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Measuring the impact of technological scaffolding interventions on micro-level processes of self-regulated workplace learning

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ABSTRACT

This paper reports on the findings of an exploratory study in which the effects of technological scaffolding interventions on micro-level processes of self-regulated learning in the workplace were investigated. Empirical research in the workplace has been much less represented than in formal education. Even less research is available that aimed to identify which technological scaffolding interventions, out of those available in a learning environment, had the highest influence on specific micro-level process of self-regulated learning. This paper reports on the findings of a case study conducted in the naturalistic settings of two organizations in Europe (N = 53) for the period of two months. Trace data about the events of engagement with the technological scaffolding interventions and micro-level processes of self-regulated learning were collected. Both a transition graph based analysis of the temporal dependencies of the collected events and multiple linear regression analyses showed that an intervention that promoted social awareness had consistently the highest effect on all the micro-level processes used in the study. This intervention was followed by the intervention that offered system-generated recommendations about learning paths, learning activities and knowledge assets to stimulate engagement into the micro-level processes within the forethought or preparatory phase of self-regulated learning. These findings suggest that both the social and organizational contexts should be taken into account when developing interventions aimed at supporting the forethought and engagement phases. Further discussion about research, methodological, and learning technology design implications is provided.

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1. Introduction

Turbulent changes in contemporary workplace pose numerous demands for knowledge workers to continuously learn and adapt to the changing environment surrounding their daily activities (Cairns & Malloch, 2011; Littlejohn, Milligan, & Margaryan, 2012). The existing literature posits that learning in the workplace is informal and autonomous (Ellinger, 2005; Eraut, 2004; Kyndt, Dochy, & Nijs, 2009; Lee et al., 2004; Tynjälä, 2008) highlighting a high degree of knowledge workers control over their learning activities and general high-level of self-directed and self-regulated learning skills. However, this ideal of self-directed learner is highly confounded by two critical research accounts. First, workplace learning research

indicates that knowledge workers are generally not proactive to start their learning or they do not have skills how to learn effectively (Margaryan, Milligan, & Littlejohn, 2009; Margaryan, Milligan, Littlejohn, et al., 2009). Rather, demands for structured learning is required in a similar manner as common in educational settings. Second, self-regulated learning research indicates that learners under-appreciate effective learning strategies, are hardly ever taught how to effectively study during their formal education, and are influenced by different types of biases (Bjork, Dunlosky, & Kornell, 2013; Dunlosky, Rawson, Marsh, Nathan, & Willingham, 2013; V. X. Yan, Thai, & Bjork, 2014). However, to satisfy the needs for the modern and future socio-economic context, knowledge learners need to enhance self-regulation of own learning that happens informal situations of their workplace (Siadaty, Jovanović, et al., 2012; Littlejohn, Margaryan, & Milligan, 2009).

Research on self-regulated learning is primarily conducted in formal educational settings (Azevedo, Johnson, Chauncey, & Burkett, 2010; Chen, 2002; Dabbagh & Kitsantas, 2005; Kumar

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et al., 2005; Winne et al., 2006; Winne, 2010a), while there is much less research available in workplace settings in spite of the recognition of the importance of self-regulated learning in the workplace (Carneiro, Lefrere, & Steffens, 2007; Littlejohn et al., 2009). According to Littlejohn et al. (2012), there are generally two critical issues related to the study of self-regulated learning in the workplace. First, goals and nature of learning are different between formal educational and workplace settings. In educational settings, learning is an objective by itself (Margaryan, Milligan, & Littlejohn, 2009; Margaryan, Milligan, Littlejohn, et al., 2009) and accompanied with the well-structured instructional support. On the other hand, workplace learning is often a "by-product of work" (Margaryan, Milligan, & Littlejohn, 2009; Margaryan, Milligan, Littlejohn, et al., 2009, p.2). In such cases, the objective of a knowledge worker is to complete a work task and learning is to help complete the task (Illeris, 2011; Ley, Kump, & Albert, 2010; Margaryan, Milligan, & Littlejohn, 2009; Margaryan, Milligan, Littlejohn, et al., 2009). Second, most of the existing research has been focused on the study of self-regulated learning from the individualized perspective. Although social-cognitive theories of self-regulated learning heavily emphasize contextual and social factors (Zimmerman & Schunk, 1989) — e.g., as reflected in recent work on co—or socially-shared regulation (Hadwin, Järvelä, & Miller, 2011, 2010; Inoue, 2007), the sheer amount of existing research (mainly from formal education) has studied the individualized perspective in social situations (Jackson, MacKenzie, & Hobfoll, 2000). While suitable for studying some processes of self-regulated learning, this approach is not suitable for workplace learning where work and learning activities are very social and intertwined (Margaryan, Milligan, & Littlejohn, 2009; Marsick, Watkins, & O'Connor, 2011).

Technology has been recognized as a promising approach to addressing ever-growing demands for learning. Present research indicates that technology can provide effective scaffolding for self-regulated learning (Azevedo, 2010; Dabbagh & Kitsantas, 2005; Winne et al., 2006; Winters, Greene, & Costich, 2008). However, what is less understood is the extent to which effects of technological scaffolding interventions, available in a software environment supporting self-regulated learning in the workplace, can be assesses. Rather, most of existing studies investigated whether there is an association between a software functionality (i.e., a technological scaffolding intervention) and a certain process of self-regulated learning. The study reported in this paper aimed to investigate which technological scaffolding intervention had the strongest effect on different processes of self-regulated learning in the workplace. To perform the study, we deployed Learn-B (Siadaty, Jovanović, et al., 2012) — a learning software environment designed to support self-regulated learning in the workplace — to two different organizations and collected trace about the software use and self-reported data about the self-regulated learning experience with the software use.

2. Supporting self-regulated learning processes in the workplace

In this section, we discuss the SRL model underpinning the theoretical framework and the technological scaffolding interventions designed to support SRL in the workplace. The section also outlines research goals pursued in the study.

2.1. Technological scaffolding for self-regulated learning

Abundance of information, proliferation in the development and use of communication technologies, and widespread social media are just some of the features that shape contemporary work.

In this environment, knowledge workers need to solve problems that have not seen before and for which no existing solutions exist (Littlejohn et al., 2012). Therefore, adapting to the rapidly changing environment and continuously learning are the foremost demands. These demands give a clear need for self-regulated learning (SRL) as one of the most critical skills in workplaces (Carneiro et al., 2007; Littlejohn et al., 2012). Although workplace learning happens in a different context than formal education, existing models and general frameworks of SRL (Pintrich, 2000; Winne & Hadwin, 1998; Zimmerman, 2001) offer a sound foundation about cognitive, metacognitive, motivational and social processes on which research of SRL in workplace can build. These models have already been accepted as a theoretical foundation for the study of SRL in different learning technologies (Winne, 2006; Winters et al., 2008).

A great majority of the current literature on SRL is centered around formal education (Winne, 2013; Zimmerman & Schunk, 2011). Significantly less attention has been dedicated to the study of SRL in workplaces (Littlejohn et al., 2012; Milligan, Fontana, Littlejohn, & Margaryan, 2015). In principle, some general conceptions of SRL may apply between the two types of learning contexts (workplace vs. formal education). However, workplace and formal education environments and opportunities for delivery and support of learning are considerably different as reported by different authors (Littlejohn et al., 2012; Margaryan, Milligan, Littlejohn, Hendrix, & Graeb-Koenneker, 2009b). This is particularly relevant with respect to the need to unveil the types of scaffolds required to be provided by learning technologies in order to promote effective SRL. Even more significant is to determine particular technological scaffolds that are critical in facilitating different phases of SRL. Similar to the general study of SRL, there is also a significant amount of the literature that looks at the technological support of self-regulated learning of SRL in formal education (Winne, 2006). However, there is much less empirical research that measures the effects of the use of technological scaffolds on the engagement into specific processes of SRL in workplace settings. Scaffolds enabled by technologies such as recommender systems and social media are of high importance due to their growing availability in learning and workplace collaborative technologies (Dabbagh & Kitsantas, 2005; Lytras & de Pablos, 2011; Manouselis, Drachsler, Riina, Hummel, & Koper, 2011; McAfee, 2009; Vargas-Vera, Nagy, & De Pablos, 2013; Verbert et al., 2012). Specifically, this study aims to fill this gap in research by measuring the impact of the use of different technological scaffolds on individual micro-level processes of SRL in workplace learning.

In a broader sense, research of technological support for workplace learning and links between formal and informal learning has recently received considerable attention in the literature. Social media and virtual worlds as spaces for collaboration and learning have especially been explored in the existing literature. The effects different incentive factors and mechanisms — such as culture, information technologies, department characteristics, and individual roles — on sharing information in online environments are among the most commonly studied topics in relation to workplace and social learning (Zhang, de Pablos, & Zhou, 2013; Zhang, de Pablos, & Xu, 2014; Zhang, de Pablos, & Zhang, 2012; Zhang, Vogel, & Zhou, 2012). Adoption of virtual worlds offered through technologies such as Second Life and their effects on team learning outcomes have also been studied (Zhang, de Pablos, & Zhu, 2012b; Zhang, Ordóñez de Pablos et al., 2014). Social media has particularly attracted researchers to look into the ways for empowering e-learning opportunities in informal learning setting and across different disciplines (Zhang, Wang, de Pablos, Tang, & Yan, 2015; Zhang, Gao, et al., 2015). However, there is the dearth in the literature that looked at the connections of these emerging