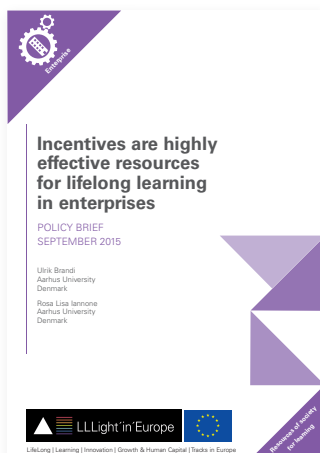
LLLight's findings reinforce the premise that incentives and balanced learning systems contribute to employee satisfaction and value creation. They are not only a means to satisfying standards and regulations; they are instruments through which the highest potential of every employee can be derived, starting from functional contributions, towards contributions of self-actualised learning.

LLLight recommends a stronger political promotion of practices in the use of employee intrinsic reward systems, particularly in larger enterprises, starting in the public sector. Research demonstrates that intrinsic rewards – while mostly non-financial – outweigh traditional, extrinsic reward practices in situations where employees have a choice of more than one option of workplace; in turn, intrinsic rewards impact enterprise-performance.

In conclusion, LLLight notes that there is room for both policy and enterprise practice to enhance mutual collaboration and knowledge sharing that can enable the identification of effective resource consolidation, investment and impact. This will firstly help bridge the gap between lifelong learning demands and lifelong learning provisions within industry and directly affect enterprise growth through employee development.

For more details on this chapter, please find:

- LLLight Policy Brief: “Incentives are highly effective resources for lifelong learning in enterprises” by Ulrik Brandi and Rosa Lisa Iannone
- LLLight Thematic Report: “Effective lifelong learning strategies and value creation at the enterprise level” by Ulrik Brandi and Rosa Lisa Iannone



Chapter 17 confirms also from a human resource management perspective that work place design and work place organization are critical not only to the development of complex problem solving, but also to skill development in general.


17. Punctuating routine work with something challenging is motivating and sharpens higher-order skills

In examining lifelong learning environments and work organisation in 194 enterprises across 53 industries, LLLight bolsters the premise that rich and complex work as well as employee- and team-driven learning initiatives reinforce continuous and sustained learning experiences at work.

Work design or work organisation encompasses the setups, channels and strategies adopted towards supporting the production, communication, and general enterprise performance, internally. By examining these aspects, LLLight can identify the coordinated efforts of work that lay the foundation to providing employees coherent competence development opportunities and continuous learning in and around the workplace.

Not surprisingly, HR leadership is largely present in large enterprises; however this also tends to lead to top-down work organisation, which may impinge on enterprise flexibility, employee autonomy and agency, as well as adaptability and response success to change

The LLLight data reinforces the premise that work design and the organisation of work are important aspects to be considered in high performance work systems (HPWS) and enterprise growth. To begin, having an human resources (HR) department, or designated HR-leader, helps systematise HR practices (HRPs). At the very minimum, transactional and traditional HRPs that are more administrative in nature are more easily handled when centralised and consequentially, larger enterprises make use of this to manage HR processes. Paralleling this trend however are an increase in hierarchy and distinction in status between employees (and ranks), which do not foster responsiveness to on-demand, work-related needs.



Hierarchy, bureaucracy and status distinction pose challenges to lifelong learning; they can encroach on feelings of belonging and may stall performance

Observations from the LLLight data reinforces the recognition that the larger the enterprise, the more systematic the organisation of learning, and the more formalised HRPs are. Linked to hierarchy and bureaucracy trends, the administrative distinction of an HR-area also tends to lead to a rather top-down organisation of work, rather than a bottom-up approach. For example, hierarchy is still very present and felt in large enterprises, which depicts the extent to which status distinction permeates workplaces. Paralleling these trends are layers of bureaucracy, which also play a role in impinging on enterprise flexibility, employee autonomy and agency, as well as change and adaptation processes. According to LLLights's empirical participant narratives, hierarchy, bureaucracy and status distinction may encroach on feelings of belonging, and a sense of "family", which erode intrinsic motivational levels.

Punctuating routine work with something different and/or challenging is motivating and sharpens higher-order skills

Furthermore, despite the fact that most of today's routine work is being undertaken by large enterprises, a slight majority of the participants report their work as being 'very' or 'extremely' challenging and that they assume decision-making power over their work design. It is known that the identification of opportunities for growth (personal and work processes) are prefaced with disjuncture; when not in harmony with the state of affairs, which is why special assignments and job-rotation are considered as incentivising HRPs for example. This is not to say that one must go looking for problems in routine work, since routine work has its strengths and must be leveraged/exploited, in a quest for evermore effective and efficient modes of delivery.

The LLLight respondents tell the story that routine work is very much a reality of work arrangements, with close to half reporting their work as 'very' or 'extremely' routine. Yet routine work inevitably draws on lower-order thinking skills and if forsaken, higher-order thinking skills begin to dull. Consequently, an individual's intrinsic motivational need to self-actualise through work abates, leading to performance repercussions, as noted in LLLight's research findings and empirical work.



Challenging work promotes learning; yet enterprise work arrangements must make time and space provisions for learning

Team-based work is constitutional to high-performance work systems and responds to intrinsic, cognitive and affective needs

LLLight's empirical work also demonstrates how challenging work is highly linked to decision-making power on the individual level in enterprises, attending to the intrinsic rewards of work. The narratives from the observations tell that challenging work is something characterising teamwork, with teams that are grouped according to business areas, but also temporary teams who come together to discuss potential solutions to newly discovered mistakes, exceptions, and atypical situations.

Team-based work is a necessary consequence of evermore complex work and HPWS. Moreover, a good proportion of work is being organised through teams. Team-based work arrangements increase as enterprise size decreases to about 10 employees; less than 10 employees typically means individuals are working alongside one another, independently. Given the motivating factors of work, team-based work responds to intrinsic, cognitive, and affective needs and is therefore an important feature in HPWS. It is one of the most successful work arrangements in fostering, ongoing, socio-cultural and action learning through interactions.

Decision-making and influence on work that is bottom-up is also characteristic of HPWS. Empirical studies underscore, in relation to high-functioning work design, that employees should be given a high degree of independence, decision-making and influence on how work processes are organised. Generally, the LLLight analysis shows that employees in smaller enterprises are more likely to experience that they have influence, as compared to employees in larger enterprises, as illustrated in figure 17.1.

Figure 17.1: How large is the influence of employees on management decisions in the enterprise for changes in the organisation of work processes and workflow?

		Influence on changes in the organisation of work processes and workflow				
		Very strong	Quite strong	Quite weak	Very weak	DK/NA
Size	10 to 19	15,0%	45,4%	22,3%	12,4%	4,9%
	20 to 49	13,0%	44,4%	26,5%	12,1%	4,0%
	50 to 249	8,2%	39,6%	33,6%	14,2%	4,5%
	250 to 499	7,5%	35,3%	38,5%	15,6%	3,1%
	500 +	8,5%	37,4%	39,8%	12,2%	2,1%

LLLight also took to analysing conflicts and challenges in the workplace settings of those participating in the empirical research, as depicted in Figure 17.2 below (the larger the word, the more mentions it got).

Figure 17.2: Most common conflicts



Employees in SMEs typically enjoy greater influence over the organisation of their work than employees in large enterprises

Understanding high-performance work systems means we must also examine conflicts and challenges in workplace environments

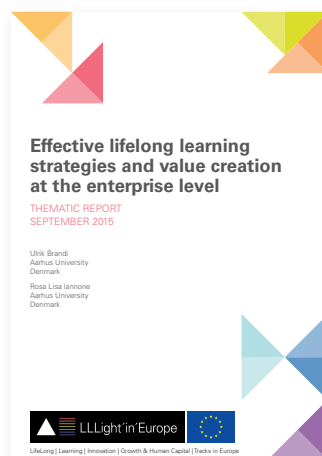
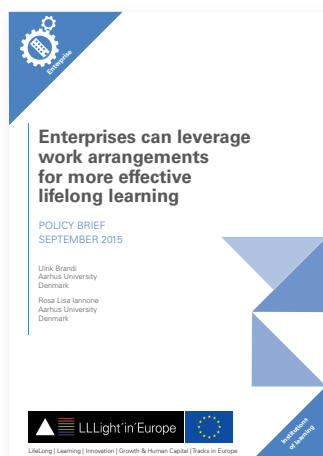
Stress and burn-outs were reported as the most important and onerous workplace problems, followed by communication breakdowns, conflicts with clients, frustrations with workloads and conflicts between management and staff.

Contextualising some of the challenges and conflicts employees reported, LLLight observed from the study that pressures from industry, clients, resources, etc. all influence communication patterns, work organisation in general and employee stress sources at work. Of course in HPWS, priority to responsiveness in conflicts and challenges are characteristic. Affecting this aspect are contextual forces that require further examination. Nevertheless, and as exemplified in some of the collected narratives, there are HRP that address problem-detection and problem-resolution so that enterprises and staff may overcome these.

In conclusion, work design and the organisation of work directly contribute to employee wellbeing and overall enterprise high-performance. The systematisation of certain aspects of HR through HR-leadership helps, however, hierarchy and greater distinction in employee status hinder HPWS. Promisingly, the respondents reported their work as being 'very' or 'extremely' challenging and that they assume decision-making power over their work design. Also, a good proportion of work is being organised through teams – also a precursor to HPWS. The study also examined workplace conflicts and challenges, where stress and burn-outs could be identified as the most prevalent, with other soft skills challenges (e.g. communication, time management, client relations, etc.).

For more details on this chapter, please find:

- LLLight Policy Brief: "Enterprises can leverage work arrangements for more effective lifelong learning" by Ulrik Brandi and Rosa Lisa Iannone
- LLLight Thematic Report: "Effective lifelong learning strategies and value creation at the enterprise level" by Ulrik Brandi and Rosa Lisa Iannone



A main actor towards the achievement of lifelong learning strategies is the public policy maker. LLLight investigated with 14 case studies of public policy trails throughout Europe, how policy making can contribute most effectively to lifelong learning of the European citizens. Chapter 18 summarizes the findings.

18. Public policy impact on Lifelong Learning is most effective when it is implemented in close partnership with companies and stakeholders

Flexicurity at the EU level includes giving recognition to the need to invest in lifelong learning for workers

At the March 2006 European Council the European Union (EU) Member States agreed to introduce reforms in their employment and social policies under an integrated flexicurity approach. At present, this approach continues to define the labor market restructuring element of the European Employment Strategy and constitutes a basis upon which political action contributing to the achievement of the 75% employment rate target set by the Europe 2020 Strategy is coordinated.

Flexicurity at the EU level includes giving recognition to the need to invest in lifelong learning for workers. With a focus on skilling, reskilling and upskilling, lifelong learning is understood to play a key role in securing employment and in ensuring an adequate adaptation of companies to rapid change of business circumstances.

In this context, the interplay between initiatives and funds for lifelong learning coming from the state (or territorial employment or education and training departments or authorities), employers and (to a less extent) individuals is expected across the EU. Such interplay is a crucial component of the construction of flexicurity policy paths towards the implementation of lifelong learning strategies in enterprise working environments.

Interplay between the state, employers and individuals are a crucial component of the construction of flexicurity policy paths

LLLight research contributes to knowledge of the experiences and practices of enterprises in relation to the formation and effectiveness of these policy paths. LLLight focused on how companies interact with their public policy environments in relation to lifelong learning. Three specific areas were selected for analysis:

- Public policy: How does public policy support participation and investment in lifelong learning by companies and their employees?
- Partnerships and networks in which companies connect with education, training and R&D providers and non-governmental organisations (NGOs): How do they contribute to developing and supporting lifelong learning opportunities within and around companies?
- Circumstances affecting lifelong learning in the workplace: How does the interplay between external and internal business circumstances result in the privileging or exclusion of particular forms of engagement and investment in lifelong learning in specific companies?

The research informing this analysis centred on the development of fourteen case studies in and around the working environments of companies based in Denmark, Italy, Germany, Slovakia and Spain. Of the fourteen companies considered, five have over 250 employees, five between 50 and 250 employees, and four fewer than 50 (including one with fewer than 10).

Investigations for the case studies involved conducting semi-structured interviews with company managers and staff as well as government representatives and other actors networked with each of the fourteen companies on focus. In total, 67 semi-structured interviews were conducted during field trips to the companies' locations where possible, otherwise the interviews were done by telephone.

The data shows a diverse array of government funding schemes and institutionalised mechanisms that are especially aimed at promoting training and skills development for employees in the private sector

The research also drew on comprehensive documentary analysis aimed at gaining insights on important contextual aspects shaping lifelong learning in these companies such as national legislation, practices of tripartite corporatism and professional regulations.


Public policy

Data on public policy support for workers' participation in lifelong learning in Denmark, Germany, Italy, Slovakia and Spain show a diverse array of government funding schemes and institutionalised mechanisms that are especially aimed at promoting training and skills development for employees in the private sector.

Except for Slovakia, employees can directly benefit from state support via tax relief provisions that incentivise individual investment in continuing education and training. Moreover, collective agreements among governments and social partners and social partners themselves play a critical role in Denmark, Italy and Spain in facilitating employees' access (free of cost) to training opportunities independently of the initiative and capacity of their employers to invest in lifelong learning.

In all of the four countries, governmental programmes and legislation ensure the allocation of public funds for supporting companies' investment in lifelong learning for their employees. Funds are most generally allocated indirectly via tax incentives, participation of governments in collective agreements and through specific regional programmes focused on employment and industrial development.

In the LLLight study, 13 out of the studied 14 companies were members of at least one association representing employers' and evidence showed that through this membership they had good access to accurate information about how the allocation of these public funds works for them.



LLLight data shows that there is neither a strong reliance nor appreciation on the part of companies regarding the current public subsidisation of their staff development initiatives

However, the data also show that there is neither a strong reliance on, nor appreciation on the part of companies regarding the current subsidisation of their staff development initiatives. In this respect, among companies there is uncertainty about the effectiveness of current public policy measures focused on encouraging lifelong learning in the workplace, with the following similarities being found across companies located in different countries.

- Publicly subsidized work-related training provision is often perceived as not generally meeting the specific lifelong learning needs of staff. This is especially the case in knowledge intensive and innovation-oriented working environments.
- Utilization of public policy provisions and funds in the areas of education and vocational training as well as of innovation and R&D, entails generating relevant lifelong learning opportunities for employees.
- Regulation of professions such as architects and health and social care professionals creates lifelong learning needs and has a significant impact in ensuring the implementation of training and staff development plans by companies.

Overall, these are key findings that reveal that lifelong learning plays an important support function across a wide range of activities and can be strengthened in enterprise working environments – almost accidentally – by policies targeting issues other than workforce training and development.

Partnerships and networks

There is plenty of research-based evidence that social networks affect the lifelong learning of individuals. LLLight research investigated how far this is also true of business enterprises. LLLight focused on partnerships with and memberships of education, training and R&D providers and NGOs.



LLLight's case study research provides a range of examples when companies exploit their engagement in partnerships and networks for the purpose of achieving competitive and business advantages as well

Accounts of the experience of engagement in these kinds of interaction, demonstrated that they enable companies demonstrate to be better positioned to take advantage of the lifelong learning opportunities available to them, with the following observations being key findings in this regard.

- Participation of companies in arrangements for facilitating apprenticeships and traineeships for students in public (higher) educational institutions helps in generating mutually beneficial knowledge exchange and skills development dynamics.
- Companies' involvement in NGOs and professional networks facilitates participation in highly valued peer-to-peer learning and knowledge transfer activities. It also contributes to a better identification of education and training needs in accordance with business development needs.
- For small and medium-sized companies, membership of specialized NGOs can be a mechanism for encouraging the development of Human Resources (HR) management expertise within the enterprise.

Although a common feature of these relations is the absence of a commercial transaction, LLLight's case study research provides a range of examples where companies exploit their engagement in partnerships and networks for the purpose of achieving competitive and business advantages as well. From a policy perspective, evidence presented in this report draws particular attention to how partnerships between companies and public educational institutions can entail risks in relation to the use of those institutions as facilitators of company strategies for marketing their products.

High skilled requirements and high skilled outputs shape the approach to lifelong learning in companies that develop project and research-based products and services

Circumstances affecting lifelong learning in the workplace

A focus on the relationship between internal and external circumstances encouraging lifelong learning within specific companies helps in gaining insight into the relative role that public policy and public economic incentives can actually play in shaping employers' investment and employees' attitudes towards lifelong learning.

LLLight's analysis systematically highlights the following aspects that emerged when interviewing company managers and staff across Denmark, Germany, Italy, Slovakia and Spain.

- High skill requirements and high skill-based outputs shape the approach to lifelong learning in companies that develop project and research-based products and services. This is marked by a preference for informal learning activities which require less investment. Public policy has no influence in engagement in informal learning within companies.
- When there is a HR function that deals specifically with training needs, professional development and lifelong learning are strategically driven by the company. In such cases, public policy exercises little or no influence. Company management shows an acute sense of how to encourage lifelong learning opportunities for their employees.
- Professional regulations can constitute a critical external intervention in how participation in lifelong learning is managed at company level. However, when they affect highly skilled employees, they are prone to be perceived as generating training obligations that do not correspond to actual learning needs.

While the study encountered various motivations driving companies' promotion and investment in lifelong learning, the above observations are based upon a sectorial analysis that helps to differentiate what kinds of learning are valuable in accordance with the service/product provided and the professional knowledge and skills required.

A focus on the right skilling, reskilling and upskilling of the workforce is on the agenda

Lifelong learning matters for the impact of policies across many areas. When planning, it is important to be aware that encouraging lifelong learning among key groups may make the difference between success and failure

This differentiation is of relevance for identifying commonalities in a diverse and changing industrial landscape. It also contributes to gathering evidence that is helpful in adjusting public policy programmes to real lifelong learning needs in the private sector.

Conclusions

The adoption by EU Member States of a flexicurity approach to employment and social affairs encompasses a significant interest in political circles about how to (re)construct policy environments that facilitate both employees' continual engagement in qualifying for employment and employers' continual ability to be successful in running their businesses. Either way a focus on the right skilling, reskilling and upskilling of the workforce is on the agenda.

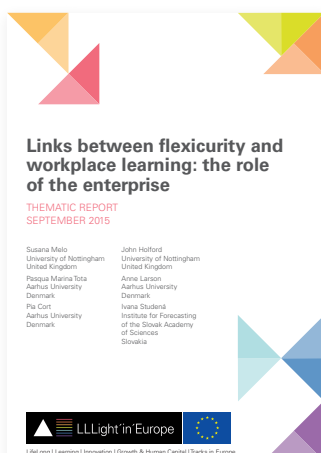
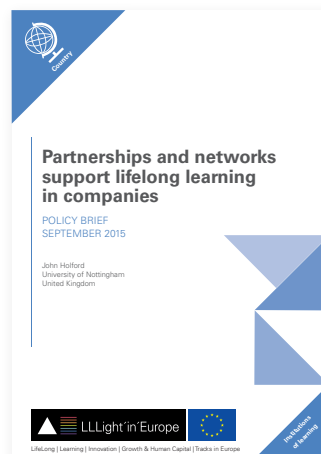
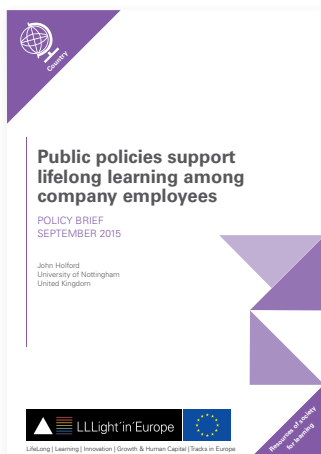
Drawing on the available data collected in the course of implementation of the LLLight'in'Europe project, the research offers some key messages of particular interest for policy-makers within the EU:

- Lifelong learning matters for the impact of policies across many areas. When planning, it is important to be aware that encouraging lifelong learning among key groups may make the difference between success and failure.
- Investment in educational and training programmes that encourage partnerships with companies and build lifelong learning within companies is recommended. However, the role of the state as a regulator of such partnerships is highly important to address the risk that specific business interests may dominate these relations.
- When allocating public funding for vocationally-related lifelong learning, it is important to consider that a number of companies and employees in some sectors may invest in training without public subsidy. It is critical to gather information about whether it is cost-effective to use public funds to support what individuals or enterprises would pay for themselves anyway.

- Importantly, and to conclude, the various factors that drive lifelong learning in companies remain only partially understood. More research is needed to investigate them. Research is also needed to identify gaps in learning when the focus of lifelong learning is product-driven or business-driven. Such research would increase efficiency in the allocation of public funds for lifelong learning.

For more details on this chapter, please find:

- LLLight Policy Brief: “Public policies support lifelong learning among company employees” by Pia Cort, John Holford, Anne Larson, Susana Melo, Ivana Studená, Pasqua Marina Tota, “Partnerships and networks support lifelong learning in companies” by Pia Cort, John Holford, Anne Larson, Susana Melo, Ivana Studená, Pasqua Marina Tota and “Technology and business needs shape training and learning” by Pia Cort, John Holford, Anne Larson, Susana Melo, Ivana Studená, Pasqua Marina Tota;
- LLLight Thematic Report: “Links between flexicurity and workplace learning: the role of the enterprise” by Susana Melo, Pasqua Marina Tota, Pia Cort, John Holford, Anne Larson and Ivana Studená.



Lifelong Learning happens in many circumstances, which are categorized by formal, non-formal and informal categories. Chapter 19 looks at which circumstances are prevailing in which countries.

19. Non-formal education dominates the circumstances of Lifelong Learning


Nature of skills required by European economies is changing. How can we deal with it?

European economies have undergone major structural changes putting in spotlight new demand on individuals' skills. Moving towards understanding of what are the ways of achieving improved skills, the role and new scope of education forms are intensively discussed as skills mismatches persist. As the demanded skills structure has been shifting from prevalingly required routine and manual tasks towards current emphasis on skills for coping with complex non-routine tasks, companies and individuals need to search for best ways how to respond quickly to development of skills all through their life span. Lifelong learning practices seem to provide a partial solution to this problem. These connections between other than formal forms of education and skills are crucial for policies on how to support effectively adult skills development.

Which forms of lifelong education are prevailing?

Countries with strong overall participation in lifelong learning are also performing well in problem solving scores. LLLight investigated the transversal skills related to dealing with problems in technologically rich environment looking for primary evidence on difference across countries.

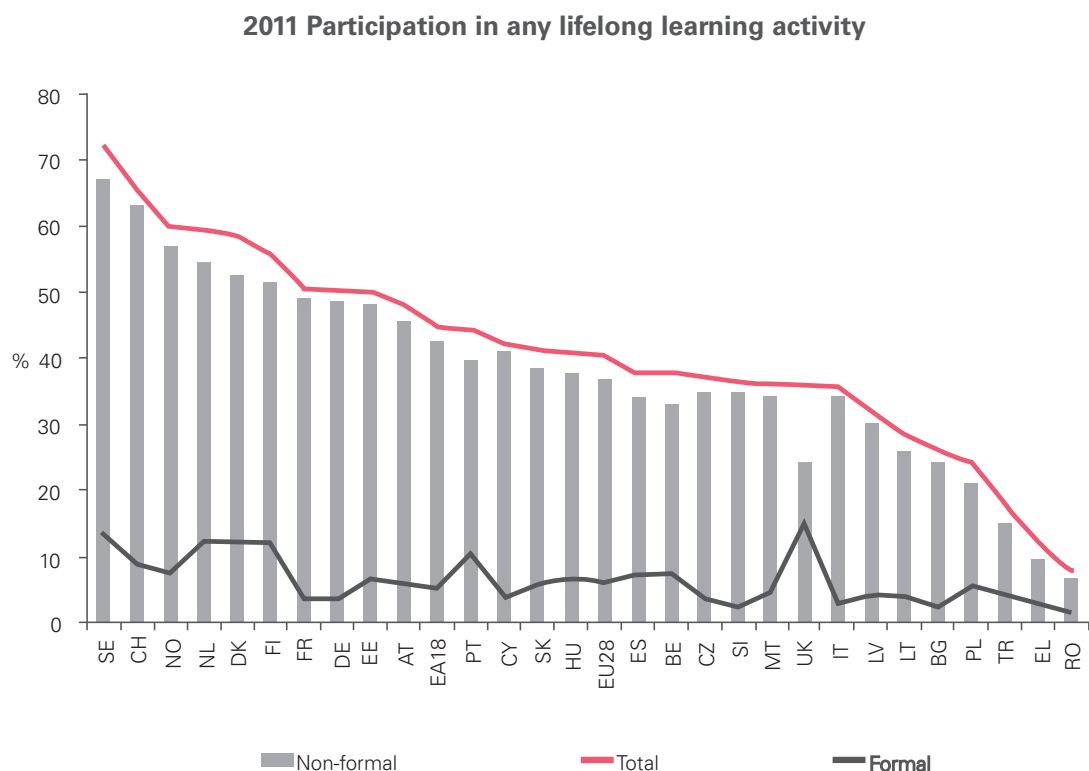
In order to understand the underlying processes that led to observed differences of skills, LLLight analyses how adults have been engaging in different types of education as captured by large European surveys on adult practice in lifelong learning.



Adult learning is happening in circumstances shaped by spectrum of individual, social and economic factors. The work environment is one of the crucial conditions in which knowledge and skills are transformed and revealed in competencies. In this process decision-making at employer level is crucial, as employers continually assess competencies of labor as crucial factor of economic performance of underlying economic activity whether it is production of goods, services or even engagement in non-profit activities. Also individual decisions with regards to participation in adult learning closely are linked to results of interaction with workplace requirements. Therefore information on forms of adult education and trainings carry information on how entrepreneurial environment and individuals observe and assesse education forms mostly effective to skills upgrade and for enhanced competencies for work.

Empirical evidence on circumstances of lifelong learning documents dominance of non-formal learning activities. In EU on average at least one in 3 European adults undertook some non-formal learning in 2011 while only about 1 from 15 adults engaged in formal learning activity (Figure 19.1). By country, the overall learning participation ranged from more than 60% in leading Sweden to less than 10 % in Romania. No clear pattern is observable in connection between the amount of formal activities and overall lifelong learning practice and developments over time.

Figure 19.1: Structure of lifelong learning activities in 2011, any education and training activity in past 12 months



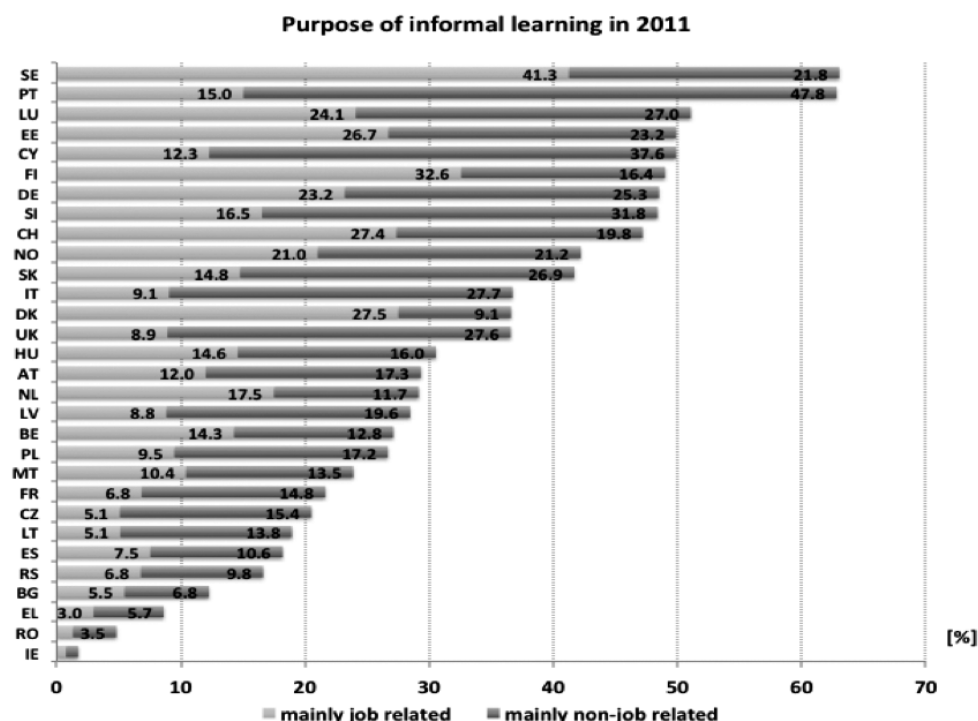
Source: Eurostat, Adult Education Survey 2011

The lifelong learning activities are mostly job related and prevalingly sponsored by employers. In the EU average, six out of ten adults undertakes learning that is related to the job and in most cases the education and training is paid by the employer (Figure 19.2).

Research shows that the structure of trainings matter. What connects lifelong learning and skills development?

Informal learning is important source of learning and it is often connected with person's job. The information from individuals living in households in 2011 includes also not working or non-active individuals but the amount of learning related to job is systematically high. In countries with strong lifelong learning practice individuals learn more also informally with relation to their jobs.

Figure 19.2: Purpose of the most recent informal learning activity in 2011



Source: Eurostat, Adult Education Survey 2011

Vocational training is prevailingly composed from two main activities, i) guidance on the job and ii) organised workshops and lectures. Guidance on the job represents elementary circumstance for skills upgrade also in countries with overall strong lifelong learning practice but in these the training is typically complemented by organised but non-formal education or training events. However, job experience remains crucial initial condition for acquiring competencies for work.

Generally, there is a great variation among European countries in relation to the informal and non-formal learning engagement and how much time people invest in lifelong learning. In some countries almost three quarters of adult population had not done a single learning activity.

LLLight confirms that the overwhelming majority of people who had undertaken any form of training acknowledges its positive impact on their efficiency and job security.

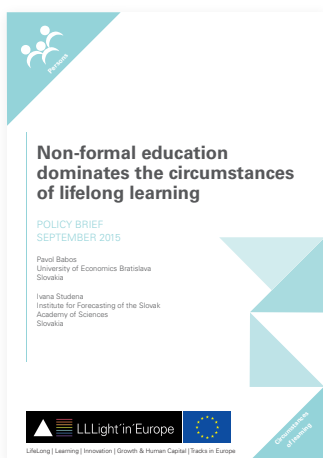
The overwhelming majority of people who had undertaken any form of training acknowledges its positive impact on their efficiency and job security

Non-formal learning forms are mostly sought out for skills upgrades. This practice dominates also in countries leading in overall adult learning and where organised but not formal education events are important learning form. Informal learning by guidance on the job is crucial starting element in building adults competencies.

Overall, the links between skills and learning are best revealed and addressed within the workplace experience. Complex problem solving skills are highly required and their measurement tools are likely to become an attractive assessment tool at individual and company level.

For more details on this chapter, please find:

- LLLight Policy Brief: “Non-formal education dominates the circumstances of lifelong learning”, by Pavol Babos, Martina Lubyova and Ivana Studena.



A key social outcome for society is the degree of employability of its work force. Holding a secure and income-rich job, is the best provision for social needs. Participation in lifelong learning appears to be an ever larger determinant of employability. Chapter 20 takes a look at LLLights insights in that regard.

20. Lifelong Learning is a growing factor in employability

Today, a university degree is not anymore a guarantee to a job


In turmoil of structural and global shifts affecting economies, some European job seekers do not find jobs in long-term. Some do not find jobs at all or get discouraged and give up on job prospects. While in the past initial higher education has been the key entrance ticket to employment, these days also young university graduates among European job seekers are in difficulties. At the same time, European employers report problems to find employees for considerable number of vacant positions. It is evident that labor market transitions are struggling with increased complexity.

Employability is shaped by skills, attitudes and knowledge.

Employability, the ability to find, keep or change a job position, when an individual needs or wishes to, is determined by combination of his or her attitudes, knowledge and skills. These interact with personal characteristics and background conditions and imply how an individual performs at the labor market.

Share of working life spent in paid employment might capture more information on employability

Prevailing empirical evidence on what and how affects employability is based on analysis of the spectrum of factors and their attribution to the current labor market status of an individual. Available studies addressed employability usually by referring primarily to the information whether an individual was employed, unemployed or inactive at the time he provided information about his work skills and education. LLLight takes a novel approach to measuring employability as based on using the share of working life an individual has spent in a paid work as a measure of employability. This approach offers interesting insights.



Different types of skills contributed to a person's employability in various ways.

The analysis broadly confirms that indeed it is a mix of personal capacities and circumstances that play key role in influencing employability. However, how personal factors play and interact in connection with employability varies across countries in relation to the country welfare and labor market structures.

Different types of skills contribute to one's employability in various ways. IT and problem solving skills are more significant among the skills spectrum and together with attitudes and non-cognitive skills they increase a person's ability to get and maintain a job. But different country frameworks decide how education and skills can improve employability while personal factors such as having children can worsen employability.

The differences in how skills, education and circumstances affect employability depend on the country economic and social structures.

From the post-communist countries, according to this analysis, the Czech Republic rewards educational level relatively high while there is no evidence that the problem solving skills would be rewarded in terms of employability. At the same time, having children is a significant barrier, especially for women who have lower employability than men. Effect of educational level on employability is high.

In contrast to this case is the way education and skills interact in countries with high employability like Sweden. In Sweden both education and skills are rewarded with higher employability. Social frameworks and support structures for families are instrumental for employability as family situation or gender do not have any (negative) effects on employability.

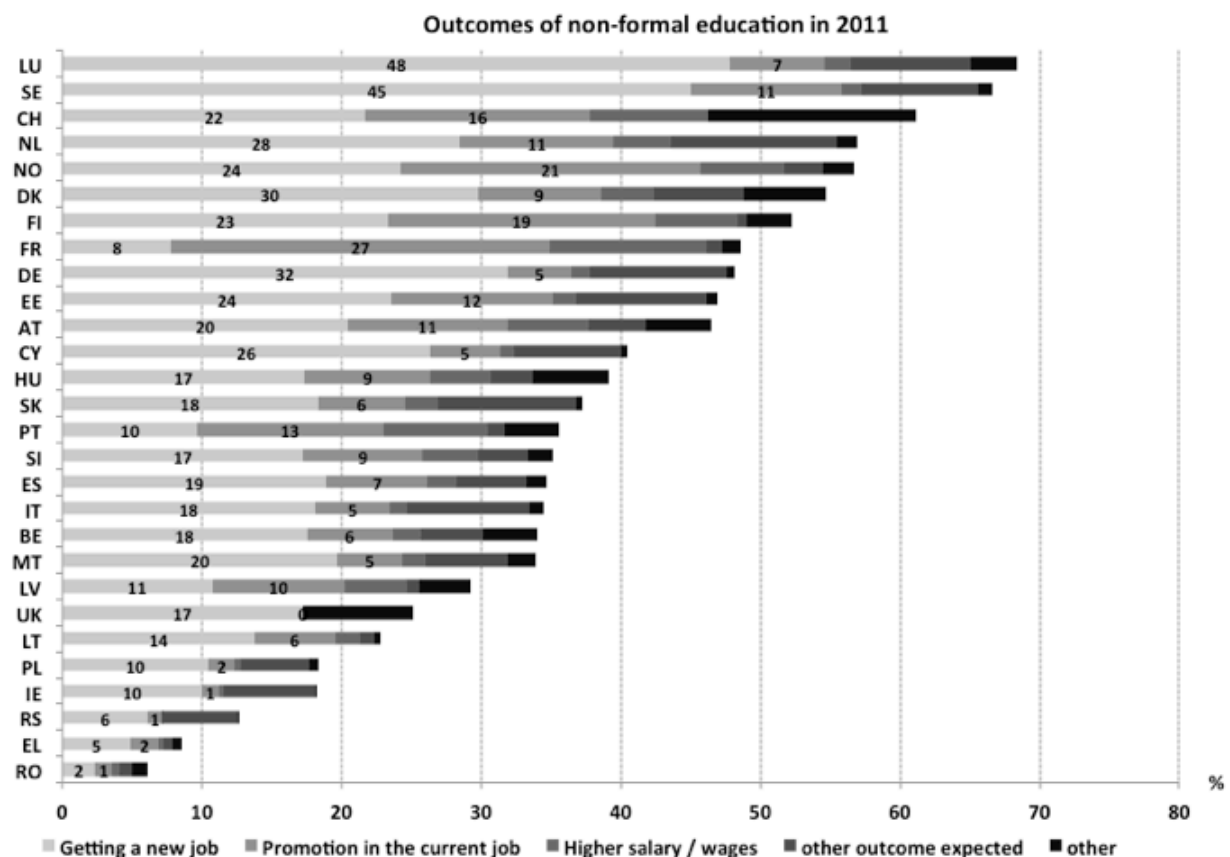
Finally, in case of UK as an illustration of an economy with relatively low investment in general education, both education and problem solving skills are relevant for improved employability. However, having children does have a negative effect on employability, though the effect is smaller than in case of the Czech Republic.

Lifelong learning participants are recognizing value of learning activities in terms of employability

This evidence reflects on the links between employability, lifelong learning and social cohesion. Participation in lifelong learning in form of training is highly relevant directly, for improved employability as well as indirectly via contribution to skills upgrade. LLLight observes that most of the outcomes of non-formal trainings are recognized by the participants to have had positive effects on employability. Participants report in most cases that the non-formal education activities have resulted in finding a job or a new job or in improving their salary (Figure 20.1).

The research undertaken in this analysis hints towards IT and problem solving skills as good candidates for enhancing ability at workplaces.

Figure 20.1: Outcomes of non-formal education activity, 2011 AES, one selected activity undertaken in span of past 12 months



Since Lifelong Learning differs significantly across countries, so does employability

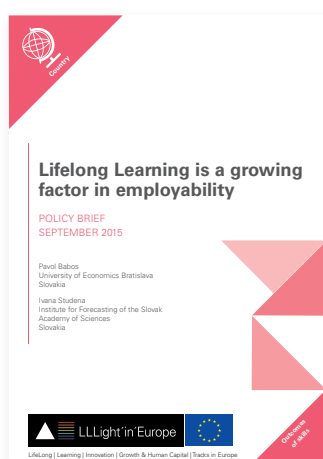
What shapes the ability of adults to learn and what prevents them in participating in learning opportunities is of crucial importance to employment and social outcomes at individual and aggregate levels.

How lifelong learning happens depends on a range of personal capacities as well as circumstances but varies significantly across countries in relation to country educational, social and labor markets frameworks. The extent to which adults participate in continued learning might be the key factor contributing to improved employability.

Circumstances that are negatively affecting individual employability should be the priority targets for policy makers. Improving access to lifelong learning might be instrumental especially if developed in closer connection to workplaces.

For more details on this chapter, please find:

- LLLight Policy Brief: “Lifelong Learning is a growing factor in employability,” by Pavol Babos, Martina Lubyova and Ivana Studena;
- Working Paper: Babos P., Comincini, L., “Employability in Different Capitalist Regimes: a Trade-off Between Formal Education and Skills?”



V. PROFILES OF ALL CONSORTIUM PARTNERS

Zeppelin University
Human Capital Growth and Innovation Center

zeppelin universität

zwischen
Wirtschaft Kultur Politik

„Zeppelin University is a state-recognised and privately funded endowment university bridging Business, Culture and Politics. Zeppelin University defines itself as an individualised, international and interdisciplinary educator of well-rounded decision makers and creative innovators in the fields of business, culture and politics, as well as a multi-disciplinary research institution exploring issues relevant to society.

Zeppelin University is a “Pioneering University” which focuses on the special interests and skills of students and researchers. Our objective: the uncompromising pursuit of academic curiosity and excellence. In 2010 and 2011, ZU was the first German university to successfully conduct a separate accreditation procedure with the German Council of Science and Humanities for the right to award doctorates.

We define management as the desire “to make the improbable probable” – the maxim of our patron, airship pioneer Graf Ferdinand von Zeppelin, whose innovative ideas changed the shape of business. Applying this axiom, the university addresses the rapidly growing demand for decision-makers and creative personnel, educated in a multi-disciplinary manner, in the fields of business, culture, media, and public policy. Zeppelin University’s research explores scientific Interfaces between scholarly disciplines in order to find solutions to today’s socially relevant questions.”

More information
www.zu.de

Department of Education (DPU), Aarhus University



„The Department of Education (DPU) at Aarhus University is Denmark’s largest research, education and communication environment in the areas of pedagogics, learning and skills development.

It was established in 2001 as a department at the Faculty of Arts at Aarhus University. It originates from the Danish School of Education (DPU), which was originally established as the Danish University of Education on 1 July 2000 by the merger of the Royal Danish School of Educational Studies, the Danish National Institute for Educational Research, the Danish School of Advanced Pedagogy and the Danish National Centre for Technology-Supported Learning. On 1 June 2007 the DPU merged with the University of Aarhus and changed status from independent university to a university school at the University of Aarhus

The Department of Education (DPU) combines basic research, application-oriented research and strategic research into how to create the best conditions for education, learning and skill development – throughout life. Its research is organised in interdisciplinary research programmes and units.”

More information
www.edu.au.dk

**China Center for Human Capital and Labour
Market Research
Central University of Finance and Economics**



„Established in March 2008, the China Center for Human Capital and Labor Market Research (CHLR) at the Central University of Finance and Economics (CUFE) is an integral part of the Advantageous Program Platform in Economics and Public Policy at the CUFE. It is an international research center for the study of human resources, labor markets, and their impact on economic development, focusing on China and related economies. We have a team of international scholars and train graduate students to international standards; we adopt international management practices in the Center’s daily operation.

Our advisory board includes two Nobel laureates, Professor Kenneth J. Arrow and Professor James Heckman, and the internationally renowned scholars in human capital research, Professor Dale W. Jorgenson, at the Harvard University, and Professor T. Paul Schultz at the Yale University.

Our major research areas include: human capital and skill measurement, human capital investment, human capital mobility, human capital and innovation, and health and human capital.”

More information

www.humancapital.cufe.edu.cn/en

University of Economics in Bratislava



“The University of Economics in Bratislava (UEB), established in 1940 as the Slovak Higher School of Commerce, is one of the most important educational and scientific-research institutions in the Slovak Republic.

The University provides higher education in the field of economics and business in Bachelor’s, Master’s and Doctoral programs for full-time and part-time students. At present, more than 14,000 students study at the University. As of 2006, it had prepared more than 75,000 graduates.

Science and research form an integral part of the University’s activities. The development of international co-operation with universities, enterprises, and institutions from the whole world is one of the University’s priorities. The University has been involved in many international projects within European Union programs such as TEMPUS, Leonardo da Vinci, Erasmus, the European Social Fund and others.

The University is a member of various international institutions, such as the EUA – European University Association, the EAIE – European Association for International Education, IUA – International University Association, Magna Charta Universitatum and others.”

More information
www.euba.sk

"The Education and Competence Studies (ECS) Group is a research and education unit (chair group) at Wageningen University's Department of Social Sciences, Division Business, Consumer and Company Studies.

It provides academic education and conducts scientific research on the identification of competence needs within the agri-food complex, the design of competence-based education, and the analysis of effects of competence-based learning on pupils, students, citizens, consumers, workers, managers, entrepreneurs, organizations and the agri-food complex as a whole. The central theme of ECS research is competence development within Wageningen University and Research Centre's key domains of healthy food and the living environment.

At ECS group, competence is defined as "the capacity necessary for effective performance", and the group's key research questions include:

What are the important competencies that develop in a changing society?

What are the inspiring competence-based learning environments in which competencies are developed?

What are the effects of these competence-based learning environments?

Research focuses on several different target groups: students in the green sector of education, students in higher and scientific education, citizens, employees and seniors in companies and institutions and entrepreneurs."

More information
www.ecs.wur.nl

Institute of Forecasting of the Slovak Academy of Sciences



The Institute for Forecasting of the Slovak Academy of Sciences was established on January 1, 1989. The Institute acts both as a research body and government think-tank for design of various policies. The Institute for Forecasting concentrates on interdisciplinary research in following areas:

- a. theoretical, methodological and conceptual issues of the Slovak society in national and world-wide context;
- b. human dimension of global environmental change,
- c. co-evolution of institutional and technology change.

The Institute provides for doctoral studies in field of Forecasting (research field No 5.1.2 'Spatial Planning') and participate on other PhD programmes such as Environmental Planning and Management (Comenius University). Institute coordinates international educational programmes (Marie Curie projects: Emerging Theories and Methods in Sustainability Research –THEMES and Multi-level Governance of Natural Resources: Tools and Processes for Water and Biodiversity Governance in Europe –GoverNat.) Fellows of the Institute act as visiting teachers at universities, international science programmes and associations. The Center for Trans-disciplinary Study of Institutions, Evolution and Policies a virtual research centre dedicated to introduce ideas from institutional, co-evolutionary and ecological economics was established in May 2008 to support trans-disciplinary research and training in Europe, primarily in the region of Central and Eastern Europe. The University of

Economics in Bratislava (UEB) has traditionally been major research and education partners for the Institute for Forecasting. The Institute and UEB jointly provided for doctoral studies in field of Forecasting. Research staff of both institutions cooperate in a number of scientific projects. Comenius University in Bratislava is the oldest and most important university in Slovakia. It cooperates with the Institute for Forecasting in the field of global environmental change. The Slovak University of Technology in Bratislava, Comenius University and the Institute for Forecasting jointly manage the SPECTRA+ Centre of Excellence, supported by the Structural Funds.

Members of the Institute developed rich networks of cooperation with several Universities in Europe and World. Examples are Edward de Bono (Malta), Corvinus University in Budapest, London Metropolitan University (UK), Center for the Study of Institutional Diversity, Arizona State University, IEEP (www.ieep.cz) at the Economic University in Prague Interdisciplinary Centre for Comparative Research in the Social Sciences (Austria), Sezéchenyi István University (Hungary), University of Exeter (UK) and others. Members of the institute are involved in the activities of international academic programmes such as International Human Dimension Programme of Global Environmental Change (IHDP) (www.ihdp.org) or academic societies as European Society for Ecological Economics (ESEE) (www.ecolecon.org).

More information
www.prog.sav.sk

„The ifo Institute is one of Germany’s leading research institutes and one of its largest and most respected think tanks. Founded in 1949 and associated to the Ludwig Maximilian University, Munich, the ifo Institute has a long history of providing German and international policy makers with advice and high-quality, actionable solutions to the most pressing economic issues.

In Germany, the ifo Institute monitors economic activity and financial trends, examines government spending and taxation, conducts industry branch analysis and has recently pioneered pension and welfare to work reforms. The institute’s new focus is on Human Capital in a world of technological change.

The ifo Institute has a range of well-known and respected publications, the most notable being the monthly Business Climate Index for Germany, the ifo Business Survey, the ifo World Economic Survey and the bi-annual ifo Economic Forecast. The ifo Institute is also one of the six institutions preparing the bi-annual Joint Economic Analysis and Forecast for the German government.

In 1999, the ifo Institute, Center for Economic Studies (CES) at Ludwig Maximilian University, and CESifo GmbH (Munich Society for the Promotion of Economic Research) together launched the CESifo Group, a research group unique in European economic research. It combines the theoretically oriented economic research of the university with the empirical work of a leading economic research institute and places this combination in an international environment. The CESifo Group consists of more than 1.000 researchers from around the world, together publishing more than 250 working papers per year, and organizes around 20 conferences per year. CESifo is also the brand name under which all CES and ifo research is disseminated internationally.”

More information
www.cesifo-group.de

„The Innovation and Growth Academy is an institution providing consulting, teaching and academic research services to key decision makers in business and government who wish to foster innovation and growth – who believe that innovativeness is a good thing, and who are excited by the prospects and progress that growth of any type can bring.

The Innovation and Growth Academy works with Associate Partners from around the world who share the same passion and competence to provide applicable knowledge to actual practitioners in this field. All Associate Partners have been or still are practitioners themselves, making use of their knowledge concerning innovation and growth on a daily basis.“

More information

www.innovationgrowth.com

University of Luxembourg



„The University of Luxembourg (UL) has been founded in 2003 as the first and only university of the Grand-Duchy of Luxembourg. It is a small-sized institution with an international reach and aims at excellence in research and education. In a reduced number of research fields identified by its successive strategic plans, its ambition is to be among the world’s top universities. UL intends to be innovative, centered on research, primarily interested in the quality of the structure it offers to its students, its teachers, and its researchers and attentive to the needs of the society around it.

The UL specializes in fulltime courses at the second and third degree levels (master and doctorate). It offers bachelor’s degrees in a limited number of disciplines as well as certain lifelong learning programmes. With the excellence of its curriculum and its research, it aims to be a focal point for elite students, teachers and researchers from all over the world.

The UL has made an interdisciplinary approach as one of the main features of its development strategy. It takes advantage of the potential of research in academic niches at the crossroads of different disciplines.

The mobility of students, teachers and researchers which promotes cultural openness is encouraged and constitutes an integral component of the University’s strategy just like multilingualism. In these two fields, the UL intends to become a laboratory for the European university of the future.”

More information

www.uni.lu

(Profile taken from this website)



The University of Nottingham is not only one of the United Kingdom's leading research-intensive universities, but – with campuses in China and Malaysia – one with a global presence. Long-established as a leading centre of research in lifelong learning, in 1922 it appointed the world's first university chair in Adult Education. In 2014, the School of Education, where the university's lifelong learning research and the Robert Peers Chair in Adult Education are now based, was ranked third (out of all the 76 submissions) in the UK's 2014 Research Excellence Framework, with 55% of its research being rated of the highest ("world-leading") quality, and a 100% rating for research impact. It was also ranked 28th in the 2014 QS world university subject rankings.

The School of Education is committed to research that makes a difference. We work to understand "what works" in education, and how we can improve educational practices and policy. However, it locates these concerns within a broader set of questions about "what matters" – in particular, the role of education in contributing to a more fulfilling, richer and socially just quality of life both for individuals and society. Its partners range from teachers and community organisers in Nottingham through to national governments and international policy bodies.

More information

www.nottingham.ac.uk/education

VI. ALL PARTICIPATING RESEARCHERS BY ALPHABET

Akulenko, Ruslan | Saarland University
Babos, Pavol | IFSAS, Slovakia
Baggen, Yvette | Wageningen University
Biemans, Harm | Wageningen University
Brandi, Ulrik | Aarhus University
Castellazzi, Silvia | Innovation Growth Academy
Chrancokova, Martina | IFSAS, Slovakia
Comincini, Laura | Leuphana University
Cort, Pia | Aarhus University
Cox, Hasse | Wageningen University
Ederer, Peer | Zeppelin University
Elkjaer, Bente | Aarhus University
Falck, Oliver | Ifo Institute
Fehst, Corinna | Zeppelin University
Freddi, Eleonora | Zeppelin University
Gavuliak, Roman | EUBA, Bratislava
Greiff, Samuel | University of Luxembourg
He, Junzi | CUF, Beijing
Heriban, Richard | IFSAS, Slovakia
Hilse, Julia | University of Heidelberg
Holford, John | University of Nottingham
Hornikova, Adriana | Comenius University
Iannone, Rosa Lisa | Aarhus University
Izakovičová, Michaela | EUBA, Bratislava
Jaster, Christian | University of Luxembourg
Karasova, Katarina | IFSAS, Slovakia
Kuhlmann, Christina | University of Luxembourg
Kretzschmar, André | University of Luxembourg
Lakatova, Dominika | IFSAS, Slovakia
Lans, Thomas | Wageningen University
Larson, Anne | Aarhus University
Li, Bo | Beijing University
Li, Haizheng | CHLR, Beijing
Liu, Qinyi | CHLR, Beijing
Löhlein, Lukas | University of Luxembourg

Lubyova, Martina | EUBA, Bratislava
Mainert, Jakob | University of Luxembourg
Mckenzie, Lisa | University of Nottingham
Melo, Susana de | University of Nottingham
Milana, Marcella | Aarhus University
Mossfeldt Nickelsen | Copenhagen University
Nadal, Eduardo | Zeppelin University
Neffke, Frank | Harvard University
Niels Christian | Copenhagen University
Nedelkoska, Ljubica | Harvard University
Neubert, Jonas | University of Luxembourg
Pardelová, Ružena | EUBA, Bratislava
Pasqua, Marina Tota | Aarhus University
Patt, Alexander | Leuphana University
Sammel, Alma | Zeppelin University
Sarvašova, Zuzana | EUBA, Bratislava
Smrčková, Jana | EUBA, Bratislava
Sodomova, Eva | EUBA, Bratislava
Studena, Ivana | IFSAS, Slovakia
Sun, Xiuli | CHLR, Beijing
Tamilina, Larysa | Zeppelin University
Tang, Tang | CUF, Beijing
Terek, Milan | EUBA, Bratislava
Tong, Ting Ting | CHLR, Beijing
Umbach, Moritz David | Zeppelin University
Vente, Joost | Zeppelin University
Vojtková, Mária | EUBA, Bratislava
Wang, Fang | Zeppelin University
Warnke, Arne Jonas | ZEW, Mannheim
Weltin, Meike | Zeppelin University
Wiederhold, Simon | Ifo Institute
Woessmann, Ludger | University of Munich
Wolf, Christina | University of Luxembourg
Wolff, Christian | University of Luxembourg
Zirbs, Christina | University of Luxembourg

VII. PROJECT IDENTITY

LLLight'in'Europe is an FP7 research project supported by the European Union, which has investigated the relevance and impact of lifelong learning and 21st century skills on innovation, productivity and employability. Against the background of increasingly complex tasks and jobs, understanding which skills impact individuals and organizations, and how such skills can be supported, has important policy implications. LLLight'in'Europe pioneered the use of an instrument to test complex problem solving skills of adults in their work environment. This allowed for the first time insights into the development of professional and learning paths of employed individuals and entrepreneurs and the role that problem solving skills play. Additionally, LLLight'in'Europe draws on a series of databases on adult competences from across the world to conduct rich analyses of skills and their impact.

These analyses were conducted in concert with different disciplines. Economists have been analyzing the impact of cognitive skills on wages and growth; sociologists have been investigating how public policies can support the development of such skills and lifelong learning; innovation researchers have been tracking the relationships between problem solving skills, lifelong learning and entrepreneurship at the organizational level; educational scientists have investigated how successful enterprises support their workforce's competences; cognitive psychologists have researched on the development and implications of cognitive skills relevant for modern occupations and tasks; and an analysis from the perspective of business ethics has clarified the role and scope of employers' responsibility in fostering skills acquisition in their workforce. The team has carried out its research and analyses on the value of skills and lifelong learning in EU countries, USA, China, Latin America and Africa.

The result is a multi-disciplinary analysis of the process of adult learning and problem solving in its different nuances, and of the levers which can support the development of these skills for both those who are already in jobs, and for those who are (re)entering the labor market, as well as the development of effective HR strategies and public policy schemes to support them.

Coordinator	Zeppelin University
Project Director	Peer Ederer
EU Project Officer	Monica Menapace
EU Contribution	€ 2,695,000
EU Project #	290683
Project Duration	January 2012 – September 2015

Supervisory Board

Xavier Prats Monné

Director-General, Directorate-General for Education and Culture, European Commission

Andreas Schleicher

Director for Education and Skills, and Special Advisor on Education Policy to the Secretary-General at OECD

Iain Murray

Senior Policy Officer responsible for Policy on Learning and Skills, Educational Policy, and Regional Government and Devolution,

Trades Union Congress (TUC), United Kingdom

Oskar Heer

Director Labour Relations, Daimler AG Stuttgart

Roger van Hoesel

Chairman of the Supervisory Board at Startlife and Managing Director at Food Valley

zeppelin universität

zwischen
Wirtschaft Kultur Politik

Zeppelin University
Germany
Ljubica Nedelkoska



The University of
Nottingham

UNITED KINGDOM • CHINA • MALAYSIA

University of Nottingham
United Kingdom
John Holford



University of
Economics Bratislava
Slovakia
Eva Sodomova



AARHUS
UNIVERSITY
DEPARTMENT OF EDUCATION

Department of Education
(DPU), Aarhus University
Denmark
Ulrik Brandt



UNIVERSITÄT
LUXEMBURG

University of Luxembourg
Luxembourg
Samuel Greiff



中央财经大学

中国人力资本与劳动经济研究中心
China Center for Human Capital and Labor Market Research

China Center for Human
Capital and Labour
Market Research China
Haizheng Li



WAGENINGEN UNIVERSITY
WAGENINGENUR

Wageningen University
Netherlands
Thomas Lans



ifo Institute
Germany
Simon Wiederhold

Innovation & Growth

Innovation & Growth
Academy
Netherlands
Silvia Castellazzi



Leuphana University Lüneburg
Germany
Alexander Patt



Institute of Forecasting of the
Slovak Academy of Sciences
Slovakia
Martina Lubyova



UNIVERSITÄT
HEIDELBERG
ZUKUNFT
SEIT 1386

Ruprecht-Karls-University
Heidelberg
Germany
Consortium partner in 2012



These **28 reports** together are the publication suite presenting the results of the LLLight in Europe project, and can be downloaded at www.lllightineurope.com