Project Number **027023**

APOSDLE: Advanced Process Oriented Self-Directed Learning Environment

Integrated Project

IST – Technology enhanced Learning

Workplace Learning Study

Deliverable D2.1

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Imprint

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2.0	2006-11-28	Third draft, completing analyses, conclusions, to do: management summary and final editing. Draft for internal Review
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Executive Summary

The goal of the workplace learning study was to examine actual workplace learning behaviour by knowledge workers in order to find out how a new application as APOSDLE can fit into existing work contexts. Another goal was to detect bottlenecks and opportunities to be addressed in the future.

The study consisted of two phases. In the first phase, data about workplace learning was collected at the partner organizations. Several data collection methods were used, including observation of workplace learning, interviews and a learning diary. 46 persons from four organisations were involved. Data was collected in 97 observation and interview sessions, and from 70 learning diary entries. In total, the data set consisted of 175 learning events experienced at the workplace. In the second phase, data was collected by means of a questionnaire for a sample of 104 workers from a wider range of European organizations in order to validate the results from the first phase.

Main results, relevant for APOSDLE, of both phases of the study are:

- **APOSDLE relevance**
  - *Key finding*: Computer based workplace learning is ubiquitous
  - *Consequence for APOSDLE*: APOSDLE addresses a phenomenon that is widespread over many different organizations.
  - *Key finding*: Learning is currently overall reasonably successful, though bottlenecks are present.
  - *Consequence for APOSDLE*: There is room for improvement in current practices, in particular in solving specific bottlenecks
- **APOSDLE general approach**
  - *Key finding*: 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 is right on target and fits into current practice. In addition, room must be present for not directly task related learning.
  - *Key finding*: Most learning events are not very complex and consists of a few steps only
  - *Consequence for APOSDLE*: No need for lengthy course-like learning support. It should be brief and to the point.
- **Learner support: interpersonal help seeking**
  - *Key finding*: When seeking help, interpersonal help seeking using face-to-face contact is used most often.
  - *Consequence for APOSDLE*: APOSDLE needs to research ways to replicate, replace or supplement face-to-face contact. It should either have its own facilities for interpersonal help seeking or fit seamlessly and effortless into current tools and practices.

  - *Key finding*: There is some evidence that current communication facilities used most often (email and telephone) are not sufficient to support learning needs: Bottlenecks are much more frequently reported from the expert role and often relate to missing support for the expert role (like forgetting), some of the bottlenecks reported relate to media characteristics.
  - *Consequence for APOSDLE*: There is room for improvement in current communication media facilities to support interpersonal help seeking. APOSDLE should offer facilities that better support the expert role in knowledge exchange.

- **Learner support: seeking help from written material**
  - *Key finding*: When seeking help from written material, digital sources are used most.
  - *Consequence for APOSDLE*: Providing easy access to company digital sources is important.

- **Influence of organisational setting**
  - *Key finding*: Several key variables that could influence the fielding of APOSDLE (what drives learning, what kind of help people seek, what is learned) are not or only weakly dependent on the organizational setting (company size, type of knowledge work, number of years in the job).
  - *Consequence for APOSDLE*: The prospective APOSDLE tools can be fairly general, only limited tailoring to the specific setting may be needed.

The results of this study provide a rich source of information regarding workplace learning in knowledge work, and will be used to inform visioning and requirements gathering activities for the future APOSDLE system.

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1 Introduction

1.1 Purpose of this document

This document gives an overview of the results of the Work Place Learning Study (WPLS) conducted between March 2006 and October 2006. The emphasis of the WPLS was on studying actual workplace learning behaviour: uncovering meaningful learning patterns, existing bottlenecks, the communicative actions, the use of resources and social activities. This information is necessary to see how a new application like APOSDLE can fit into the existing work context, but also for detecting bottlenecks and opportunities that can be addressed. In addition, it allows a comparison with requirements elicited by other means in the project. A detailed comparison with these is outside the scope of this document. This comparison will be made in deliverable D.6.3 ("Use Scenarios & Application Requirements 2") to be delivered in March 2007.

In this chapter we first provide some background on developments in the area of workplace learning in general. Next we will outline the role of the study in the APOSDLE project, followed by some definitions that are relevant for understanding the study.

The second chapter addresses the methods that were employed in conducting the study, ranging from observations at the workplace to a survey among a wider group of organizations and people. Empirical results are presented in Chapter 3, following the order of the two main phases of the study and a systematic comparison between the outcomes from Phase 1 and 2 is made. Finally, in Chapter 4 results are summarized and conclusions are drawn that are pertaining to the goals and scope of the APOSDLE project.

1.2 Workplace learning

European Council March 2000 in Lisbon:

"One of the top priorities of the European Union is to become the most competitive and dynamic knowledge-based economy in the world."

Since the 1970s, the economic growth of many European countries changed from being industry-dependent or agriculture-dependent into knowledge-dependent. To emphasise that knowledge is the key to economic progress, the contemporary society is frequently defined as 'the Knowledge Society'.

As a result, an ever increasing part of the working population is defined as 'knowledge workers', whose essential operational and value creating tasks rely on knowledge. Knowledge is their critical work resource: developing, using, and/or transferring knowledge are their daily tasks.

Continuous changes, like technological and scientific innovations, make workplace learning an essential component of knowledge workers' daily activities. This learning is considered as crucial for enhancing corporate competitiveness, employment and employability (Skule, 2004). Having the ability and opportunity to learn efficiently and especially to manage and apply new knowledge effectively within work processes, is important for the quality of knowledge-intensive work. Creating optimal conditions for knowledge workers to learn at work not only improves the competitiveness of organizations, it also supports the knowledge society to reach its full potential.

Workplace learning is a complex and challenging research area: there is still a lack of standardized research and appropriate conceptual and methodological tools (Collin, 2006). 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 (Collin, 2006). Learning at work can also occur in many forms, varying from formal learning in training courses to informal learning like 'over the shoulder learning'

(Twidale, 2005). According to Hiemstra (1994), most adults prefer to have some responsibility for their own learning. To stay competent, knowledge 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. Livingstone (2001) describes self-directed informal learning 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 of 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 (Olgren, 2000). Learning strategies facilitate learning by making it easier, faster, more enjoyable, more self-directed, more effective, and more transferable to new situations (Oxford, 1990).

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), although first significant empirical research concerning adults' self-directed learning projects started in the 1970s, inspired by Knowles and pioneered by Tough (Livingstone, 2001). Still, it was only since the 1990s that this subject gained more attention. In 1996, Hiemstra stated that 'the explosion of knowledge, research, literature, and interest related to self-directed learning has been phenomenal during the past decade' (Hiemstra, 1996). Currently, self-directed learning is still a prominent focus of research (Montalvo & Torres, 2004).

Burns (1995) conducted a study to identify the most useful and differentiating characteristics which enable salespeople to acquire and apply knowledge in both job and training situations. This study showed that self-directed learning was closely linked to two co-dependent dimensions of individual preferences: learning attitude and problem solving orientation. Holman, Epitropaki and Fernie (2001) tested a valid six factor model for cognitive and behavioural learning strategies that adults use in a work context. Their study also shows that adults use similar learning strategies at work as they do in educational settings. However, a limitation of their research which they mention themselves is that it relies on self-report questionnaire-based measures only. The authors suggest broadening the methodological scope to include among others in-depth qualitative interviewing and observations.

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 (Warr et al., 1999). Livingstone describes the current situation as follows:

> 'In light of conceptual confusion, varied measures and the very limited amount of comparative data, researchers' knowledge of the extent, processes, content, outcomes and trends of adults' informal learning and training remains very crude. The extensive empirical work on self-directed learning in the 1970s has led to very little cumulative development of understanding of the phenomenon of informal learning to date. Researchers keep rediscovering portions of informal learning anew with little effort to date to replicate earlier discoveries.'

Therefore, more needs to be known about current workplace learning practices, especially learning strategies used in self-directed workplace learning.

Summarizing, we can say that the topic of workplace learning has been studied before, but there is considerable room for additional research that uses a multi-method approach for identifying and validating learning strategies how they actually appear in the workplace, and tries to link empirical data to tools intended to support workplace learning.

1.3 Workplace learning in APOSDLE

The focus of the APOSDLE project is to enhance knowledge workers' productivity, by delivering individual-based and process-oriented learning support for knowledge workers within their computer based work environment. The APOSDLE tools, which aim at supporting self-directed learning and task performance, are developed in the next 3.5 years.

To create successful tools, it is necessary to study actual workplace learning behaviour and get a clear understanding of how this informal kind of self-directed learning currently takes place. This understanding is needed to see how the tools can fit into the real work context. Bottlenecks and opportunities related to workplace learning that are found in the study are important issues that should be taken up in the project. This study aims to do this, by detecting ways of learning (the learning patterns) and usage of resources for learning. Questions like “In what situations does self-directed learning occur?”, “Which sources do people consult to gain new knowledge?”, and “What type of knowledge do people learn at work?” will be answered. Within this context, workplace learning at computer based workplaces is the focus of the data collection.

Identifying learning patterns and practices is not the same as determining learning strategies. Patterns can be described as schemes, models and practices can be described as actions. Instead, learning strategies are described as thoughts and behaviours engaged in by the learner in order to achieve certain goals or purposes. Learning patterns can provide clues for the practices people use to aid the acquisition and development of knowledge (Holman et al., 2001) or for the used learning strategies. By using the identified patterns and practices, it is possible to determine which learning strategies are used.

1.4 Important definitions

A description of definitions used during the WPLS is needed, because they are crucial for interpreting the results, but they also explain the scope of the study. Moreover, some definitions differ from those given in the APOSDLE Glossary.

Workplace

A central concept in this study is a workplace. The dictionary Wordnet describes a workplace as ‘*a place where work is done’.* This definition is too broad. In order to have a narrower and operational understanding of the workplace, the following description is used: *‘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 environment*. However, within the WPLS we have also looked at learning that takes place *outside* the computer based workplace. This provides an impression of the (main) learning situations. It is important to determine where *currently* learning is taking place, because it gives a clue about future learning contexts, and makes it possible to determine whether computational support is sensible.

Learning

Besides a definition of a workplace, it is also necessary to understand what is defined as learning. As one cannot observe learning directly, an operational definition is needed that relies on other cues. The use of information is considered as learning *if the information or knowledge is stored consciously or subconsciously for future use.* Learning is thus related to information use, but there is one important difference between learning and information gathering. The result of the first is newly gained knowledge and of the second the result is nothing permanently as information is used only once.

Self-directed learning: in APOSDLE this is described as *‘referring to self-directed exploration and application of knowledge by learners with the purpose of advancement in a learning domain’*.

Information

Data that are used and has to be interpreted anew every time it is used. Information is data to which meaning is attached by the interpretation of the recipient of the data.

Knowledge

Data that, as a result of an interpretation of a user, leads to the capability to carry out a task or an action. Knowledge is associated with the capability of an agent to carry out a task. It is a result of

mental processing of information. Knowledge can be applied for different purposes. Knowledge can be partially explicated in a knowledge artefact.

Knowledge worker

A knowledge worker is described as someone who has been schooled to develop, use, and/or transfer knowledge, rather than using mainly physical force or manual skills.

Knowledge types: three different knowledge types were discerned, based on Merrill's Component Display Theory (1983). Their definitions are:

> **Facts (knowing what)** - logically associated pieces of information. Some examples are names, dates, and events. An example is knowing a particular section of a law.
>
> **Concepts (knowing why)** - symbols, events, and objects that share characteristics and are identified by the same name. Concepts make up a large portion of language and understanding them is integral to communication. An example is knowing the interpretation of a law.
>
> **Procedures (knowing how)** - a set of ordered steps, sequenced to solve a problem or accomplish a goal. An example is like knowing how to run a court session

2 Design of the Study: Methods and Scope

The WPLS consisted of two phases. Collecting detailed data about workplace learning as it currently occurs in the organizations participating in the project (ISN, CNM, IHK and EADS) was performed in Phase 1 of the study. The findings from this phase will provide an in depth insight into current workplace 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 people at their workplaces, as it is this actual behaviour that provides the context for the future fielding of APOSDLE. This does not mean that motivational issues are not important in this respect, but measuring these for a still unknown application in a (distant) future will probably not yield reliable data. Anyway, the assumption behind much usability work is that fitting in and aligning with current work practices is an important success factor for any application.

2.1 The multi method approach

From previous research (see for example Holman et al., 2001) 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.

The multi-method data collection approach we designed consisted of five 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 recollection of memories;
3. *Simulations*: replay of self-directed learning situations from the past if observations are not sufficiently rich or abundant;
4. *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;
5. *(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 four methods were used in Phase 1 of the study. The fifth one, the online survey, is used in Phase 2. Because 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 in a wider range of contexts was possible.

2.2 Phase 1: data collection in the APOSDLE application partners' organizations

In phase 1 data collection was carried out in the APOSDLE application partners' organizations. These organizations participate in the project because they represent three different types of application environments for the prospective system: a large private corporation, a public organization and a network of SME's. Thanks to this, these organizations are easily accessible and they can be used very

early in the project because no time consuming negotiations about participation are needed. For those not familiar with these organizations, Appendix B contains a brief characterization of them and the work and the locations that provided the data.

The main goals for Phase 1 were:

- Identifying learning patterns that people follow during their daily work
- Finding bottlenecks they encounter during these learning patterns
- Tracing successes and failures of learning efforts
- Finding which types of knowledge people try to acquire

2.2.1 Time frame

The preparation of the observations, interviews and simulations started in the second week of March 2006. The actual data collection started in early April 2006 and lasted till the end of June. In planning the first part of the study several data collection contexts (places to observe, interview and perform simulations) were created. The emphasis was on creating a data collection context of actual workplaces that provided a high probability of observing self-directed learning at the workplace.

2.2.2 Goals and requirements for each method

Observations

- *Overall goal*: collecting objective data about actual learning in the workplace
- *Time span*: limited, two or three days for each partner
- *Location*: computer based workplaces, not-computer based workplaces, meeting room and workplaces outside the office
- *Persons*: six employees (knowledge workers) of each application partner; vary as much as possible in the tasks, functions and experience levels of the participants
- *Roles*: emphasis on the role as a learner and also (if this occurs during observation) on the role as an expert

Interviews learners

- *Overall goal*: collecting opinions and self reports about behaviour based on recollection of memories about experienced learning in the workplace
- *Time span*: limited, two or three days for each partner
- *Location*: computer based workplaces, not-computer based workplaces and workplaces outside the office
- *Persons*: four to six employees of each application partner; vary as much as possible in the tasks, functions and experience levels of the participants
- *Roles*: emphasis on the role as a learner
- *To focus on*: Interviewees are asked to remember three to four learning moments[1] and for each moment questions will be asked

[1] When the knowledge worker also fulfilled the role of an expert during the observations, he/she was be asked to remember one or two learningmoments

Interviews experts

- *Overall goal*: collecting opinions and self reports about behaviour based on recollection of memories about being consulted as an expert in the workplace
- *Time span*: limited, two or three days for each partner
- *Location*: computer based workplaces, not-computer based workplaces and workplaces outside the office
- *Persons*: depending on the observed number of employees of the application partners that fulfil the role as expert; vary as much as possible in the tasks, functions and experience levels of the participants
- *Roles*: emphasis on the role as expert
- *To focus on*: Interviewees are asked to remember one or two moments/events where they were consulted as an expert and for each moment/event questions will be asked

Simulation with learners

- *Overall goal*: replay of one participant of situations from the past if observations are not sufficiently rich or abundant to get an impression of learning in a computer based workplace
- *Time span*: limited, two or three days for each partner
- *Location*: computer based workplace
- *Persons*: four employees of each of the application partners; vary as much as possible in the tasks, functions and experience levels of the participants
- *Roles*: emphasis on the role as a learner

Diary study learners

- *Overall goal*: self recording of behaviour of actual learning in the workplace over a longer time span than can be achieved with observations
- *Time span*: six weeks, selected persons are asked to keep diaries for certain days in the week
- *Location*: computer based workplaces, not-computer based workplaces and workplaces outside the office
- *Persons*: six employees of each of the application partners; vary as much as possible in the tasks, functions and experience levels of the participants
- *Roles*: the role as a learner

2.2.3 Participants

In section 1.4 a definition of a workplace is provided, but only for its nature. In preparation for the data collection for the WPLS, all partners received an e-mail with requirements for the selection of locations, times and of participating employees. As they know their organization best, they were asked to select the locations, employees, situations and times that fit best the requirements of the study. No specific attention was given to the knowledge domain of the participants, since the focus was not on the content of what was learned but on the learning patterns and practices. Except the employees for the observations and interviews (because the interviews occurred immediately after the observations), an employee should only participate in one method. In the selection of employees there should also be as much variation as possible in tasks, functions and levels of experience.

2.2.4 Procedure

Before the actual beginning of the study, the staff of City University visited the application partners in March 2006 to get an impression of the workplaces and possible opportunities for observation. Since computer based workplaces were the most vital workplaces, most observations and all simulations are conducted at these workplaces. This way more content-oriented aspects of a learning moment at computer based workplaces could be determined. In addition, observations at other workplaces were conducted too, to develop a broader understanding of workplace learning.

For the observations, interviews and simulations 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. It was advised to inform the employees that the purpose of the visit was 'observing information use at the workplace'.

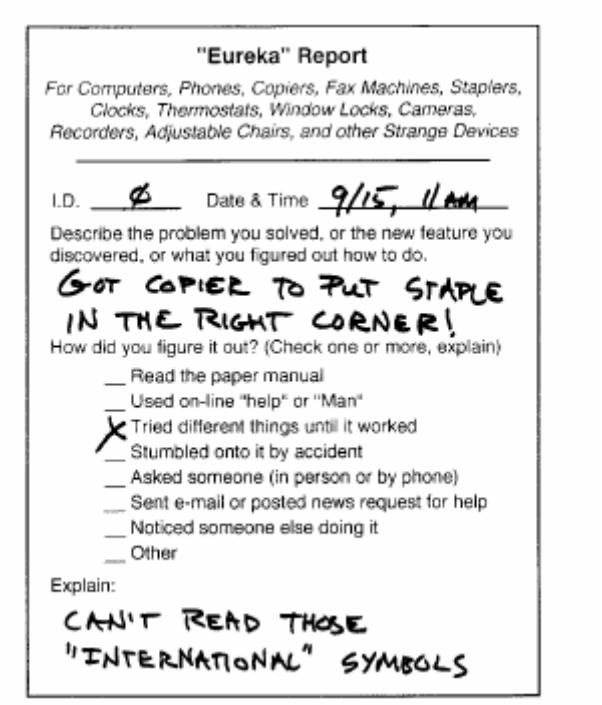
The data collection consisted of sessions that lasted approximately 60 to 105 minutes, depending on the number of methods involved. Observations at the workplace lasted 60 minutes and were followed by an interview, which took 45 minutes, or a simulation that took approximately 20 minutes. Depending on the type of workplace (computer based, not-computer based, meeting room, outside the office) one or two of the methods were used.

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. If something was unclear for the researcher, a short question could be asked. 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 the questions for a learner and an expert interview. The answers of the participants were noted down by the observer. For the simulation the protocol was asking the participant to remember a learning event and replay it while the researcher observed the behaviour and took notes. The results were descriptions of the simulated behaviour of the participants, as explained and performed by the participants. In Appendix C the specific protocols for the observations, interviews and simulations are described in more detail. As data collection using diaries is rather different from the other methods, more details are provided below.

2.2.5 Diaries

The time-span of the diary study was six weeks between mid May and the end of June 2006. Participants were asked to report (un)successful personal learning events that took place in their work context. 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 (Livingstone, 2001). Therefore, a participant could report about three types of learning moments: successful and intended, successful and coincidental, and unsuccessful learning events. Key features of attention were different aspects of self-directed learning: what triggers a learning moment, what is the intended goal or knowledge need that had to be met, how learning takes place, which resources are consulted, bottlenecks, and etcetera.

To report learning moments, Eureka Reports (see Figure 1), a type of diary study that focuses on recording learning events in everyday work, were used as a starting point for the design of a diary in this study (Rieman, 1996). The original Eureka Report was adjusted to the specific goals of this study by adding questions and changing the lay-out. The report contained questions related to the key features of attention mentioned above. Some answers were already pre-defined, but most questions were open-ended. Although it probably would have been simpler or less time consuming for the participants to answer the questions with pre-defined answers, open-ended questions offered participants the possibility to use their own terminology. Moreover, it was impossible to describe all possible situations that could occur in advance.



"Eureka" Report

For Computers, Phones, Copiers, Fax Machines, Staplers, Clocks, Thermostats, Window Locks, Cameras, Recorders, Adjustable Chairs, and other Strange Devices

I.D. Ø Date & Time 9/15, 11 AM

Describe the problem you solved, or the new feature you discovered, or what you figured out how to do.

GOT COPIER TO PUT STAPLE IN THE RIGHT CORNER!

How did you figure it out? (Check one or more, explain)

__ Read the paper manual
__ Used on-line "help" or "Man"
X Tried different things until it worked
__ Stumbled onto it by accident
__ Asked someone (in person or by phone)
__ Sent e-mail or posted news request for help
__ Noticed someone else doing it
__ Other

Explain:

CAN'T READ THOSE "INTERNATIONAL" SYMBOLS

Figure 1 The original eureka Report (Rieman, 1996)

The application 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 preferred number of participants was six participants per application partner.

The Eureka Report was accessible through a webpage, see Appendix D for an overview of the questions in the Eureka Report. Each participant received a personalized link to the website by e-mail. This way every participant had a unique ID and the participants didn't have to log in or fill in questions about their name, the date and time. See Figure 2 for a screen shot of the first part of the Eureka Report. To reduce the burden for the participants, they were asked to fill in the Eureka Reports only a few (work) days a week. These days varied for each participant: some had to do it on Mondays, Wednesdays and Thursdays, others on Tuesdays, Wednesdays and Fridays or Mondays, Wednesdays and Fridays, and so forth.

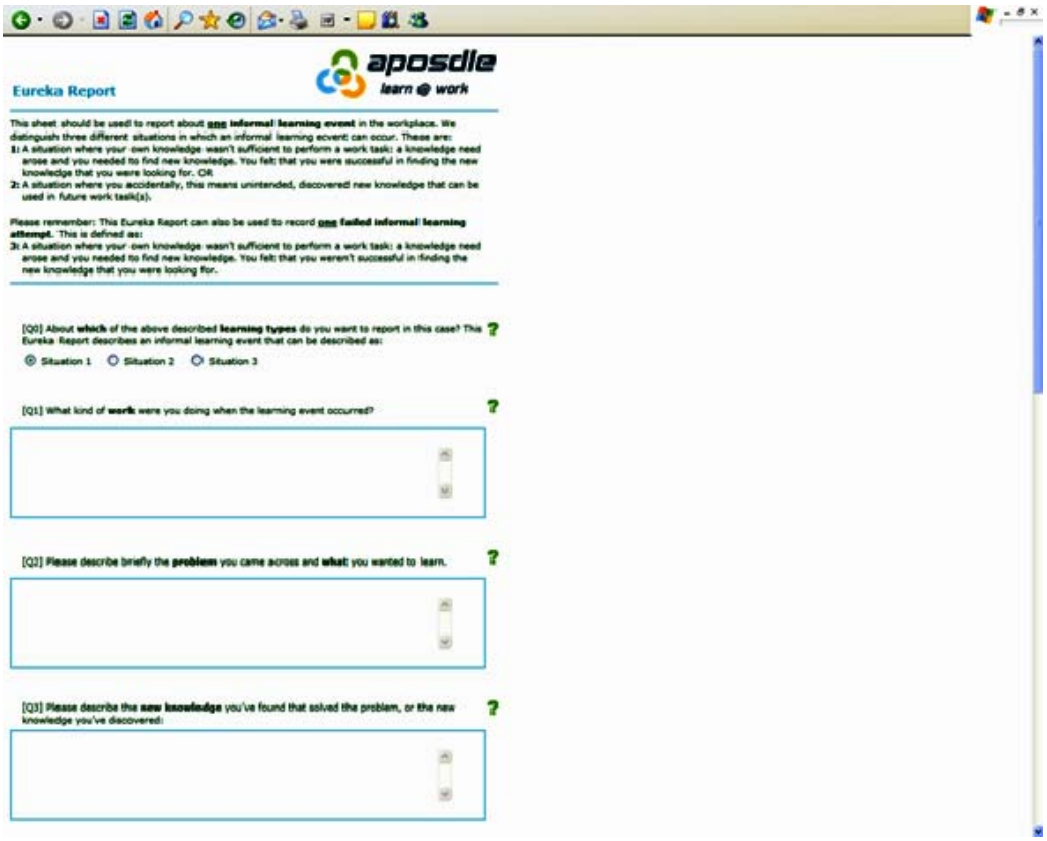


Figure 2 Screen shot of the Eureka Report

Because the mother tongue of the participants wasn't English and because it was preferred by the application partners, the Eureka Report was also available in German. After all, it is easier to express oneself in one's own language. Participants were instructed by e-mail about the goal of the study and when and how they had to fill in a Eureka Report. In addition, an instruction document was sent to the participants by mail before the start of the study. A help-document, which explained the questions and terms used in the Eureka Report, was also linked to the questions on the website. Furthermore, additional comments could be noted by the participants at the end of a Eureka Report.

Every week each participant received an overview of their number of submitted Eureka Reports. At the end of the first reporting week and in case of ambiguous or unclear answers, the investigator contacted the participant by phone. After the first week the submitted Eureka Reports (if there were any) were discussed and the participants were asked if they experienced any problems. The participants could also ask for clarification about the reporting procedure, like questions as to what constituted a "Eureka" event.

2.3 Phase 2: Workplace Learning Survey

2.3.1 Method

The preparation of Phase 2 of the WPLS started the last weeks of August 2006. The actual data collection started in mid September 2006 and lasted till the beginning of November. The goal of the Work Place Learning Survey was twofold: the first was to verify the most important outcomes of the WPLS. Which findings of the WPLS 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 was required. Secondly, the results of the survey, together with the results of Phase 1, could also be used to identify patterns and practices in workplace learning as they currently occur in European organizations. That way used learning strategies could be determined.

2.3.2 Sampling

Generally speaking it's next to impossible to draw a random sample from the target users of APOSDLE. First, they are not precisely known, which precludes a proper definition of the population. Second, if they were known, they are probably very difficult to approach, in particular when resources available do not allow the hiring of very expensive market research companies. Furthermore, it's known that sending questionnaires to organizations and/or people in organizations yield very low response rates, mostly below 1%. Faced with these problems, we decided to opt for a kind of "snow balling" sample procedure that intends to maximize the response. This approach entailed that each partner got in touch with some of their contacts in different organizations (first step) and asked them to find some suitable respondents (second step). This meant that there could be a few contacts that deliver many participants, but there could also be many contacts that each deliver a few participants. It also means that it was not possible to influence the precise number of people who received a request to participate, and thus 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 of the study. However, the maximum proportion of participants from the partners' own organization shouldn't be more than 33%.

The aim of this two-step approach method was to capitalize on personal relations. By approaching the contacts of all partners and ask them to look for some participants, relational obligations started to play a role. People tend to do more for people they know, because they feel a social obligation to do so. This aspect of the method was seen as an important factor to ensure a reasonably high response.

The contact organizations received an instruction which explained the type of participant looked for. These selection criteria for the respondents were provided in order to keep the selection of respondents under control. Suitable respondents were described as knowledge workers who spend at least 60% of their working time at a computer based workplace, a workplace where a personal computer is present.

2.3.3 Procedure

The participants were approached via an e-mail sent by contacts of the project partners, which explained the goal of the survey briefly and subsequently asked the recipient for their participation. Through a link in this mail they could access the online survey anonymously. Once the participant started to fill in the survey, the data were automatically collected in a data repository.

As the content of the questionnaire was partly determined by findings from Phase 1, it is described in more detail in section 3.2.3.

3 Results

In this chapter the results of the WPLS are described. First the results from Phase 1 of the study, followed by the results of Phase 2. Finally, results from both phases are compared.

3.1 Phase 1: Identifying workplace learning strategies by observation, interview and diaries

This section describes the results of Phase 1: collecting workplace learning data in the organizations of the APOSDLE application partners in order to identify workplace learning strategies.

3.1.1 Data collected, data preparation and sample characteristics

Data collection period

Period of data collection

Work Place Learning study, i.e. observations, interviews and simulations:

- ISN April 5th, 6th and June 30th
- CNM May 2nd, 3rd, 4th
- IHK May 29th, 30th, 31st
- EADS June 20th, 21rst

Diary Study:

- May 15th till June 23rd (six weeks)

Participants

As mentioned in Chapter 2, one person could take part in more than one method, for example in an observation and an interview. In total 46 different persons participated in the study. In total 97 observation sessions, interview sessions, and/or simulation sessions were conducted, involving 41 different persons. Together 17 persons participated in the diary study and submitted Eureka Reports, of which 12 also participated in at least one of the other methods. This distribution of participants per partner is shown in Table 1.

Table 1: Number of participants per method

	Method			
Partner	**Observations**	**Interviews**	**Simulations**	**Eureka Reports**
IHK	22	9	1	6
EADS	8	8	0	5
ISN	5	6	0	1
CNM	6	10	0	5
Total	**41**	**33**	**1**	**17**

For observations, most observations were done at IHK and least at ISN. This reflects the size of the organizations and the opportunities to observe. As part of the work in EADS is confidential, it was more difficult to find observation and interviewing locations. However, in the reported learning moments in the diaries this was corrected. In addition, an equal distribution of participants over the Eureka Reports was achieved. ISN stands out with just one participant, however, looking at the relative size of ISN compared to the other three, it turned out to be difficult to find more persons fairly strongly bound to a computer based workplace (see also the description of the organization and the nature of the work in Appendix B).

It should be mentioned that the original collected data contained a larger number of observations, interviews, simulations and Eureka Reports. However, not all data were usable, because it had to involve learning (according to our definition given in section 1.4) or because there was overlap in data, for example if a diary entry of a person was similar to what was observed at the workplace of that person.

Interrater agreement

To examine the reliability of the coding, the interrater agreement was determined. A second coder coded a subset of 50 (see Skalski, 2002) of the 175 learning events. Cohen's Kappa, which is a suitable measure for mainly nominal data, was calculated (.807) which is good and no changes had to be made.

Learning events: the unit of analysis

To make the data collected comparable across different methods, we decided to take a "learning event" as the unit of analysis. Following the definition of learning in 1.4, a learning event was defined as a moment during work when a participant went to search for information having a high likelihood of future (re)use.

The key for a learning moment to be classified as a learning event is if it has a high likelihood of being (re)used in the future. For nearly all learner roles (93%) it holds that the newly acquired knowledge will be re-used in future. The results per partner, see Table 2 show no meaningful differences: the percentage of re-use varies between 88% (EADS) and 100% (ISN).

Table 2 Percentage of learning events where learner indicated reuse of knowledge is intended in the future (learner role only, N=102)

	Yes (N=95)	No (N=7)
ISN	100 %	0 %
CNM	96 %	4 %
IHK	95 %	5 %
EADS	88 %	12 %
Total	**93 %**	**7 %**

Table 2 shows that the likelihood of re-use of almost all learning events is high, which implies that they can be included as "true" learning events (in terms of the definition) in the analysis

A distinction is made between learning events of individuals and groups, and looking at learning events from the side of the expert. The learning events are therefore labeled as experienced from a *learner role*, in a *group setting* or from an *expert role*. Learning events experienced from a learner role were all learning events in which a learner was observed or interviewed, or were taken from the

Eureka Reports or simulations. Learning events experienced from an expert role were all learning events which were derived from interviews from persons in an expert role (that is, being approached by colleagues for help). Learning events in group settings are learning events that occur at a departmental meeting, a meeting with a customer or an internal meeting that was observed. The size of the groups where we observed learning events varied from two to seven persons. Although we also observed larger groups, we didn't observe important (or better: APOSDLE relevant) learning events.

Data about 175 Learning Events (LE, 138 learner roles, 8 group settings and 29 expert roles) are collected. The data on the learning events are collected using Eureka Reports (71), observations (40)[2], interviews (34) and simulations (1). The data for the expert roles are all obtained by interviews.

The raw data (observation reports, answers to interview questions, diary entries) for the learning events were coded (see for interrater reliability above) by the two researchers from the UT on several aspects. These aspects are, for example, basic personal or group characteristics, the used method (e.g.,observations, interviews, simulations or Eureka Reports), consulted sources (e.g., who or what was consulted for finding the knowledge, like a written material or a colleague), used media (e.g., what communication medium was used to contact a colleague, like email), type of learned knowledge (fact, procedure or concept), and if there were bottlenecks.

Because the data set for learner roles is largest (138 learning collected events refer to learner roles), they were used for nearly all analyses. The data of expert roles and groups settings aren't used for all analyses for mainly the data set is smaller (8 group settings and 29 expert roles) and therefore has limitations as to which analyses are meaningful. Whenever data from group settings and expert roles are included this is shown in the tables

Sample characteristics

As for the sample characteristics it should be stated that as our unit of analysis is a learning event, we describe the sample by describing the nature of these learning events. However, these events are obtained by observing, interviewing and reporting using people in organizations. The selection procedure for these people can be found in 2.2 and the results in Table 1. In addition to this and the description in the next section we only present data about the gender of the participants as these were not part of the selection schema.

Table 3 shows that the overall ratio of men to women who experience learning events is 2 to 1, which means that more men than women participated. Although the exact ratio in the partners' organization is not known, it seems that in most organizations men form the majority. This is reflected in Table 4 where the ratio per partner is shown Only at IHK an equal number of men and women participated. We do not know whether this skewed distribution has any consequences for the results. We don't know of any studies that have reported women experiencing significantly different learning events. In any case, the number of women in the sample and the number of found learning events makes it likely that any "woman specific" learning event, if it exists, was captured.

Table 3: Percentage of male and female participants experiencing learning events (N=167)

	Male	Female
Learner Role	67 %	33 %
Group Setting	Na[3]	Na
Expert Role	62 %	38 %
Total	**71 %**	**29 %**

[2] As there were 62 observations (see Table 1) it can be derived that not all observations yielded learning events.

[3] Na= not applicable (no data or not relevant)

Table 4: Percentage of male and female participants experiencing learning events per partner (N=167)

	Male	Female
Learner role	67 %	33 %
ISN	78 %	22 %
CNM	58 %	42 %
IHK	50 %	50 %
EADS	75 %	25 %
Group setting	Na	Na
Expert role	62 %	38 %
ISN	86 %	14 %
CNM	78 %	22 %
IHK	17 %	83 %
EADS	57 %	43 %
Total	**71 %**	**29 %**

As we could (and would) not control the submission of Eureka reports, checking the distribution over people and partners makes sense. The number of Eureka Reports (ER) submitted per participant varied from none to 11. The average is 4 per participant (4.4). Looking at the submitted Eureka Reports per partner, the distribution is as follows: IHK: 11, EADS: 38, ISN: 7, and CNM: 14, thus EADS has submitted most. This can have an influence on the results as almost half of the learning events are derived from the Eureka reports. However, this influence is not so easy to trace. It seems that the nature of the work at EADS is slightly different from that of the other partners, being more research oriented. As we will split the results in the next section for each partner anomalies can be detected.

3.1.2 Phase 1 results

The presentation of the results is split into four parts: the first addresses the notion of learning patterns, the second one focuses on other aspects of learning events and the third is devoted to analyzing the relation between learning patterns and other aspects of learning events. The fourth part investigates relations between success of learning events and other variables.

3.1.2.1 Learning patterns

The recording of a learning event is very concrete, describing all the details of one event (e.g. specific knowledge need, learned or sought knowledge, specific bottlenecks). To achieve a more abstract and simplified description, only certain aspects of one learning event are classified. The data provided by the methods used enable us to identify patterns people follow when attempting to learn something during their daily work. As mentioned in Section 1.3 patterns refer to schemes or models, suggesting patterns are structured and abstractions of certain aspects of reality. In this study learning events are represented in a structured and abstracted manner, namely by describing them in terms of *learning patterns*. A learning pattern, as an abstraction of a learning event, is defined as a time ordered structure consisting of a *trigger*, a *solution type* and *communication media* used. A learning pattern focuses on modeling the learning *behaviour*: what were people doing at the time the learning took place (trigger of learning), how did they find the knowledge (solution type) and which type of communication medium is used (communication media).

These factors or components of a learning pattern of a learning event are:

1) *Trigger*: the primary mover for the need to learn something

- Task driven learning (1): A person lacks certain knowledge to continue in a task.
- Curiosity learning (2): A person intentionally looks for new knowledge, not because a task needs it, but because the person has a general interest in the topic.
- Coincidental learning (3): A person accidentally discovers new knowledge when reviewing information sources or when talking to others.

2) *Solution type*: what kind of solution is attempted

- Interpersonal help seeking (1): Contacting a colleague for assistance.
- Seeking help from written material (2): Looking for knowledge in digital or paper based documents
- Practical application (3): Trying things out and discovering some new knowledge

3) *Communication media*: media that are used when searching for a solution

- Face-to-face (1): for example face to face meeting, telephone
- Paper based medium (2): for example books, reports
- Digital (3): for example email, chat

The numbers in the above list are used for the description of the learning patterns (see later on).

First we will present separate results for these learning pattern factors, which are also split for each of the partner organizations. Next the learning patterns that were detected are described, followed by an in-depth analysis of how learning patterns depend on or influence work environment variables.

Characterization of each learning pattern factor

Trigger: intentional learning or not?

Most learner role events (75%) were intentional, meaning that someone intended to learn something, most of the time driven by the task they were working on, see Table 5. One out of four learner role events (25%) was unintentional, which means that the learning was coincidental. An example of unintentional learning is learning something during a coffee break, when talking to colleagues. All group settings and expert role learning events were intended.

Table 5: Percentage of intentional and unintentional learning events (N=146)

	Intentional	**Unintentional**
Learner role	75 %	25 %
Group setting	100 %	0 %
Expert role	100 %	0 %
Total	**80 %**	**20 %**

Solution type

When someone notices that his or her own knowledge isn't sufficient to perform a work task leading to a knowledge need, they can try different solution types to find the knowledge. In Table 6 an overview of these solutions types is given. Each type that was used in a learning event was counted and more types could be used in one learning event.

Interpersonal help seeking, like approaching colleagues or clients, is used most frequently (70%), in particular in group settings learning events (100%). Digital written material, like the internet, intranet or PDF-articles are also favoured in both learner role events (63%) and group settings events (63%). Paper based written material, like books, prints or magazines, play a less important role (17%). Practical application, that is trying things out in practice, also doesn't occur relatively often (16%). In group settings however, paper sources are often consulted (50%).

Table 6: Solution Types involved in each of the learning events (N=146)

	Interpersonal Help seeking	**Seeking help from paper based written material**	**Seeking help from digital written material**	**Practical application**
Learner role	70 %	17 %	63 %	16 %
Group setting	100 %	50 %	63 %	0 %
Expert role	Na	Na	Na	Na
Total	**42 %**	**11 %**	**37 %**	**9 %**

In case of interpersonal help seeking, seeking help from written material (paper based or digital), different types of sources could be consulted. The source can be a person, something made of paper, or coming from a digital source that is located on one's computer, on a network or the internet. We have counted the number of types that are consulted in every learning event. Table 7 presents an overview of the total number of types of consulted sources. The number of types of consulted sources in group settings is mostly two (63%) or three (25%). In learner roles almost the same is found: one (60%) or two (33%) types of sources are consulted. This means that in most learner role events end after consulting personal and/or digital sources.

Table 7: Number of sources (personal, digital or paper) used in each learning event (N=146)

Total number	**Three**	**Two**	**One**	**Total**
Learner role	7 %	33 %	60 %	**100 %**
Group setting	25 %	63 %	13 %	**101 %**

Table 8, which gives a more detailed overview of which specific sources are consulted, shows that colleagues, internet, meetings and digital documents are consulted most. When colleagues are consulted, these are often colleagues from the same room or site (larger companies). The internet refers to a large range of sources, like search engines such as Google, discussion forums, company websites and encyclopaedia such as Wikipedia. Intranet, internal systems or databases, menu buttons, help menus or personal presentations (without the use of PowerPoint) are consulted less for finding new knowledge.

Table 8: Types of sources consulted in learning events (N=322, total number of consulted sources)

Consulted source (in attempt to find a solution)	Frequency	Percentage %
Colleague (=Face-to-face, telephone)	71	22 %
Internet	56	17 %
Meeting (with colleagues or clients)	48	15 %
Digital documents/PDF	29	9 %
Paper based sources (like magazine, hand-outs, brochure, notes, binders)	25	8 %
Test/trail	21	7 %
PowerPoint	15	5 %
Books	14	4 %
Application (test, source)	14	4 %
Intranet, internal systems or database	12	4 %
menu buttons/help function application	4	1 %
Personal presentation	4	1 %
Other	9	3 %

Used communication media

The communication media used in finding a solution were categorized in three groups: face-to-face, paper and digital with different instances. Face-to-face media include direct contact with persons, like a conversation with a colleague or a phone call. Paper media includes letters or memos and digital media refer to e-mail and chat programs. More than one communication medium could be used in one learning event.

Face-to-face is used most frequently in learner role events (67%) and exclusively in group settings events (100%), seeTable 9. Experts mentioned more digital (72%) and paper (10%) media use than the learners (respectively 16% and 1%).

Table 9: Communication medium used in learning events (N=175)

	Face-to-face	Paper	Digital
Learner role	67 %	1 %	16 %
Group setting	100 %	0 %	0 %
Expert role	100 %	1 %	72 %
Total	**73 %**	**2 %**	**24 %**

In Table 10 the types of used communication media are presented in more detail. It is not surprising that direct, face-to face communication is used most, followed by the digital communication medium e-mail. The use of the medium phone, a special form of face-to-face communication, is almost equal to the use of e-mail. Like the results in Table 9 also suggest, paper based media are used rarely.

Table 10 Types of communication media used in learning events (N=194, total number of used types of communication media)

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

In a learning event, more types of communication media could be used to contact and consult sources.

Table 11 shows an overview of the number of types of used communication media in the different learning event types. In learner role events, no communication media are used in approximately one out of four cases (28%) This occurs for example when someone successfully searches and finds something on the internet: no communication medium is needed. In most of the other learner role events, one type of communication medium is used (62%). Using two (9%) or three (15%) types of communication media is rare in learner role events, while the use of one type of communication medium was typical for group settings events (100%). Experts frequently mentioned the use of two types of communication media (69%)

Table 11 Number of types of used communication media in the different learning event types (N=175)

Total number	Three	Two	One	None
Learner role	1 %	9 %	62 %	28 %
Group setting	0 %	0 %	100 %	0 %
Expert role	7 %	69 %	24 %	0 %

Structure of learning patterns

Using the three factors or components mentioned before (trigger, solution type and communication medium), every learning event can be described in a structured way. When this is done, one can identify more and less frequent patterns, giving an indication about which behavioural sequences dominate workplace learning.

Every learning pattern has *one and only one* trigger, but can consist of any sequence of solution type-communication medium combinations. For example, a learning event that starts with a task driven learning need, consults a colleague by means of a face-to-face contact is coded as 1 ->1(1) (see for codes above). If in a learning event after consulting a colleague also a written digital source is consulted the coding is 1->1(1) ->2(3).

Of the 175 learning events 140 (80%) were task triggered and 35 (20%) were triggered by coincidence, all in learner roles. None of the events was triggered by curiosity. Together they led to 57 different patterns of which 49 appear (sometimes exclusively) in learner role events. For an overview of the patterns of all learning events see Appendix F.

In the list below the frequency of the pattern types for *coincidental learning events* is shown (note that the first symbol is deleted as it is always 3):

17 times the pattern1 (1),

5 times the pattern 2 (3),

12 times a patterns that consist of some sequence of solution type 1 (interpersonal help seeking) and/or 2 (consulting written material)

1 time the pattern 1 (1) -> 3(3)

As can be seen from this list, the majority is found in the pattern “interpersonal help seeking->face-to-face”, followed by “seeking help from written material->digital”. These two patterns are considered key patterns for coincidental learning. Other patterns are less frequent, in particular patterns that consist of a sequence of more than 2 solution types, or combinations with both of the two key patterns.

For *task driven learning events* in *learner roles* alone the list looks as follows:

42 times the pattern1(1)

30 times the pattern 2(3)

17 times one of the two patterns consisting of some sequence of solution types 1 (interpersonal help seeking) and 2 (consulting written material).

Again interpersonal help seeking-face-to-face dominates, but less so as in coincidental learning. Also there is a preponderance of one step patterns, though there are several two step patterns (see Appendix F).

For the *expert role* learning events, which were all *task triggered*, the distribution was:

27 times the pattern 1(1)

13 times the pattern 1(3)

5 times the pattern 2 (3)

3 times the pattern 1 (3) -> 2 (3)

Interpersonal help seeking->face-to-face (and sometimes by mail) and seeking help from written material-> digital can be seen as key patterns for expert roles.

The key patterns found for coincidental and task driven learning described above are similar: all involve face-to-face interpersonal help seeking and seeking help from digital written material. However, these key patterns didn’t cover all the 57 learning patterns that were found. The remaining learning patterns were all relatively long combinations of solution types and communication media but were limited to a few learning events. In order to deal with the remaining the patterns, we looked if

they were based on (this means derivable from or a combination of) one of the learner roles' key combinations. We decided to look at derived key patterns of learner role events, because of the relative size of the learner roles data compared to the other data (see also the explanation in 3.1.1). For learner roles 45 derived patterns were found, see Table 12. For group settings, besides once the solution of consulting a person face-to-face, 7 derived patterns were found. For expert roles 7 derived were found, in addition to the solutions of consulting a book and the expert's key combinations. For the derived expert's and group combinations hold that they often were similar to those of the learner roles. Only 6 patterns, referring to 28 events, were not based on one of the key learning patterns of learner role events. Concluding: the three key patterns of learner role events cover 51 (90%) of all found learning patterns and 147 (84%) of all learning events. This indicates that variety in learning patterns is limited.

Table 12 Derived learning patterns

Derived learning patterns	Frequency in learner roles' learning patterns	Frequency in group settings' learning patterns	Frequency in expert roles' patterns
A combination of a remaining pattern and consulting a person face-to-face *once*	8	3	2
A combination of remaining patterns were consulting a person face-to-face occurs *twice*	7	2	3
A combination of a remaining pattern and consulting a digital source *once*	6	0	0
A combination of remaining patterns were consulting a digital source occurs *twice*	4	0	0
A combination of remaining patterns were consulting a digital source occurs *thrice*	3	0	0
A combination of a remaining pattern and the combination of consulting a person face-to-face *once* and consulting a digital source *once*	17	2	2

3.1.2.2 Other aspects of learning events

What was learned?

The learning that was observed and reported covered a wide variety of topics. A rather straightforward example is learning how to handle spreadsheet columns in MS Excel, a more complex one is learning about the features of engine of an airplane allowing more efficient assembling and maintenance.

Three more general types of knowledge were discerned: facts, procedures and concepts, see Table 13. A concept is the type of knowledge that was learned most frequently, especially in group settings (63%) and learner roles (43%), but all three types are present in substantial amounts. Experts,

however, mentioned procedure as the type of knowledge they were consulted for most (45%). Learning procedures occurred more often in learner roles (29%) than in group settings (13%).

Table 13: Type of knowledge acquired in the learning events (N=175)

	Fact	Procedure	Concept
Learner role	28 %	29 %	43 %
Group setting	25 %	13 %	63 %
Expert role	21 %	45 %	35 %
Total	**27 %**	**31 %**	**42 %**

Successful learning event or not?

Proportionately many learner roles (72%) and group settings (63%) are successful, that is, the needed knowledge is found, which indicates that mostly people learn what they wanted to learn (see Table 14). There were also some learning events (15%) that weren't finished at the time the observation/reporting took place. It didn't occur frequently that learner role learning was postponed (6%) or failed (7%).

Table 14: Percentage of successful learning events (N=146)

	Successful	Failed	Not finished yet	Postponed
Learner role	72 %	7 %	15 %	6 %
Group setting	63 %	0 %	38 %	0 %
Expert role	Na	Na	Na	Na
Total	**71 %**	**7 %**	**16 %**	**6 %**

Workplace were the learning took place

As the emphasis during data collection was on computer based workplaces, it is not surprising that most recorded learner role events (68%) took place at these workplaces and far fewer (4%) took place at workplaces without a computer, see Table 15. Group settings often occurred in a meeting room (75%), this could be a separate room or an office were people gathered to meet. Some learner roles events (12%) took place outside the office, for example at customer sites.

Table 15: Locations in which learning events were experienced (N=175)

	Computer based	Not-computer based	Meeting (room)	Outside the office
Learner role	68 %	4 %	16 %	12 %
Group setting	13 %	0 %	75 %	13 %
Expert role	48 %	35 %	17 %	0 %
Total	**62 %**	**9 %**	**19 %**	**10 %**

Bottlenecks

During a learning event there could have been difficulties (bottlenecks) that influenced the learning event in a negative way. In total 76 learning events, out of the 175 learning events, involved one or more bottlenecks. In absolute numbers most bottlenecks occurred in learner role events, simply because the majority of learning events are situated in a learner role. In terms of learning events with and without bottlenecks, expert roles are proportionally more bottleneck prone (72% with a bottleneck) than learner (48%) and group settings events (13%) see Table 16.

Table 16 Percentage of learning events with and without bottlenecks (N=175)

	Yes	No
Learner role	48 %	53 %
Group setting	13 %	88 %
Expert role	72 %	28 %
Total	**43 %**	**57 %**

After determining that one ore more bottlenecks occurred in a learning event, a more detailed study of the bottlenecks was conducted. All the bottlenecks were categorized and the frequency per category was recorded. No group settings bottlenecks remained: the bottleneck that was found was not relevant for APOSDLE, being out of the scope of the project. In total 147 bottlenecks remained, distributed as follows: 106 bottlenecks for the learner role events and 41 bottlenecks for the expert role events .

An overview of all the bottlenecks is given in Appendix E. The bottlenecks that occurred most frequently in learner role events, that is more than three times, are shown in Table 17. 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.

All the bottlenecks in the expert role events are shown in Table 18. Similar to the learner role events, time is also often a bottleneck: not having enough time to help is mentioned most frequently. Lacking the knowledge or experience to help is also mentioned often. Not being able to remember something or communicating with other departments are also bottlenecks that were mentioned some times.

Table 17 Bottlenecks participants experienced most often during learning events in learner role events

Category	Description	Frequencies Learner role	Frequencies Expert role
Interpersonal help seeking	Can't reach colleagues to help.	5	0
	Colleagues can't help (for example because of the specific nature of the question(s).)	6	0
	Can't reach colleagues to help.	5	0
Information problems	The information is too specific for immediate use.	5	0
	Too much information (for example: needs to filter it to find the information looked-for, which costs time.)	7	0
	The information is not sufficient to solve the problem.	8	0
	No information is available.	7	0
Search problems	Don't knowing exactly what it is you're looking for.	7	0
	Don't knowing exactly what it is important to know.	4	0
	Don't knowing exactly where to look for the information.	6	0
"Opportunity" problems	Not having enough time to learn.	7	0
	Not having access to all information.	5	0
Media problems	Lack of a supporting (KM/learning) system.	3	2
	Doesn't like certain characteristics of a medium (more general than 21).	4	2
Internal sources	Clear rules about knowledge storage are missing.	2	2

Table 18 Bottlenecks participants experienced most often during learning events in expert role events

Description	Frequencies Learner role	Frequencies Expert role
The question isn't formulated clearly.	0	1
Not having time to help.	0	9
Not able to help.	0	2
Not able to remember it.	0	4
Communicating with other departments is difficult.	1	2
Not knowing if you it is your responsibility to help someone.	0	1
Lacking (domain) knowledge/experience.	1	7
Being a perfectionist. (And thus spend much time in making your assistance perfect).	0	1
Presenting what you say in an understandable way.	0	2
Language problems with foreigners.	0	1
Organization of internal communication.	0	1

3.1.2.3 Analysing learning patterns: relations with environment variables

In this section we will investigate if learning patterns depend on or have an influence on several variables discussed before. We will call these "environment variables" as they either can shape learning patterns or can be influenced by learning patterns. For this we need a variable that can capture the fundamental structure of a learning pattern in terms of complexity.

Learning patterns consist of one trigger and n-tuple combinations of solution type-communication media. The *sequence length of a learning pattern* is defined as the number of those combinations; the more combinations, the longer the sequence of a learning pattern and the more complex. We will use this variable as the key one for characterizing learning patterns in the analysis.

As environment variables we will include:

- Success of the learning event
- Learned knowledge type(s)
- Location of learning event
- Frequency of bottlenecks associated with learning events

We will perform the analysis only on the learner events from the learner role data as they constitute the largest part of all events, making statistical analyses meaningful.

The frequency of sequence lengths of the learning patterns is shown in Figure 3.

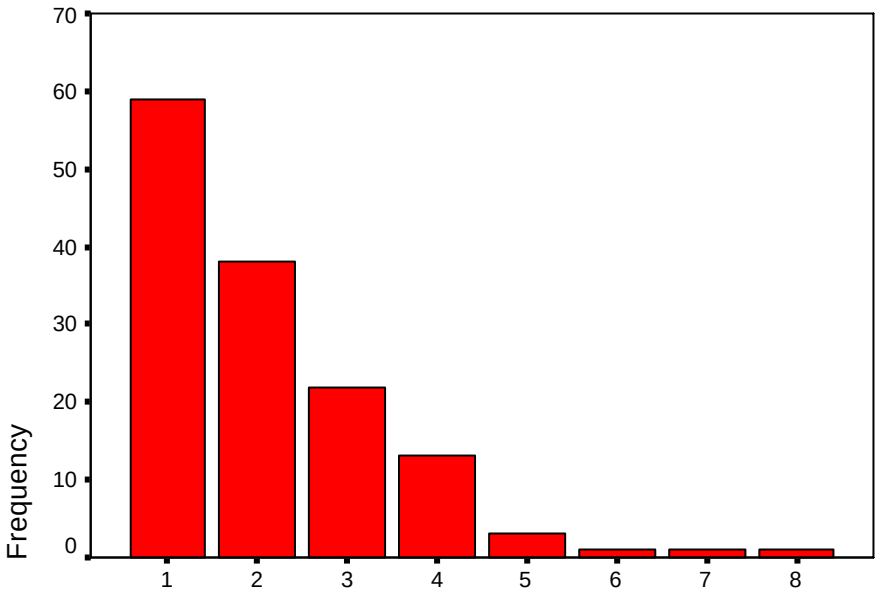


Figure 3 Frequency of sequence lengths of the learning patterns

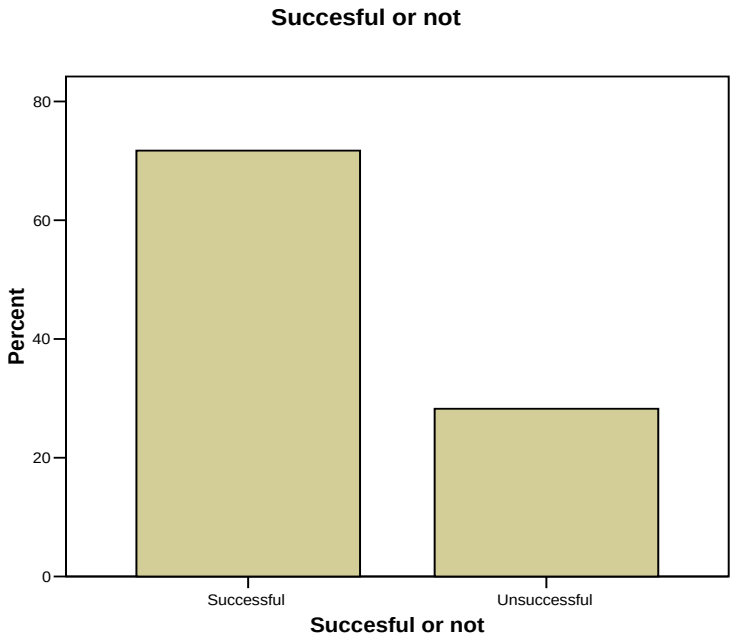


Figure 4 Percentage successful learning events and unsuccessful learning events

From Figure 3 it can be seen that most learning patterns have a sequence length of 1 or 2. More complex patterns are rare.

The first issue is whether the success of a learning event is related to the sequence length of a learning pattern. As can be seen from Table 14, the distribution between the learning events outcomes types is skewed. Taking the four possible outcomes as the variable will not give meaningful results. A dichotomy (successful – unsuccessful) probably gives an improved (i.e., more clear) overview. This

was done for the data of the learner role events as they generated most learning events. After dividing the learning events in 1) successful and 2) unsuccessful learning events, see Figure 4 the distribution is less skewed: 72% is successful and 28% isn't.

Intuitively one expects that short sequence patterns are more likely to lead to success, because failure in the first try will create the need to make other efforts. Table 19 below shows the distribution of 138 learner role events over the two outcome categories (success, unsuccessful) and the sequence length of a learning pattern. As can be seen from Table 19 the large majority of successful learning events consist of sequences of length one or two. The average sequence of length is two (average=2.09, SD=1.3) and 70% of all the learning patterns consist of one or two combinations. Learning patterns consisting of more than four combinations occur rarely.

By means of an analysis of variance[4] we can find out whether there is a significant difference in sequence length between successful learning events and unsuccessful learning events.

The analysis of variance yielded a significant effect ($F=2.493$, $p< .05$). A Post-hoc test shows that shorter learning patterns are more successful, see Table 19.

Table 19 Success of learning events as a function of sequence length of learning patterns

Successful or not	**sequence length of a learning pattern**					**Total**
	1	2	3	4	5+	
Successful	47	31	11	7	3	**99**
Unsuccessful	12	7	11	6	3	**39**
Total	**59**	**38**	**22**	**13**	**6**	**138**

The sequence length is related to the knowledge type that is learned ($F=3.676$, $p<.05$). The occurrence of each sequence length for each knowledge type is shown in Table 20. A Post hoc test shows that learning facts has a significantly shorter sequence length than learning concepts.

[4] As the distribution of sequence length is skewed the median is a better estimate of central tendency than the mean. This means that a monotone (MONANOVA) analysis of variance would have been better. Unfortunately we had no access to this method. In general however, in skewed distributions the mean underestimates the central tendency compared with the median. This leads to a lower likelihood of finding differences, thus staying at the safe side of making inferences. Post-hoc test is Tukey HSD.

Table 20 Knowledge type as a function of sequence length of a learning pattern

Knowledge type					Total
		Fact	Procedure	Concept	
The sequence length of a learning pattern	1	25	12	22	**59**
	2	8	15	15	**38**
	3	3	8	11	**22**
	4	2	5	6	**13**
	5	0	0	3	**3**
	6	1	0	0	**1**
	7	0	0	1	**1**
	8	0	0	1	**1**
Total		**39**	**40**	**59**	**138**

The expectation is that the occurrence of bottlenecks will make the sequence length longer. The results of the variance analyses show that the occurrence of bottleneck indeed makes the sequence length longer ($F=20.328$, $p < .05$): when no bottlenecks occur, the average sequence length is 1.73 in contrast to a sequence length of 2.77 when bottlenecks occur.

In Table 21 the average sequence length for four different locations where workplace learning can take place are given. The sequence length is not affected by the location of the learning event ($F=2.193$, $p > .05$).

Table 21: Sequence length of learning patterns as a function of location

Learning Location	Mean sequence length
Computer based	2.23
Not-computer based	2.00
meeting (room)	1.45
Outside the office	2.19
Total	**2.09**

In Table 22 the average sequence lengths for each partner are given to see whether type of organisation makes a difference (ISN: 1.74, CNM: 2.55, IHK: 1.86, EADS: 2.11). Although Table 22 suggests significant differences between the partners, the sequence lengths are not significant different ($F=2.160$, $p > .05$).

Table 22 The average sequence lengths of learning patterns per partner

Partner	Mean sequence length
ISN	1.74
CNM	2.55
IHK	1.86
EADS	2.11
Total	**2.09**

3.1.2.4 Analysis of success of learning events

Finally we will see if success of learning events is related to several other variables.

Success and total number of types of used media

Table 23 shows that the use of one type of or no communication media more often results in a successful learning event than when more than one type of communication media is used, which is consistent with the effect of sequence length as using more media will lead to longer learning pattern sequences. The effect of the number of types of used media on the success of a learning events is significant ($F=4.057$, $p<.05$).

Table 23: Success of learning events as a function of sequence length of learning pattern

	Total number of types of used communication media				Total
Successful or not	**1**	**2**	**3**	**none**	
Successful	1	7	70	21	**99**
Unsuccessful	0	6	16	17	**39**
Total	**1**	**13**	**86**	**38**	**138**

Success and knowledge types

Knowledge type show no significant effect for the four categories of success (Chi-square=11.25, $p>.05$). In Table 24 shows a crosstab of success as a dichotomy and the three knowledge types. The analyses reveals that the type of knowledge has a significant effect on the success of a learning event (Chi-square= 7.811, $p<.05$). Learning facts or concepts are successful more often than learning procedures, see Table 24.

Table 24 Success of learning events as a function of knowledge type learned

	Knowledge type			Total
Successful or not	**Fact**	**Procedure**	**Concept**	
Successful	31	22	46	**99**
Unsuccessful	8	18	13	**39**
Total	**39**	**40**	**59**	**138**

No significant effects of the total number of types of used sources (Eta=.049) on the success of learning events were found.

Additional analyses

Additional analyses were done, looking at the effect of the same variables applied in the analyses above, to see if they had an effect on knowledge type and partner. Knowledge type is not influenced by the total number of types of used communication media (Eta=.133) and the total number of types of used sources (Eta=.264). However, the location where the learning takes place effects the knowledge type that is learned (Chi-square=18.062, p<.05). In Table 25 the differentiation over the locations is given, showing that all three knowledge types are learned most at computer based workplaces and rarely at not-computer based workplaces.

Table 25 Knowledge type learned as a function of location

	Computer based	Not-computer based	Meeting (room)	Outside the office	Total
Fact	23	3	11	2	**39**
Procedure	35	1	2	2	**40**
Concept	36	2	9	12	**59**
Total	**94**	**6**	**22**	**16**	**138**

The relation between knowledge type and the occurrence of bottleneck showed that bottlenecks are effected significantly by the knowledge type that is learned (Chi-square=9.418, p<.05).Table 26 gives the overviews of the occurrence of bottlenecks for the three knowledge types, signifying that the learning of facts is relatively unproblematic compared to the learning of concepts and procedures.

Table 26 Knowledge type as a function of the occurrence of bottlenecks

	Yes	No	Total
Fact	7	23	**30**
Procedure	21	16	**37**
Concept	28	23	**51**
Total	**56**	**62**	**118**

Further analyses also showed that the variables sequence length (Eta=.200) and total number of types of used sources (Eta=.136) do not differ significantly for the four partners. The location of learning (Chi-square=14.933, p>.05) and the occurrence of bottlenecks (Chi-square=.421, p>.936) are also not significantly different between the four partners.

3.1.3 Summary of Phase 1 results

As mentioned in 2.2 the focus of Phase 1 was to collect data about learning patterns, bottlenecks, successes and failure of learning efforts and the types of knowledge people learn. In this section the main results will be summarized and also some other interesting results will be described briefly.

Learning patterns

The results show that most learning events, 80%, were triggered by the tasks people were performing. A smaller amount, 20%, was triggered by coincidence and none were triggered by curiosity. In all 57 different learning patterns were found in all the learning events and after deduction three key learning patterns remained, namely:

1. interpersonal help seeking face-to-face,
2. seeking help from digital written material, and
3. patterns consisting of some sequence of interpersonal help seeking and/or seeking help from written material.

The key patterns don't mention consulting paper based written material or practical application (trying things out), because when they appear, they are combined with learning pattern 1 or 2. Paper based sources are for example often consulted in group learning situations. These three key patterns explained 51 (90%) of the found learning patterns and 147 (84%) of all learning events. As shown by the key patterns, one or two step learning patterns predominate; most learning patters consist of one or two combinations of a solution type-used medium. In the case of interpersonal help seeking, colleagues are consulted most frequently face-to-face and less by e-mail or telephone. When someone seeks help from written material, the internet is consulted most. More than learners, experts mention the use of more communication media and the use of email as communication media.

Bottlenecks

Not all learning events were problem-free: in 43% of the learning events bottlenecks were encountered. In learning events from expert roles, the likelihood of experiencing bottlenecks is even higher (75%). Most problems that learners experience are related to inefficient providing of information or not being able to search information efficiently. The experts find it difficult when they lack the knowledge or experience to help. Learners and experts mention not having sufficient time to learn or help frequently as a bottleneck.

Success and failure

A comparison between application partners shows that relatively many learning events at ISN are successful. In general, most learning events are successful, which indicates that people learn what they want to learn. Some learning was postponed or unfinished learning events that weren't finished at the time the observation/reporting took place. When looking at the success rate, it appeared that unsuccessful learning events had a longer learning pattern sequence length, and used more communication media types.

Types of knowledge

The learning of facts, procedures and concepts are all present in learning events in substantial amounts, but concepts is the type of knowledge that was learned most frequently. Experts mention they are consulted most for explaining procedures. Learning procedures also seems to generate most problems and is least successful.

Other aspects

Although not mentioned before, an interesting finding from the observations is that people often work at multiple tasks simultaneously and can be involved in different learning situations at the same time.

Most learning of individuals occur at a computer based workplace and fewer at places outside the office. It is not surprising that groups learn most in meeting rooms. Some additional analysis reveal

that success of a learning event, when defined as a dichotomy (successful versus unsuccessful), is influenced by

- the sequence length of a learning pattern,
- the total number of types of used communication media, and
- the type of knowledge that is learned.

The total number of types of used sources or application partner has no influence on the success of a learning event.

Analysis also showed that the sequence length of a learning pattern is affected by the knowledge type that is learned and the occurrence of bottlenecks. In addition, results showed that the location of learning has an effect on the type of knowledge that is learned.

3.2 Phase 2: the workplace learning survey

This section presents the results of Phase 2 of the WPLS. As the design of the questionnaire was strongly influenced by the results of the Phase 1, this design is elaborated first. Next the sample characteristics and the results are described. A summary and conclusions section is also included. A comparison with the results of Phase 1 and the ultimate relevance for APOSDLE is deferred to the next section and the final chapter.

3.2.1 Design of the questionnaire

The design of the survey questionnaire was driven by the principles listed below:

1. a rather brief questionnaire, because people who volunteer for answering mostly don't like long ones
2. a preference for questions with closed answer categories which speeds up processing of the data
3. to be administered through the Internet which allows easy and personal access for respondents
4. focusing on the main points from Phase 1 that had to be validated in the survey and some additional factors from the literature.

We will deal with each of these in turn.

Our initial aim was to limit the questionnaire to not more than two pages, but this came into conflict with point 4 above and also to a certain extent with point 2. In the end 25 questions were included, maybe more than optimal, but still within reasonable boundaries. We assumed that ease of access and answering by using an Internet version could compensate for the length. A pilot with the questionnaire showed that answering took on average 20 minutes, which we deemed to be acceptable.

The processing of the data from Phase 1 was time consuming as it entailed a substantial amount of interpretation and coding of relatively unstructured information. For the survey a more cost-effective approach was needed, which resulted in the use of rating scales and distributing a fixed amount of points over several alternatives. Both allow for a straightforward use of quantitative analysis methods.

Sending and collecting paper based questionnaires is now quickly overtaken by Internet based approaches, which have proved to be better (see Bronner et al., 2003). Several commercial services are now available and we used SurveyMonkey® because it provided the functionality we needed.

The survey was based on insights from the first results of the WPLS. Also, relevant literature about learning strategies at work was used in the design process of the survey. The Holman et al. (2001) validated six factor model for learning strategies that adults use in a work environment, was used as a starting-point for the design of the statements in the survey. Holman et al. (2001) found six learning strategies: Reproduction, Extrinsic work reflection, Intrinsic work reflection, Interpersonal help seeking, Written help seeking, and Practical application. 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 the factors of the model of Holman et al. (2001) partly matched the first insights about used learning strategies. Especially those learning strategies that affect the learning behaviour were comparable. Therefore several statements were used in the survey to identify used learning strategies. Other statements and questions were also added, to verify other results of the study. Overall the focus was again on identifying behaviour rather than attitudes.

The 25 statements or questions that are used in the survey are shown in Appendix G. The survey consisted of three types of questions or statements divided over two parts. In the first part, a number of statements had to be judged using a four-point scale which varied from "completely similar" to "not

similar at all". This part also included questions in which 100 points have to be distributed over several answers, the constant sum scale questions. 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 have to be answered. Figure 5 shows a screen shot of the survey.

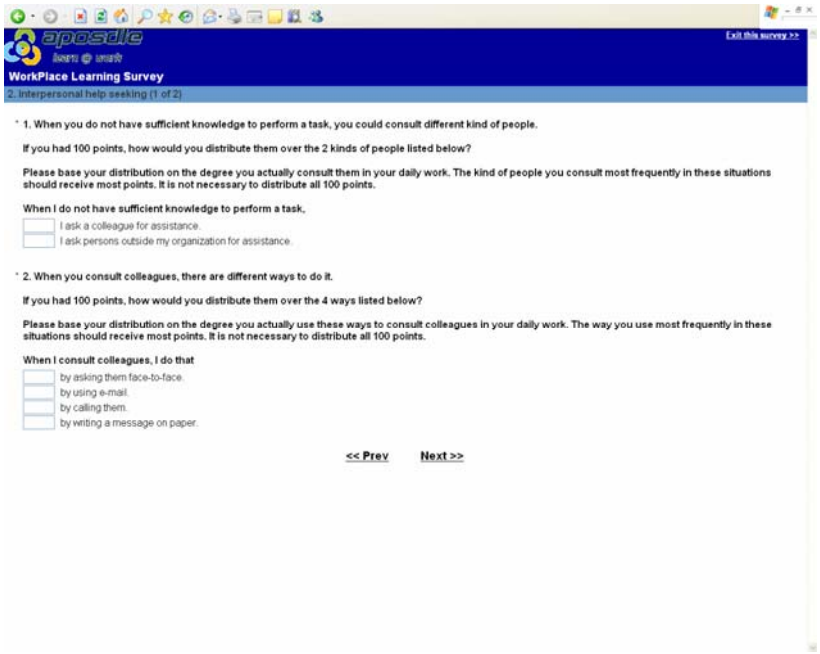


Figure 5

The questionnaire was accessible trough Internet (see before) in the period between October 6th, 2006 and November 3rd, 2006. After a slow start things gathered speed later on and finally 104 people answered the questionnaire. Of these, seven did not complete the questionnaire for unknown reasons. We removed them from the sample, so the final sample size is 97 persons.

3.2.2 Sample characteristics

As was mentioned before, our sample cannot be seen as a random sample from a population. The best we can aim at is a reasonable distribution over several characteristics that extend the range of observations we made during Phase 1. In this section we will present data on the sample characteristics.

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 just found knowledge about word processors to a document). Table 27 below shows the results.

Table 27: Average number of points (out of 100) distributed to three types of knowledge work (constant sum scale)

	Average number of points
Developing new knowledge	32
Passing on knowledge to others	32
Using obtained knowledge	38

As can be seen from Table 27 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. We will return to these types later.

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 (see Table 28).

Table 28: Time spent at computational workplace (N=97)

Time spent at computational workplace	Percentage of answers
0-25 %	2 %
26-50 %	7 %
51-75 %	32 %
76-100 %	59 %

Table 28 shows that the large majority of the respondents spent 50% or more at a computer based workplace as intended. 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 29).

Table 29: Size of company

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

From Table 29 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.

The three variables presented above are the key ones for assessing the nature of the sample. However, we also collected data about other variables that can provide insight in the properties of the sample. We will briefly deal with them below.

The majority of the respondents (71%) is between 21 and 40 years, most (60%) of them are employed between 1-10 years by the company they are currently working for, they have spent between 1-10 years in their current job (67%) and males are in the majority (62%). Finally most of them see themselves as experienced (56%) or as an expert (36%). These numbers show an acceptable distribution over the relevant variables: they indicate a sample with reasonably experienced persons. A reason of concern could be the relatively small number of novices as they may constitute a group with specific requirements for APOSDLE. On the other hand one could also argue that novices are initially a better target for formal training outside the work environment.

Summarizing this section 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. In the next section we will provide the results for the aspects that link it to Phase 1.

3.2.3 Phase 2 results

The presentation of results follows the same structure as those of Phase 1. First we will show the data for the three factors or components that constitute a learning pattern, next other aspects will be presented. The data obtained in the survey doesn't give information about separate learning events, so we cannot detect learning patterns in the data[5].

Overall it makes sense for the future fielding of APOSDLE to find out if there are differences in the work environment of the respondents and their background. When large differences are found, a more precise tailoring of the system to the target users maybe necessary. We will analyze differences for three variables which seem to be the most important in shaping the environment in which workplace learning takes place:

- Size of the company
- Type of knowledge work (see above: developing new knowledge, pass on knowledge to others, use obtained knowledge)
- Number of years in the current job

The first variable is immediately available in the questionnaire. The second one must be based on the distribution of points over the three types of knowledge work in Table 27. This question allows a large range of distributions and if we want to classify each respondent uniquely in each category we need a

[5] This is due to the fact that we asked in the survey about *general* learning experiences. We will return to this issue in section 3.3.

rule. We decided on the following rule: if a respondent gives 50 points of more to one type of work he or she is classified as being mostly a knowledge worker of that type. The rationale is that when 50 points are given, this is by definition the majority of the points. If none of the three types of knowledge work receives 50 points, the respondent is classified as an *all round* knowledge worker. Applying this rule to the sample yields four categories:

a) Mainly developing knowledge (n=18)

b) Mainly passing knowledge to others (n=19)

c) Using obtained knowledge (n=31)

d) All round knowledge workers (n=29)

We will use these categories in the analyses[6].

The third variable above will be described in a separate paragraph as it does not make sense to relate it to all variables included for the first two.

Characterization of each learning pattern factor

Trigger: What drives learning?

In Phase 1 we distinguished three ways that could drive learning at work: task driven, curiosity driven, coincidentally. In the survey we asked a question to distribute 100 points over each category, giving most points to the situation that fits daily work best (see Table 30).

Table 30: Average number of points (out of 100) distributed to three types of learning triggers (fixed sum scale)

	Average number of points received
Driven by the task(s) I'm carrying out	50
Driven by my curiosity	34
Driven by coincidence	15

Task driven learning dominates, but curiosity driven learning is more prevalent than in Phase 1. An explanation for this difference is difficult to find, maybe it's due to the presence of a larger number of people from large organizations or of people who are developing new knowledge which seem to be less bound to a specific task.

There are no significant differences between the knowledge work types for each of the three drivers in Table 30. The same holds for company size.

Solution type

The large majority of the respondents turn for personal help to colleagues (72 points out of 100). There are no significant differences for knowledge work types and company size in the points allocated to personal help from colleagues and help from people outside the organization.

Next we deal with turning to written material. In a statement we described a situation in which one wants to use written material to satisfy a learning need and asked how similar this situation was to what the respondents experienced (see Table 31).

[6] All analyses were carried out by using one way analysis of variance with either company size or knowledge work type as the factor and other numerical variables as the dependents. A significance level of .05 was adopted and Tukey HSD post-hoc analyses were performed.

Table 31: Is turning to written material for help similar to what is experienced?

	Percentage of answers
Not similar at all	3 %
Somewhat similar	22 %
Very similar	41 %
Completely similar	35 %

Turning to written material is overall very similar to situations people experience in their daily work, which is of course one of the main improvement goals for APOSDLE.

Again there are no significant differences between similarity of using written material and knowledge work type and company size.[7]

Communication media

First we will deal with interpersonal help seeking, followed by turning to written material.

Table 32 shows how they distribute 100 points over different communication media to contact other people for interpersonal help seeking.

Table 32: Average number of points (out of 100) distributed to four types of communication media used in interpersonal help seeking (fixed sum scale)

	Average number of points received
Face-to-face	45
E-mail	27
Calling	23
Writing a paper message	3

As can be seen from Table 32 face-to-face contact is used most frequently, followed by E-mail and calling.

Analysing differences in media used for interpersonal help seeking, a significant difference was found for writing paper messages. All round knowledge workers give significant more points to this than other knowledge workers ($p<.05$). However, the number of points involved is small (see Table 32). Furthermore there is a non-significant but substantial difference in the points given to face-to-face contacts. People mainly passing knowledge to others give on average less points to face-to-face than other knowledge workers (passing average is 37 points, for the other categories 48 points).

Company size shows no overall significant difference for face-to-face, but a post-hoc analysis shows that people from small companies give on average more points to face-to-face than people from medium sized and large companies ($p<.05$). No differences were found for e-mail, but for calling an overall significant effect of company size was found ($F=2.9$, $p<.05$). A post-hoc analysis shows that this is due to a difference between people in small companies and large companies. The former giving less points to calling (average=16.5) than the latter (average=26). The same pattern was found for writing paper messages, though the differences are between large companies at one hand and small

[7] The test for this relation depends on the interpretation of the "simililarity" question. If one assumes it to be a 4-point rating scale, analysis of variance is the method to be used. Seeing it as an ordinal scale, cross-tabulation with Eta as coefficient is the proper way. In this case both ways did not give significant results.

and medium sized companies at the other hand (p<.05), but also referring with a small number of points.

Just as for interpersonal help seeking, we also asked which sources were used most frequently when turning to written material by distributing 100 points (not necessary to distribute all points, see Table 33).

Table 33: Average number of points (out of 100) distributed to two types of sources used in seeking help from written material (fixed sum scale)

	Average number of points received
Digital sources like articles, e-books, websites	69
Paper based sources like books, essays or notes	27

As Table 33 shows digital sources are by far the most used, showing that APOSDLE neatly fits into existing practices of using written material for satisfying learning needs.

For knowledge work type we did not find an overall significant difference between the number of points given to digital sources, but a post-hoc analysis showed a significant difference (p<.05) between knowledge workers developing knowledge (average=78 points) and all-round knowledge workers (average=64 points). Concerning paper based source we found an almost significant difference between knowledge worker (p=.053). The post-hoc analysis showed a significant difference between all-round knowledge workers (average=35 points) on one hand, and development knowledge workers (average=22 points) and knowledge workers who mainly use knowledge (average=23 points) on the other.

For company size, no significant differences were found.

The effect of knowledge type and company size on other aspects of learning

What is learned?

What people are learning at the workplace (distributing 100 points over 3 types of knowledge, no need to distribute all points) is shown in Table 34.

Table 34: Average number of points (out of 100) distributed to three knowledge types learned (fixed sum scale)

	Average number of points received
Facts (know what)	32
Procedures (know how)	34
Concepts (know why)	28

Table 34 shows a slight preponderance of know-how, but in general all three categories are learned. For APOSDLE this implies that support for all three knowledge types should be present.

There were no significant differences between knowledge work types in allocated points to the different types of knowledge in Table. The same holds for company size.

Where does learning take place?

As we saw before, learning is not necessarily limited to one location. It can also occur in meetings and other social occasions. We asked the respondents to distribute 100 points over 4 locations (no need to distribute all points, see Table 35).

Table 35: Average number of points (out of 100) distributed to four places where learning takes place (fixed sum scale)

	Average number of points received
My computer based workplace	56
Workplaces without computers in the office	12
Meeting rooms	21
Places outside the office	19

Clearly most points are received by computer based workplaces. Combined with the finding that the majority of the respondents spent 50% or more of their working time at a computer based workplace (see Table 28) it can be said that sample contains mainly people who can be seen as potential target users of APOSDLE.

Type of knowledge work makes no significant difference for computer based workplaces. For workplaces without a computer there was no overall significant difference, but a post-hoc analysis showed a significant difference between knowledge workers who develop knowledge (average=7.5 points) and knowledge workers who use knowledge (average=15 points). Meeting rooms show in the post-hoc analysis a significant difference between knowledge workers who pass knowledge (average=27 points) and all-round knowledge workers (average= 18 points). Finally, for meeting places outside the office no differences were found.

Company size has a significant effect ($F=4.2$, $p<.05$) on the points received by learning at a computer based workplace. This is entirely due to the difference between small and medium size companies (averages are 65 and 67 points) and large companies (average=51 points). Almost the opposite was found for meeting rooms ($F=3.3$, $p<.05$) where the post-hoc analysis showed a difference between medium sized (average=15 points) and large companies (average=24 points). For places outside the office the picture was the same as for meeting rooms ($F=3.3$, $p<.05$), but there was also a significant difference between small (average=13 points) and large companies (average=21 points). No differences were found for workplaces without computers in the office.

We also asked whether learning does occur at all by using the statement “I rarely learn something new in my daily work”. Of the respondents, 72% answered that this was not similar at all to their daily work, another indication the sample consists of APOSDLE’s target users. No significant differences were found for knowledge work type and company size.

Bottlenecks

First we describe bottlenecks in interpersonal help seeking, followed by bottlenecks in turning to written material.

The process of interpersonal help seeking can suffer from several bottlenecks people actually experience. The respondents could distribute 100 points over these bottlenecks but were not obliged to use all 100 points. See Table 36 for the answers.

Table 36: Average number of points (out of 100) distributed to three bottlenecks experienced in interpersonal help seeking (fixed sum scale)

	Average number of points received
1. I often don't know who knows what in our organization	23
2. Colleagues I consult are often too busy to help me	21
3. Colleagues often can't help me because of the specific nature of the questions I ask them	27

The differences between the three bottlenecks are small, indicating that the respondents experienced these bottlenecks almost equally.

For the second category in Table 36 (busy colleagues) there was no overall effect of knowledge work type, but the post-hoc analysis showed significant differences between people who develop knowledge (average=31 points) and people who use knowledge (average=17 points) and all-round knowledge workers (average=19 points). No effects were found for the other two categories in Table 36.

Company size has a significant effect on the first category in Table 36: not knowing what other people know ($F=5.6$, $p<.05$). This is entirely due to the difference between large companies (average=29 points) and small (average=12 points) and medium sized companies (average=12 points). No significant effects of company size were found for the other categories.

The bottlenecks from Table 36 can have less or more serious negative impacts on learning at work. The respondents were asked to select from a list one bottleneck that hampers their learning at work most. The third bottleneck from Table 36 was selected most frequently (25%), the other ones scoring around 15%. Obviously there is some lack of nearby competence that provides a quick answer to a learning need. No differences in frequency of selected bottlenecks for type of knowledge work and company size were found.[8]

In addition, it is interesting to see which bottlenecks/problems in the area of consulting written sources receive most points in terms of frequency of experiencing them (no need to distribute all points, see Table 37).

Table 37: Average number of points (out of 100) distributed to four bottlenecks experienced in seeking help from written material (fixed sum scale)

	Average number of points received
1. The information I find is often too general for immediate use	26
2. I often don't find helpful information in sources from my own organization	22
3. I often don't find helpful information in sources from outside my own organization	15
4. Trying to find something in written material often costs me too much time	29

[8] This relation was tested by crosstabulating both nominal variables and computing Chi-square.

From Table 37 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.

Type of knowledge work does not have an overall significant effect on the first category in Table 37, but a post-hoc analysis shows that there is a significant difference for category 1 (too general information) between knowledge developers (average=32 points) and knowledge users (average=20 points). Also no significant overall difference was found for category 3 (sources outside own organization), but the post-hoc analysis shows a significant difference between knowledge developers (average=10 points) and all-round knowledge workers (average=19 points). For category 4 (too much time) no significant differences were found, but people mainly passing knowledge to others (average= 20 points) give less points to this category than the other knowledge workers (average=30 points). Finally no significant differences were found for category 2 from Table 37 sources within organisation).

No significant differences were found for company size.

As for serious negative impacts, bottleneck 4 (39%) and bottleneck 1 (23%) from Table 37 are most frequently selected as having the most negative impact on learning at work. This stresses even more the need derived from Table 37.

No significant differences (see footnote 5) were found for knowledge work type and company size.

Personal strategies

Apart from these general approaches, we wanted to find the prevalence of some more personal strategies to support learning at the workplace. Table 38 contains these personal strategies with the percentage of answers in the different categories.

Table 38: Percentage of respondents agreeing to three statements about personal strategies for learning at the workplace

	Completely similar	Very similar	Somewhat similar	Not similar at all
I keep a personal collection of reference materials that are essential for my work task(s)	34%	38%	26%	3%
Rather than spend time reading or asking someone's advice, I try to understand something better by trying it out in practice	8%	35%	44%	13%
When I learn something new in the course of my daily work, I often make notes	20%	40%	26%	13%

Apart from turning to other people and/or written material, trying things out first does occur frequently. This could entail that in APOSDLE not only "learning by telling" should be supported but also "learning by doing". Making personal notes and reference materials also score high. If APOSDLE is offering learning resources it seems a good idea to fit into these practices by providing storing of them in personal spaces. Whether these personal spaces should also be accessible for other people from the organizations is a different matter.

For none of the strategies in Table 38, a significant difference was found for type of knowledge work and company size.

The effect of job experience on learning

In the paragraphs above we systematically checked whether there are differences between type of knowledge work and company size as independent variables and a large set of other variables. This could also have been done far more comprehensively including many other independent variables. In order to keep the results within reasonable bounds, we choose the two dealt with above. Nonetheless, in this paragraph we will perform a limited number of analyses with the question "How many years have you spent in your current job" as the independent variable, because it is interesting to see how job experience could influence aspects of learning[9]. As dependent variables we focus on those which are associated with learning patterns: interpersonal help seeking (communication medium, bottlenecks), turning to written material (sources, bottlenecks). Finally we will look at differences in what is learned.

To make the categories of the independent variable "How many years…." more equal in size, we recoded the last two (11-15 years and more than 15 into one category), leaving four categories: less than one year, 1-5 years, 6-10 years, more than 10 years.

Interpersonal help seeking

Number of years in the current job does not lead to overall significant differences concerning the number of points allocated to asking colleagues, though people with more than 10 years experience tend to assign less points than the other categories (average other categories=75 points, average 10 years or more=64 points). No effects were found for asking persons outside the own organization.

Concerning contacting other people face-to-face, no overall significant difference was found, but the post hoc analysis showed a significant difference between people less than one year in the job (average=48 points) and people 1-5 year in a job (average=49 points) and people 10 or more years in the job (average=34 points). No significant differences were found for the other ways of contacting people.

The bottleneck "not knowing what other people know" is not significantly related to years in the job, though people less than a year in a job give more points to this bottleneck than the other categories (1 year average=35 points, other category average=20 points). The average number of points is lowest for people 6-10 years in their current job. No effects of number of years in the job were found for the other bottlenecks.

Turning to written material

Number of years in the job does not lead to significant differences in similarity score for turning to written material.

For digital sources there is a significant overall difference ($F=3.1$, $p<.05$). The post hoc analysis shows this to be due to differences between 1-5 years in the job (average=73 points) and 6-10 years in the job (average=76 points) and more than 10 years in the job (average=56 points). No differences are found for paper based sources. For face-to-face interpersonal help seeking and using digital material people more than 10 years in the job allocate significantly fewer points to them than people less than 10 years in the job. As the respondents were not obliged to distribute all 100 points, this difference can be due to the fact that people longer in the job distribute less than 100 points, which could indicate that they do.

No overall effect was found for the bottleneck of "too general information", but a post hoc analysis shows that there is significant difference between less than one year in the job (average=29 points) and 6-10 years in the job (average=30 points) and more than 10 years in the job (average=15 points). The category 1-5 years is in between (average=26 points, but not significant). No significant effects were found for the other bottlenecks.

[9] Clearly number of years in a job and age are related though not perfectly. We take number of years in the job as the best indicator of experience, but technically age is a potential intevening variable we can't filter out properly as it is measured in a different scale (absolute versus relative).

What is learned?

No effects of number of years were found for facts and procedures. For concepts no overall effect was found, but a post hoc analysis shows a significant difference between 6-10 years in the job (average=34 points) and more than 10 years in the job (average=22 points). The general tendency is that the number of points allocated to learning concepts increases with number of years in the job, but sharply drops when one is 10 or more years in the job.

3.2.4 Summary

The comparison between the results of Phase 1 and Phase 2 will be done in the next section. This summary will try to pull together the results of the analyses performed in the previous section using type of knowledge work, company size and numbers of years in the current job as independent environment variables.

Types of knowledge work

Earlier in this section we made a distinction between four different types of knowledge workers (abbreviations used in the summary are in brackets):

Mainly developing knowledge (developers)

Mainly passing knowledge to others (passers on)

Using obtained knowledge (users)

All round knowledge workers (all-rounders)

The following significant differences were found for different types of knowledge work: developing, passing to other, using and all-round:

All-rounders use more paper messages when seeking interpersonal help

Developers use more digital sources than all-rounders when turning to written material

All-rounders use more paper than developers when turning to written material

All-rounders use more paper than users when turning to written material

Users learn more frequently in workplaces without computers in the office than developers

Knowledge passers learn more frequently in meeting rooms than all-rounders

Many of these differences seem to be a result of all-rounders tending to more traditional sources, and developers to more digital means.

Developers suffer more from the bottleneck of too busy colleagues than users

Developers suffer more from the bottleneck of too busy colleagues than allrounders

Developers suffer more from the bottleneck of too general information in written sources than users

Developers suffer less from the bottleneck of not finding helpful information in sources outside the organization than all-rounders

Given the total number of analyses performed the number of differences found is relatively small. A simple count of how frequently a type of knowledge work is involved in a significant difference shows that developers and all-rounders lead the pack (7), followed by users (4) and knowledge passers (1). If there is any difference in the environment of the type of work this is for developers and all-rounders. However, for many important other variables (what is driving learning, solution type, what is learned, personal strategies) no significant differences were found. This seems to warrant the conclusion that variation due to type of knowledge work is small.

Company size

The following significant differences were found for company size:

- Small companies have more face-to-face interpersonal help seeking than large companies
- Small companies have more face-to-face interpersonal help seeking than medium sized companies
- Small companies resort less to calling in interpersonal help seeking than large companies
- Small and medium sized companies use less written messages in interpersonal help seeking than large companies
- Small and medium sized companies learn more frequently at computer based workplaces than large companies
- Large companies learn more frequently in meeting rooms than medium sized companies
- Large companies learn more frequently in places outside the office than small and medium sized companies
- Large companies suffer more from the bottleneck not knowing what other people know than small and medium sized companies

More or less the same can be said for company size as for type of knowledge work: a relatively small number of differences. Some are straightforward, such as more face-to-face interpersonal help seeking in small companies. The only major effect can be seen in places were learning takes place: large companies are clearly different from small and medium sized companies in having less learning in computer based workplaces and more in meeting rooms and other places outside the office. For APOSDLE this could entail that supporting learning at work by tools that are not mobile, could be less effective in large companies. Also for company size, no differences were found for other important variables (what is driving learning, solution type, sources used when turning to written material, what is learned). Variation due to company size is small.

Number of years in current job

For the number of years in the current job, the following differences were found:

- People less than one year in the job and people 1-5 years in the job turn more frequently face-to-face to other people for interpersonal help seeking than people more than 10 years in the job
- People 1-10 years in the job turn more to digital sources than people more than 10 years in the job
- People less than one year and 6-10 years in the job suffer more from the bottleneck of too general information in written sources than people more than 10 years in the job.
- People 6-10 year in the job learn more concepts than people more than 10 years in the job.

Counting differences, the category that stands out most is people more than 10 years in the job (7) , followed by 6-10 years in the job (3), people 1-5 years in the job (2) and people less than 1 year in the job. From this it can be derived that people more than 10 years in the job could be a class in its own. However, just as with the other two independent variables, no effects were found for other important dependent variables (solution type, learning facts or procedures, several bottlenecks).

Summarizing the effects of environment variables we can state the points below:

- What drives learning is independent of environment variables
- Solution types (interpersonal help seeking, turning to written material) chosen for learning events is to a large extent independent of environment variables

- What is learned is to a large extent independent of environment variables
- Media chosen is to some extent independent of environment variables, some local differences were identified for type of knowledge work (developers), company size (large companies versus small and medium sized) and number of years in the current job (people more than 10 years in the current job versus other job categories).
- Where people learn is strongly dependent on company size, large companies learn more frequently outside the computer based work place than small and medium sized companies

A limitation of these results can be seen in the fact that the unit of analysis was a person instead of a learning event (see also next section) which may have concealed some of the dependencies which would have been present when analyzing events. We will return to the summary of these results when discussing the consequences for APOSDLE in Chapter 4.

3.3 Comparing results from Phase 1 and Phase 2

In this section we make a comparison between results from Phase 1 and Phase 2 of the Workplace Learning Study. This comparison has to be interpreted with care for several reasons. The most important caveat has to do with the nature of the data. In Phase 1 the unit of analysis is a learning event. Such a learning event is a unique observed or reported entity which is not tied to a person. The unit of analysis in Phase 2 is a person, a respondent, which does not report about one specific learning event but about general experiences during learning at the workplace. In methodological terms this is a difference between a *point* (a unique learning event) and a *distribution* (a collection of learning events over time for one person leading to general experiences). As a consequence, comparisons are formally between incomparable entities and should be taken with care and can be seen as indicative only. On the other hand, the results from Phase 2, based on a distribution, can help in generalizing results from Phase 1 which were not measured in Phase 2. The assumption is that if the outcomes of Phase 2 on some crucial variables are similar to the ones from Phase 1, there is some basis for stating that results found in Phase 1 can be valid for a wider range of organizations and learning situations than included in the data collection in Phase 1. This could hold in particular for the findings for learning patterns, which we could analyze in Phase 1 but not in Phase 2.

The second reason for being careful in making comparisons is because the way the data are collected is different. In the survey we used self-report questions, while in Phase 1 observations, interviews and 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.

When reading the next two sections these general considerations should be taken into account.

The comparisons are based on concepts that were investigated in *both* Phases. From Phase 1 we take the results of the learning events as experienced from the role of learner as the yardstick as they are most frequent. Also, in Phase 2 no group settings or expert role were addressed. More general conclusions can be found in the next chapter.

Characterization of the learning pattern factors

- Trigger: what drives learning?
  In both phases the most frequent trigger for learning at the workplace is a task someone is working on. In the survey more curiosity driven learning is reported.
- Solution type.
  Interpersonal help seeking from colleagues is very frequent in both phases, but also turning to written material is frequently mentioned in both.

- Communication media.
  In interpersonal help seeking, face-to-face is mostly used as a way to contact colleagues in both phases. When learners turn to written material they have a strong preference for digital sources over paper sources.

Summarizing: for most of the learning pattern factors, the similarity between what was found in Phase 1 and Phase 2 is substantial.

Other aspects of learning

- What is learned
  There is some difference between Phase 1 and Phase 2. In Phase 1 learning of concepts is more frequent than learning of procedures and facts. In Phase 2 they are reported almost equally frequent. The main point is that in both phases the three different knowledge types are mentioned quite frequently.
- Where does learning take place?
  In selecting mostly people spending the major part of their time at computer based workplaces, it is to be expected that most reported learning also happens at this location.
- Bottlenecks
  In Phase 2 all three mentioned bottlenecks in interpersonal help seeking were present almost equally, which also occurred in Phase 1. The bottleneck having the most negative impact in Phase 2 was the lack of specific knowledge colleagues have, which is also the most frequent bottleneck in Phase 1. When turning to written material, in particular digital material, three out of four bottlenecks are frequently mentioned in Phase 2 as well as Phase 1: too general information, finding something takes too much time, lack of information in company sources.

In both phases re-use of obtained information and knowledge scored very high, implying that our data indeed reflect learning experiences rather than information search for once-a-time problem solving.

Summarizing: for other aspects of learning similarity between what was found in Phase 1 and Phase 2 is major. The difference between what is learned in both phases is not that important as all types of knowledge are present.

Pulling things together, we can say that on all important aspects of learning that were measured in both phases of the Workplace Learning Study, outcomes are quite similar. Keeping the caveats from the introduction in mind, there is evidence that other results obtained in Phase 1 can be valid over a wider range of organizations and learners than the application partners in APOSDLE could provide. In the next chapter we will investigate what these results imply for the APOSDLE view and the APOSDLE prototype(s).

4 Summary and Conclusions

This study investigated current workplace learning patterns and practices. In general it can be confirmed that learning at the computer-based workplaces is ubiquitous, at least in the way as it was defined in this report. Although coincidental and curiosity driven learning occurs, we found that most workplace learning is triggered by the tasks people are performing. Within the APOSDLE project, each task is considered to be linked to one or more (work related) competencies, which consist of certain knowledge assets. In our analyses of Phase 1 we observed that most knowledge needs arise when someone is performing a task and recognizes a knowledge gap. In order to fulfil the knowledge need a search for knowledge begins. Coincidental learning occurs for example when new knowledge is acquired in a spontaneous conversation with colleagues. In this case, no knowledge need was recognized, but the new knowledge can be used in the future. Curiosity driven learning wasn't found in Phase 1, but the survey of Phase 2 confirmed that one's own curiosity can be a reason to learn. In Phase 2 of the study, we also found that environment variables such as company size, type of knowledge work and years of experience in current job, have no influence on the drivers (triggers) of learning. Neither of these variables is directly related to the reason why people learn.

For both coincidental and task related learning, the same key learning patterns were found. The three key patterns stress the importance of interpersonal help seeking (colleagues) and seeking help from digital written material as used strategies in workplace learning. The key patterns are most of the time not very complex, consisting of one or two steps involving either interpersonal help seeking combined with face-to-face contact or turning to written digital material. Phase 2 of the study shows that environment variables play a negligible role in choosing between seeking interpersonal help and turning to written material. Although most data in Phase 1 was related to the learning of individuals, there seem to be some differences between the learning of one person and groups. As learners learn most at computer based workplaces, groups appear to learn most in meeting rooms. The data also suggest that groups tend to use, besides face-to-face communication and digital sources like PowerPoint presentations, paper based sources too. Since there was little data collected about group learning, no key patterns for this type of workplace learning were found. Further research is necessary to understand group learning processes and strategies better.

Data about the expert role in workplace learning also revealed some interesting findings, especially about the bottlenecks. Overall, 43% of all learning events encountered one or more bottlenecks. One of the problems experts bring up most is not having the specific knowledge or experience about the matter they are consulted about. Bottlenecks learners experience most are related to inefficient providing of information (too much or too general) or not being able to search information efficiently (for example, not knowing what is important). Time also has a constraining influence on workplace learning, since lack of time is mentioned frequently as a bottleneck by both learners and experts.

In Phase 2 the presence of these bottlenecks was confirmed. In addition, the results showed that the process of interpersonal help seeking isn't always problem-free. In Phase 1 the presence of such problems was already revealed, but in Phase 2 it became clear that people experience two bottlenecks most frequently, namely not knowing who knows what and lack of specific knowledge with colleagues.

Another remarkable finding of Phase 1 is that most learning events, even though bottlenecks are experienced, are successful. Successful means that the knowledge need is fulfilled in a satisfactory way so that the learner can move on in the work. If a learning event wasn't successful, this could be because no knowledge could be found, the learning was postponed or because the learning wasn't finished at the time of the study. Success of learning events, when defined as a dichotomy (successful versus unsuccessful), is influenced by three aspects, namely 1) the complexity of a learning pattern (less complex more success), 2) the total number of types of used communication media (less media more success), and 3) the type of knowledge that is learned (facts more successful than concepts and procedures). Conversely, the total number of types of used sources has no influence on the success of a learning event.

Maybe one of the most important findings for the APOSDLE tools is the finding about which knowledge types are learned most. Concepts are learned most frequently, closely followed by procedures and facts. Experts also mention all three knowledge types, but according them they are consulted most for explaining procedures.

Relevance for APOSDLE can be approached in two ways: detailed comparison with the current set of requirements for APOSDLE or a high level overview that refers to the key assumptions behind and envisaged key functionalities of the prospective system. The former will be done later in the project, for the latter we made a table that comprises the main findings in one column and the consequence for APOSDLE of that finding in another column.

APOSDLE Relevance	
Key finding	Consequence for APOSDLE
Computer based workplace learning is ubiquitous.	APOSDLE addresses a phenomenon that is widespread over many different organizations.
Learning is currently overall reasonably successful, though bottlenecks are present.	There is room for improvement in current practices, in particular in solving specific bottlenecks.
APOSDLE General Approach	
Key finding	Consequence for APOSDLE
Workplace learning is strongly driven by work tasks, but learning driven by curiosity is also present.	With the task related approach to learning support, APOSDLE is right on target and fits into current practice. In addition, room must be present for not directly task related learning.
Most learning events are not very complex and consists of a few steps only.	No need for lengthy course-like learning support. It should be brief and to the point.
The three main types of knowledge are equally present in learning at the workplace.	APOSDLE must support learning facts, concepts and procedures.
People often work at multiple tasks simultaneously and can be involved in different learning situations at the same time.	APOSDLE must enable support for multiple learning situations simultaneously. It should be possible to postpone certain learning situations or save them for future use.

(continued)

Interpersonal Help Seeking	
Key finding	Consequence for APOSDLE
When seeking help, interpersonal help seeking using face-to-face contact is used most often.	APOSDLE needs to research ways to replicate, replace or supplement face-to-face contact. It should either have its own facilities for interpersonal help seeking or fit seamlessly and effortless into current tools and practices.
Main bottlenecks in interpersonal help seeking are: not knowing who knows what and colleagues lacking the specific knowledge to be able to help.	Support facilities should include identification of experts for the current learning need.
There is some evidence that current communication facilities used most often (email and telephone) are not sufficient to support learning needs: Bottlenecks are much more frequently reported from the expert role and often relate to missing support for the expert role (like forgetting), some of the bottlenecks reported relate to media characteristics.	There is room for improvement in current communication media facilities to support interpersonal help seeking. APOSDLE should offer facilities that better support the expert role in knowledge exchange.
Seeking Help from Written Material	
Key finding	Consequence for APOSDLE
When seeking help from written material, digital sources are used most.	Providing easy access to company digital sources is important.
Main bottlenecks in turning to written material are too general information, takes too much time and information not present.	Digital material provided should be as close as possible to the learning need. High precision and recall are needed if APOSDLE is to beat existing searching and browsing facilities. Relating search results to current learner context and providing material without the need to explicitly search can be key benefits delivered by APOSDLE. When learning is curiosity driven, a more browse based approach to providing material may be beneficial.
Influence of the Organizational Setting	
Key finding	Consequence for APOSDLE
Several key variables that could influence the fielding of APOSDLE (what drives learning, what kind of help people seek, what is learned) are not or only weakly dependent on the organizational setting (company size, type of knowledge work, number of years in the job).	The prospective APOSDLE tools can be fairly general, only limited tailoring to the specific setting may be needed.
Of the organizational setting, only company size had a strong influence on where people learn: people from large companies learn more frequently outside the computer based workplace than small and medium sized companies.	A “mobile” APOSDLE could be of value for people from large companies.

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