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Education and working life: VET adults' problem-solving skills in technology-rich environments

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ABSTRACT

The rapidly-advancing technological landscape in the European workplace is challenging adults' problem-solving skills. Workers with vocational education and training need flexible abilities to solve problems in technology-rich work settings. This study builds on Finnish PIAAC data to understand adults' (N = 4503) skills for solving problems in technology-rich environments. The results indicate the critical issue that more than two thirds of adults with vocational education and training have weak skills or lack the skills in solving problems in technology-rich environments and that more than one fifth of these adults are at risk. Furthermore, this study indicates that the likelihood of having fragile problem-solving skills is six times higher for adults with vocational education and training than for adults with at least upper secondary qualification. Since the need for problem-solving in technology-rich environments is likely to increase in the future, this study also identifies the indicators for problem-solving skills differences. The models predicting problem-solving skills on the basis of theoretical assumptions as well as empirical support are presented. Our results indicate that adults' lower performance does not seem to be associated with the vocational education and training educational system itself, but is mostly due to age, education in years, occupation, and gender, as well as work-related and everyday life factors. In practice, the models help to develop new approaches to enable novel problem-solving skills in technology-rich environments based on the current European workplace needs.

1. Introduction

The European workplace is changing rapidly. For example the industrial sector, where factories are transitioning from mass-production technology to more flexible production methods, e.g. with the aid of robotic techniques, is going through a radical process of structural change (Goos, 2013). Companies that are facing economic hardships are innovating their production processes, often resulting in large-scale changes in working practices (Jaimovich & Siu, 2012). These organisational changes result in changes in adults' occupations (Attwell, 1997). The current trend at workplaces seems to be that technologies are taking over routine tasks, leaving workers to accomplish non-routine tasks (Goos, 2013). This structural change involves millions of adults with vocational education and training (VET). In Finland alone, more than 100,000 jobs have disappeared from the industrial sector over the past ten years (Taloussanomat, 4.1.2014). In line with this, the largest decline in occupations at the European level concerns typical VET occupations, such as craft-workers and machine operators (Goos, Manning, & Salomons, 2009). Moreover, when studying the susceptibility of jobs to computerisation, Frey and Osborne (2013) mentioned that about 47 percent of jobs in the US are at risk of disappearing within the next 20 years.

The technological landscape influences society and its necessities regarding adults' skills. According to scholars like Frey and Osborne (2013), Attwell (1997), Levy (2010), and Stenström and Tynjälä (2009), the key challenge in addressing evolutions for working life involves developing vocational skills and professional expertise that match the changing needs of society. As a direct result of current technological advancements, job descriptions of adults with VET change (Maclean & Wilson, 2009; Tuomi-Gröhn & Engeström, 2003). VET

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workers are facing two major challenges: (1) a technology challenge, as there is a snowballing need for continuous professional development to deal with the evolving character of technology (Herder et al., 2006), and (2) a problem-solving challenge, as there is crucial extension of skills needed in problem-solving within these new technology-rich settings (Brand-Gruwel & Stadtler, 2011). In line with these challenges, it is widely agreed that problem-solving in technology-rich environments (TRE) is one of the most important skills for working life (e.g. Goos, 2013). At the same time, it is not yet clear what kind of proficiency adults with VET currently have with regard to problem-solving skills in TRE and what kind of factors contribute to successful adults' skills.

To guide research, policy, and practice, empirical evidence of adults' skills and competencies is needed. The data from the Programme for the International Assessment of Adult Competencies (PIAAC) from the Organisation for Economic Co-operation and Development (OECD) comprise the most comprehensive source of information about adult skills ever undertaken (OECD, 2013a). PIAAC provides important insights into adults' literacy, numeracy and problem-solving in TRE skills. In particular, PIAAC can be used to identify and predict current and emerging needs in problem-solving skills in TRE. Additionally, PIAAC information can provide further comprehension of the relationship between education and the world of work. As such, it encourages us to develop new ways of increasing learning throughout adults' working careers.

2. Aims

The aim of this study is to identify and discuss the level of problem-solving skills in TRE of adults with VET. More specifically, our aim is to reveal what basic skills 16–65 year-old adults with VET and adults with other educational backgrounds have regarding problem-solving in TRE. Considering the changing needs of European workplaces, especially with relation to problem-solving skills, the first aim is to identify adults with VET that can be considered "at-risk" (i.e. having very limited problem-solving skills), "weak performers", "moderate performers" and "strong performers". The first two research questions are:

RQ1: What is the level and distribution of problem-solving skills in TRE for adults with VET?
RQ2: How is the level and distribution of problem-solving skills in TRE of VET-adults related to adults with other educational backgrounds?

Having identified the "at-risk", the "weak performers" and the stronger performing adults, the second aim is to explore which factors are highly associated with being either at-risk or more proficient as a worker and whether the differences in problem-solving between VET adults and adults with other educational backgrounds actually depend on the VET itself. The respective research questions are:

RQ3: What factors explain the variation in problem-solving skills in TRE?
RQ4: What are the differences in problem-solving skills in TRE between adults with other educational backgrounds and VET adults in predefined age groups, before and after controlling the effects of statistically significant background factors?

3. Methods

3.1. Material: PIAAC data

PIAAC data were used in this study. PIAAC is a large-scale, ongoing programme for monitoring performance in literacy, numeracy and problem-solving in TRE amongst adults. In total, 24 countries participated in the first round. The objective of the PIAAC was to determine whether adults' basic skills were at a sufficient level to respond to the unpredictable needs of the future. Direct measures of skills were developed to accomplish this feat (OECD, 2013b).

In this article, we focus on the assessment of problem-solving (for definitions of problem-solving, see e.g., Brand-Gruwel & Stadtler, 2011; Levy, 2010) in TRE. In PIAAC, problem-solving in technology-rich environments is defined as follows:

> "Problem solving in technology-rich environments involves using digital technology, communication tools and networks to acquire and evaluate information, communicate with others and perform practical tasks. The first PIAAC problem solving survey will focus on the abilities to solve problems for personal, work and civic purposes by setting up appropriate goals and plans, accessing and making use of information through computers and computer networks". (OECD, 2012, p. 47)

In assessing problem-solving in TRE, the aim was to evaluate adults' ability to use technology for accomplishing complex problem-solving tasks. The participants solved tasks using various sources of information on a laptop computer, such as an Internet browser, e-mail, or word processing programme. Furthermore, to allow researchers to understand what kinds of skills participants used and how actively, participants answered questionnaires about their skills and their backgrounds. The background questionnaire, the tasks and the assessment framework were designed by international expert groups (see OECD, 2012).

Proficiency in problem-solving is measured on a scale ranging from 0 to 500. Additionally, proficiency scores are grouped into four proficiency levels based on the knowledge and skills required to complete the tasks within those levels (see OECD, 2013b). These predefined proficiency levels include: (1) below Level 1, or 'at-risk performers': proficiency scores ranging from 0 to 240 points, (2) Level 1, or 'weak performers': scores ranging from 241 to 290 points, (3) Level 2, or 'moderate performers': scores ranging from 291 to 340 points, and (4) Level 3, or 'strong performers': scores ranging from 341 to 500 points. A detailed description of the PIAAC proficiency scales and levels as well as the knowledge and skills required to complete the tasks within those levels is provided in the PIAAC Technical Report (OECD, 2013b, chap. 21). Additionally, in line with the study guidelines (see OECD, 2013b), the sample encompasses a "not classified" group that, for example, failed the ICT core test, had no computer experience or "opted out" of taking computer-based assessments. For these participants, the problem-solving proficiency scores are not available and they could not be included in the statistical analyses.