

## Self-regulated Workplace Learning: A Pedagogical Framework and Semantic Web-based Environment

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### ABSTRACT

Self-regulated learning processes have a potential to enhance the motivation of knowledge workers to take part in learning and reflection about learning, and thus contribute to the resolution of an important research challenge in workplace learning. An equally important research challenge for the successful completion of each step of a self-regulatory process is to enable learners to be aware of the characteristics of their organizationally-embedded learning context. In this paper, we describe how a combination of pedagogy and Semantic Web-based technologies can be utilized to address the above two challenges. Specifically, we demonstrate the proposed solution through the Learn-B tool that leverages ontologies to support self-regulation in organizational learning.

### Keywords

Self-regulated Learning, Workplace Learning, Ontologies, Personal and Organizational Learning

### Introduction

Basic modes of workplace learning include i) incidental and informal learning, which takes place as a side effect of the work, ii) intentional, but non-formal learning activities related to work activities, and iii) formal on-the-job and off-the-job training (Tynjala, 2008). Ideally, intentional learning at workplace is initiated by perceiving a gap of knowledge or competences for certain present or future tasks. This further means that knowledge workers are aware of their competences and can identify their learning needs based on the present or forthcoming requirements of a task, project, duty or any other of their responsibilities in the organization and in collaborative teams. Motivated and proactive learning, however, rarely happens in everyday work environments. Unless provided with structured learning scenarios in formal settings, most people are not proactive enough to initiate a learning process or simply do not know how to learn (Margaryan et al., 2009).

Self-regulated learning (SRL) (Zimmerman, 1989) contains motivational elements to address the above stated challenges. According to Knowles (1975), SRL refers to a process, "... in which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies, and evaluating learning outcomes" [p18]. Empirical research brings evidence that, individuals who are oriented toward self-regulated enhancement of competences and excellence within their tasks show high intrinsic motivation, high task persistency and high self-efficacy beliefs (Zimmerman, 1990; Covington, 2000).

We propose that one way of increasing intentional workplace learning is through promoting workers' self-regulation by enabling them to consciously embed their learning needs within clearly defined organizational goals. Communicating organizational goals and visions to workers has been proposed as a motivator for revising, reflecting and sharing individual knowledge and competences at workplace (Nonaka & Takeuchi, 1995). Planning one's learning goals intentionally as part of the projects or tasks that one is responsible for may firstly require that associated organizational and group goals and expected competences be accessible and compared with personal competence profiles. Secondly, seeing that co-workers are proactive as learners in the workplace and being able to monitor their learning process for certain competences can add the motivational component for learning at the workplace.

In our work, we consider SRL in the workplace as a part of organizational learning. In particular, we base our research on a well-known organizational knowledge building model proposed by Nonaka and Takeuchi (1995), which highlights the renewal of organizational level norms and visions based on the generalization of workers'

experience and the guidance which individual workers receive from the organizational knowledge. However, this model does not target the importance of SRL in the workplace as a motivational element for learning and reflecting about learning. Elaborating on the original knowledge building model, Pata & Laanpere (2008) propose that in order to perform intrinsically motivated learning in organizational contexts, learners have to align their learning activities to their organizational learning goals, the learning activities of other members of the organization and their own learning goals. To be able to do this, learners need personalized information – i.e., information relevant to them and their present learning context – about the organization’s objectives and expectations, learning activities and achievements of co-workers and learners’ own progress with regard to their current learning goal(s). However, access to this kind of information is not straightforward as today’s knowledge workers often use diverse tools for their everyday working and learning practices; thus the traces and outcomes of their activities are dispersed among different and often heterogeneous tools. To be turned into information relevant for learners, the traces (i.e., activity data) about learners’ learning activities and created knowledge objects (KOs) have to be structured, organized and well annotated, so that they can be (re-)discovered and (re-)used inside the organization (Siadaty et al., 2010).

To address this challenge, we propose the use of ontologies as they are highly suitable for integrating data originating from different, often dispersed and heterogeneous sources (Allemang & Hendler, 2008). They are, among other things, an excellent means for the integration of: i) traces about individuals’ activities across diverse tools and services, and ii) individuals’ knowledge into shared, organizational knowledge (Jeremic et al., 2009). Specifically, the network of ontologies that we developed within the IntelLEO EU project (IntelLEO D1.4) enables formal representation, and seamless integration of data about individuals’ learning experiences (i.e., learning activities and their context), knowledge being shared as well as different kinds of annotations (tags, comments, ratings and the like) which capture either personal or community reflections on the shared content/knowledge. These ontologies provide the basis for all the functionalities of Learn-B, our tool aimed at scaffolding SRL processes in intentional/non-formal learning in organizational contexts.

In this paper, we first elaborate on the pedagogical foundation of our work and describe the functionalities of Learn-B which support the proposed pedagogical model. Then, the role of ontologies in data integration is explained and exemplified. After presenting the research method in conducting, and the results of the initial evaluation of Learn-B, we conclude the paper by comparing our work to the related work and by outlining directions for further research.

## **Pedagogical Framework**

There are a number of models offering alternative perspectives about how learning is self-regulated (e.g., Boekaerts, 1997; Pintrich, 2000; Winne & Hadwin, 1998; Zimmerman, 1989). These perspectives can be categorized into two major sets: one referred to as the “process” perspective and the other one as the “component” perspective to SRL (Dettori & Persico, 2008). SRL in the process perspective is rather goal-oriented: it consists of a set of phases which cyclically repeat during learning activities of self-regulated learners and influence one another. The component perspective, on the other hand, identifies cognitive (behavioural), meta-cognitive, motivational and emotional aspects of (self-regulated) learning and bears a meta-cognitively weighted definition of SRL (Puustinen & Pulkkinen, 2001). Following a process-based perspective, self-regulation has been referred to as the ability to plan, monitor and evaluate one’s own learning processes and strategies (Inoue, 2007). Accordingly, self-regulated learners typically engage in *Planning*, *Monitoring* and *Reflection* processes, where they set their goals and strategic plans; observe their performance and apply appropriate strategy changes; and compare their self-observed performance against some standard, such as one’s prior performance (Jackson et al., 2000; Puustinen & Pulkkinen, 2001).

To gain a better understanding of SRL in workplace, however, some major challenges should be addressed. Firstly, the majority of conventional interpretations of SRL are based on an individualistic perspective (Jackson et al., 2000). Such perspectives contradict the social nature of the workplace, where individuals’ work and learning activities are highly social and community centered. The role of the social context becomes bolder when it comes to defining and evaluating learning goals, adapting one’s strategies to social/organizational norms and receiving incentives or experiencing inhibitors from the communities the learner belongs to. Furthermore, SRL is highly context dependent and the unique features of a learning environment can influence whether or not a learner enacts SRL practices (Boekaerts & Cascallar, 2006; Whipp & Chiarelli, 2005). The contextual nature of workplace learning implies that the organizational context puts an imperative impact on how workplace learning is conducted and the desired goals are achieved.

To address the above stated challenges, in our research we have extended the approach proposed in (Pata & Laanpere, 2008), that is built on Nonaka and Takeuchi's (1995) knowledge building model, with self-regulatory learning support to promote intentional workplace learning, along with elements to support the social as well as the organizational nature of learning at workplace. Pata & Laanpere's (2008) elaborated knowledge building model suggests that aligning one's learning activities with i) organizational normative goals, ii) learning goals and activities of other members in the organization and iii) the individual's own learning goals enables learners to stay on track and motivates them to engage in learning processes. The extensions to the elaborated knowledge building model, in particular, include i) SRL practices to support individuals in initiating and conducting their learning processes; ii) social embeddedness elements to support the social nature of workplace learning; and iii) support for the harmonization of individual learning goals with those of the organization to foster the contextual dimension of learning at the workplace. All these extensions play an important role in enhancing the motivation of individuals to take part in learning and knowledge building activities at their workplace. We call this extended pedagogical framework "*SRL@Work*" and for it to work effectively, we suggest the following proposition and further investigate it within the study presented later in the paper. Accordingly, we hypothesize that providing users with the necessary input from both the social and organizational contexts of their workplace would support them to engage in self-regulatory learning at workplace, specifically, in conducting the planning and monitoring practices of *SRL@Work* model.

## **Learn-B: A Semantic Web-based tool implementation of *SRL@Work***

Via Learn-B, knowledge workers can benefit from recommendations, originating from the organizational and social context of their workplace, to better identify their competence gaps; find the most fitting learning strategies, (extracted from the organizational memory) to reach the missing competences; monitor their learning progress, share and document their learning experiences and, compare their self-observed performances against organizational benchmarks and/or the performance of their colleagues. To illustrate the functionalities of Learn-B from the perspective of the challenges discussed in the Pedagogical Framework and the role of the underlying ontologies, in the following we walk through a typical scenario for workplace learning involving a newcomer in a large organization. A description of the functionalities of Learn-B and the way each of them contributes to supporting our *SRL@Work* pedagogical framework are given in (Siadaty et al., 2011); technical details about the Learn-B environment are further described in (Siadaty et al, 2012).

### **Usage Scenario**

Brian is a newcomer in a company who plans to start his learning and knowledge building activities at his new workplace. However, like many other newcomers, he is concerned about gaining/enhancing the competences required for the duties assigned to his new organizational position. Our previous research (Siadaty et al., 2010) shows that lack of familiarity with organizational needs, policies and expectations is one of the major challenges that newcomers face in larger companies. Likewise, Brian is not sure wherefrom he can obtain the information about competences related to his new duties. To help Brian start his learning process and *plan his learning goals*, the *Contextual Recommendation of Available Competences* feature of Learn-B provides him (under the Duties category) with a ranked list of the competences which are valued by his company and required for accomplishing his duties. Additionally, Brian can benefit from the personalized visual hints that indicate those competences of higher importance for him, considering his current state of expertise with regard to the duties he is responsible for (Figure 1. A).

Having analyzed the organizational requirements and his learning needs, Brian can now *set a new learning goal* in his Learn-B environment (Figure 1. B), and add the selected competences to it. Next, he needs to obtain information about the best ways to achieve these competences and *make his personal plans*. For each recommended competence in his Learn-B, Brian can glance over the *Recommended Learning Paths, Learning Activities and Knowledge objects* for that competence (Figure 1. C), and also explore their *Usage Information*, such as visual representations showing the number of users, along with their organizational positions, who have been successful in achieving a certain competence by following a recommended learning path, the average time that took other users to complete a recommended learning path, or indicators representing how "live" a learning path has been recently, e.g., the number of comments, rankings, tags, and submitted help requests for it (Figure 1. D). The recommendation of a learning path

is further augmented with the number of users (or organizational roles) who have successfully finished this path or a revision of it, and their average completion times (Figure 1. G). All in all, this information enables Brian to better plan for his learning process and allocate the appropriate resources for achieving his learning goals. Again, the integrated set of ontologies (see The Underlying Ontologies section) is the main enabler for the induction of all this diverse information based on the activities of various users in different working environments.

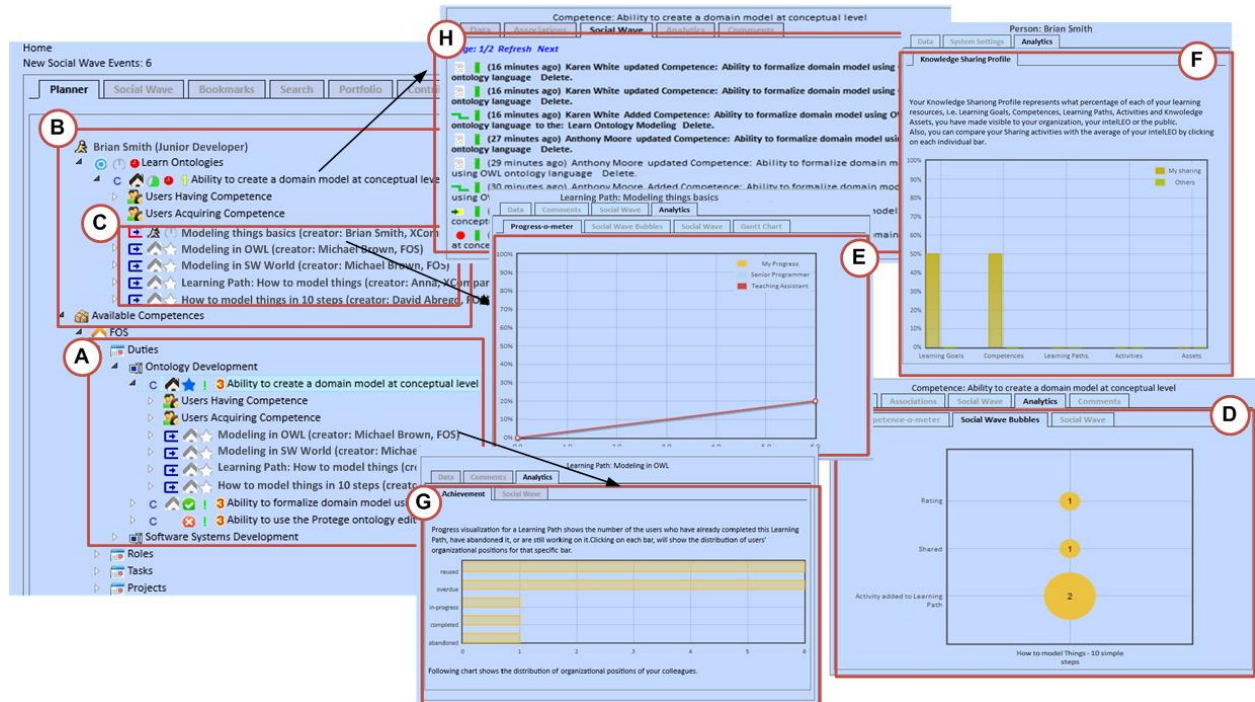


Figure 1. Screenshots of the Learn-B environment

Once Brian has chosen learning paths for the competences comprising his new learning goal, he can simply follow the selected learning paths toward achieving each competence. At this level, *Progress-o-meter* enables him to *monitor his learning process* (Figure 1. E). Further, the updates provided by *Social Wave* enable Brian to better adapt his learning strategies with regard to the social context of his organization (Figure 1. H). To monitor the extent of sharing his learning experiences within the organization and compare it with that of other users within the same group, project, or the entire organization, Brian can make use of his *Knowledge Sharing Profile* (Figure 1. F). Having all these activities tracked and gathered in one place is supported by the underlying ontologies, as explained in the following section.

## The Underlying Ontologies

Learn-B relies on an interlinked set of ontologies as its common (linked) data model. It provides the ground for the data linking and exchange among the tools integrated in Learn-B. Being developed within the IntelLEO project (<http://intelleo.eu/>), the ontologies are named after the project. They have been developed by following a combined top-down (review of existing work in the field) and bottom-up (requirements elicitation from IntelLEO business cases) approach. By following the recommended practices in ontology engineering (Allemang & Hendler, 2008) and publishing Linked Data on the Web (Heath & Bizer, 2011), when developing the ontologies we relied on and linked to the vocabularies and ontologies already available and in use. The ontologies are designed to be modular and extensible. Due to space limits, we do not discuss the details of the underlying ontologies, i.e. the IntelLEO ontologies, in this paper. Examples showing how these ontologies support the gathering and integration of various users' activities could be found in (Siadaty et al., 2011). Also, detailed specifications of all the IntelLEO ontologies are available at: <http://goo.gl/gt3cM>.

## Method

To advance our understanding on how SRL practices are enacted in workplaces, how they can be supported considering the non-formal, contextual and social characteristics of learning at the workplace, and thus to evaluate the integrity and effectiveness of our ensuing SRL@Work pedagogical framework (see the Pedagogical Framework section), we developed the Learn-B environment. However, contrary to what is currently pursued by many researchers in the field (Amiel & Reeves, 2008), the purpose of developing this environment was to “improve”, not to “prove”. Thus, to explore the effect of the provided functionalities we believed they should undergo a continuous cycle of design-reflection-design in close collaboration with practitioners and in the context which they were designed for. In view of that, we followed a Design-based Research (DBR) approach where educational interventions are viewed holistically, i.e., they are evaluated via interactions in real practices (Design-based Research Collective, 2003). Such a contextual perspective helped us to better understand the effect of the designed functionalities and facilitated the assessment of our pedagogical framework.

In this section, we first introduce the research question addressed in this paper, the respective research hypotheses, and the research model (Figure ) we built to investigate our research question and hypotheses. We then describe the main components of the conducted study and the processes used in its preparation and execution.

## Research Question and Hypotheses

The study was driven by the following main research question (RQ):

*RQ- How do learners perceive the usefulness of various functionalities of Learn-B in performing SRL practices at their workplace?*

This research question aimed to examine the general usage beliefs of users about how the different functionalities provided by Learn-B (Siadaty et al., 2011) helped them engage in the three SRL practices, i.e. Planning, Monitoring and Reflection. Based on our pedagogical framework, our a-priori assumptions were as the following:

- *Contextual Recommendation of Available Competences* informs users of the learning needs and expectations of their organization along with the available competences which users can choose from. This helps users to not only harmonize their learning goals with those of their organization, but to better know their learning context and make decisions accordingly. Our a-priori hypothesis is that this functionality supports users in performing the Planning practice, in particular the goal setting/task analysis (hypothesis H1.a) and making personal plans sub-practices (hypothesis H1.b).
- By providing users with information about the available learning paths and knowledge objects for achieving any of the available competences, *Recommendation of Learning Paths, Learning Activities and Knowledge objects* further allows users to get to know their learning context in accordance to the learning objectives of their organization. Our respective assumption here is that this functionality supports users to perform the Planning practice, in particular the goal setting/task analysis (H1.c) and making personal plans sub-practices (H1.d).
- The *Provision of Usage Information* functionality fosters the social embeddedness dimension of workplace learning by letting users know how the other members of their organization have approached their learning goals. Our hypothesis is that such information firstly aids user to get acquainted with their learning context (H1.e) and create their personal plans accordingly (H1.f). Furthermore, it allows users to share their learning experiences with their colleagues when applying any necessary strategy changes, based on the observed usage of learning resources by their colleagues (H1.h).
- *Progress-o-meter* informs users of their progress toward their learning goals and brings their attention into their individual learning progression. Hence, our a-priori hypothesis with regard to this functionality is that it supports users in their Planning phase of their self-regulatory practices; so that users can make/adjust their personal plans according to their own individual progress (H1.g).

We built a research model, shown in Figure 2, to investigate our research question. We investigated this research question by looking into users’ perceptions of the usefulness of the provided support in conducting their SRL processes at their workplace. A specific set of question items were used as indicators of the perceived usefulness of different dimensions of each functionality. These question items are listed in Tables 1, 2 and 3. The SRL practices,

shown in the central part of Figure 2, were manifested via the three tasks that the users performed in the study. The blue dotted arrows represent the RQ and the respective hypotheses in our research model.

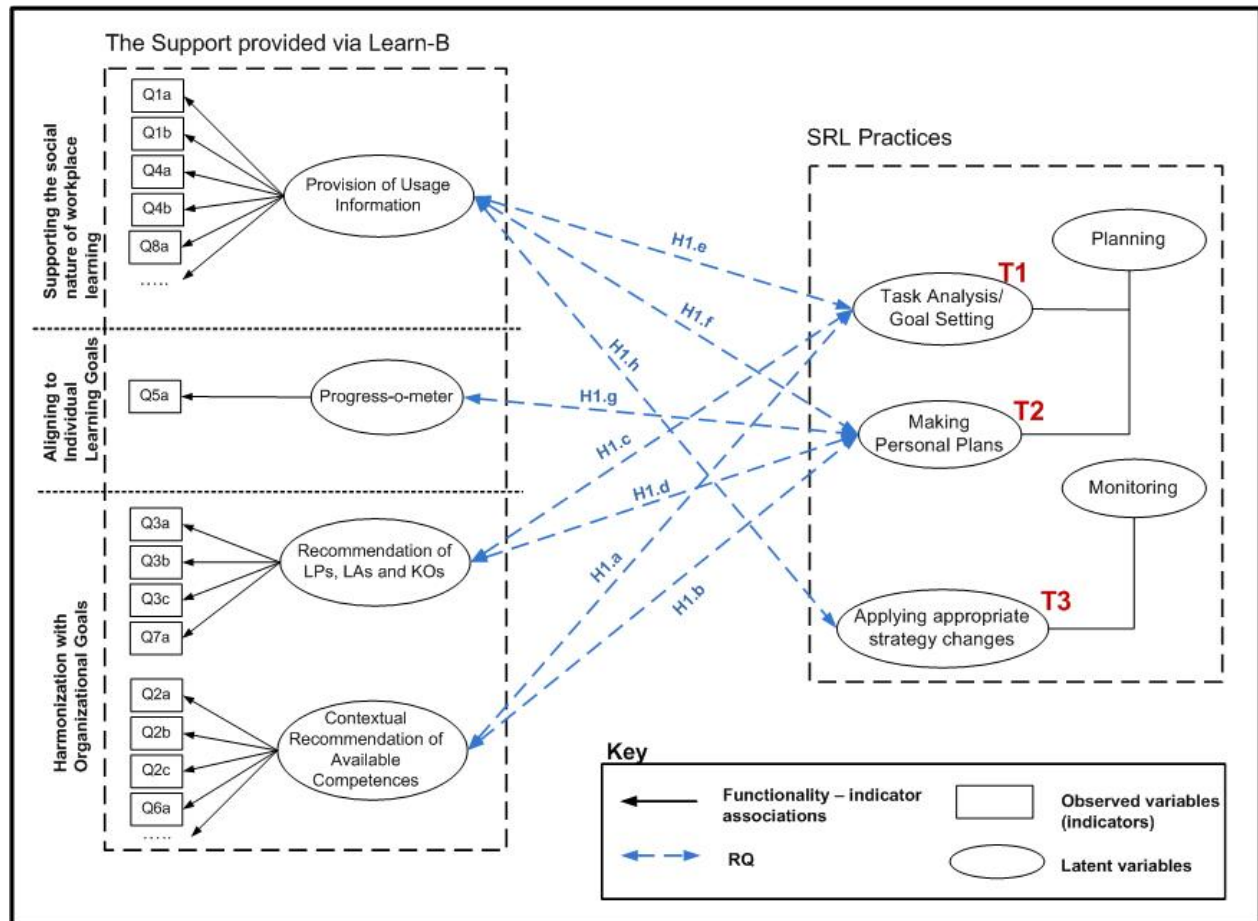


Figure 2. The applied research model

## Study Design

### Design

The purpose of our study was to evaluate the efficiency of the proposed solution, Learn-B, in supporting non-formal self-regulatory learning at workplace, based on our SRL@Work pedagogical model. We formulated our research question accordingly, and used prototypes of the main functionalities of Learn-B to investigate it.

Due to the empirical nature of our research question, the study was designed with an exploratory focus in that users' perceptions of the usefulness of Learn-B's functionalities in conducting SRL practices were to be assessed. In addition, to avoid users getting lost in the Learn-B environment and to support the usage of the functionalities we intended to evaluate in this study without running an extended training session, we used a structured scenario to guide the users through a number of tasks. A detailed description of these tasks is given in the Procedure sub-section. Scenarios, in general, are used to present and situate proposed solutions in the practical context of end-users, and are regarded as a very useful technique to visualize the consequences of the introduction and usage of an innovative technology, tied to practical concerns from the end-users everyday life (Eisma et al., 2003; Carroll, 2000). Last but not least, to advance the existing research knowledge related to supporting SRL in workplaces of different natures, we aimed to have a user study with a sufficiently diverse sample of organizational contexts. With such a sample inherently varied in terms of its data, we were able to analyze the resulting data in the way needed to address our research question.

## Participants

An early prototype of Learn-B was evaluated in February 2011 with end-users from three different business cases participating in the IntelLEO project. Thirty users participated in the study: 8 from the first business case of the project (a leading car manufacturer), 12 from the second (an SME) and 10 from the third business case (a teacher professional association). Majority of the participants had university degrees (83.3%). There were 23.3% users with 10 or more years of working experience, 36.7% with 3 to 4 years' experience, 23.3% with 2 to 3 years, and the rest had less than one year of work experience in their current organizational positions.

## Materials

The materials used in the study included: the questionnaires, the Learn-B environment loaded with each business case data separately, and the study scenario tailored to each business case.

To measure users' usefulness perceptions of the Learn-B's functionalities, we designed questions targeting the different dimensions of each functionality and included them in a proper section of the questionnaires which the users filled in after each study task. For instance, the *Provision of Usage Information* functionality was indicated through two dimensions: i) Analytics, including information such as the number of people who worked with/used a specific resource holding the same or related duties/roles as the user, their average completion time, etc. where the details of the provided analytics varied per resource; and ii) Social stand, which reflected what other members of the organization thought about a certain resource, implemented in diverse forms such as keywords, comments and ratings of other users. A description of these questions, the specific functionality that each question manifests, and the learning task (i.e., SRL practice) after which the question was answered are shown in Tables 1, 2 and 3. The questionnaires were comprised of 5-point Likert scale items with values ranging from 1-Strongly Disagree to 5-Strongly Agree for the usefulness of the functionalities items.

We asked participants to perform a series of tasks, described in the learning scenario, using Learn-B. The study scenario was phrased in a manner specific to each target business case, such as "requested by the management" in case of the first business case (i.e., the leading car manufacturer) or "as part of the user's professional development plan" in the third business case (i.e., the professional teacher association).

## Procedure

The study was conducted on site of each business case of the IntelLEO project. The end users were asked to complete a series of learning tasks in the context of a learning scenario, authentic to the specific organizational context of each business case. At the beginning of the study, the participants were familiarized with the study scenario and the included learning tasks. The learning tasks were the same across the business cases, in order to allow for the comparison of results between the three different organizational settings. For instance, all of the participants were asked to create a learning goal based on a set of recommended competences, while these recommended competences differed across the three business cases. Upon completing each task, the participants were asked to fill in the corresponding questionnaire. The tasks are described in the following.

**Task 1.** In the first task of the learning scenario, the users were asked to create a learning goal in Learn-B, select one or more from the three available organizational competences and include them in their newly created learning goal. Each competence had a specific set of attributes that described it in more details. After finishing this task, the participants were asked about the functionalities that they perceived as useful in performing this task. According to the SRL model that our pedagogical framework is based upon, this task represents the Planning practice, and the "Goal Setting/Task Analysis" step of this practice, in particular.

**Task 2.** In the second task, the users were requested to browse, select and adapt one of the available learning paths related to the organizational competences from Task 1. The learning paths were accompanied with different information such as users' comments and ratings, achievement information (e.g. the number of users who already completed a given learning activity in a learning path), and various knowledge object formats (e.g. URL, text documents, videos). After finishing the task, the participants were asked to identify the functionalities that they found

useful when choosing a learning path. By choosing and adapting a learning path for their learning goals, users engaged in the Planning practice of their SRL process, the “Making personal plans” step specifically.

**Task 3.** In this task, users were asked to add a knowledge object to one of the learning paths chosen in Task 2. The knowledge object was supposed to be defined in the form of an external URL and the participants had to link it to one of the learning activities in the respective learning path, and set its attributes such as visibility, personal rating, tags, etc. After completion of the task, the participants were asked about the functionalities that they found useful when documenting their one own learning resources, in terms of user-added knowledge objects. This task represents the Monitoring practice of the SRL@Work model, “Applying appropriate strategy changes” step.

## Data Analysis

To examine our research question, we analyzed the questionnaires’ data using descriptive statistics including mean and standard deviation values. Using standard descriptive statistics to analyze the type of the data and research questions we had is a common practice, as reported by Blaikie (2003). Also, it is noteworthy to mention that although there exist two schools of thought on analyzing Likert-scale data i.e., ordinal vs. interval (Carifio & Perla, 2008), we followed the latter. This choice is backed with a significant amount of empirical evidence indicating that Likert scales can be used as interval data (Carifio & Perla, 2008; Carifio, 1987). To gain a summative view over users’ usefulness perceptions, we grouped the responses to question items into “Not-Agree”: Likert-scale responses 1, 2 and 3 and “Agree”: Likert-scale responses 4 and 5.

## Results and Discussion

We analyzed the descriptive statistics of the respective questionnaire items, shown in Tables 1, 2 and 3, to examine our research question. The first column in these tables shows the functionality; the second column is the indicator question item as it was presented in the questionnaire; the third column gives the number of users who agreed with the given question item and finally, the fourth column shows the descriptive statistics. For each question, we report the central tendency measure i.e., Mean (M), Standard Deviation (SD) and the number of valid responses (N). In the following, we have organized the presentation and discussion of the results according to each performed SRL (sub-) practice.

### Planning: Task Analysis and Goal Setting

H1.a (Figure ): Results from the users’ answers (Table 1) show that almost all of the users agreed that *seeing the available competences* within their organization (Q2c) is useful when they are creating their learning goals (M = 4.62, SD = 0.56, 28 out of 29 users), followed by 86% of them considering *seeing the available learning paths* for a competence (Q3c) another useful functionality when planning their learning goals (i.e., doing Task Analysis). General information about a competence such as its name, description and keywords (Q2g) was acknowledged as useful by 82% of the users (n = 29, M = 4.38, SD = 0.86). More individualized information about a competence such as its priority with regard to the user’s organizational position (Q2d; M = 4.31, SD = 0.81), the pre-requisites for achieving it (Q2f; M = 4.17, SD = 0.81), and its expected level to be acquired by the user (Q2e; M = 4.03, SD = 0.94) were the other factors provided by the *Contextual Recommendation of Available Competences* which users found useful when planning for their learning goals (86%, 82% and 72% of the users, respectively). These results suggest that users found it important to know about the learning objectives of their organization, as well as their position with regard to these objectives, such as the priority of a certain competence for their organizational role, when planning their own learning goals.

H1.e ( Figure 2): Amongst the *Usage Information* provided, only the comments (*Social stand*) on a given competence were perceived useful for planning learning goals by a majority of the users (Q1c; M = 4.14, SD = 0.87); however, most of them, 83%, did not agree that having positive comments from the colleagues was the reason for them to choose a given competence (Q1a, M = 2.83, SD = 0.96). In line with the results related to planning their learning goals, a noticeable number of users (76%) also did not agree that being accomplished by many of their



colleagues was a reason for them to include a certain competence in their learning goal (Q1b;  $M = 3.05$ ,  $SD = 0.93$ ). The *Analytics information* (Q1d:) number of users who already achieved a competence ( $M = 3.10$ ,  $SD = 1.12$ ) and (Q1e:) their organizational roles ( $M = 3.28$ ,  $SD = 1.19$ ) were also mostly not considered as useful – i.e., 66% and 52% of the users, respectively, did not agree with the corresponding questionnaire items. We believe these results indicate that users study the social context of their organization when setting their learning goals; however, this is not the most influencing element for them; other factors such as organizational goals and expectations might play a more central role in how users define and create their learning goals.

Table 1. Descriptive statistics related to RQ - Planning: Task Analysis and Goal Setting.

Functionality	Question Description in the questionnaire	# of users in agreement	N, Mean, Std Dev.
Provision of Usage Information	Q1a: I selected a specific competence, because it had positive comments from my colleagues. (Median score across all selected competencies.)	5	29, 2.83, 0.957
	Q1b: I selected a specific competence, because many colleagues successfully completed it. (Median score across all selected competencies.)	7	29, 3.05, 0.929
	Q1c: When I plan my personal learning goals, I think it is useful to see comments from my colleagues concerning the competence.	24	29, 4.14, 0.875
	Q1d: When I plan my personal learning goals, I think it is useful to see how many people have already achieved and not yet achieved this competence.	10	29, 3.10, 1.012
	Q1e: When I plan my personal learning goals, I think it is useful to see the role of employees who [have] achieved this competence.	14	29, 3.28, 1.192
Contextual Recommendation of Available Competences	Q2a: I selected a specific competence, because it was the competence I would need most urgently to increase my job performance. (Median score across all selected competencies.)	21	29, 4.00, 0.973
	Q2b: In general, visual icons beside each available competence help me to pick those competences that fit my immediate learning needs.	11	29, 3.21, 0.940
	Q2c: When I plan my personal learning goals, I think it is useful to see the available competences within my organization.	28	29, 4.62, 0.561
	Q2d: When I plan my personal learning goals, I think it is useful to see the priority of the available competences for my position.	25	29, 4.31, 0.806
	Q2e: When I plan my personal learning goals, I think it is useful to see the expected level of the available competence for my position (low, medium and high level).	21	29, 4.03, 0.944
	Q2f: When I plan my personal learning goals, I think it is useful to see if I have the pre-requisites for an available competence.	24	29, 4.17, 0.805
	Q2g: When I plan my personal learning goals, I think it is useful to see name, description and keywords of a competence.	24	29, 4.38, 0.862
Recommendation of Learning Paths, Learning Activities and Knowledge objects	Q3a: I selected a specific competence, because... it had many available Learning Paths. (Median score across all selected competencies.)	16	29, 3.55, 1.055
	Q3b: Seeing all the available and recommended learning paths for each competence help me better make a decision whether to choose a competence or not.	22	29, 3.93, 0.753
	Q3c: When I plan my personal learning goals, I think it is useful...to see the available learning paths for a competence.	25	29, 4.31, 0.806

In line with the above results, when it comes to setting their goal(s) and choosing competences to include in them, 72% of the users agreed that they picked those competences that they needed most urgently to increase their job performance (Q2a); however, only 38% of the users agreed that the visual icons accompanying available

competences helped them to specifically choose the competences that fit their immediate learning needs (Q2b;  $M = 3.21$ ,  $SD = 0.904$ ) – *H1.a*. This might have been due to the unfamiliar design and lower graphical resolution of the icons. Seeing all the available and recommended learning paths (Q3b) was another factor highly acknowledged as useful, by 76% of the users ( $M = 3.93$ ,  $SD = 0.75$ ), for choosing a specific competence; further endorsed by over half of the users who agreed that they chose a given competence because it had many learning paths available (Q3a) – *H1.c*.

### Planning: Making Personal Plans

Having analysed the learning context and set their learning goals, the users were prompted to choose a learning path in Task 2 (i.e., perform the “Making Personal Plans” SRL@Work practice). The users’ responses to the respective questionnaire indicate that almost all of the users (96%) agreed that seeing all the matching available learning paths and their included learning activities and knowledge objects (Q7a) is useful when they want to choose a learning path ( $M = 4.44$ ,  $SD = 0.583$ , 24 out of 25 users) – *H1.d* (Figure ). Seeing their personal progress in completing a learning activity (*Progress-o-meters*, Q5a), was the other functionality perceived noticeably useful by the users when choosing their learning paths ( $n = 25$ ,  $M = 3.88$ ,  $SD = 1.09$ ) – *H1.g* in Figure 2.

Table 2. Descriptive statistics related to RQ - Planning: Making Personal Plans

Functionality	Question Description in the questionnaire	# of users in agreement	N, Mean, Std Dev
<b>Provision of Usage Information</b>	Q4a: I perceive the following functions as useful, when I have to select my learning path...to see my colleagues' rating of a learning activity or document.	15	25, 3.60, 0.764
	Q4b: I perceive the following functions as useful, when I have to select my learning path...to see the keywords of a learning activity or document.	16	25, 3.68, 0.900
	Q4c: I perceive the following functions as useful, when I have to select my learning path... to see the comments of my colleagues concerning the learning activity or document.	18	25, 4.00, 0.764
	Q4d: I perceive the following functions as useful, when I have to select my learning path...to see how many people completed the activity or are still actively involved it.	9	25, 3.00, 1.19
	Q4e: I selected a specific learning path, because the learning activities and documents had positive comments from my colleagues.	9	25, 3.24, 0.831
	Q4f: I perceive the following functions as useful, when I have to select my learning path...to see the roles of the colleagues, who finished this learning activity.	9	25, 3.00, 1.155
	Q4g: I selected a specific learning path, because many colleagues were and still are involved with the related learning activity.	7	25, 2.92, 0.997
	Q4h: I selected a specific learning path, because... the learning activities and documents had a good rating from my colleagues.	7	25, 3.04, 0.841
<b>Progress-o-meters</b>	Q5a: I perceive the following functions as useful, when I have to select my learning path ... to see my personal progress for a learning activity.	18	25, 3.88, 1.092
<b>Recommending Available Competences</b>	Q6a: I selected a specific learning path, because the related learning activities and documents had a good and clear description.	12	25, 3.48, 1.085
<b>Recommendation of LPs, LAs and KOs</b>	Q7a: I perceive the following functions as useful, when I have to select my learning path... to see the available learning paths, learning activities and documents within my organization.	24	25, 4.44, 0.583

In addition to the keywords accompanying learning activities/documents a learning path is composed of (Q4b), colleagues’ ratings of (Q4a) and their comments about these resources (Q4c) were the other *Usage Information - Social Stand* which users majorly found useful when making their personal plans; *H1.f* in Figure 2 ( $M = 3.68$ ,  $SD =$

0.90; M = 3.60, SD = 0.76; M = 4.0, SD = 0.76, respectively). However, contrary to when setting their learning goals, more than half of the users (64%) did not find *Usage Information - Analytics* such as the number of people engaged in a certain learning activity (Q4d) and their organizational roles (Q4f), useful for making personal plans (M=3.00, SD = 1.19; M = 3.0, SD = 1.55; respectively). Again, these results suggest that although information such as other users' comments and ratings could help with the Planning practice in general, users do not heavily draw on the social context, and specifically the achievement information of their colleagues when making their personal plans. This finding might be due to the unfamiliar look and design of the respective visualizations, or users' difficulty in interpreting them; accordingly, it requires further investigation.

When asked about the reasons on why they chose a certain learning path, good and clear descriptions of the respective activities and documents (Q6a) were the only functions perceived useful by nearly half of the user (M = 3.48, SD = 1.08) – *H1.b*. Similar to the results for when setting their learning goals, most of the users did not agree that positive comments (Q4e) or high ratings (Q4h) from the colleagues were necessarily the reasons for them to choose a given learning path (M = 3.24, SD = 0.831; M = 3.04, SD = 0.841, respectively). Likewise, neither being completed by many of their colleagues (Q4g), nor knowing the number of colleagues involved with/working on a learning activity (Q4d) were considered as the reasons to choose a learning path by a good number of the participants, (M = 2.92, SD = 0.997; M = 3.00, SD = 1.190, respectively). This indicates that users prefer to know clearly what options their organization is offering them, rather than merely relying on the achievement information or performance of their colleagues. Such results could be indicative of a poor organizational culture that does not nurture trust among employees. However, this is an early assumption and certainly requires further investigation.

### Monitoring: Applying appropriate Strategy Changes

In Task 3, users were asked about the functionalities that they found useful for adding a new knowledge object to their learning path chosen in the previous task. This task was aimed at investigating the self-regulatory Monitoring practice, and specifically its “Applying an Appropriate Strategy Change” step. Results from users' answers to the respective questions show that setting the visibility of their newly added learning activity/document (Q8c) and adding keywords to it (Q8a), were perceived as useful functions by nearly 80% of the users (M = 4.13, SD = 0.741; M = 4.17, SD = 1.274, respectively); followed by a 62% of the users who asserted that being able to also rate the new learning resource(s) was useful when they aimed to adapt their learning paths, Q8b (M = 3.67, SD = 1.007) – all three questions address hypothesis H1.h in **Error! Reference source not found.**

Table 3. Descriptive statistics related to RQ – Monitoring: Applying appropriate Strategy Changes.

Functionality	Question Description in the questionnaire	# of users in agreement	N, Mean, Std Dev
Provision of Usage Information	Q8a: When I want to document my own learning resources, I think it is useful...to add keywords.	19	24, 4.17, 1.274
	Q8b: When I want to document my own learning resources, I think it is useful...to allow the rating of my new knowledge asset.	15	24, 3.67, 1.007
	Q8c: When I want to document my own learning resources, I think it is useful...to set the visibility of my learning activity and document.	19	24, 4.13, 0.741

### Related Work and Conclusions

Different approaches to supporting individuals' active participation in learning and knowledge building activities at workplace have been the subject of several research efforts recently. The main focus of the APOSDLE project was on supporting individual workplace learning, making employees aware of the available knowledge sources for a task at hand (Lindstaedt & Mayer, 2006), while harmonization of individual and organizational learning and the effect of the social nature of workplace on learning were not addressed.

To provide the required support for the knowledge maturing process, the MATURE project relied on the semantically-empowered social software tools such as semantic wikis and semantic social bookmarking tools. Whereas this project gave a significant contribution to understanding and supporting the (knowledge) maturing

model (Maier & Schmidt, 2007) as an organizationally-guided learning process, the importance of SRL and social-embeddedness in workplace learning were not investigated.

The central component of the TENCompetence EU project (Koper & Specht, 2008) is Personal Competence Manager which supports users in identifying their competence gaps, choosing the appropriate learning paths towards the achievement of the missing competences and directing them to the appropriate learning resources (Kew, 2007). Obviously, this software solution bears a lot of similarities to Learn-B; however, we believe that we have made a step forward by introducing a framework for motivating intentional/non-formal workplace learning.

Being based on the SLATES framework (McAfee, 2006), the OrganiK project is oriented primarily toward supporting knowledge management in organizations through combining elements from the domains of Enterprise 2.0 and Semantic Web technologies (Bibikas et al., 2008), whereas less attention is paid to workplace learning.

The ARISTOTELE project (ARISTOTELE Project) aims to support the creation and further strengthening of a connection between organizations' learning strategies and real learning needs of its employees. Even though the research work of this project bears resemblance to our work presented in this paper, it seems to be missing an important component our approach is based upon – motivational framework for workplace learning.

As advancement to the abovementioned research initiatives, in this paper we have proposed a novel pedagogical framework, named SRL@Work, that extends the traditional model of SRL with elements originating from and necessitated by the social and organizational context of workplace learning. Most importantly, SRL@Work argues for the alignment of one's SRL practices with their own learning goals, learning goals of other organizational members, and the organization's learning goals. Aiming to assess the validity and effectiveness of the proposed pedagogical framework, we have developed Learn-B as our research prototype following the Design-based Research approach. With Learn-B, we organized an empirical study to evaluate the main propositions of the SRL@Work pedagogical framework and to gather users' feedback that would help us rethink and improve the design of both the proposed framework and the software prototype. As shown in the previous section, the study results do support the main propositions of our SRL@Work model, though further exploration of some observed issues is needed. For instance, we found that users did not heavily draw on the social context (e.g., other users' comments and ratings, and achievement information) when making their learning plans. This could have been caused by the unfamiliar look and design of some of the Learn-B's features (such as the visual indicators and charts) aimed at communicating information originating from the social context, but it could also indicate that the organizational culture that does not nurture trust among employees. This and other early assumptions, derived from the study results and stated in the previous section, need further investigation which we intend to do as a part of our future work. In fact, we have just finished a more comprehensive user study based on a combination of quantitative and qualitative evaluation methods. It is our belief that the data collected in this study, will help us obtain deeper empirical insights into the unresolved issues and bring us some new insights about employing self-regulatory practices in the context of workplace learning. In parallel with the analysis of the collected data, we intend to work further on the development of Learn-B and in particular improvement of its support for documenting and sharing learning experiences, and collaborative learning.

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