

# How Do People Learn at the Workplace? Investigating Four Workplace Learning Assumptions

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**Abstract.** Any software development project is based on assumptions about the state of the world that probably will hold when it is fielded. Investigating whether they are true can be seen as an important task. This paper describes how an empirical investigation was designed and conducted for the EU funded APOSDLE project. This project aims at supporting informal learning during work. Four basic assumptions are derived from the project plan and subsequently investigated in a two-phase study using several methods, including workplace observations and a survey. The results show that most of the assumptions are valid in the current work context of knowledge workers. In addition more specific suggestions for the design of the prospective APOSDLE application could be derived. Though requiring a substantial effort, carrying out studies like this can be seen as important for longer term software development projects.

## 1. Introduction

Any software development project starts from certain assumptions about the state of the world that are thought to be valid. Most EU funded project are no exception to this rule. However, checking the truth of these assumptions is often hard to do and most projects proceed as if they are true. From the many failures in software development (see for example, [1], [2], [3], [4]) we know that a mismatch between assumptions and reality is one of the main causes why things don't turn out as expected. In the context of the APOSDLE project<sup>2</sup>, about supporting workplace learning, we decided to investigate the assumptions behind the project plan and goals, by carrying out a workplace learning study in

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participating, organizations, followed by a more general questionnaire distributed over several other companies and organizations. This paper starts with describing the context of the APOSDLE project focusing on the assumptions about reality underlying the project. In order to place the project in the wider context of workplace learning a brief overview of this research domain is given with the aim to clarify some terminological issues. Next we will turn to the design of the empirical investigation. The research questions are answered in the results section. Finally results are compared with the assumptions and consequences for the future design and implementation of the APOSDLE system are discussed. Attention will also be paid to lessons learned that could be relevant for other projects.

## **2. The APOSDLE Project**

The goal of the APOSDLE project is to enhance knowledge worker productivity by supporting informal learning activities in the context of knowledge workers' everyday work processes and work environments. This is to be achieved by building and testing a comprehensive and integrated computer based set of work, learn and communication tools. The key distinction of the APOSDLE approach, compared to more traditional (e)Learning approaches, is that it will provide integrated ICT support for the three roles a knowledge worker fills at the professional workplace: the learner, the expert and the worker. Chiefly the support will be provided within the working environment and not in a separate learning environment. It will utilize contextualized communication for knowledge transfer. Finally, it will be based on personal and digital knowledge sources available in an organization and does not require the switch to a new system [5].

The following assumptions about the state of the world underlie the APOSDLE project:

- People do learn during work quite frequently
- Learning during work is mainly driven by the work people are doing
- While learning during work, bottlenecks occur that must be overcome
- Interpersonal communication is important when learning during work

The major thrust of this paper is to report the results of empirical research into the validity of these assumptions and the consequences for the APOSDLE approach. More in general, it addresses the following research questions derived from the assumptions:

- How frequently do people learn during work?
- What drivers/triggers learning during work?
- Are there bottlenecks when people learn during work?

- Which solutions do people use to satisfy a learning/knowledge need during work?

### **3. Workplace Learning: a Brief State of the Art**

Workplace learning is a complex and challenging research area: there is still a lack of standardized research and appropriate conceptual and methodological tools [6]. Nevertheless, some characteristics of workplace learning are agreed upon, like the influence of work tasks and contexts on what and how people can learn at work [6]. Learning at work can also occur in many forms, varying from formal learning in training courses to informal learning like ‘over the shoulder learning’ [7]. According to [8], most adults prefer to have some responsibility for their own learning. To stay competent, knowledgeable workers have to take responsibility for their learning. They learn autonomously by exploring and using knowledge in their daily work. This type of learning is defined as self-directed learning. In [9] self-directed informal learning is described as ‘ [...] intentional job-specific and general employment-related learning done on your own, collective learning with colleagues of other employment-related knowledge and skills, and tacit learning by doing’. Self-directed learning includes using one or more learning strategies, which are defined as thoughts and behaviours engaged in by the learner in order to achieve certain goals or purposes [10].

Several psychological and educational scientists have studied self-directed learning and learning strategies. The first empirical studies of informal learning activities of adults date back to the 1960s (U.S. national survey, see [9]), although first significant empirical research concerning adults' self-directed learning projects started in the 1970s, inspired by Knowles and pioneered by Tough (see [9]). Still, it was only since the 1990s that this subject attracted more attention. In 1996, [11] stated that ‘the explosion of knowledge, research, literature, and interest related to self-directed learning has been phenomenal during the past decade’. Currently, self-directed learning is still a prominent focus of research [12]. Up till now, most research about self-directed learning is conducted in educational settings, from preschool till postgraduate levels. Learning strategies have also almost never been systematically measured in work-related research either [13]. Therefore, more needs to be known about current workplace learning practices.

In terms of [14] APOSDLE is directed towards non-formal learning. Non-formal learning can be distinguished from formal learning by lacking key characteristics of formal learning:

- A prescribed learning framework
- An organised learning event or package
- The presence of a designated teacher or trainer
- The award of a qualification or credit

- The external specification of the outcomes

Non-formal learning is classified by [14] using two dimensions:

1. Time of local event or stimulus: past episodes, current experience, future behaviour
2. Level of intention: implicit learning, reactive learning, deliberative learning

The type of non-formal learning addressed in APOSDLE can be characterized, using these terms, as based on current experiences (work), reactive (near spontaneous and unplanned) and deliberative (time set aside specifically for this purpose). More in general it is about *incidental* noting of facts, opinions, impressions ideas and *recognition* of learning opportunities (**reactive**) and *engagement* in decision-making, problem-solving and planned informal learning (**deliberative**).

Based on these theoretical considerations we decided to use the following operational definitions of the main concepts:

- **Workplace.** *‘A physical location, a time and the nature of the workplace (computational or not). It is in fact a micro world in which an employee works’.* In the context of APOSDLE a workplace is described as a *computer based work environment*.
- **Learning.** The focus of the study is mainly on actual behaviour: what people do. As one cannot mostly observe learning directly without administering some kind of test, which is clearly not feasible in actual work contexts, an operational definition is needed that relies on other cues. The use of information or knowledge is considered as learning *if the information or knowledge is stored consciously or subconsciously for future use*. This is in line with the conceptual model of knowledge work as proposed by [15] which states that the outcome of performing knowledge work can either be *learning* (a change in the state of an organization’s knowledge resources) and/or *projection* (the embedding of knowledge in an organization’s product and service outputs). If only the latter occurs, no learning takes place.
- **Knowledge worker.** A knowledge worker is described as someone who has been schooled to develop, use, and/or transfer knowledge<sup>3</sup>, rather than using mainly physical force or manual skills.

#### 4. Design of the Investigation

The study consisted of two successive phases. Collecting detailed data about workplace learning, as it currently occurs for knowledge workers in the four organizations participating in the project, was performed in Phase 1. The findings from this phase provide an in depth insight into current workplace

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<sup>3</sup> This division in these three different activities of knowledge workers is based on how the Dutch Central Bureau of Statistics divides the knowledge worker population

learning practices in a *limited* number of organizations. In order to obtain a *more general* insight, the objective of Phase 2 was to verify and generalize important outcomes of Phase 1. To investigate this, knowledge workers of a larger sample of European organizations were involved.

In general, the study was focused on obtaining data concerning *actual behaviour of knowledge workers at their workplaces*, as it is this actual behaviour that provides the context for the future fielding of APOSDLE. From previous research (see for example [16]) it became clear that investigating workplace learning in terms of actual behaviour requires a variety of data collection methods that allow for data collected at different times and places in order to prevent a blinkered view on what actually happens.

Our multi-method data collection approach consisted of four methods:

1. *Workplace observations*: collecting objective data about actual self-directed learning behaviour in a limited time span;
2. *Interviews*: collecting opinions and self reports about self-directed learning behaviour based on recollection of memories;
3. *Online diaries*: self recording of self-directed learning behaviour over a longer time span than can be achieved with observations by using an online diary;
4. *(Online) Questionnaire based survey*: an online questionnaire containing the most important outcomes of the first four methods and aiming to collect data to verify these results.

The first three methods were used in Phase 1. The fourth one, the online survey, is used in Phase 2. As organizations from the private, as well as from the public sector were involved and because the methods were sampled over time, work and people, generalization of the results to a wider range of contexts is possible.

#### **4.1 Phase 1: Data Collection in the APOSDLE Application Partners' Organizations**

In this phase use was made of workplace observations, interviews and online diaries.

For the observations and interviews 2-3 day visits to each application partner were organized. The purpose of the visit was deliberately not told, to avoid an effect (a bias) on the usual behavior of the employees. As they know their organisations best, partners were asked to select locations, times and of participating employees that fit best the requirements of the study. In the selection of employees there should also be as much variation as possible in tasks, functions and levels of experience.

The data collection consisted of sessions that lasted approximately 60 to 105 minutes. Observations at the workplace lasted 60 minutes and were followed by an interview, which took 45 minutes. During an observation, the participant had to maintain his normal work activities and pretend there was no observer, while

the observer sat nearby the employee and made notes about the behaviour. The results of these observations were short descriptions of the observed behaviour of the participants, especially workplace learning behaviour. For the interview a schema was used which contained questions about reported learning events.

In the diary part, participants were asked to report successful and unsuccessful personal learning moments that took place in their work context during six weeks. It was stressed that unsuccessful learning moments could also be reported, because the amount of time that people spend in learning processes is not necessarily positively correlated with successful learning outcomes [9]. A participant could report about three types of learning moments: successful and intended, successful and coincidental, and unsuccessful learning moments. To report learning moments, Eureka Reports, a type of diary study that focuses on recording learning in everyday work, were used as a starting point for the design of the diary [17]. The APOSDLE partners decided on suitable participants from their organizations, based on the request to find knowledge workers that spend at least 60% of their working time at a computer based workplace. The Eureka Report was accessible through a webpage. To reduce the burden for the participants, they were asked to fill in the Eureka Reports only a few (work) days a week.

## **4.2 Phase 2: Workplace Learning Survey**

The data collection for Phase 2 made use of a questionnaire accessible through Internet. The goal of the Work Place Learning Survey was to verify which findings of Phase 1 could be generalized. This was a crucial question since Phase 1 was conducted at four partner organizations and for APOSDLE to succeed, a broader scope is required.

### **4.2.1 Sampling**

As it is next to impossible to draw a random sample from the target users of APOSDLE, and mass mailings of questionnaires to organizations yield very low response rates, we decided to opt for a kind of “snow balling” sample procedure that intends to maximize responses from target users. This approach entailed that each APOSDLE partner got in touch with some of their contacts in different organizations (first step) and asked them to find some suitable respondents (second step). As it was not possible to influence the precise number of people who received a request to participate, it was not possible to calculate a response rate. The contacts could come from organizations like current or former customers, associations, daughter companies, and so on. Some of the participants could come from the partners’ own organization, as long as they were not directly involved in APOSDLE or had participated in Phase 1. However, the maximum proportion of participants from the partners’ own organization shouldn’t be more than 33%. The contact organizations received an instruction which explained the type of participant looked for. Suitable

respondents were described as knowledge workers who spend at least 60% of their working time at a computer based workplace.

#### 4.2.2 Procedure

The survey was based on insights from the first results of the study. Also, relevant literature about learning strategies at work was used in the design process of the survey. Although at the start of the survey the analysis of the data from Phase 1 of the study wasn't yet completed, it was clear that several factors of the model of [16] partly matched the first insights about used learning strategies. Therefore several statements were used in the survey to identify and validate used learning strategies from Phase 1. Overall the focus was again on identifying behaviour rather than attitudes.

For this paper the questions in which 100 points have to be allocated to several answer categories, the constant sum scale questions, are the most relevant. An example of this kind of question is:

*When you consult colleagues, there are different ways to do it. If you had 100 points, how would you distribute them over the 4 ways listed below?  
Please base your distribution on the degree you actually use these ways to consult colleagues in your daily work. The way you use most frequently in these situations should receive most points. It is not necessary to distribute all 100 points.*

*When I consult colleagues, I do that*

- by asking them face-to-face..... points*
- by using e-mail..... points*
- by calling them..... points*
- by writing a message on paper..... points*

In the second part of the survey, some general questions concerning personal information and general information about the organization had to be answered.

## 5 Results

In this section we present the results of the two phases for the research questions based. As they are based on different types of data, we start with an elaboration of the data collected.

### 5.1 Characteristics of the sample

The unit of analysis for the data collected in Phase 1 is a *learning event*, which is defined as a situation during work when new information or knowledge is acquired that has a high likelihood to be (re)used in the future. These learning events were extracted from observations, interviews and diaries using a predefined coding scheme. To examine the reliability of the coding, a second coder coded a subset of 50 (see [18]) of all collected learning moments. Cohen's

Kappa, which is suitable measure for nominal data, was obtained (.807). It turned out that 93% of the collected learning moments could be classified as learning events. Altogether 135 learning events were recorded.

The unit of analysis in Phase 2 is a *person* reporting in general terms about his/her learning experiences during work. We received 104 filled in questionnaires. Seven were not filled in completely for unknown reasons and were removed from the sample, leaving 97 questionnaires for the analysis. The goal of sampling was to obtain a reasonable distribution over several characteristics that extend the range of observations we made during Phase 1. The first, and probably most important factor, is the nature of the work of the respondents. We asked them to distribute 100 points over three different types of work related activities: developing new knowledge (for example, working in a research environment), pass on knowledge to others (for example, teaching), use obtained knowledge (for example, applying knowledge in engineering). Table 1 shows that the distribution over the three types is almost equal. This means that our survey covers respondents who are active in every type, excluding a bias to one of the types.

**Table 1.** Average number of points (out of 100) allocated to three types of knowledge work<sup>4</sup>

<b>Types of knowledge work</b>	<b>Average number of points</b>
Developing new knowledge	32
Passing on knowledge to others	32
Using obtained knowledge	38

As APOSDLE is focused on working and learning at a computer based workplace we asked the percentage of their time the respondents worked at such a workplace. Of the respondents, 91% spend 50% or more of their time at a computer based workplace. This makes the sample fit the target users of APOSDLE.

Phase 1 of the study was mainly conducted at relatively small organizations. Our intention was to broaden the organizational scope of the study in the survey, so we asked for the size of the organization (see Table 2). From this table it is very clear that we succeeded: 66% of the respondents came from large organizations. This enables us to investigate whether the results of Phase 1 can be generalised to larger organizations.

<sup>4</sup> Tables 1, 3, 5, 6 and 8 give the average number of points allocated out of 100 by the respondents. Respondents were not forced to allocate all 100 points..



**Table 2.** Size of the company

<b>Company size</b>	<b>Percentage of answers</b>
Small (<50 employees)	21 %
Medium (50-250 employees)	13 %
Large (>250 employees)	66 %

The three variables presented above are the key ones for assessing the nature of the sample. Based on this we can say that the sample to a very large extent satisfies our initial ideas about how it should look like for making a comparison with findings from Phase 1.

When making a comparison between results from Phase 1 and Phase 2, two issues must be taken into account. The most important caveat has to do with the nature of the data. In Phase 1 the unit of analysis is a reported or observed learning event. The unit of analysis in Phase 2 is a person, who does not report about one specific learning event but about general experiences during learning at the workplace. The second reason has to do with different ways of data collection. In the survey we used self-report questions, while in Phase 1 observations, interviews and diary reports were used which subsequently were coded. Though we tried to measure the same concepts in both Phases, we can't be sure that different ways of measuring the same concepts yield comparable outcomes.

### **5.2 Do People Learn Quite Frequently During work?**

In terms of collected data we cannot answer this question precisely as we did not keep a tally of "not learning at work". An indication can be found in the Phase 1 observation and diary data. Of the 138 learning events, 48 were observed during 62 observation sessions, each lasting 1 hour, which is an 0.77 hourly occurrence rate. In the diaries 71 learning events were reported in the submitted reports of 17 people over a time period of 6 weeks, though not covering all days in that period: about 11 learning events per week, or two a day. This indicates a lower incidence of learning events compared with the observations. Taking the observational data as the upper bound and the diary data as the lower bound, we can safely state that within this interval learning during work is a quite frequent.

### **5.3 Is Learning During Work Mainly Driven by the Work People Are Doing?**

In the Phase 1 data we made a distinction between two "triggers" for a learning event: intentional (driven by the work the person is doing) and unintentional

(driven by curiosity or coincidence). Of the recorded learning events, 75% were intentional and 25% unintentional, clearly indicating a preponderance of work(task) driven learning.

In the survey we asked people to distribute 100 points over three types of learning triggers. The results are shown in Table 3. Task driven learning dominates, but curiosity driven learning is more prevalent than in Phase 1. An explanation for this difference may be due to the presence of a larger number of people from large organizations.

**Table 3.** Average number of points (out of 100) allocated to three types of learning triggers (constant sum scale)

<b>Learning triggers</b>	<b>Average number of points received</b>
Driven by the task(s) I'm carrying out	50
Driven by my curiosity	34
Driven by coincidence	15

#### **5.4 Do Bottlenecks Occur while Learning During Work?**

From the data in Phase 1 we can first derive whether learning events were successful or not. Of the recorded learning events 72% were successful, 7% failed, 15% were not yet finished and 6% postponed. This indicates a reasonable success rate<sup>5</sup>. However, being successful does not imply that everything went smoothly. Of the recorded learning events 48% did not encounter any bottlenecks, but 52% did. Overall 104 bottlenecks were reported. Table 4 gives an overview of the most frequently reported bottlenecks.

Most problems seem to be related to information: there is too much information, the information is not sufficient to solve the problem or no information is available. Problems also occur often when people search information: it is unclear what has to be found, what is important to know or where the information can be found. Not having sufficient time to learn is also a problem that is mentioned frequently.

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<sup>5</sup> Though comparable data are hard to come by, this percentage is higher than the 50% reported by [19] whose data are about information search in general.

**Table 4.** Bottlenecks participants experienced during learning events

<b>Bottleneck category</b>	<b>Description</b>	<b>Frequencies</b>
Interpersonal help seeking	Can't reach colleagues to help.	5
	Colleagues can't help (e.g. because of the specific nature of the question(s))	6
Information problems	The information is too specific for immediate use.	5
	Too much information (for example: needs to filter it to find the information looked-for, which costs time.)	7
	The information is not sufficient to solve the problem.	8
	No information is available.	7
Search problems	Don't knowing exactly what it is you're looking for.	7
	Don't knowing exactly what it is important to know.	4
	Don't knowing exactly where to look for the information.	6
"Opportunity" problems	Not having enough time to learn.	7
	Not having access to all information.	5

In the survey in Phase 2 we made a distinction between bottlenecks experienced when trying to find help from persons (Table 5) and when trying to find help in written material (Table 6).

**Table 5.** Average number of points (out of 100) allocated to three bottlenecks experienced in personal help seeking (constant sum scale)

<b>Bottlenecks interpersonal help seeking</b>	<b>Average number of points received</b>
I often don't know who knows what in our organization	23
Colleagues I consult are often too busy to help me	21
Colleagues often can't help me, question too specific	27

The differences between the three bottlenecks are small, indicating that the respondents experienced these bottlenecks almost equally. From Table 6 one can derive a strong need for more specific information that is delivered relatively fast. At the same time, either the sources in the own organization are insufficient or not well accessible.

**Table 6.** Average number of points (out of 100) allocated to four bottlenecks experienced in seeking help from written material (constant sum scale)

<b>Bottlenecks seeking help from written material</b>	<b>Average number of points received</b>
The information I find is often too general for immediate use	26
I often don't find helpful information in sources from my own organization	22
I often don't find helpful information in sources from outside my own organization	15
Trying to find something in written material often costs me too much time	29

### **5.5 Which solutions do people use to satisfy a learning/knowledge need during work?**

In Phase 1 we recorded what kind of solutions people use to satisfy a learning/knowledge need during work. During one learning event several solutions could be attempted. We found four solution categories: interpersonal help seeking, seeking help from paper based written material, seeking help from digital written material and practical application (“trial and error”). Interpersonal help seeking is used most frequently (70%). Digital written material, like PDF-articles, follows (63%). Paper based written material, like books or magazines, play a less important role (17%). Practical application, trying things out, is less used (16%). Clearly contacting people for helping is quite frequent. Which communication medium people use when contacting other people for help is shown in Table 7. It is not surprising that face-to face communication is used most, followed by e-mail. The use of the phone is almost equal to the use of e-mail. Paper based media (for example written notes) are used rarely.

**Table 7.** Types of communication media used in learning events (N=194)

<b>Types of communication media used</b>	<b>Frequency</b>	<b>Percentage</b>
Face-to-face (like colleagues, a meeting)	119	61 %
E-mail	36	19 %
Phone call colleague	35	18 %
Paper based medium	4	2 %

For the survey data we cannot directly compare the used solution types. For technical reasons we asked the question for interpersonal help seeking using a constant sum scale, while for turning to digital material and practical application we used a 4-point rating scale asking whether the described situation is not similar or completely similar to what a respondent usually does. For interpersonal help seeking the option “I ask a colleague for assistance” received on average 73 points out of 100. This shows a substantial preference for contacting people close by. The similarity of turning to written material is 75% (very similar (42%) and completely similar (33%)). The results for practical application are different. The “somewhat similar” category receives 44% of the responses, against 42% for “very similar” (34%) and “completely similar” (8%). Clearly interpersonal help seeking and turning to written material also dominate in the survey<sup>6</sup>.

Table 8 shows how survey respondents distribute 100 points over different communication media to contact other people for interpersonal help seeking. As can be seen from Table 9 face-to-face contact is used most frequently, followed by E-mail and calling.

**Table 8.** Average number of points (out of 100) allocated to four types of communication media used in interpersonal help seeking (fixed sum scale)

<b>Types of communication media used</b>	<b>Average number of points received</b>
Face-to-face	45
E-mail	27
Phone call colleague	23
Paper based medium	3

<sup>6</sup> These results are overall in line with the ones reported by [20].

## 6. Summary and Discussion

The research reported in this paper was arranged around four questions related to the assumptions behind the APOSDLE project. The data allow us to answer these questions and spell out the consequences for APOSDLE.

- **How frequently do people learn during work?** At computer based workplaces learning is ubiquitous. *Consequence for APOSDLE:* APOSDLE addresses a phenomenon that is widespread in many different organizations.
- **Are there bottlenecks when people learn during work?** Learning is currently overall reasonably successful, though bottlenecks are present. *Consequence for APOSDLE:* There is room for improvement, in particular in solving specific bottlenecks
- **What drives/triggers learning during work?** Workplace learning is strongly driven by work tasks, but learning driven by curiosity is also present. *Consequence for APOSDLE:* With the task related approach to learning support, APOSDLE fits into current practice. In addition, room must be present for not directly task related learning.
- **Which solutions do people use to satisfy a learning/knowledge need during work?** When seeking help, interpersonal help seeking using face-to-face contact is used most often. When seeking help from written material, digital sources are used most. *Consequence for APOSDLE:* APOSDLE needs to replicate, replace or supplement face-to-face contact. It should either have its own facilities for interpersonal help seeking or fit seamlessly and effortlessly into current tools and practices. Providing easy and tailored access to digital sources is important.

Overall we can say that the findings corroborate the four key assumptions behind the APOSDLE approach. Apart from the results reported in this paper, other results from the investigation will influence the design of subsequent APOSDLE prototypes.

As for similar system development projects which depend on a tight integration into organizational settings, this investigation can be seen as a very valuable addition to more common requirements elicitation procedures, which have the tendency to drift into wish lists for which not much empirical evidence can be mustered. Furthermore, a more detailed investigation using observations, interviews and diaries which can only be done in a limited number of organisations, can be fruitfully combined with a more survey oriented approach covering a wide range of organisations. However, there is a cost involved. Doing and reporting the research requires the investment of several person months of effort. Nonetheless, when planning projects, considering including a more detailed study into the empirical validity of its underlying assumptions about the state of the world should not be overlooked.

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