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Abstract: Using the PIAAC survey, this study examined social characteristics of work and cognitive skills. Results negatively associated collaboration at work and PIAAC scores, contradicting current thinking on workplace interactions.

Keywords: PIAAC, workplace collaboration, workforce development

An implicit assumption in much of the learning organization literature is that collaboration will enhance individual learning and development of a variety of technical skills, especially for jobs that require coordinating with others. However, there is contrary evidence suggesting confirmation bias (Beckman, 1990) and other faulty learning dynamics (Marsick & Watkins, 2015) in teams inhibit learning. Though the workplace and learning organization literature examines strategies to leverage learning and collaboration to support the development of occupational skills and collective knowledge generation, there is little research on the link between collaboration and the development and maintenance of fundamental skills, such as literacy, numeracy, and problem-solving in technology-rich environments (PS-TRE), that employers now say are lacking, yet required for workers to continuously learn in work today. The purpose of this study is to investigate the connections among collaboration and information sharing at work, as measured by the Program for the International Assessment of Adult Competencies (PIAAC), a survey of adult skills conducted in 33 countries, as guided by the following research questions:

- To what extent are respondents' level of collaboration or cooperation at work predictive of their literacy, numeracy, and problem solving in technology-rich environments?
- To what extent are respondents' level of information sharing at work predictive of their literacy, numeracy, and problem solving in technology-rich environments?

Background and Theoretical Framework

Led by the Organization for Economic Cooperation and Development (OECD, 2012), an international, governmental collaborative dedicated to economic development, the PIAAC dataset comprises extensive background demographic data, including but not limited to educational and work history, family background, civic engagement, and health information. In addition, the background questionnaire includes a Job Requirements Approach (JRA) module to assess the relevance of job skills that are critical to the respondents' work. PIAAC included these questions to support research on the demand side of the labor market and to conduct skills gap analyzes. Particularly relevant to this study are JRA questions related to the social dimensions of jobs, including the time spent cooperating with co-workers and sharing work related information.

Rapid change in technology and the economy has sparked renewed interest among policy makers, practitioners, and scholars in the skill sets that contribute to individual performance and career security (International Labor Office, 2010). Recently, workplace learning scholars (Kim, Hawley, Cho, Hyun, & Kim; Marsick & Watkins, 2015; Rausch, 2013; Skeul, 2014) have turned their attention to understanding the characteristics of jobs that demand a high degree of learning among the incumbent, sometimes referred to as learning intensive jobs (Skuel, 2014). Central to this research is understanding how work structures support or thwart high levels of individual learning and skill development of relevant work-related technical, cognitive, and so-called non-cognitive, social skills (OECD, 2009). Another important question is whether and how an individual can increase their cognitive capabilities and competence by engaging in work activities (Rausch, 2013)

The primary focus of the PIAAC survey and the central value of the dataset, however, is derived from a skills-based assessment of participants' literacy, numeracy, and PS-TRE proficiencies. Although data exists for numerous nations, in this paper we focus specifically on the US dataset. The argument is often made that collaboration will enhance individual learning and skills, and yet the empirical evidence to support this claim is limited. The PIAAC data set represents a rare opportunity to examine these phenomena on a large scale. The framework for this study integrated recent research on the characteristics of jobs that require a high degree of learning, or learning intensive jobs, with the PIAAC background questions that solicited the

task and skill requirements of the respondent’s job. Table 1 identifies the variables and questions related to the social characteristics of learning intensive jobs.

Table 1. Social Characteristics of Learning Intensive Jobs as Related to the PIAAC Background Questionnaire

Learning Intensive Jobs	PIAAC Background Questionnaire
Team learning, spirit of collaboration and collaborative skills (Yang, Watkins, & Marsick, 1998)	D_Q13a: how often do you learn from peers and supervisor
Assistance in performing tasks (feedback, etc.) (Rausch, 2013)	F_Q02b: Teaching others
High degree of exposure to the demands of others (Skule, 2014)	F_Q01b: percent of time working cooperatively with others
Inquiry and dialogue (Yang, et al, 1998)	F_Q02a: Sharing information
Openness and accessibility of people (Marsick & Watkins, 2014)	
Work across boundaries (Marsick & Watkins, 2014)	F_Q02c,d: how often make speeches/presentations, sell products/service
Extensive professional contacts (Skule, 2014)	F_Q04b: negotiate with people in and out of firm G_Q05h: participate in discussions on the internet
Informal/tacit communications (Marsick & Watkins, 2014)	G_Q05h: participate in discussions on internet
Tacit communication with supervisor (Kim, et al, 2016)	
Tacit communication with co-workers (Kim, et al, 2016)	

Methodology

Within the PIAAC dataset (OECD, 2016), the study was delimited to eight industry sectors, shown in Table 2, that are predicted to add a significant number of new jobs to the US economy in the next decade (U.S. Bureau of Labor Statistics, 2015). Given the focus of US industries, this study examined data from the United States PIAAC Household Survey. The complete U.S. PIAAC data set included 8,670 respondents (OECD, 2016) all of whom were between the ages of 16 and 74 years. Across all industries, approximately 55% of respondents were women and the most common level of educational attainment was a high school diploma or equivalent, at

about 41%. For this study only those who identified into one of the eight industries and answered the questions on collaboration and information sharing, as well as gender and education level were included, which yielded a total of 2,601 respondents.

We used SPSS in conjunction with the IDB Analyzer in order to account for the plausible values of literacy, numeracy, and problem-solving in technology-rich environments (PS-TRE) and the sampling weights of the PIAAC questionnaire. To respond to the research questions, we built a linear regression model for each industry corresponding to the PIAAC response variables, background questionnaire variables (including collaboration, F_Q01b, and information sharing, F_Q02a), and the demographic variables, gender (AN_01) and education level (derived from BQ_01a). For all models, significance was determined by an alpha level of 0.05.

Select Results

The coefficients of the independent variables in each of the eight industry models are presented in detail in Table 2. The analysis shows that while there are some consistencies across industries – such as education level being positively related to all three PIAAC scores in all but one case (PSTRE scores in Construction) – there are some results that contradict current thinking. The PIAAC data shows that the level of collaboration people engage in at work is negatively associated with their PIAAC scores for seven of the eight included industries, with the largest negative impacts occurring in the Administrative and Support Service Sector (AdSupp) and the Wholesale and Retail Trade Sector (WRT). In AdSupp the models show that for each step in increasing collaboration the predicted LIT score is reduced by 7.33. This means that a person who collaborates all of the time has a predicted LIT score about 29 points less than someone who does not collaborate at all. For WRT the difference between two such people is 34 points. These collaboration effects are largely made up for through education – however this data shows that while we might think collaboration leads to personal development and growth, this data seems to show that is not the case. Such results have implications in the adult education, human resource development, and training fields.

Discussion and Conclusions

Collaboration, as seen in the literature on the learning intensity of jobs, is a key factor in whether and how learning, both individual and collective learning, occurs on the job. However, in this study there is little to suggest a connection between collaboration and the development or maintenance of cognitive skills, as defined by PIAAC. These results suggest Adult Education

(AE) and other training and development professionals need to deepen their understanding of the industry contexts and the implications of context for commonly held understandings of the learning potential of jobs. In particular, the field needs to both broaden and deepen its focus on the types of skills that are accounted for in learning models and interventions. As work becomes increasingly collaborative and skills-based, more emphasis on development basic cognitive skills must be integrated into AE strategies and programs. Practitioners must become more aware of the nature of work being performed in certain settings and how differences in the way work is structured and the broader cultural context call for different types of collaboration and different skill sets. One sized strategies and interventions cannot account for these differences. A new focus on AE's role in the development and maintenance of basic, cognitive skills, as defined in PIAAC is also required.

AE scholarship can be enriched by a new focus on the changing nature of work, and in particular the implications for the labor market and the skills of the workforce. Although organizational scholars recognizes the importance of knowledge, skill, and learning in work today, this body of research lacks a robust theory of learning and an empirical framework to study the learning practices and processes that underlie emerging work configurations (Sawchuk, 2013). The result is that the rich learning lives of workers, as wells as the challenges workers face in developing and maintaining vital cognitive skills are often overlooked in research on new forms of work. New scholarship is needed into the dynamic reciprocal relationship between work, learning, and opportunity in the emerging labor market.

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Table 2

Means and Regression Coefficients of PIAAC Measures by Industry

Industry Sector	<i>N</i>	Literacy			Numeracy			PS-TRE					
		<i>R</i> ²	β_i	<i>SE</i>	<i>t</i>	<i>R</i> ²	β_i	<i>SE</i>	<i>t</i>	<i>R</i> ²	β_i	<i>SE</i>	<i>t</i>
Accommodation and food service	331	0.12				0.13				0.04			
<i>M</i>			217.8	13.92	15.65		198.5	14.01	14.17		251.09	17.15	14.64
Education level			15.07	2.7	5.58		16.32	2.84	5.75		6.81	2.89	2.36
Collaboration			3.79	3.54	1.07		2.8	3.57	0.79		3.66	3.91	0.94
Information sharing			0.92	2.57	0.36		1.42	2.6	0.55		-1.65	2.63	-0.63
Gender			-1.31	6.31	-0.21		7.9	6.58	1.2		0.8	6.06	0.13
Administrative and support service	172	0.26				0.3				0.11			
<i>M</i>			237.36	20.4	11.64		221.98	22.61	9.82		276.13	19.59	14.1
Education level			14.27	2.9	4.92		17.72	3.22	5.5		6.08	3.45	1.76
Collaboration			-7.33	3.33	-2.2		-8.38	3.7	-2.27		-4.42	3.33	-1.33
Information sharing			7.37	4.15	1.78		5.66	4.63	1.22		0.02	4.48	0
Gender			-10.68	7.43	-1.44		0.94	8.49	0.11		-12.85	9.53	-1.35
Construction	190	0.12				0.15				0.07			
<i>M</i>			247.78	17.92	13.83		221.34	15.16	14.6		251.79	20.05	12.56
Education level			11.39	3.73	3.05		14.69	3.56	4.13		5.44	3.31	1.64
Collaboration			-5.83	4.36	-1.34		-6.81	4.5	-1.51		-5.42	5.31	-1.02
Information sharing			5.97	3.63	1.65		6.5	3.98	1.63		6.41	5.54	1.16
Gender			-10.44	8.18	-1.28		9.78	10.31	0.95		-11.73	12.62	-0.93
Education	415	0.16				0.17				0.07			
<i>M</i>			270.81	10.68	25.36		249.72	11	22.7		279.66	12.46	22.45
Education level			8.45	1.88	4.49		9.38	1.85	5.07		4.86	2.05	2.37
Collaboration			-4.68	1.69	-2.77		-5.67	1.99	-2.85		-4.55	1.74	-2.61
Information sharing			2.49	1.96	1.27		3.06	1.98	1.55		0.91	2.08	0.44
Gender			-0.78	5.48	-0.14		11.54	5.76	2.01		0.2	5.08	0.04

Note: Bold indicates significance at the .05 level.

Table 6 (Continued)

Industry Sector	<i>N</i>	Literacy			Numeracy				PS-TRE				
		<i>R</i> ²	β_i	<i>SE</i>	<i>t</i>	<i>R</i> ²	β_i	<i>SE</i>	<i>t</i>	<i>R</i> ²	β_i	<i>SE</i>	<i>t</i>
Financial and insurance	183	0.19				0.33				0.14			
<i>M</i>			255.57	18.09	14.13		199.89	20.41	9.79		245.9	16.27	15.12
Education level			11.21	2.49	4.51		16.4	2.6	6.3		9.46	2.34	4.04
Collaboration			-6.17	3.1	-1.99		-3.79	3.1	-1.22		-1.21	2.72	-0.44
Information sharing			6.44	3.62	1.78		8.99	3.31	2.72		3.2	3.68	0.87
Gender			-5.37	7.13	-0.75		10.48	7.23	1.45		5.05	6.98	0.72
Human health and social work	546	0.29				0.3				0.17			
<i>M</i>			210.74	10.79	19.53		191.35	11.24	17.02		217.93	14.51	15.02
Education level			13.87	1.41	9.82		15.34	1.72	8.91		9.08	1.43	6.36
Collaboration			-4.71	1.59	-2.95		-5.76	1.68	-3.43		-2.83	1.76	-1.61
Information sharing			10.08	2.41	4.19		9.39	2.53	3.72		7.95	3.2	2.49
Gender			9.33	6.38	1.46		20.22	6.19	3.27		13.33	6.22	2.14
Public administration and defense; compulsory social security	271	0.17				0.22				0.12			
<i>M</i>			238.5	22.08	10.8		222.87	22.68	9.83		255.83	19.23	13.3
Education level			10.41	2.42	4.3		12.29	2.58	4.76		8.34	2.23	3.73
Collaboration			-1.74	2.8	-0.62		-3.16	3.18	-1.00		0.55	2.63	0.21
Information sharing			5.94	4.41	1.35		4.22	4.9	0.86		-0.84	4.4	-0.19
Gender			3.78	5.93	0.64		20.35	6.93	2.94		11.43	8.25	1.39
Wholesale and retail trade; repair of motor vehicles and motorcycles	493	0.25				0.24				0.14			
<i>M</i>			239.92	10.67	22.49		224.92	11.44	19.66		252.7	13.66	18.5
Education level			11.66	1.63	7.17		11.83	1.71	6.93		7.4	1.95	3.8
Collaboration			-8.55	1.84	-4.64		-10.01	1.83	-5.47		-7.25	1.82	-3.99
Information sharing			10	1.88	5.33		9.93	2.04	4.87		6.93	2.26	3.07
Gender			-3.74	4.66	-0.8		9.87	4.84	2.04		0.3	4.7	0.06