

The University of Birmingham
Schools of Psychology and Computer Science

MSc in Cognitive Science

SALL:

Specifying a system to

Support Academics' Lifelong Learning

by

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September 2000

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Acknowledgements

There are several people that contributed to this report. Mainly, all academics that devoted some of their valuable time to give me information about their learning. Among them, Mike Sharples, who supervised this attempt with patience and inspiring comments. He made this attempt an enjoyable challenge.

People from Educational Technology group facilitated this project, especially the design and evaluation process. Paul Radman who offered me valuable advice about the interface. Richard fgs who offered technical support when there were problems with Hyperstudio. But most of all, I would like to thank Giasemi Vavoula, who helped me with long discussions, comments on my work and references.

Roberta Roberts offered me innumerable aid. Without her language corrections and our discussions about learning support and interfaces, this report would be different.

Finally, I would like to thank Thomas Spyrou. As an academic, an ex-colleague and a friend facilitated the whole process while answering my questions, offering me inspiring comments and mainly supporting me at the hard moments. His contribution was inestimable and thus, I dedicate this project to him.

I thank you all.

Abstract

This project focuses on the specification of a system to support academics during the lifelong learning process. The initial data collection involved conducting interviews and a survey amongst academics from several disciplines. The collected data was combined with learning theories to reveal the ways in which technology could support academics. Subsequently, the needs that would be addressed by the proposed system were considered. Accordingly, the guided metaphor of the system was decided to be the Symposium. Symposiums are interrelated with learning, support formal and informal interactions and produce familiar mental models. This metaphor guided the design space mapping and facilitated the design rationale. The system's specification was stated by the interaction design based on HCI guidelines. Thus, the interface was designed by gaining continuous feedback from potential users with expertise in HCI (formative evaluation). At the end a final evaluation of the interface design was also conducted in order to reveal the weaknesses and strengths of the proposed system as well as to highlight future improvements.

1. Introduction

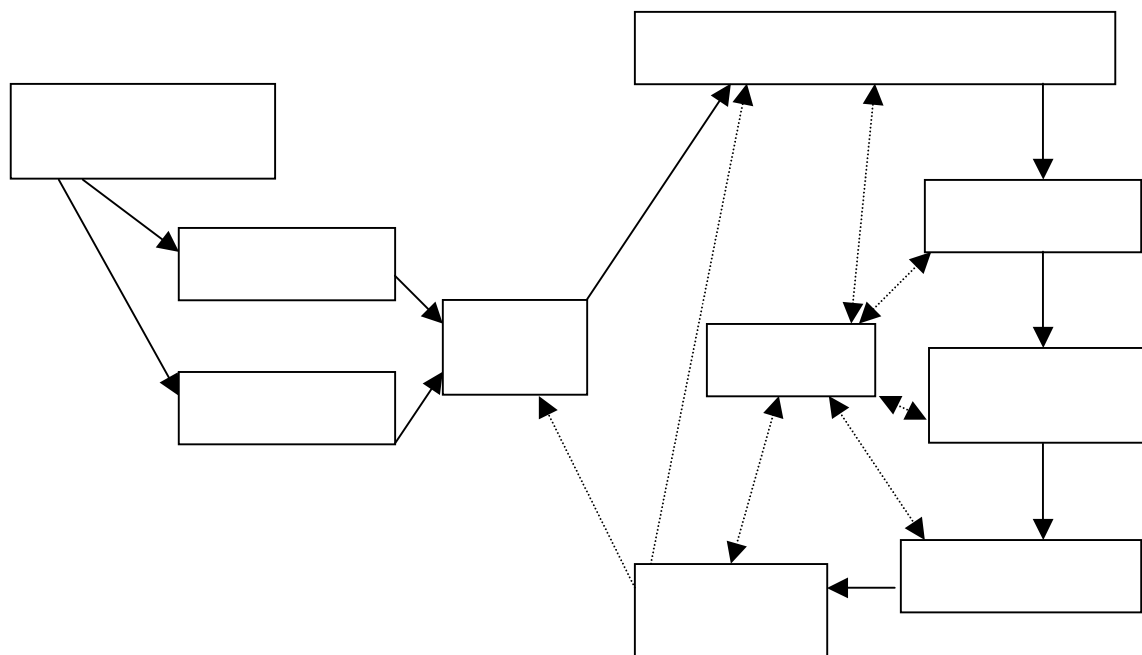
This report focuses on specifying a technological system to support academics' lifelong learning. This involves studying the learning processes of academics, their interactions with people and tools as well as their shortcomings. These investigations will reveal the issues that technology could address. Subsequently, specific issues will be adopted by a proposed system in order to support aspects of academics lifelong learning processes.

Thus, the aims of this project are

- to investigate academics' learning processes and their difficulties;
- to specify which of those difficulties could be addressed by a supportive system;
- to create a system image consistent with their mental models;
- to specify the system and define the design space (options and rationale); and finally,
- to propose a scenario of system's use and evaluate it

A methodology capable of capturing the specification of such a system is the socio-cognitive engineering methodology proposed by Sharples et al. (2000) (figure 1.1). It aims to analyse the complex interactions between people and technological tools and then transform this analysis into a usable, useful and elegant socio-technical system: a technology which would fit into its social context (Sharples et al. 2000).

Figure 1.1: overview of development method



The following chapters describe this methodology. Chapter 2 (General Requirements) focuses on the general context of lifelong learning and specifies general functions that a supportive learning system should have. Chapter 3 (Observational Studies) describes the process of data collection about academics' lifelong learning. Chapter 4 (Socio-cognitive framework) analyses several learning theories and identifies how they correspond to the socio-cognitive learning experiences of academics. Academics' learning difficulties are explained under the spectrum of each theory to reveal the issues in which academics might need support. Chapter 5 (Task Model) addresses how technology could support academics' difficulties performing learning activities and specifies which of those the

proposed system will focus on. Chapter 6 (System Image) deals with the specification of the system's guiding metaphor. Chapter 7 (Design Space and System Specification) specifies the design rationale and investigates the design options for the proposed system. Chapter 8 (Implementation) describes the implementation of a rapid prototype. Chapter 9 (Testing/Evaluation) evaluates the design procedures and Chapter 10 provides a general discussion. The socio-cognitive engineering methodology contains a full implementation and the creation of a deployed system. However, these were not part of this project and they could be addressed in a future report.

1.1. Interdisciplinarity

This is an interdisciplinary project. The initial data collection is based on psychological techniques (interviews and a survey). The data was then combined with learning theories to understand how academics learn and also interpret their difficulties. Subsequently, state-of-the-art technologies were studied to investigate the suitable ways to support academics. During the system specification, guidelines from interactive system design were used to provide academics with a tool that would be useful and usable. Human Computer Interaction (HCI) guidelines were used during the design options stage to provide the important issues of the interface. Interactions with people from Educational Technology group (School of Electronic and Electrical Engineering, The University of Birmingham) and Interactive and Intelligent Agents group (Information and Communication Systems department, University of the Aegean) facilitated the development of this project, since their expertise in lifelong learning and user interface proved quite valuable. Their expertise was especially useful during the evaluation of the prototype, where they provided valuable comments and improvements to interactions and learning support.

2. General Requirements Specification

2.1. Overview

The rapid changes in the way we live our everyday lives have resulted in an emerging need for individuals to learn over a lifetime. Learning is no longer restricted to the place and time in which it will be acquired (school) and applied (workplace). People have effective learning opportunities while passing through different social settings, like home, school, work and thus participate in a lifelong learning process (Fischer et al., 1998). Therefore, the traditional view of education, where worthwhile and valuable knowledge is passed from the old generation to the new, has now largely changed. Since learning does not occur only inside schools and universities (but also in workplaces, families, etc.), education is just one provider among many others of potential resources of learning material (Jarvis et al., 1998).

Furthermore, the amount of information that can now be collected, synthesized and communicated has risen enormously in speed, precision and power. For individuals to learn, they have to sort and synthesize the interesting information and to distinguish meaningful messages from surrounding noise. (Bentley, 1998). This is a continuous learning process. In the learning society that is emerging, learners should actively and consciously lead these changes instead of passively attending them with less understanding and control (Davies, 1998).

In particular, academics as learners and adult educators participate in the process of learning over a lifetime in a dual role: firstly, through adapting (rapidly and responsively) to growths and shifts in resources and secondly, through inspiring students to be self-directed learners: to consider learning as a vital part of their lives, which is driven by the desire and need to understand and to accomplish new tasks (Fischer et al., 1998; Bentley, 1998).

On the other hand, learning takes place within a social and cultural environment that has particular technologies. Learners exploit the technological tools and resources that are provided by the society, to acquire knowledge and solve problems (Sharpley, 2000). Technological tools are not just means to access information but also an environment to analyse, synthesize and represent information in different contexts. Technology can provide this environment in which the functionalities of complex systems can be learnt (like biology, city planning, etc.). It can also provide learners with an environment to support thinking strategies and techniques. It can simulate a series of intelligent encounters with the problems and resources of different learning situations (Bentley, 1998).

2.1.1. Intended contexts of use: Place and Time

Since technology can provide such a support to learners, tools' context of use should be consistent with their learning activities.

The place and time in which learning can occur, has changed as learning is positioned in a socio-technological context. Learning can be considered as a beneficial process of acting within an environment and reflecting upon it (Sharpley, 2000). It can happen at any time, in any place.

With the advent of information technology, the place and time of learning process have broadened. Learners can use technological tools to extend the facilities that the institution can provide (i.e. on-line library). They do not have to be to the physical location of the

institution to make use of it (Jarvis et al., 1998). These tools also allow learners to access learning material at any time, without 'office-hours' restrictions.

In particular, academics as learners can accomplish their learning tasks while at the office; at home, on the train, etc., during the whole day or night. Thus, a system, capable of supporting them during their learning processes, should be available wherever and whenever academics might need it.

2.2. Functional Requirements

There are some general features that a technological system should have in order to support individuals during their lifelong learning process (the particular support that academics should receive, will be discussed at next chapters) (Sharples, 2000). These features can refer to personal tools like memory aids, communication devices, etc. that are highly portable and intuitive and thus require no previous experience of the technology.

While learners use a technological tool, they gain experience and do not need the same level of explanations on subsequent uses. Thus, the tool should be adaptable to user's evolving skills and facilitate their development. It also needs to be persistent in supporting the learner's accumulation of resources and knowledge despite changes in technology. The tool should be networkable to allow real-time communication among learners.

Furthermore, according to Fischer et al. (1998) a system that supports self-directed learning should go beyond the 'gift wrapping' approach where 'technology is wrapped around old frameworks of education'. Fischer states that such a system should:

- be user-directed and supportive: the system should allow users to choose the tasks and problems they deal with and still providing them with learning assistance contextualised to their chosen problem.
- support a range of expertise in order to be used over a lifetime where users progressively move to different level of expertise.
- promote collaboration between colleagues to allow users to learn from each other, to create mutual understanding and to take advantage of the distributed knowledge along their network of learning (Fischer, 1998).

During lifelong learning, interactions with people and tools have an important role for the experience of the learner (Fischer et al., 1998; Dey et al. 1999; Sharples, 2000). In human-human interaction, information flows through shared cues or contexts that act as a basis for interaction between the participants. Information can characterize the situation of an entity, where an entity can be a person, a place or a physical or a computational object. On the other hand, in human-computer interaction, there is relatively little contextual information available. Contextual information may be any entity, including the user and the computer themselves. If the system's access to a context is increased, the richness of communication with human's interaction is improved and hence the usefulness of the device. Therefore, the system should be context aware and thus provide task relevant information and/or services to the user (Dey et al. 1999).

3. Observational Studies

Observational studies investigate how learning activities are performed in their normal contexts (Sharples et al., 2000). To explore academics' lifelong learning, data was collected from interviews and a DELPHI survey. These were conducted on academics of the University of Birmingham and the University of the Aegean.

The interviews were taken from seven academics from the Schools of Psychology (2), Electronic and Electrical Engineering (2), Computer Science (2), the University of Birmingham and the Department of Information and Communication Systems (1), the University of the Aegean. They were asked about:

- their ways of learning,
- the locations of learning,
- the tools they use,
- their learning difficulties, and
- how they manage to overcome them.

Most of the academics were interviewed once; however, some of them were asked repetitively, during the process of the project, to clarify further details of academics' learning.

The answers of the DELPHI survey came from eight academics from the Schools of Electrical Engineering (3), Computer Science (2) and Education (3), in the University of Birmingham. They were asked about their learning difficulties, the tools/resources that they employed while learning and those that they would employ if such tools/resources were available.

The Delphi technique is a method of structuring group communication processes so that a group of individuals (academics), as a whole, could deal effectively with a complex problem –lifelong learning (Linstone, 1974). The group communication process and its structure can be understood by explaining the Delphi survey procedures.

The DELPHI survey had five phases:

1. a set of four open questions were constructed (Appendix A - 'Delphi survey part 1') and distributed among a large group of academics by e-mail.
2. responses were received from 11 academics. They provided feedback that contained their own views and experiences.
3. the results were summarized and a new questionnaire was conducted based on the previous results (Appendix A – 'Delphi survey part 2'). It was sent to the respondent group.
4. the respondent group had to rank the summarized answers based on a review of the group response. They could revise their views and assess the group judgements anonymously.
5. the data coming from the respondent group (eight academics) was collected and ordered the ranked responses (Appendix A – 'Combined data from interviews and survey').

The overall sample is considered as representative of academics since it consists of 15 academics from several different disciplines. The learning difficulties reported were not restricted to particular research areas but concerned with broad problems of academics' learning processes. A set of summarize results are showed below. The data about academics learning difficulties are organised into groups to facilitate understanding and

retrieval. The interviews' questions, the Delphi survey and the detailed data are provided in Appendix A.

<p><u>Academics' learning activities:</u></p> <ul style="list-style-type: none"> • reading, • writing • teaching (and lecture preparation) • discussing-interacting with people, society, nature • thinking and problem solving • attending seminars and/or conferences • observing nature • experiencing everyday life • keep up-to-date with changes in technology • watching videos 	<p><u>Main learning difficulties</u></p> <ul style="list-style-type: none"> • Management of learning projects <ul style="list-style-type: none"> Interleaved tasks and Interruptions Time related difficulties Physical/emotional difficulties • Nature of information • Skills/cognitive processing shortcomings and their surpassing • Special needs-related¹
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Figure 3.1. Summarized results from interviews and survey

¹ Special needs will not be taken into account (apart from colour-blindness at the phase of screen design), since the data and the time available was not enough. However, special needs considerations could be part of future considerations.

4. Socio-Cognitive framework

The socio-cognitive framework refers to ‘theory-based studies of the underlying cognitive and social processes’ (Sharples et al., 2000). Thus, the data gathered about academics’ lifelong learning will be discussed under the spectrum of several learning theories. These learning theories are:

- experiential learning theory (Kolb, 1984) where learning is seen as an individual process of transforming experience,
- conversational theory (Pask, 1976; Laurillard, 1993), where learning goes beyond the individual to the participants of a dialogue,
- expansive learning theory (Engeström, 1991), where the learners are situated in the community and they interact with its members, rules and tools.
- transformative learning theory (Mezirow, 1990), where learning is a self-developmental process,

The aim of this chapter is to analyse academics’ lifelong learning processes and to explore how technology could support academics.

4.1 *Experiential learning*

According to experiential learning theory, learning is the process through which ‘knowledge is created through the transformation of experience’ (Kolb, 1984). It can be viewed as an integrated cyclic process that begins with concrete experience. To learn from the experience, data and observations are collected and form abstract concepts and generalizations. These concepts are tested on new situations, which feedback to actors and modify their behaviour/thoughts (see Figure 4.1). Learning also occurs in the interplay between expectations and experiences. Individuals in their everyday lives, may have a sense about other people, the actions they have to carry out, etc. but occasionally they experience misunderstandings and/or unforeseen circumstances that force them to change these views. Since the same facts might happen more than once, they realise that these misunderstandings are reduced. It is because the relationship between their behaviour and their expectations has changed (Kolb, 1984).

4.1.1 **Relating theory to academics’ learning activities**

Experiential learning theory provides a means of capturing the way academics learn while thinking, writing or reading: they set a problem (a particular experience), which arises from themselves, by attempting to write a thought or by reading. They collect data through books or other sources, and they reflect on it their previous experiences. They form an abstract solution (concept), they test it in new circumstances and accordingly they modify their initial experience.

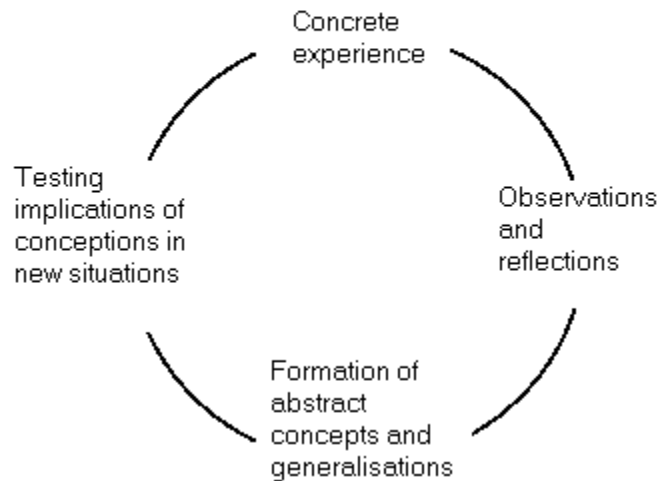


Figure 4.1: An experiential learning cycle

4.1.2 Relating theory to academics' learning difficulties

However, academics quite often face difficulties in accomplishing their learning tasks. These difficulties have been grouped (as showed in the previous chapter) and examined under the perspective of the experiential learning theory.

I. Management of learning projects

Interleaved tasks

Following experiential learning theory, academics' difficulties in learning are seen as reflecting discontinuities in the above cyclic process. For example, an important reported difficulty of academics appears to be the competitive demands of their tasks. The cause of this difficulty could be that academics are exposed to demanding interleaved tasks (experiences) that do not allow to each learning cycle to complete. While they are occupied with one task (i.e. lecture preparation), another one might appear that demands attention as soon as possible (i.e. a telephone ring). Once it finishes, they might return to the previous task or there might be another task waiting (they might have a meeting with a possible sponsor). Actually, they may never be able to return to previous tasks since there might be continuous interruptions (a student might knock on their door or they might receive urgent e-mails). The continuous change from one task to another causes the moving of the current task to the foreground, while the other tasks are waiting in the background.

Considering the issues that influence these changes, we could extract important information about interleaving learning projects. Thus, the changes between foreground and background tasks can be affected by the location where the task is accomplished. There are tasks that academics deal with at the office and others that they prefer to accomplish at home (or after office hours). For example, some academics prepare lectures at the office but they prefer to read research papers at home. During lecture preparation, academics need to organise prior knowledge and present it in forms that students can understand. They also check how well they know the subject and revise. During that process it is not very important not to be interrupted. In contrast, while reading the

abstract ideas of other researchers, they need to understand and probably to reflect on the reading material and they are not tolerant of interruptions.

However, at different locations they have different resources available which might indicate restrictions on how learning tasks can be done. For example, while at the office they have high speed internet connection; while at home they might have a lower speed connection. Moreover, home provides different tasks to be done, e.g. pay attention to the children. Hence, location might specify the resources availability and some of the (background) tasks waiting to be done.

What is more, the time that academics consider for each task can vary from a few minutes to several hours: but still they have to capture any progress they might achieve.

Academics also need to remember each task's history, forthcoming sub-tasks as well as general goals and expectations. Therefore, each time they consider one task they need to remember its relevant context.

In addition, interleaved tasks need very good planning since they might appear concurrently or have very close deadlines. Hence, academics need to prioritise the tasks according to particular criteria (e.g. importance for the university, professional appraisal, personal goals, etc). However, these criteria incorporate a generic fuzziness and academics complain about vaguely defined research goals. For example, they are involved in state-of-the-art research with fuzzy boundaries between streams of thought. Considering that interleaved tasks could be of similar importance, they capture the sense that the academic learning has conflicting priorities. For instance, academics might have to attend a research meeting while they have to prepare for a lecture. What is more, they may not succeed in completing the tasks on time, and thus, they may experience pressures because of pending deadlines. For example, considering that some tasks are more flexible in meeting their deadlines than others, academics seem also to consider this property before deciding which task to accomplish first.

Time restrictions

On the other hand, academics have also to deal with administrative work. Academics often complain that administrative tasks distract them from their important learning tasks due to the time such tasks take. Thus, when academics have to deal with extra administrative work, they tend to complain that they do not have the required time to complete tasks and gain a valuable learning outcome.

Academics also complain about workload. There might be a huge amount of experiences that lead to learning cycles, which academics find hard to manage. In particular, each learning cycle requires a particular amount of time to be completed depending on the task, the person, the environment. When academics are exposed to experiences that do not give them the appropriate time to retrieve the processed experience, they tend to have difficulties. These could lead to complaints that they do not have time to think through ideas or to practice.

Considering that learning tasks have restrictions based on the time of the day they need to be accomplished, time related difficulties are stressed. The academic profession is mainly about thinking (data from interviews), which takes place not only during the working hours (e.g. 40 hours per week) but also during all the living hours (e.g. 112 hours per week). However, they do not have the same rate of productivity during the whole day. The time of the day/night that each learning task can be considered is different depending on task's demands and the academic's learning style. For example, when writing an

article that needs reflection on prior ideas and thoughts, academics might prefer to be at home where they are not interrupted. They might also prefer to work during the night or early in the morning, depending on when they are more productive.

Physical/emotional difficulties

In addition, there are times that academics feel tired and they need a rest; times that they feel bored and need a break; times that they feel stressed and need relaxing. Thus, they have to invent techniques to overcome these difficulties that fit with their learning style. For example, they might relax by being occupied with intellectual and physical tasks (exercise) by turns. Alternatively, they might prefer to consider an administrative/teaching task (e.g. marking) after a task that needs deep thought. When they become tired from a learning task, they might prefer to consider a non-academic task, e.g. learn how to cook a new recipe. The alternation of tasks could help them overcome their physical/emotional difficulties and be more effective.

II. Nature of Information

Apart from having difficulties in managing their learning projects, academics need to have the appropriate information to retrieve. However, they often have difficulties with the nature of information available.

Initially, we should consider that there is a distinction between information and knowledge. Information can be considered as elaborated data that generates a meaning (Checkland, 1986); academics have to reflect on it, form abstract concepts, test them and finally, acquire knowledge, skills etc. Knowledge is the outcome of the learning cycle. Academics may have a great exposure to information flow but it is not always appropriate to become knowledge. For example, through the Internet they can have a lot of information but it is not always valid, up-to-date or original and thus, useful.

Therefore, when academics complain about the overload of detailed information, they might have a big collection of data or observations (information). This might cause difficulties in reflecting on each of them (as well as generating such data into knowledge). The opposite effect can be observed in academics complaints about lack of information: they might not have data or opportunities for observations to reflect on. Difficulties in reflecting on information could also occur when there are questions about its validity or its appropriateness: the observations might not be sufficient and cause worries about the relevance of information.

Additionally, the available information might not be in the appropriate format to be retrieved. It might originate in a different language and the translated version may not capture philosophical or cultural issues or be understood by people with special needs (i.e. blindness). Alternatively, the data might contain poor representations of conceptual material (i.e. inappropriate use of language or not enough explanations) and academics might not be able to reflect on it.

Considering the information flow, academics use specific learning objects that would give them access to useful, correct or interesting information. For example, they use books mainly to gain access to established knowledge and wider discussions; conference papers to gain new prototype knowledge and to become informed about what is going on in current research; journal papers to access in-depth information about issues they are interested in, etc. Academics should have access to these media as soon as possible in order to have the time required to (plan to) read and reflect on these media.

4.1.2 Criticism

However, so far, the description of the learning process focuses on the individual learner without capturing the interactions that take place when two or more learners meet. Learning is also a communicative process, and it takes advantage of the dynamics of interactions between learners.

4.2 *Conversational theory*

A learning theory that seems to describe interactions between individuals in detail is the “conversational theory”. Pask (1976) approaches learning as ‘a conversation involving communication between two participants in the learning process, who commonly occupy the roles of learner and teacher’. Similarly, Laurillard considers the process of learning to be ‘inescapably and essentially a dialogue’ (Laurillard, 1993). Although, Laurillard focuses on the explicit dialogue between a teacher and a student, she also specifies the applicability of the model to an internal dialogue of the learner with themselves (Laurillard, 1993). In an internal dialogue domain, the learner can be the ‘teacher’ who directs attention to what needs to be done, as well as the ‘learner’ who assimilates the subject to be learnt (Pask, 1976).

The conversational framework operates at a level of description of actions in the world (Figure 4.2) and it recognises the second-order character of academic knowledge (Laurillard, 1993). Academic knowledge is acquired through exposition, argument, and interpretation; it becomes part of somebody’s knowledge through reflections on experience and it represents a second-order knowledge of the world. On the other hand, there is knowledge that results directly from one’s experience (first-order), which has to integrate the academic knowledge to achieve assimilation (Laurillard, 1993). Thus, learners might become aware of knowledge from their own experiences that follow experiential learning cycle (first-order knowledge), as well as from other learners’ experiences (second-order knowledge). Each one has his/her own learning cycle and they interact at the level of descriptions of experiences and action settings.

According to Laurillard, the conversational framework has the following characteristics (Laurillard, 1993):

Discursive: both parties agree on the learning goal of topics and task goals; the environment enables the learners to act, generate and feedback descriptions appropriate to the topic goal; they have access to each other’s conceptions; they reflect on each others descriptions and adjust the descriptions in order to gain more meaningful ones for both learners.

Adaptive: the focus of the dialogue should be based on the relationships of both learners’ conceptions.

Interactive: both learners act to achieve the learning goal through feedback related to the nature of the task goal. The output should be an observable change of the conceptual ‘world’.

Reflective: both learners support the process through which they continuously link the feedback of their action to the topic goal. The pace of the learning process depends on the needs of both learners: they have (or should have) the time required for reflection to occur.

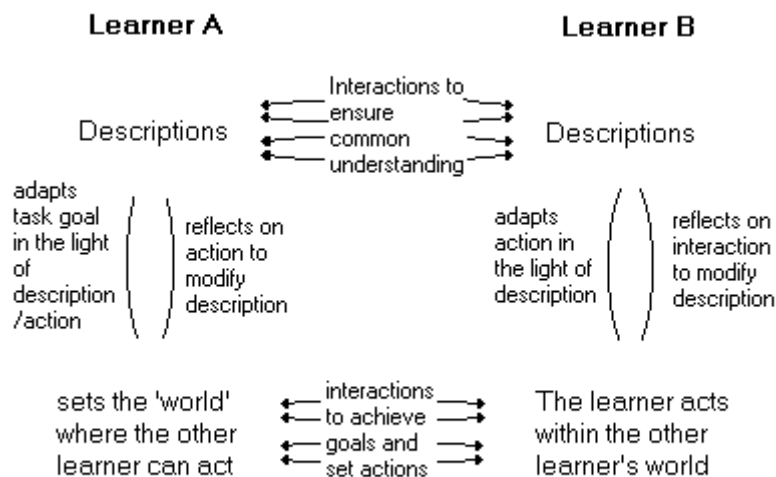


Figure 4.2: The Conversational Framework

According to Laurillard, the conversational framework seems to capture the way students learn from academics. She claimed that learning is more effective when there is one-to-one interaction. Indeed, experiments in student's learning described by Bloom (1984), suggested that tutoring provides the best learning conditions. While tutoring, the learner spends more time on the learning task; (s)he has the time to adapt it and reflect on it. Misunderstandings and misconceptions can be realised soon and be expressed not only verbally but also non-verbally through body language and facial expressions. Thus, learning might be easier and more successful (Bloom, 1984).

4.2.1 Relating theory to academics' learning activities

Although academics' learning is not based on tutoring in terms of guided practice, one-to-one interaction and face-to-face communication have an essential contribution to their learning interactions. There are several times in an academics' life where they become learners taught by colleagues, staff, family, etc. While in a conversation, academics learn through exchanges of conceptions and descriptions with the other participant of the dialogue. Therefore, the conversational model might be an appropriate way to capture academics' learning, when it concerns interactions between people. In particular, academics mentioned that they learn while teaching. The conversational model could capture this interaction where teachers and students are both learners in a continuous learning process. For example, while supervising, academics have one-to-one interaction with the student/supervisee; an essential condition for the conversational model. As soon as the meeting begins the learning topic is defined as well as the task goal. Learners engage descriptions of the world which might be new either to the student or to the academic. Therefore, academics could get an overview of a new topic from the student. During the discussion, each one expresses different descriptions of the topic. Occasionally students teach back knowledge to academics in order to enhance their own understanding and/or to inform the teacher. From each description academics and students adapt different actions, generate new descriptions and give feedback through reflections to the other's conceptions and misconceptions. Thus, they might discover new ways of approaching ideas (and themselves) to achieve the learning goal. Furthermore, discussion becomes a medium through which learners interact and generate ideas and knowledge.

In addition, academics might discuss their difficulties in understanding or generating information in formal meetings (i.e. in conferences) or informal ones (i.e. in common rooms) with colleagues. This might be another situation captured by the conversational model. Through discussions, different descriptions of the same topic might appear. Each participant adapts actions in the light of descriptions and so set up a conceptual 'world' where they can act. Their interactions, based on discussions about the actions, lead them to achieve their learning goals. After setting the appropriate actions, learners reflect on their initial descriptions in order to modify them according to their goals.

The interactive process of the conversational model seems also able to capture the fact that academics can find desirable information from colleagues. What an academic wants to learn in a particular time, another one might have learned previously or might know a way to learn it. Through their dialogue, academics might be informed about conceptual 'worlds' that would stimulate them to adapt actions and reflect on new descriptions.

Furthermore, academics learn from colleagues not only about new skills or knowledge but also about informal facts, like tacit rules, intellectual trends or opportunities for grant proposals. Learning of these tasks is mediated by the dialogue, which, most of the time, is confidential, and the conversational model is appropriate for capturing it. Colleagues 'describe' the real 'world' in terms of tacit rules or hidden opportunities; academics, then, reflect on these descriptions and adapt their actions. Colleagues may also provide advice to academics about ways of presenting their work or the appropriate time to present it, according to the 'mood of the committee'. Thus, the outcome of this dialogue captures the meta-knowledge of the academic profession that helps them make professional choices and create career plans.

However, there is a distinction between formal and informal discussions with colleagues. Formal meetings usually have a fixed location, agenda and participation of academics. Moreover, academics need to be prepared of what will be discussed and to remember the commitments they have undertaken. Thus, they need the availability of cues that would remind them what has been already done and what they are about to do (context information). What is more, during formal meetings, it is discussed the process of knowledge acquisition and the directions that the common thought will have (data from interviews). For example, at a research project meeting they need to remember the project's history and the project's future tasks in relation to their personal goals, etc. While interacting with participants, they try to accommodate their learning needs to the goals of the research project in order to gain job's satisfaction.

On the contrary, informal meetings can occur everywhere, have not a predefined agenda, and participants can start or finish the dialogue according to their will. Informal meetings usually refer to trends or opportunities for action and not to knowledge (data from interviews). Thus, the relevant information that academics have to remember during formal and informal meetings is completely different and can be described by the actions academics undertake.

Therefore, the formality or informality of meetings influences the context of a conversation and thus the memory aids (cues) that academics need. In particular, for formal meetings it is essential to know who are the participants, what issues will be discussed, how these issues are relevant to academic's learning needs, and at the end of the meeting, what commitments academics have undertaken. However, to participate in informal meetings academics need to locate the participants (in order to meet them) and at the end, to remember what has been said.

Moreover, academics also learn while thinking. When questioned, they mentioned that they specify questions about a problem (or descriptions of an object) and look for answers. It could be that the two participants of the conversational model exist inside the learner's head and they have an internal dialogue. Through this dialogue, they do 'thought experiments' and thus, exercise analytic and synthetic abilities: while they describe a concept (analysis), they adapt a set of actions, they define the conceptual world, and they reflect the actions back on the descriptions (synthesis). They also use techniques to re-bring emotional states in mind when they are in tranquillity. This concept might arise from reading research literature; from observing nature or from any other stimuli one might encounter in everyday activities. When they meet anomalies (i.e. data that do not fit together), they have to develop new actions and re-define the conceptual 'world' in order to reflect on modified descriptions that could resolve these anomalies.

Another way that academics learn seems to be through writing i.e. personal or lecture notes, articles, etc. The conversational model can capture this process if we consider that academics have an internal dialogue with the potential reader or themselves. They might try to interpret their knowledge and ideas in ways that would be easier for readers to understand. Thus, they form different descriptions of the conceptual material and they adapt many different actions in order to back up their ideas through different perspectives. Mind maps can play an important role to this process. They can provide alternative ways to present concepts using many different visual cues (i.e colours, shapes) (Buzan et al., 1996). As a result, they allow academics to give better structure to their ideas.

4.2.2 Relating theory to academics' learning difficulties

However, academics mentioned difficulties in communicating with other people. Below is presented an analysis of each of these difficulties along with ways in which academics could receive support.

I. Management of learning projects

Time related difficulties

A crucial matter of the conversational model is the time that the learners need to learn from interactions. Laurillard suggests that the learners should take the required time to adapt actions in the light of descriptions and to reflect on interactions to modify these descriptions (Laurillard, 1993). Unfortunately, academics have difficulties in offering the required time to themselves and colleagues to complete the (conversational) learning process. They often complain about a lack of time to think through ideas or a lack of time to have informal meetings. They also complain about too much work, which do not allow them to learn properly. If there is not enough time, all the learning phases might happen in a hurry and thus, academics would not figure out misconceptions or they might be engaged in actions not relevant to their learning goals.

Those time restrictions could diminish, if we reconsider the context in which one-to-one and face to face communication happens. For example, the conversation needs the synchronous participation of both learners. Thus the speaker and the listener have to be at the same place, the same time. Considering the academics' difficulties in finding time to meet with colleagues (at the same place), academics could use technology that would provide them with synchronous and asynchronous transportation of image, sound and text and thus, enable them to have meetings even if they are in different places and/or different times.

Interleaved tasks

Academics may be able to handle more learning tasks if they plan their time according to their learning needs and style. For example, they could make realistic estimations of the time needed to perform a task. At this point, a tool could help academics not to overload their time schedule of day/week with tasks that they do not have the time to achieve.

However, considering that most of academics' learning projects are interleaved, time estimations are not always possible. Very often academics have to leave a learning project uncompleted to be involved to another project that is more urgent or persistent.

Moreover, interleaving learning tasks capture academics' interleaving learning needs. As they are involved in a learning activity, they might decide to be occupied with another one, before completing the first. Thus, academics need to prioritise their learning activities (according to their needs) and they could employ a tool to remind them those priorities.

Nevertheless, there are often learning tasks that demand attention as soon as they appear, even if they are not scheduled. For example, although academics are involved in a conversation with another learner, there might be interruptions that stop their learning process. The demands of other interleaved tasks do not allow to the current learning task to complete, and for the learners to cure misunderstandings and misconceptions in their descriptions. Another way of approaching interruptions might be at the level of their conceptual world: while academics participate in a conversation with a co-learner, they describe and act in a conceptual world. When people, phones or emails invade their current conceptual world, they might be forced to change the 'world', without letting the previous learning process complete. Thus, they have to remember all the issues that construct the conceptual world of each task they are involved in (and compose the context of each task).

II. Nature of Information: access to communication media

Academics also acknowledged difficulties about accessing the appropriate information. The conversational model provides a resource that the experiential learning cycle ignores: colleagues. Academics communicate with their colleagues through face-to-face discussions in their offices, conferences, common rooms, corridor, etc. They also use phones, email, discussion lists or other media. Each medium provides different access to people. For example, face-to-face communication provides subtlety to responses; communication through telephone provides subtlety restricted to speech (or lack of speech). Email can be more formal since it is written as opposed to oral speech. These media can provide academics with one-to-one as well as one-to-many interactions. Academics could have access to all the above communication media with the choice to have one-to-one and/or one-to-many interactions. For example, they could have a tele-conference that would allow them to speak to many people at the same time and, if they wish, to have a private discussion with a participant.

4.2.2 Criticism

Nevertheless, in order to capture the entire process of academics' lifelong learning, we need to position learning within the social context in which it happens. Academics live in society and have different social roles from which they acquire knowledge, skills, beliefs and attitudes. In particular, apart from being teachers within academia, academics experience several other social roles, each of which might result in new experiences that broaden their learning. The fact that academics come across several learning tasks during

the day can produce unforeseen relations between tasks that would lead to new ideas or experiences and thus enhance learning. Therefore, we need another learning model to extend academic's lifelong learning to its social framework.

4.3 The expansive learning theory

Expansive learning theory takes advantage of the social-technical features of lifelong learning and unites academic knowledge with the knowledge gained from interactions within the society. Society consists not only of people but also of social roles, rules and tools. Engeström (1991) proposed the expansive learning model to facilitate school learning, however it also explains the self-organisation required in lifelong learning during social activities. “[Good expansive learners] can design and implement their own futures as their prevalent practises show symptoms of crisis” (Engeström, 1991).

The expansive learning model of Engeström consists of seven parts each of which is connected with the others in triangles: rules, community, division of labour, subjects, object, outcome, tools (figure 4.3).

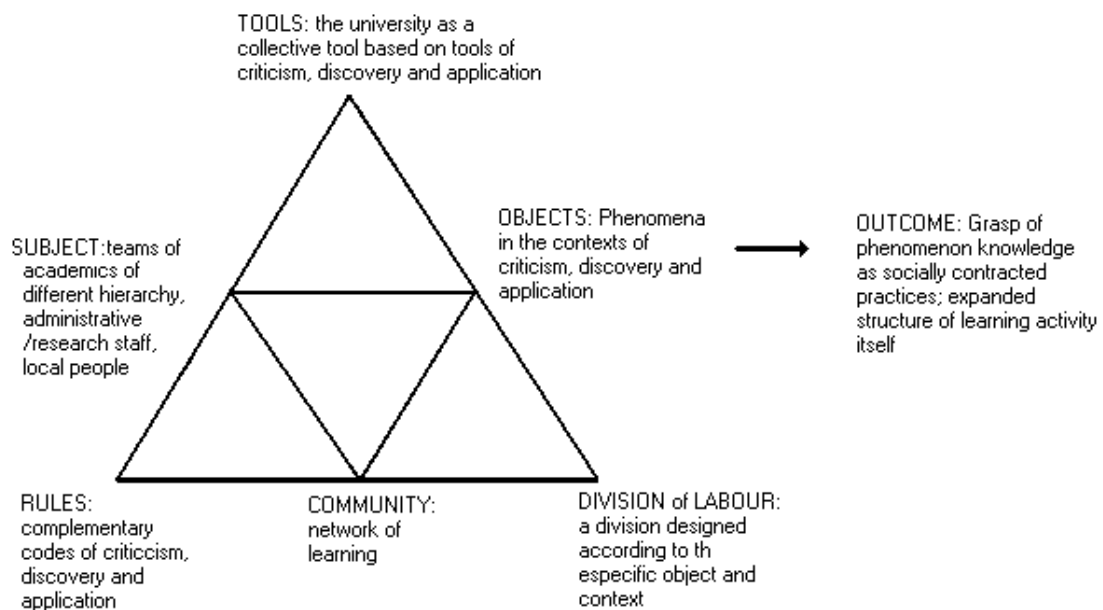


Figure 4.3: An expansive learning model for academics (based on Engeström, 1991)

Rules refer to the norms and standards that regulate the performance during the learning activity (Engeström, 1991). Rules in academia involve the code of practice, the legislation of university, tacit rules that control the nature/spirit of the working environment. Rules also specify the tasks that academics have to accomplish in the short/long term, any constraints that specify how they are supposed to carry out their work, the deadlines they have to consider, etc.

Community refers to those who share the same object of activity (Engeström, 1991). It includes the social context in which academics act while learning. Interactions between people in a community define an exclusive human network of learning. During each learning task, academics have a different community in which they act (the office with the people supporting academics, the home and their family, etc.).

Division of labour refers to the distribution of tasks among the members of the community (Engeström, 1991). It includes the practices which specify the roles and

the assignment of tasks to each participant. In academia, it involves the norms through which is decided who will accomplish each subtask of a learning project.

Subject refers to the academic that carries out the learning activity.

Depending on the task, the subject might also refer to teams of academics holding different positions in the hierarchy, researchers, administrative staff, relatives, or other people who cooperate with academics to complete a learning task.

For example, when academics write a collaborative article for a conference, the collaborators are considered to be the subject of the learning task (write an article) that will interact with the community (the referees). The community will interact with the rules (the conference's quality standards for papers) and they will accept, suggest revisions or reject the paper. Subsequently, based on the division of labour, referees will interact with the conference secretariat to inform the writers about the result.

Object refers to the phenomena that stimulate learning in academics. Engeström argues that the phenomena can be considered under the context of discovery, the context of application and the context of criticism. Each context highlights different approaches to phenomena depending on their nature and the depth that academics want to be involved. The *context of discovery* highlights the power of experimenting, modelling, symbolising and generalising; the *context of application* emphasizes the influence of social relevance and knowledge embeddedness, the involvement of community and the guided practice; the *context of criticism* pays attention to the strengths of resisting, questioning, contradicting and debating (Engeström, 1991).

For example, while academics participate in a conference, they might be involved in different learning situations, each of which might activate a different context of learning. While they attend a presentation, academics approach the speaker under the context of discovery: they experience the power of the experiments that the speaker has done, the models and symbols that (s)he has used, and the generalisations (s)he has assumed. In addition, while they participate in a discussion panel, they approach the discussing subject under the concept of criticism: through the dialogue, they might question the strengths and weaknesses of each opinion, challenge the other participants, or be involved in philosophical debates. What is more, during breaks they approach conference attendees under the context of application: they experience abundant interactions with them through discussions about problematic situations. While walking through the exhibition, they might study the demonstration of products and thus, they have the chance to question the embeddedness of knowledge. Of course, each of these situations do not exclude the different contexts existing together in one's mind. Thus, while in a discussion panel, academics may discover new issues, in a presentation, they may discuss about the application of the presented thoughts, etc. Therefore, the conference can be the phenomenon that encourages academics to approach learning under the context of criticism, discovery and application.

The outcome refers to the result of learning. It might be a body of knowledge formed with social contributions (Engeström, 1991). Hence, in the conference example, the outcome would be the knowledge that academics acquire, the ideas they generate, the people they meet and can access in the future, etc.

Finally, the tools refer to the media required for criticism, discovery and application (Engeström, 1991). In the conference example, we could consider everything that attendees use during the conference as tools. There might be the notebook with the pen, the participant's list with their organisation name and research interests, the name card that they wear and see other people wearing, etc.

4.3.1 Relating theory to academics' learning activities

The expansive learning model of Engeström positions the learners in a social context which provides them with people, tools, rules and roles to support their learning process. It captures the potential that society provides for academics to learn. While academics are involved in a learning task, they become a part of a learning set of triangles, each vertex of which indicates specific rules, tools, colleagues.

Academics might be a vertex of a triangle (subject=academic) or they might be a part of a vertex: they might be individuals that learn while interacting with a social group (i.e. university), or they might be part of a social group (subject=research group) that learn through interactions with another one (i.e. university). Likewise, academics might interact within the community of the classroom, the research group or family. On the other hand, each person that interacts with academics carries his/her own triangle of interactions. The common issues, that each triangle contains, form the shared knowledge within the society.

4.3.2 Relating theory to academics' learning difficulties

I. Management of learning projects

Interleaving tasks

It has been mentioned previously that academics deal with interleaved learning projects during the day. These projects can be interpreted as triangles that co-exist and form a complex structure of rules, roles, tools and people. Academics have to put these tasks/triangles in order and thus, to prioritise their learning goals. However, each triangle has its own demands, leading academics to complain about competing demands of tasks. The tasks/triangles of their personal life might compete with those of their profession, since they have to be with the family in the evening and work at the same time.

What is more, interleaved tasks/triangles can interpret interruptions: while academics prepare the lecture, they have to interact with a student that enters their room; while they are in a meeting, they may have to answer a telephone. Interruptions are caused by people and can be divided in those mediated by telephones, computers or other media (tools) and those that happen without the use of media. Interruptions mediated by tools can be controlled by academics provided that they have access to appropriate means: for example, voicemail to avoid interruptions by phones. However, interruptions caused directly by people need different treatment: academics have to invent techniques and employ different artefacts. For example, they publish their timetable on the Internet and they post it up on their door. In that timetable (artifact), there are days devoted to research where students are dissuaded from visiting them. Thus, the timetable has an 'agreement of meaning' (Kristoffersen, 1999) between academics and students, colleagues, etc., which says i.e. 'do not interrupt' or 'enter the room if you have an appointment' and helps people to establish means of interaction. It is also important that a kind of explanation/confirmation also exists in order to form common agreements of the meanings of artifacts (Kristoffersen, 1999). Therefore, academics need to ensure that these artifacts' meaning agreements are shared by the people with whom they interact.

Furthermore, if there are too many learning tasks/triangles in process, academics might experience lack of closure between their thoughts: they have to deal with many unrelated tasks simultaneously (and thus participate in many different learning triangles). Instead of having to deal with all the issues of the learning tasks, academics delegate the trivial tasks

to colleagues, assistants or students. They usually keep a bird's eye view of the higher management issues and do not concentrate on the details. Thus, they need support in choosing the trivial tasks that can delegate to other people.

On the other hand, even if academics delegate the work, they might fail to gain the required outcome. Thus, they have difficulties with the division of labour and the people that form the committees. For example, academics' interaction with the administrative staff might not meet the expected results and thus, academics are charged with extra administrative work. Moreover, they might not have the required support from their colleagues and students (who form the community of the current learning task), and have to accomplish the tasks by themselves. As a result, they have to reconsider who will do what or they are obliged to do the work by themselves. Academics could receive support for these managerial issues in terms of controlling each task early on, to avoid pending deadlines.

Time related difficulties

Academics might deal with vague descriptions of a phenomenon: its issues might not facilitate understanding within the context of discovery, application or criticism. For example, consider a badly written paper that does not help the reader to construct a full understanding of its ideas. Academics cannot generalise what is written or evaluate the knowledge embeddedness. These difficulties become more intense if there is not enough time for action and reflection through the context of criticism, discovery and application. Thus, academics do not have the time to read every article they find; they need a broad view of what is written, to understand if it is interesting and/or worthy to be read.

II. Nature of Information: access to the appropriate 'societies'

Academics complain about insufficient knowledge of a relevant field. When academics are introduced to a new field they need to know the key papers, authors, institutes etc. of the field. Sometimes they can gain a broad overview from colleagues. But most of the time, academics need an in-depth and updated knowledge. Thus, they need a tool that would provide them with field information including institutes, experts, etc. It should support interactions with experts, briefings and/or detailed information depending on their particular needs.

Furthermore, academics also demonstrate difficulties concerning the detail information and/or lack of it. These difficulties can reveal problems in handling tools: information comes through media provided by society (e.g. journals whose subscription is paid by the university). When tools cannot be controlled by academics, they provide too detailed information. For example, they have access to all papers that are relevant to their field instead of access to key-papers only. When appropriate tools are not provided by the university (i.e. the latest bibliography), academics might have difficulties in finding information. Thus, they could use field information with the choice to gain briefings (eg. review papers) or detailed information (e.g. lab tours- what a particular research team has done).

The inability to find the original/appropriate information may also mean that the relation between academics and their communities is not efficient enough. Therefore, although their colleagues believe to have helped them, it seems that academics cannot gain enough help. Academics then could ask for help from other people, for example from members of scientific societies. In particular, members of societies can gain access to the societies' libraries (or e-libraries) and meet people that work in a relevant field. They have other privileges e.g. early information about special events. Considering the advantages of

becoming a member of scientific societies, the supportive tool for academics should encourage them to establish e-societies with people they interact with and thus facilitate the information flow for them and the other members.

Alternatively, academics could ask for more appropriate information from authors of papers that stimulate them to research a particular field. Apart from the e-mail address, they need to know his/her expertise, degree of citation, colleagues, etc. Thus, they could have a tool that would provide the information needed for each author (e.g. profile) they find interesting.

III. Skills and cognitive processing shortcomings

Academics also need to recall information or thoughts of the past. A habit that helps academics to remember every thought or interesting information is to write it somewhere that would find it again. It would be convenient to have a notebook that could be available anywhere and could sort these notes according to their context. Thus, even after the elapse of long periods, they could be able to find that information without delays.

Finally, academics have difficulties in recalling acquired information even after long periods. According to the expansive learning model, difficulties in recalling indicate problems in the relation between the learning object and the learning outcome. The phenomena explored under the context of criticism, discovery and application were not strong enough to structure a body of knowledge that would be available for a long time. Thus, academics would need specific cues to recall the process of what they had learnt.

4.3.3 Criticism

However, Engeström's model does not indicate how academics learn or how the interactions between subjects and the whole society might occur. What is more, it does not indicate how subjects become aware of the social rules and roles or how they can find access to the provided tools. Academics become aware of the rules and roles of society through conversations with people; they become aware of the tools through 'thought experiments' and discussions. Therefore, the expansive learning model clarifies the interactions that takes place in academics' lifelong learning but the previous models capture the ways that these interactions will generate knowledge.

Hitherto is described the learning process of academics as individuals (experiential learning theory), as a result of the interaction between learners (conversational theory) and as the outcome of social interactions (expansive learning theory). However, academics become involved in more advanced learning tasks as time passes. Thus, a learning theory that pays attention to the adult's self-development process is needed.

4.4 Transformative learning

Mezirow (1990) approaches learning as a process that occurs through transformations of actions or reflections while individuals live through. These transformations occur through criticism of other people and themselves in instrumental, communicative or self-reflective learning.

4.4.1 Relating theory to academics' learning activities

In particular, the process of instrumental learning is applied in problem-solving situations (or learning how to do things) where learners try to control and manipulate the environment and/or other people (Mezirow, 1990). After taking an action, academics would reassess the effectiveness of the strategies and the tactics they used. They look back to examine if they made use of all the advantages they could, if they evaluated alternative hypothesis correctly, or if their inferences were unbiased. This problem solving process involves criticism that reflects on the learning content or on procedural assumptions and results in corrective actions.

Communicative learning involves a conversation between participants as well as a critical evaluation (Mezirow, 1990). Academics seem to challenge the validity of what is said (by the other speaker or writer) in terms of its truth, comprehensibility, appropriateness (in relation to social norms) or authenticity. According to this theory, through reflective procedures, academics attempt to ignore prior judgements or biases and to review the evidence and arguments critically. They may also turn to those they feel they are best informed, least biased, and most rational to review the evidence and arguments and thus to arrive at better judgements. Under different situations, they might arrive at different judgements, since the social norms change and the validity of what is asserted is subject to change as well.

Critical self-reflective learning seems to provide explanations about academics choice of particular actions instead of others and the consequences of what they do. According to Mezirow (1990), critical reflection 'addresses the question of the justification for the very premises on which problems are posed or defined in the first place'. Thus, while thinking, academics might challenge the validity of some of the presuppositions of their prior learning. This process requires that academics become critically aware of their established and habitual expectations and that they question high-order theories, beliefs and propositions (meaning perspectives). For example, consider the introduction of the Internet into academics' offices. They had to transform their propositions of how they could find new or interesting information. Since technology offers more and more tools, academics learn how to transform their working tasks or even their concept of work in order to follow technological change. Thus, they seem to become critically reflective by challenging the established definition of the task to be accomplished or the problem to be addressed. They might even find a new metaphor that 'reorients problem solving efforts in more effective ways' (Mezirow, 1990).

Thus, a system that aims to support the lifelong learning of academics needs also to support this transformative process. To do so, it has to know academics' current skills and update its 'reactions' while academics evolve through time.

4.5 Conclusion

In summary, to capture academics lifelong learning several learning theories have been discussed. The experiential learning cycle describes the process that takes place inside academics minds; the conversational model captures the dialogue between learners; the expansive learning model describes the interactions within society; the transformative model indicates the self-development process that happens through time. These theories were the framework to discuss academics' learning activities and their difficulties over a lifetime. Through this discussion, several issues have been arisen that technology could address. In the following chapter, these issues will be extended to reveal more specific

ways through which technology could support academics, and finally the exact problem that the supportive system will focus on will be stated.

5. Task Model

In the previous chapter, the learning difficulties of academics were organised in three main categories. They have been raised from the grouping of academics learning difficulties that was mentioned in Observational Studies and analysed under the spectrum of learning theories (Socio-cognitive framework). Using the same categories, this chapter explores how technology could support academics in overcoming breakdowns or difficulties whilst performing everyday learning activities (Sharples et al., 2000). Issues of user's skill evolution are also discussed and, at the end, the exact problem that the proposed system will focus on is specified.

5.1. Management of learning projects

A supportive tool should provide academics with support in planning their learning tasks. The system could be portable (compatible with the technology they already use), aware of academic's location and the tasks waiting to be done. This support could be provided by informing the user about

- resources availability (i.e. access to peripherals, network connection, etc.),
- the remaining tasks

The tool should be aware of the time of the day, since this limits the number of tasks academics can deal with. For example, academics cannot delegate to colleagues work during the evening unless they are together (assuming that delegation needs also acceptance of commitment). The time of the day can also indicate the productivity of the academic and thus the supportive tool should advise the user about when to accomplish each task. The tool could also provide academics with the information whether or not their time schedule of the day/week is overloaded (if they have overestimated the amount of tasks that they could accomplish).

Moreover, a supportive system could provide academics with an environment to specify crucial events (i.e. reports to be delivered for a research project) and define deadlines' flexibility. It could also propose techniques to meet these deadlines e.g. by setting internal (to the team) deadlines. Furthermore, it could support academics in priority criteria specification in order to select the tasks that need consideration immediately.

To handle interruptions, the tool could provide a group of artifacts (i.e. timetable to present availability) and their meaning agreements, i.e. 'do not interrupt'. Artifacts and meaning agreements could be shared between different user's (i.e. other academics) and could also be published on the web to support people that do not have the tool (i.e. students).

The technological tool that would support academics with the management of their learning tasks could be considered as an advanced time-scheduling tool. It would facilitate the composition of their programme and also provide additional features to support their thinking processes and memory.

5.2. Memory aids

Such a tool would provide academics with a convenient way to support thinking and recalling of their thoughts. For example, academics often use paper and pens to write down their ideas or create diagrams to capture the associations between thoughts. Depending on their style, they might prefer to write instead of type their ideas or they might use lists, images, etc. instead of diagrams. Thus, a tool that would always be available to capture their thoughts in all the possible ways (i.e. handwriting, typing, drawing, etc.), could support academics thinking.

The tool could store the notes according to their context (i.e. subject) and provide access to them even after long periods have elapsed. The notes could be linkable to each other. These notes could also be shared with the members of the academics' research team, to publish thoughts or experiences from events that were not possible for everybody to attend (Davis et al., 1999). In the same context, academics could also store field information about institutes, scientific societies, experts, products, etc.

Moreover, in the research literature, there is a debate about what the context of each task might be. Thus, according to Bergqvist et al. (1999) the context of each task could be:

- (i) the history of the conceptual world,
- (ii) the participants,
- (iii) the place of the task (Bergqvist et al. 1999).

In contrast, Dey et al. (1999) claim that the context of each task is composed of

- (i) who will do what (participants),
- (ii) what will be achieved (sub-goals),
- (iii) when it has to finish (deadlines),
- (iv) a tag that indicates complete/incomplete (the completed tasks form the task's history, and the incomplete the current tasks), and
- (v) comments (Dey et al., 1999).

The supportive tool could compose the context of each task according to what the academic would consider as important.

5.3. Access to Information

Academics also need to have access to the appropriate information, the process of which would result in knowledge. Therefore, a supportive tool could filter the useless information. For example, through the Internet, academics are exposed to information that often is trivial and useless and thus, not trustworthy (data from interviews). Some academics, however, prefer to use cues from web-sites about what is new. Since there is no established way to search all the web-sites that are relevant to the user, the tool could also provide academics with new sites that are related to their research interests.

Furthermore, there are sites that academics trust (i.e. web-sites of scientific societies, publish companies, etc). These sites usually refer to established publishing media (e.g. books, journals) and provide access to e-libraries, on-line bookstores or to reviews/abstracts of papers. These sites could be searched more intensively (i.e. become 'Highlighted sites' to indicate 'Bookmarks' of Netscape). The tool would also ensure access to those sites without the delays of registration or subscription. From these sites academics can also gain information about conferences or other research events.

The information, that academics are exposed to, is mostly reading material. For academics to recognise if an article is interesting enough to be read, they would need a tool to provide a broad view of the articles that are in electronic format (Graham, 1999). This service would facilitate the process of discarding the trivial information and recognising the important information. For example, there are readers that read the abstract, then they read the introduction and the conclusion and only if they are still interested, they read the main body of the article. A broad view of an article could facilitate the process to browse the article even if it is in electronic format.

5.3.1. Access to information: supporting communication

Considering the social structure of academic knowledge, it is important for academics to communicate and interact with people. Since people are not always available at the desired place and time (see previous chapter), academics would need a tool to support asynchronous and synchronous transportation of image, text and sound.

Asynchronous transportation would help academics overcome restrictions on being physically present at the same place, at the same time. It would eliminate the borders of information flow and would allow collaboration between colleagues from all around the world. The meeting place could be virtual and academics would enter it at any time. Asynchronous transportation would provide academics with the required time to reflect. It would support situated learning - the academic can integrate the ideas discussed with the working environment (Green, 1998).

On the other hand, synchronous transportation would enhance academics' motivation to participate in discussions and provide them with the power of a direct question and answer. It would facilitate group cohesion through quick feedback on ideas discussed (Green, 1998). It can also support rapid learning when there is an urgency to find information and reflect on it.

However, the appropriateness of these two types of transformation depends on the personal style and the context of interactions and thus, it would be better if the system allowed academics decide which type of transformation to use.

The type of transportation can also indicate how informal or formal the interaction might be. Synchronous transportation could facilitate informal interactions since users can clear out misconceptions more quickly than in an asynchronous dialogue. The direct questions and answers allow academics to talk 'off the record'. Thus spontaneous responses can be triggered that would enhance the establishment of a friendly environment.

5.3.2. Access to information: Access to appropriate 'societies'

The importance of scientific societies for academics has been mentioned in the previous chapter. When academics would be able to talk to colleagues without time or place restrictions, their participation in activities of societies would be enhanced. What is also important to enhance (in order to establish societies to participate), is to locate the relevant 'members' to their interests and to encourage them to join the society. Thus, technology should support academics in finding people with relevant interests.

Furthermore, technology should support the activities that would establish such a society. Thus, it would provide the environment for academics to organize, coordinate and take part in discussions or other events. Technology could also support academics in finding briefings (e.g. review papers) and/or detailed information (e.g. lab tours- what a particular research team has done) according to their needs.

5.4. Capturing evolution of academics' skills

Additionally, academics would need the supportive tool to be 'intelligent' and thus, be aware of their current skills and be informed when changes may happen. The system could update user's profile: changes in user's profile would interpret evolution of user's skills. Thus, while the user's profile develops, the system can react in more advanced ways. The system would also react differently to support different level of understanding (i.e. novices and experienced users). Moreover, as the user accomplishes more tasks, the system could create a memory through which strategies could be suggested (like: 'remember what you did then ...').

5.5. Problem Statement

The above issues reveal possible ways that academics would receive support from a technological tool. However, to specify the supportive system, it is necessary to specify the exact problem statement and thus, the design's objectives (Newman et al., 1995).

The problem statement would arise from the specific situation that needs support (*situation of concern*). In this case, the situation of concern will be to 'support academics accessing appropriate (field) information'.

But what does it mean to achieve an *adequate level of support*? It can be defined as ensuring that academics are provided with rapid and easy access to information. Since accessing information is a learning process, the effectiveness of the supportive system does not only lie in the provision of tools to perform specific tasks faster and better (i.e. to find the most famous paper of a subject immediately). The effectiveness of this system lies also in supporting the links between tasks and the information resources that the tasks share (issues relevant to reading a paper, i.e. discussing it). Hence, the users 'are supported in a systematic way instead of piecemeal, and technology really represents a system' (Newman et al., 1995).

Moreover, it is necessary to specify the *form of the solution* that the situation of concern could take. For example, interactive technology could be a means of alleviating the situation of concern (Newman et al., 1995). Furthermore, how this alleviation will be available, needs to be specified. Among the several layers of support that technology and resources can provide, this project deals with the provision of the user interface with which the user interacts directly (Newman et al., 1995).

Therefore, the problem statement could be defined in a single sentence:

*“Specify an interactive supportive tool
for rapid and easy access to (field) information
by academics”*

Therefore, the supportive system will focus on providing appropriate information to academics. This kind of support apart from offering reading or other material, includes communication support (synchronous and asynchronous), establishment of scientific societies, provision of people with expertise in a subject. Thus, the system would provide

academics with field information. Moreover, this information should be organised in such a way that academics would access it according to its context.

6. System Image

The system image refers to the specification of system's guiding metaphor (Norman, 1986). Erickson (1990a) defined metaphors as 'an invisible web of terms and associations that underlies the way we speak and think about a concept'. They function as natural models allowing people to use their knowledge of familiar, concrete objects to give structure to more abstract concepts.

Metaphors in design can be understood using a concept of analogy/symmetry (Stubblefield, 1998; Erickson, 1990b). Design by symmetry involves the use of one concept (the source) to provide to the other (the target) with a deep structure or underlying process. Once their underlying symmetry is established, the designer can extend the symmetry and suggest familiar source concepts to the target (Erickson, 1990b). However, according to Stubblefield (1998) the metaphor indicates a complex interaction between source and target in which our knowledge of the target can equally change our understanding of the source (Stubblefield, 1998).

On the other hand, Copper (1996) argues that it is hard to find metaphors to provide users with appropriate mental models. Additionally, inappropriate metaphors can constrict users' thinking and cause them great difficulties (Cooper, 1996). A way to propose an appropriate metaphor would be to look at the *whole* process of learning and not just the part that fits the standards of existing systems (i.e. to extend the 'desktop' metaphor to describe learning activities) (Harris et al., 1999; Norman, 1990). Therefore, the starting point of generating a metaphor is to examine the situations where academics learn. The aim would be to discover the 'situation' that would provide them with the domain to access field information while thinking, reading, interacting with colleagues and social structures in an evolving way. This situation should not restrict academics' actions or thinking and it would be better if it were associated with a pleasant experience.

A learning situation can be described under different perspectives or dimensions. For example, it can have a spatial dimension and provide the place where learning happens; it can have a temporal dimension and provide the time that learning occurs; it can have an anthropomorphic dimension and provide a facilitator or assistant of learning process. Alternatively, it can have combined dimensions (i.e. spatiotemporal).

Some metaphors are discussed below using these dimensions. Each idea will be evaluated according to the following questions proposed by Erickson (1990a):

- How much structure does the metaphor provide?
- How much of the metaphor is actually relevant to the problem?
- Is the metaphor easy to represent?
- Will your audience understand your metaphor?
- In which ways may the proposed metaphor be useful later?

The 'Library' metaphor

The library metaphor can describe a learning situation in a spatial dimension. It refers to individual and decontextualised learning where the learner (on their own) reads or thinks about knowledge written in books/articles. Learners would not learn within a context of

the workplace (contextualised learning) but instead focus on second-order knowledge that results through exposition, argument and interpretation of information. The library can provide an amount of structure to the system (i.e. books, journals, multimedia, etc.).

However, library is associated with a 'searching and finding information' structure instead of an 'acquiring knowledge' structure. Even though searching and finding information is a prerequisite of learning, the guided metaphor should go beyond learning prerequisites and capture also learning processes and outcomes. Moreover, academics' learning activities are not contacted within a pre-specified place. They can happen anywhere and the 'library' metaphor seems to diminish the freedom of the learner by defining the place in which learning happens.

The 'university' metaphor

Alternatively, the university could be a metaphor to present two-dimensional learning situation (spatiotemporal). It has a space that is quite broad and can be extended to 'the outside the campus' world. It has specific time intervals (terms, semesters), which can be devoted to academic learning. Moreover, the university is academics' workplace and thus, it also includes learning from everyday activities (contextual).

The university metaphor provides the system with an appropriate amount of structure. However, this structure may not be applicable to academics learning activities. The university metaphor associates the system with all academics' professional activities and not only their learning activities. Therefore, it might lead users to form false expectations about gaining support during all daily tasks.

What is more, there is a problem with assimilation of the physical and virtual world. When people navigate in a natural environment, they have the time to sense the presence and purpose of the surroundings objects. They can understand which objects can be penetrated on collision. They can also infer the socio-cultural context of the buildings: even though a building is called 'Staff House', people can understand that this is a meeting place. However, danger lurks in virtual navigation environments: users are usually exposed to experiences that are not consistent with their everyday understanding of the real world (Xiao, 1998). Thus, the transition from the physical to the virtual grounding of space has problems that decrease the effective support of users' learning activities.

The 'conference' metaphor

The conference metaphor was also considered, to express a multi-dimensional learning situation. The conference can be described as a *situation* where academics can be active and reflective: they can share/discuss their own experiences (active), and/or they can share the experiences of other academics (reflective). It provides academics with various activities relative to the problem statement: access to new information, access to field experts, briefings, key-papers, etc. Academics can meet people from different backgrounds and expertise and discuss different embeddedness of knowledge. During a conference, academics can generate new ideas from several discussions. They can also create field consortiums and access the current trends and the shared knowledge of the subject area (Fahlén et al., 1993).

The 'conference' metaphor contains the semantic of *rapid learning*. Academics become aware of the shared knowledge of the conference within a short time period.

The conference also considers *reflective learning* where academics discuss ideas, data, or other material and reflect on it. It deals with *second-order knowledge*, and *decontextualised* learning (it does not include learning within the context of the workplace, i.e. office). However, the learning experience is partially *contextualised* since it refers to academics' learning during plenary sessions, workshops, etc. of a symposium. It facilitates *group learning* as it provides academics with access to other researchers and facilitates the establishment of field groups and alliances.

Thus, the conference metaphor has the required structure for the creation of a mental model. Whether this structure is appropriate or not to learning situations needs to be examined. The conference has a specified time and location where it happens and many of its activities are performed in parallel. Therefore, academics have to choose in advance which of the conference's activities they will attend. If they regret their choices (i.e. if the presentation is not interesting), they might not be able to leave and attend another activity. Moreover, the structure of the conference is quite formal: the roles of the participants are specified in advance (i.e. organising committee, scientific committee, participants-presenters, participants-attendees); participants have to follow the predefined schedule that specifies the time of sessions, breaks, etc.

Even though the conference appears to be a pleasant learning situation for academics, it is quite a formal event with restrictions that are not necessary for a learning environment. For example, there is no reason why academics should follow a timetable if activities are available anytime (i.e. through video). Activities do not need to be papers or other publishable material. Academics might prefer to learn in the absence of formalised objects (like papers, books, etc) and concentrate on discussing and thinking. Additionally, the session topics are specified in advance and thus, participants cannot create new conference sessions "in the fly", as the conference progresses, to meet particular and immediate needs. There is no reason for conferences to have a very short duration if academics will not need to stay away from their offices.

Moreover, the term 'conference' has been associated with completely different meanings in design technology. It provides the simultaneous transformation of sound or image (i.e. tele-conference; video-conference) and might generate restrictions to the use of the system by academics.

From the 'conference' to the 'symposium' metaphor

Bearing in mind the pro's and con's of the 'conference' metaphor, it was decided that a different name would resolve the problems that the 'conference' name caused. Among the alternatives, the most appropriate appeared to be the 'symposium'. 'Symposium' is the Greek term for drinking-gala. It has also the meaning of philosophical conversations and conferences (Macdonald, 1974). Its meaning has associations with a combined context of informal interactions (drinking-gala), argumentation and thoughts exchange (philosophical debate) as well as the formal activities of a conference. Thus, it can be the situation which academics can discuss, share opinions and learn while they swing from informal interactions to formal, according to their taste.

Several academics were asked to confirm this concept. They agreed that the symposium reminds them of a pleasant situation where they can meet people, discuss and share their ideas, knowledge etc. Therefore, the symposium metaphor provides the system with a structure that is relevant to academics' learning.

The symposium metaphor is quite easy to represent since it carries a distinct range of terminology (submit, review, etc) and objects (i.e paper, discussion, etc) that can be useful to academics' learning process. It also includes the transformation of understanding through chatting or collaborating with participants. Moreover, academics deal with symposiums from an early stage of their career since publications are important grounds for their professional appraisal. Symposiums are means of publishing their work as well as meeting and interacting with people from the same research area. Thus, it is a familiar concept and productive mental model.

The symposium metaphor could also be extended to capture other dimensions of learning activities. For example, participants can be provided with an advanced time-schedule that would present not only the symposium's activities but also those required to manage all their learning projects. It can be updated every time a new learning project appears.

However, the current concept of the symposium does not capture all the learning activities in which academics might be involved. For example, the symposium metaphor does not provide enough associations for the first-order knowledge that results directly from one's experience. The experience of participating in the symposium is not enough to capture the whole spectrum of first-order knowledge. It excludes the knowledge that results from acting in the everyday workplace as well as the individual learning activities that take place while thinking.

Nor does the metaphor capture academics' long term learning which could be guided by a (long period) research project. During such a project, academics need support to manage people, reports, deadlines, which are not captured by the symposium metaphor. Academics might also need support to monitor people's progress. The symposium metaphor could become useful at particular periods where academics would need to learn rapidly or might need to find appropriate people but it needs additional features to include this kind of managerial support.

Nevertheless, at the previous chapter, it was decided that the supportive tool would focus on providing support to access (field) information. The symposium metaphor can capture quite well this issue. It is an event where academics can meet other researchers and discuss their research activities and problems; can become aware of state-of-the-art research and share their thoughts. Since the environment would facilitate discussions, the framework for establishing societies is structured: academics would become familiar with each other and form a 'virtual community'. Moreover, each symposium carries information about people, key-papers, embeddedness of knowledge that form the context of the learning activity.

7. Design space & System Specification

The design space is a detailed investigation of design options for the proposed system. It is used to explore possibilities and record design decisions and rationale (Dix et al., 1998).

In specifying the design options and rationale, it was important to focus on the proposed metaphor (symposium) and to figure out the important activities that result in a useful learning outcome. Thus, the activity of academics' learning throughout the symposium was studied.

Initially, the focus was on the informal-formal dimension of the symposium metaphor. Symposiums may swing between drinking-gala and conferences. Which features of the drinking-gala might become useful to academics' learning activities and which should be excluded? Likewise, which features of the conference should be highlighted and which not?

Thus, the symposium metaphor will not be based on a spatial dimension (i.e. place to happen, rooms, etc) since this requires the appearance of 'heavy' graphical objects on the screen. These cover a lot of space and are not associated with special meanings (i.e. 'go to common room to see who is available to have a chat'). The same meaning (i.e. informal chats) can be explained by other features (i.e. chat area) without generating spatial restrictions. What is more, the 'room' concept might become an obstacle to the information flow since its 'walls' would separate different types of information.

On the other hand, the use of the symposium metaphor will not be founded on a temporal dimension as well. Symposiums do not need to have a time limit as they do not keep academics away from their offices and thus, academics can participate as long as they wish. However, the organiser of a symposium may specify broad dates of the symposium, to indicate when its activities are useful or out-of-date.

During the symposium, participants may come and go at any time. Some of the participants might attend from the beginning and some might come later. Thus, participants should be able to 'submit' their work as long as the symposium lasts. Thus the system could be a rehearsal for academics to test their ideas before entering more formalised events. Moreover, participants will be able not only to submit papers, field-trips, lab-tours (or other formalised work) but also notes, ideas, references or other informal work. They might propose an idea and receive feedback from other academics.

7.1 Design Rationale & System Specification

The approach taken in specifying the system's design rationale was based on the Design Space Analysis, proposed by MacLean et al. (1991). Following this approach, a set of questions is conducted to elicit the major issues of the design. Therefore, two potential users were approached to state their activities and preferences during a symposium and specify which of them were the most important.

They were (informally) asked questions like:

- What would you like to do while you are in a symposium (activities)?
- Which of those activities are essential for learning?
- What learning material do you use?

The answers reveal the important activities of a symposium and the objects to be available during a symposium's event. Thus, academics stated that *scientific discussions* were of the most important/enjoyable activities of a symposium. They could be either informal (chats) or formal (discussions). They are the medium through which academics meet other researchers and encourage alliances and friendships. They can provide academics with new ideas, since participants may often discuss about their problematic situations and their solutions.

Reading material is also important when they do not have the time for discussions or when participants are not available to share their work. However, the core symposium activities would be presentations, discussions, field trips, lab-tours, etc., surrounded by (relevant or irrelevant) discussions.

7.1.1 Walk around a symposium

Therefore, discussions would be a central part of the symposium and the system would provide the environment to encourage them. Additionally, academics would be provided with reading (or other) material as references. Figure 7.1 captures the alternatives that the users could have while they are in a symposium.

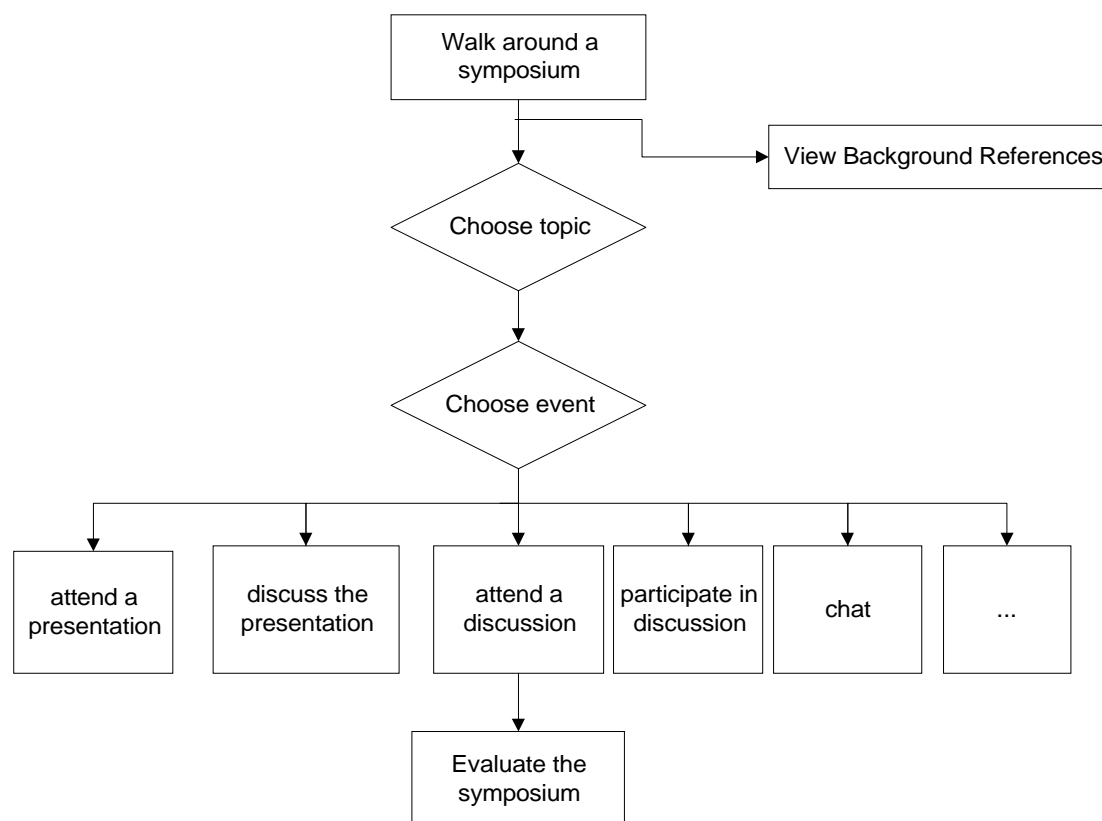


Figure 7.1: Alternatives of ‘walking around a symposium’

7.1.2 Specify your initial activities

However, before ‘walking around a symposium’, academics need to find out if there is a symposium that meets their current learning needs. If there is no such symposium, they could start a new one.

According to Newman & Lamming (1995), these activities could be modelled as below:

- Realising what an academic needs to learn

- Organising a new symposium
- Finding a symposium to satisfy their need
- Walking around a symposium

We can see that there is an intermediate goal of organising a new symposium or finding one. Thus, a hierarchic model could look like Figure 7.2

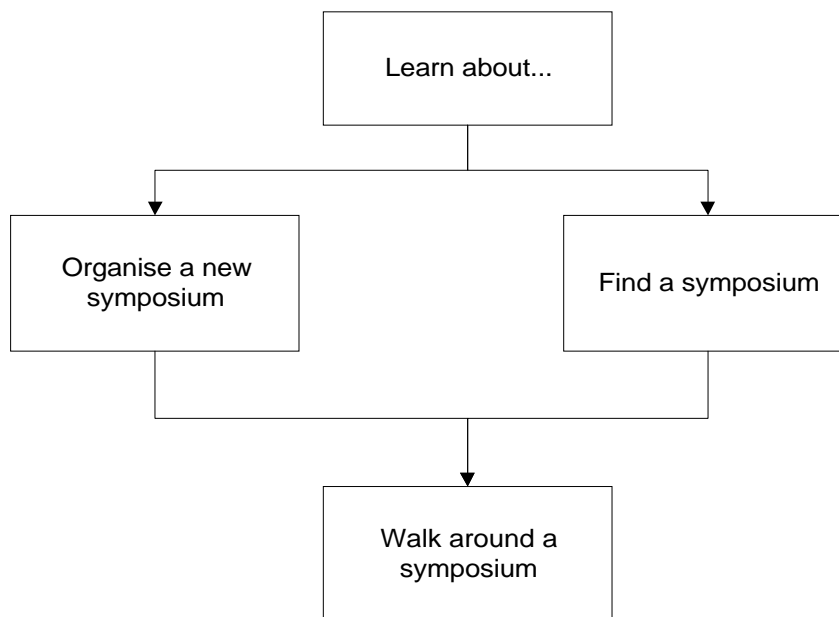


Figure 7.2: A hierarchic activities analysis

From this diagram, it can be seen that the model comprises of two subtasks and poses the question: are both tasks performed every time? If not, the system should support one without the other (Newman et al., 1995)? It was decided that users could follow any subtask but they would be advised to organise a new symposium, only if they cannot find an existing symposium to satisfy their learning needs.

I. Start a new symposium

A next issue that needed clarification was how symposiums can be organised from scratch. After discussions with a potential user the distinguished issues decided to be:

The relevant disciplines. Every research subject can be examined under several perspectives. The discipline could specify the perspective through which a subject can be studied. However, today's scientific tendency for interdisciplinarity means that many learning activities involve more than one discipline. Thus, the system's design should also support the study of interdisciplinary subjects.

The relevant keywords. The keywords can represent the detailed research subjects that are considered in a symposium. They seem to be a well known 'script language' between academics/researchers that specify exactly the issues they want to discuss.

The title. Each symposium has a title that specifies the main question under investigation. Each symposium has a unique title.

The (session) topics. Topics can be considered as subcategories of the title. Symposiums can have a general title and detailed topics or a detailed title and only one topic. If there are several topics, each of them specifies the particular events taking place during the symposium. Academics might be interested only in specific topics and might want to attend/participate only in some events.

Participant's name. The success of a symposium can be ensured if experts are participating. According to the information given to the system before, the system would find the key-fellows of the subject-area and propose to be invited. Users can view each fellow's profile and the invitation text before sending them the invitation. They can specify how many of them they want to invite by clicking on Yes/No buttons (Figure 7.4 & 7.5).

II. Find an existing symposium

The above procedures could also be the base of finding/locating a symposium. Academics would specify their learning needs by writing the relevant disciplines, and/or keywords, and/or words of a title, and/or topics, and/or participants' names (since users might be invited to a symposium by other academics, they should be able to locate a symposium by participants' name).

Therefore, the proposed solution would contain two interconnected systems (Newman et al., 1995). Each of them has subtasks that are presented in Figure 7.3

<p>2a. <u>Organise a new symposium</u></p> <ul style="list-style-type: none"> a. Specify disciplines b. Specify keywords c. Specify title d. Specify session topics e. Specify participants f. Edit 'Call for Participation' g. Create 'Background References' h. Start a symposium 	<p>2b. <u>Find a symposium</u></p> <ul style="list-style-type: none"> i. specify your learning needs <ul style="list-style-type: none"> i. Type disciplines of interest ii. Type relevant keywords iii. Type possible words in the title iv. Type possible session topics v. Type names of possible participants j. select a symposium
<p>2.</p>	<p>3. <u>Walk around a Symposium</u></p>

Figure 7.3: The procedures to find/start a symposium

The above specifications have a dual goal: they provide academics with a means to organise their learning needs and they provide information for the system to find academics with relevant expertise to participate in a symposium.

7.2 Design options and decisions

However, apart from the design rationale, it is essential to specify the interface and interactions by visualising design issues, alternatives and decisions. The methods of interactions are examined under the spectrum of human-computer interaction principles and/or results of empirical studies (Sharples et al., 2000).

7.2.1 General issues

According to Shneiderman (1998), effective screen designs must provide all the necessary data in a proper sequence for performing the task. The design rationale specifies the sequence of tasks' performance. Its effectiveness is discussed in the Evaluation section. However, users also need to know what the previous/next steps would be. Thus, it was decided that SALL should have a window on the right that would show the steps required to complete each task. Moreover, 'next' and 'previous' buttons would facilitate navigation.

Shneiderman also argues that supporting task performance requires: (i) meaningful groupings of items, (ii) consistent sequences of groups, (iii) orderly formats (Shneiderman, 1998).

Considering the meaningful groupings of items, each screen is divided in five areas (Figure 7.4):

- the top, where the *title* of the system is shown;
- the bottom, where *Help* instructions are provided;
- the right area where (the previous and future) ‘*steps*’ are presented;
- the left area where information about *participants* is displayed (list of participants and participant’s profile).
- The *middle* area is the main body of each task/step. The main activities of the user take place in this part.

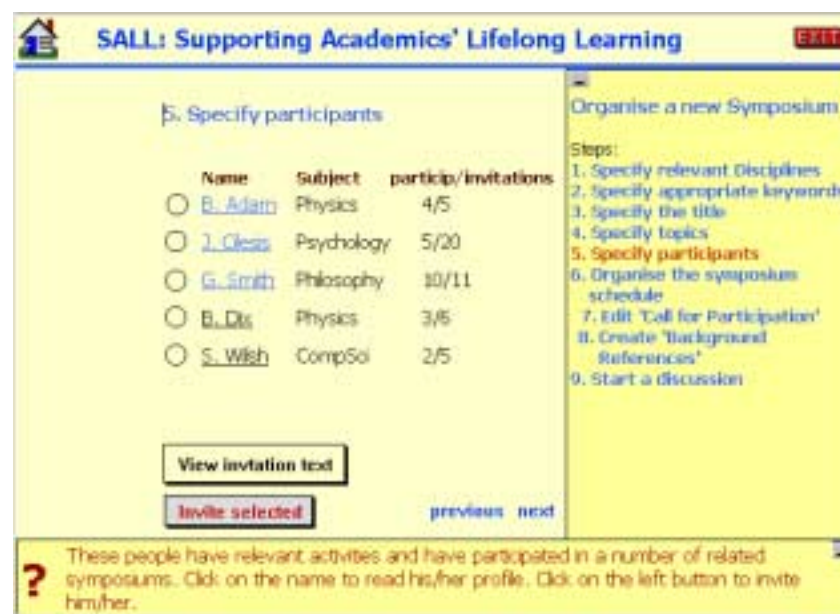


Figure 7.4: The ‘Specify Participants’ screen of ‘Organise a new symposium’ task

In meeting the ‘consistency of sequence of groups’ criteria, the right and the bottom areas appear in slightly different background colours. There are also borders dividing them. Their appearance and placement is the same on all the screens. Each area is informed while the user performs different jobs. For example, the writing in ‘Steps’ area is numbered (the orderly format requirement is also satisfied), in bold format and blue colour. One job at a time is coloured red, to indicate that it is the current one.

On the other hand, Smith and Mosier (1984, in Shneiderman, 1998) proposed a set of data-display guidelines. These were also followed in the SALL system. In particular,

- the data displayed to users is in directly usable form; users are not required to convert the displayed data.
Most of the time, users can select the displayed data instead of typing.
- Among different screens, a consistent format is maintained.
During the design process consistency issues were always considered. At the final evaluation phase, no consistency problems were mentioned.
- The sentences are short and simple.
- Only affirmative statements were used; negative statements was avoided.
- When lists are displayed, a logical principle is applied to order lists (i.e. sequence of tasks to organise a new symposium).

- Labels are sufficiently close to their data fields but separated enough to be read.
- Each screen has each own brief title to be distinguished. There is enough space between the title and the main body of the screen.

The screen design could be different for experienced and/or novice users (Figure 7.5). Once users become accustomed to the interface, they may not need the navigation or the Help area to be continuously visible. Thus, the right and bottom areas can be hidden and leave empty space to display different information. However, users can also restore the supplementary areas if they want to view them again.

Therefore, the screens dimensions decided to be (6*4.5) to produce an interface that could also be viewed from a handheld device.

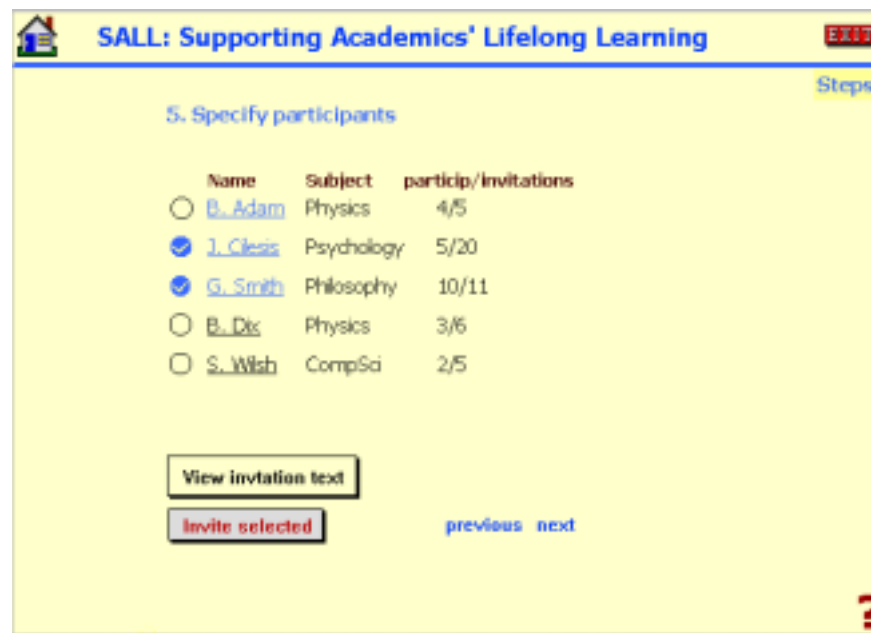


Figure 6.5: The 'Specify Participants' screen of 'Organise a new symposium' task for experienced users.

7.2.2 Use of colour

The screens contain colour-coding signs to organise information into groups and to facilitate their comprehensibility to the user. However, it is clear that such a decision can cause pitfalls and so a set of guidelines were considered, proposed by Shneiderman (1998).

Design for the monochrome first: It is beneficial to design for the monochrome first since the designer should focus on the layout of contents as well as the sequence. Related fields can be better grouped by drawing boxes around the group. The interface of SALL was first drawn on paper where no colours were used. Boxes were used to group information that become more visible when the colour added.

Be alert to common expectations about colour codes. The interface took advantage of Internet navigation rules. Blue-coloured, underlined characters were used to indicate links to another pages/screens. The 'exit' button was coloured red to suggest danger to exit the system.

Be consistent in colour coding: The colours do not change meaning at different phases of the system. Coloured bullets were used to indicate degree of relevance to users' interests. A bullet coloured like the background (yellow) was used to indicate irrelevance. The same colour (yellow) was used to indicate No, in Yes/No decisions.

Use colour pairings correctly: For example, blue-red pairing; in this case the blue appears to recede and the red to come forward. This trick was used in the ‘Steps’ window where the user can view the sequence of navigation. The previous and subsequent steps were in blue and the current one was red.

Consider the needs of colour-deficient users. The most common deficiency is red-green blindness in which both of the colours appear grey. The SALL system avoids red-green pairing to facilitate colour-deficient users.

7.3 User’s scenario

This section discusses the proposed scenario, and explains the design options under the spectrum of each job that the user has to accomplish. The reader can view the screens of each task/step by looking at the Appendix B.

Task 1: Decide what you want to do

Imagine an academic that would need to learn about Heuristic Evaluation of supportive computer systems. They would refer to SALL to organise a symposium to learn about it.

Task 2a: Organise a new symposium.

Step 1a: Specify the disciplines involved in the learning need. Users can see a list of very broad discipline areas and need to specify in which particular ones they are interested.

Step 1b: Specify the disciplines. The next screen will show more specific disciplines. The user needs to specify the degree that each discipline is relevant to the symposium.

Buttons’ decisions

At the beginning, coloured-based buttons were used to indicate the relevance of each discipline on both screens. However, users experienced difficulties understanding their tasks on the second screen. They viewed more disciplines (i.e. Computer Science under Science) but they could still select the broad ones (i.e. Science). To overcome these difficulties it was decided to differentiate the selection process on each screen.

Thus, users can mark the relevant (broad) disciplines by clicking on Yes/No buttons. The ‘Yes’ button will indicate the disciplines that the users need in more detail.

At the second screen, users would not be able to select the broad disciplines viewed at the first screen. They should click on colour-based buttons to express relevance of more specific disciplines (yellow=irrelevant, sky-blue=least relevant, blue=relevant, dark-blue=most relevant). Colour-relevance buttons were considered to offer the vague description wanted, unlike numbered buttons (which are discrete and could also be associated with marking) or Yes/No buttons (which do not offer variation of the positive answer).

Step 2: Specify/select keywords. Users can view some keywords proposed by the system. They can select which keywords interest them by clicking on colour-based buttons to express the degree of interest. They can also specify their own keywords if the proposed ones are inadequate/inappropriate.

Step 3: Specify a title for the symposium.

- a. SALL proposes the titles of current or past symposiums that might be of interest. Users can specify which of them are relevant and to what extent (by clicking on coloured-based buttons). They can also specify their own title.

- b. If they don't specify a title, SALL will generate one. Users may either agree with it or disagree. If they disagree, they would have to specify their own. If they agree, they can continue.

Sequence change

Initially, users would go to the next step without being aware of the symposium's title. After discussions with potential users, it was decided to add one screen where users could view the title and decide if they like it or not.

Moreover, the titles provided by SALL were blue and underlined, causing expectations that there were some links. Since there was no link, the colour of the titles changed to black.

Step 4: Specify the topics of the symposium. They can either choose those proposed by SALL or type their own.

Step 5: Select participants/experts: Users can view lists of people that are relevant to those disciplines/research areas and invite them or not. Yes/No buttons implemented this choice. The people viewed (experts in that area) are generated by the system. Users can view experts' responses to previous invitations (participations/invitations) to infer the possibility that the expert will respond. They can also view the invitation text and change it before sending it.

Users can continue to the next step without inviting any experts. However, it is better to invite some, in order to ensure some initial participants.

Buttons' decisions and more information to the user

Initially, the 'No' button was blue, which was confusing since it had a different meaning on other screens (blue=relevant). This was changed to yellow to ensure consistency with the 'irrelevant' meaning assigned in the previous screens.

Moreover, users asked to view the invitation text. Since the user may know some people and not know others, the users were subsequently provided with the choice to change the invitation text accordingly.


Step 6: Organise the symposium's schedule. Users can arrange the sequence of topics available for discussion/participation. They can drag and drop any topic, to put it in the right position.

At this point users can either start a discussion if they have responses from invitations or produce a 'call for participation' to have more contributors (Step 7).

They can also create a list of Background References, where participants can read the organiser's approach or any material that 'experts' have proposed (Step 8).

Step 9: You can 'start a Symposium.'

Buttons' decisions

When users had finished the first task of the system's demonstration, they were asked whether they understood particular system's functions or not (i.e. the alternative to hide/show parts of the screen). For this example, the answers were negative. The buttons provided for these actions (left and right/top and down arrows) were completely misunderstood. As a consequence many alternative buttons were tested resulting in the use of familiar '' button of Ms-Windows to indicate 'minimization a window' and the name of the window to indicate 'maximization a window'. The position of the buttons was also tested. Although

the initial idea was to be consistent with the Ms-Windows environment and to show the 'maximize' button at the bottom of the window's area, users preferred to have it at the top, opposite to the '■' button to understand their relation at once.

Moreover, the 'Help' area (at the bottom of the screen) was not understood. It was therefore decided that a big character with an appropriate meaning would be used to trigger attention. The question mark (?) was used and understood by all evaluators. Meanwhile, the language of the 'Help' area became more concise whilst still being comprehensive.

Task 2: Walk around a Symposium

Once users have specified a symposium, they can 'walk around' its events. The information presented during this phase required more space than that provided by the middle section of the screen. Thus, some '*artifices*' were used to overcome such screen restrictions. Some (less important) windows made minimizable to let other (more important) windows appear.

Step 10: Select a topic. Users can view the symposium's title, the topic they have specified/chosen before and choose the most interesting one (i.e. Heuristic evaluation).

Step 11: Select an event. They can view several events under the topic's title. They can add an event and/or search for an event (if there are too many events to read). Users can click on one event to continue or they can follow the order that SALL has created and click on the 'next' button.

Step 12a: Paper presentation & discussion. While attending a presentation, they can watch the video (adjust the volume) and view the slides. At a particular point they might want to start/participate in a discussion. This can be done by clicking on the appropriate button ('raise hand') to view the discussion area on the right. Alternatively, it is possible to view the paper. By clicking on the appropriate button a paper can be viewed, saved to a file, printed or reviewed. To view the discussion area or the paper, the 'Steps' window is minimized. However, the 'Steps' window can be restored.

On the left side of the screen, users can see the presenter's profile or the profile of any other participant. A highlighted name means that the participant is online and can have a synchronous chat/discussion with them.

At the bottom, the Help window can be minimized and users can start a chat with another user. This arrangement allows the user to chat while participating in an alternative activity. If the user needs help, they can click on the 'question mark' button to restore Help.

Users can click on the 'next' button to continue to another event (proposed by SALL), or 'previous' to choose which event they want to attend.

Appearance of screen

The appearance of the presentation screen underwent many changes during the design process. Initially, the slides covered the middle part of the screen and the user would have to hide the participant's window (on the left) to view the video, control the volume and brightness and participate in discussions. Moreover, the buttons that describe these alternatives were judged by the evaluators to be unsuitable.

Thus, the buttons were changed to simpler ones and the option to adjust the brightness was deleted. The rest of the buttons were positioned in the main part of the screen and the slides become smaller. The user could also navigate between the slides. The left area of the screen now shows only information about participants and is more consistent with the other screens.

Step 12b: Discussion. It is possible to attend a discussion that has already started. All the previous messages can be viewed. Discussions' references are also provided. A user may volunteer to write its summary. The user may also start a new discussion. Also, they can always continue their chat or start a new one: the chat is always accessible.

Design decision

Initially, the symposium supposed to have only a paper presentation screen. However, during the design process it was realised that doing so meant that the main feature of the symposium metaphor (discussions) was not captured. Thus, the discussion screen was incorporated.

Step 13: Evaluate the symposium by marking its outcome. This is achieved by clicking on the numbers to select the appropriate one (marking rate: 1=disappointing, 5=excellent).

The evaluation criteria were changed during the design process. Initially, the criteria were focused on how well the system had satisfied academics' learning expectations. Later, the evaluation criteria focused on the learning outcome of each symposium in general. Thus, it was consistent with the prerequisite of the problem statement of the Task Model to support the learning *process* and not only the '*fast*' accomplishment of learning activities.

Alternative Scenario

Task 2b: Find an existing symposium

Step 1: Express you learning needs in terms of disciplines/keywords/words in a title/topics/participants. All or a single box can be fill in.

Step 1.2: Users can specify if they want to view past symposiums or current symposiums only.

Step 2: Select a symposium. The results generated by SALL are displayed along with the degree to which they match the request.

Format on the screen

Initially, the titles were not aligned and it was not clear that they were links to symposiums. What is more, the user could continue on the next Step without specifying which symposium they wanted to view.

The format of the titles were altered to be consistent with Internet navigation rules (links being blue and underlined). The 'next' button of the screen was grey out. If the user clicked this button, they would be presented with a prompt message instructing them to click on a title instead.

Step 3: Walk around a symposium: identical to Task 3.

Exit the system. Click on the exit button on the right top. View the prompt message and decide whether to exit the symposium or not.

8. Implementation

Producing a fully implemented system was not an objective of the project. However, during the system specification process, a working prototype was created in order to facilitate evaluation.

“Prototyping resolves uncertainty about how well a design suits users’ needs” (Preece et al., 1994). It facilitates the process of extracting information from users about

- the functionality of the system,
- the operation sequences,
- the needs for user support,
- the required representations,
- the appearance of the interface and its impact on the users (Preece et al., 1994).

The rapid prototype was developed in order to collect information about the adequacy of possible designs (Preece et al., 1994). This prototype cannot be developed into a final product. It will be discarded once the requirements of a full prototype are determined. Meanwhile, it facilitated the process of recognising an adequate design.

HyperStudio (Baird and Baird, 1997) was used to develop the prototype of SALL. Apart from testing the screen design, HyperStudio enables the designer to test the functionality of the proposed system.

A scripting language was also required to achieve some effects and to end up with a working demo. HyperLogo (Westerfield, 1997) was combined with HyperStudio to create the demo. The scripts used can be viewed in Appendix C.

9. Testing/Evaluation

Evaluation focuses on gathering data about the usability of the design, by a specified group of users, for a particular activity in a specified environment or work context. It can be formative, occurring throughout the design life cycle. Formative evaluation guides design by providing feedback which can lead to modification of it. Thus, evaluation facilitates the production of a useful and usable tool. On the other hand, evaluation can be summative and take place after the tool has been developed. Such evaluation takes the form of judgements about the finished item (Preece et al., 1994; Dix et al., 1998).

Evaluation in this project was formative and comprised of many phases: occurring during each design phase and a final evaluation.

9.1. Testings during each design phase

When it was considered the ‘symposium’ to be the guided metaphor of the system, three academics were asked about the mental associations of its concept. Their answers were considered consistent with the goals of the system.

When the design rationale was to be specified, two academics were asked about the learning activities of a symposium and the material they used. Their answers formed the events that the symposium would capture at the rapid prototype stage (paper presentation,

discussion and chatting, background references). An academic was also asked to evaluate the procedures to start a new symposium/find a symposium. His contribution resulted in the final sequence of tasks.

During the prototype implementation phase, three subjects (post-graduate students) were asked informally to test the interface design. These subjects were experts in the application (lifelong learning process) as well as in user interface domains. Issues such as consistency, language expression, visibility of objects, navigation and recognition were discussed. It was an iterative process through which the screens' design changed directly. During this phase, the designer was responsible for interpreting the subject's actions in order to infer how these actions were related to the usability of the interface design (Nielsen, 1993). However, the fact that the subjects were experts in the interface domain facilitated this inference process. The terminology they used and the comments they made captured the required changes of the interface in a suitable way.

9.2. Final Testing

During the last phase of evaluation a questionnaire with a set of usability criteria was conducted based on a combined 'Heuristic evaluation' proposed by Nielsen (1993) and a user testing technique proposed by Shneiderman (1998). Among the several approaches to evaluating the design, the 'heuristic evaluation' approach had the following advantage; it was a relatively fast method (Dix et al., 1998) and could meet the time limitations of the project. Heuristic evaluation involves experts assessing the design against known usability criteria or *heuristics*. The evaluators perform the task-set and assess the prototype's conformance to the criteria at each stage. If a violation is detected, the design can be revised and resolved before the implementation stage (Dix et al., 1998). On the other hand, the user testing technique covered interface details such as the readability of characters and layout of screens, appropriate terminology and screen sequencing (Shneiderman, 1998). Such details influenced the usability criteria that appeared in the evaluation's questionnaire (Appendix B).

The formal evaluation had two main aims:

- the evaluation of the metaphor and of the learning outcome of the system
The aim was to assess the usefulness of the metaphor; to provide academics with a productive mental model; and to estimate the means of learning that the system offers.
- the evaluation of the system's usability and design
The aim was to assess the usability of the prototype in terms of screen design, aesthetics, navigation, terminology, help and learnability of the system

9.2.1 Method

Subjects had to read a scenario which explained the situation that was simulated. Later, they started 'walking' through the interface. They examined the cognitive and operational activities required to go from one screen to another. They also reviewed the actions required to achieve the learning task. At the same time, their comments were written on a paper. On completion, they filled in the questionnaire and added comments. (Appendix C). Finally, a general discussion was conducted with each of the subjects.

9.2.2 Subjects

The subjects included two academics. However, three post-graduate students were also involved, as the time of the year (mid of August) meant that there were not enough academics available.

9.2.3 Results

Metaphor evaluation	3.80
Does the system provide a useful means of learning?	4.50
Overall user interactions	4.00
Screen design	4.10
Aesthetics & minimalist design	4.20
Navigation	4.40
Terminology: Consistency & Standards	4.30
HELP	4.60
Learning	4.00
Total Average	4.20

Figure 9.1: Evaluation results of SALL

The results from the Heuristic Evaluation were quite positive. The system gained an overall mark of 4.2 on the scale of 1 to 5.0. All the users were impressed by the design and the interactions.

They reported that the metaphor help them produce a productive mental model without constraining the functionality of the system (mark 3.8). Although the system does not capture all the learning activities of academics, this was a design decision taken at a previous stage. In general, all the evaluators reported that the system provided them with a useful means of learning and gave an average mark of 4.5.

The screen design (characters, formatting and user's freedom) was considered successful (mark 4.1). The aesthetics of the design (pleasant screens, amount of information displayed, arrangement of information) were also successful with an overall mark of 4.2. Navigation (sequence of screens, going back and forward, consistency with the symposium's tasks sequence) was very good rated with a mark of 4.4. The terminology was judged to be quite consistent and related to the symposium's tasks (mark 4.3). The provided Help was almost excellent to the user's tasks and gained the mark of 4.6. Finally, learning to use the system (availability of instructions, visibility of objects, trial and error exploration) was adequate and was given a mark of 4.

9.2.4 Discussion

Evaluators provided useful comments about possible improvements of the system. The comments are grouped by: the appearance of screens and the terminology.

1. The appearance of screens

Some users were concerned about the buttons used. According to those users, buttons did not have a consistent place in which they appeared and were seemed to be positioned randomly on the screen. The designer avoided arranging the buttons in a column of information since there were many such arrangements. In addition, the buttons provided by HyperStudio were big and could not fit in a small (imaginary) column. The time limits did not allow for the implementation of more than a few 'unique' buttons.

Due to the limited library of buttons, alternative objects like graphics or texts had to be used. This sometimes caused users some misunderstandings. The cursor did not always change in familiar ways (i.e. to become a hand) whenever there was an action behind those objects. Thus, the difference between buttons, text and images that did something and those that did not was not always clear.

A problem also existed with the feedback given to the user. There were only three screens with feedback messages. This was not enough to cover all the different cases; however this was due to time constraints: the designer focused on the main symposium pages and not the supportive ones.

There were some instances, where it was not clear (to some users) which button to use to continue. Most of these cases occurred as a result of implementation constraints. For example, on the paper presentation screen, users should have access to the presentation's video as soon as they reached the screen. However, video animation was not implemented in this prototype and thus, the users had difficulty in understanding the whole process.

2. Terminology:

There were a few difficulties with terminology. For example, it was not very clear to some users what was the difference between the symposium's title and topics. This difficulty might appear since those users were postgraduate students that not familiar with the symposium concept. Alternatively, a different name (like session, strand, etc.) could be more descriptive.

The discussions with the evaluators highlighted the users' preference for an informal means of lifelong learning rather than a means that could be also formal. Thus, formality seems to be a major acceptability factor for the use of the system: although learning can occur in formal situations as well as in informal, academics seem to prefer using an informal tool rather than a formal one. The prototype demonstrated more formal events (i.e. paper presentations and discussions) than informal (i.e. chatting area has only a small space at each screen, not a screen of its own). However, this project concentrates on a dynamic balance of formal and informal learning activities. A future implementation would incorporate these features more effectively.

The results of the evaluation also suggested that the SALL prototype could use a more active approach, demonstrating the degree of freedom that the user has: they would be able to create/participate in a small symposium with a discussion only or they could attend a relatively big symposium with several events.

Many of the above difficulties could be reduced if the self-explanatory page (i.e. 'SALL: what you should know about it') was implemented or if a manual could explicitly present the alternatives that the users have. However, considering that users usually do not read manuals and academics in particular, would not have the time to focus on such a reading material, it is better to ensure that the system's functionality is apparent.

10. Discussion-Conclusions

The evaluation results were more than encouraging to continue with a full implementation of the system. However, the project aims do not include such procedures. This chapter will demonstrate the main difference of SALL from other allied systems and propose possibilities for future work. At the end, there is a conclusion of the work done.

10.1 The proposed system in relation to other (existing) systems:

The system differs significantly from existing discussion areas. Most existing online discussion areas focus on a broad group of users in order to gain participation and so, the quality of the discussions is often questioned in terms of academics' learning needs. They might be formal (www.mightymedia.com) or informal (www.h2g2.com) but they cannot ensure that there will be response from other users. Since the potential users are not specified, one might send a question and never receive an answer or receive an answer that is not adequate. Thus, it is also quite important to know to whom users are talking and if they have any expertise to the area or not.

In contrast, SALL has a very focused group of users: academics. Academics, though, tend not to be involved in discussions without a guarantee that there will be a useful outcome (to them or to the other participants): discussing with colleagues is an appropriate guarantee to participate and keep responding to peer's enquires. Since academics' profile is always displayed, it can be ensured that users are aware of the expertise of each participant and thus, the quality of discussions could be safeguarded.

A system that is similar to SALL is 'Colloquia' (<http://colloquia.bangor.ac.uk/II/>). It aims to support group working and group learning. It provides the user with the opportunity to set up a learning group of a particular topic (context) and to add people, resources (websites, documents), sub-topics, discussions etc. Thus, like SALL, the activities can be meaningfully stored based on their context instead of date/author name that the user has to memorise.

However, 'Colloquia' is based on folders that represent an activity and the user has to select the relevant people, resources, tasks and sub-activities and put into it. Thus, the user has to set up the relevancies of each activity without gaining any support from the system. On the contrary, SALL searches the relevancies and suggests them to the user. Moreover, the symposium metaphor provided SALL with useful terminology and helped the system to be task-focused instead of being restricted by the popular 'desktop' metaphor. The different activities are 'events' instead of 'folders' providing a more accurate mapping onto the users task.

Furthermore, 'Colloquia' is founded on informal interactions whereas SALL aims to capture both formal and informal interactions. Even though, SALL's current prototype demonstrates formal interactions more than informal, it can be easily changed to a more informal discussion or chat by covering the whole alternatives of the symposium's interactive 'events'.

On the other hand, 'Colloquia' is focused on both working and learning activities whereas SALL is only a learning environment. Thus, 'Colloquia' provides the environment to capture aspects of lifelong learning that SALL excludes (i.e. learning in the workplace). However, lifelong learning is such an endless process that it could not be captured in a 3-

months project. The structure of SALL, though, permits its extension to a broader system that would satisfy all the academics' needs.

10.2. Future development

The current specification of SALL is adequate to continue to the next phases stated by the socio-cognitive engineering methodology.

Implementation

According to this methodology, the system needs to be fully implemented. It needs a program specification that would provide the algorithm and the knowledge representation of the system. These would be the guideline to the structured program of the system.

Intelligent Agents

A very important part of the system's implementation is its intelligence. In order the system to be helpful requires agents with extra intelligence that would 'understand' academics needs and filter the irrelevant information. Implementing such a system could be a great challenge.

Design for all

The system could take care of the particular needs that the users might have (i.e. left-handed and right-handed users). It could also support translation from written to sound to be usable for blind users. It can make available the choice between e.g. text presentation instead of graphical environment to support colour-blindness. It can also provide users with automated language translation service to support problems due to different languages

Deployment

If this system were to be deployed, it would need many extra considerations. For example, it would need to involve marketing issues, sales strategies and customer support services to be successful. Some trial products should be spread along academics to reveal the problems that they will have through testing it in the workplace. The results from these testings might influence the system's image or bits of the socio-cognitive framework to satisfy new ways of working. This is part of the iterative design process, which focus on providing users with useful and usable tools consistent with the socio-technical context of use (Sharples, 2000).

10.3. Conclusion

This report has attempted to provide an explanatory view of how a system can be specified to support academics during their lifelong learning processes. It aims to have a clear flow of ideas and accurate citation and reference list.

Its interdisciplinarity lies in its use of psychological techniques, leaning theories, HCI guidelines, and some programming. User's advice was sought and technological support was investigated throughout the project.

The Socio-Cognitive Engineering methodology was followed to specify a useful, usable and elegant supportive system. Thus, it was investigated explicitly:

- academics' learning processes & their difficulties (*socio-cognitive framework*);
- difficulties that could be addressed by a supportive system (*task model*);
- the *system image* that would be consistent with their mental models;

- the *system specification* and the *design space* and finally,
- a scenario of system's use and the *evaluation* of it

The design space of the system was quite successful according to the results of the evaluation. Hyperstudio 3.2 software was used and many scripts were conducted to enhance user's interactions with the system.

The evaluation was an iterative process, where potential users or people with expertise in design interface provided fruitful comments. The system was informed accordingly until the last evaluation stage where evaluators completed a questionnaire to measure the usability of the system.

To conclude, SALL is a successful specification of an interactive supportive tool for rapid and easy access to field information by academics.

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Online discussion areas

www.mightymedia.com

www.h2g2.com

Colloquia <http://colloquia.bangor.ac.uk/ll/>

Appendix A

Interviews' questions

- How do you understand the concept of learning?
- What types of learning do you do (how do you acquire learning)?
- Which types of learning are they connected to your work?
- Where do you learn and what tools do you use?
- What problems do you face while learning?
- What kind of tools and resources do you use to help you overcome the above problems?

DELPHI survey - Part I

I am a Cognitive Science MSc student and I am investigating factors of academics' lifelong learning in order to design a system to support them. As a part of this process I am conducting the Delphi survey. This survey has two stages: the first one includes answering the questions below. The second stage will involve your ranking the responses from all the respondents to the first survey.

This first part of the survey should not take more than 15 minutes and I would appreciate your responses.

The questions are:

- Try and recall the learning (of any kind) that you have carried out over the past week.
- Please specify up to 5 difficulties that you faced when you were learning (eg. time limits, interruptions, lack of resources etc). Be fairly specific, e.g. "interrupted by the telephone" rather than just "interrupted".
- Please list up to 5 tools or resources that you actually used to help you to overcome these difficulties.
- Please list up to 5 tools or resources that would have liked to have available to help you with your learning.
- Please list up to 5 tools or resources, that are not yet invented or on sale but might become available within the next few years, which you could imagine might help you with your learning.

Please mail your response to msc53sxa@cs.bham.ac.uk

Thank you,

Stamatina Anastopoulou

DELPHI survey - Part 2

Please rank the answers in terms of your own learning. The ranking should be in a descending order, with 1 indicating the most important and 10 the least.

The questionnaire has three parts and your tasks are:

1. to rank the top **ten** difficulties you have while learning,
2. to rank the top **ten** tools you use while learning and
3. to specify **five** ways by which you might get help from the tools.

It should not take more that 15 minutes and I would appreciate your responses. I shall send you a short summary of the results from this second survey.

Please review all the answers listed below before ranking them.

SECTION I

Please rank the top **ten** difficulties you have while learning.

Difficulties while learning

Competitive demands of tasks (i.e. family in the evening, marking)	
Conflicting professional priorities	
<i>Interruptions</i>	
From telephone	
From door	
From e-mail	
From students	
<i>Accessing information</i>	
Lack of information	
Overload of detailed information	
Worry about the irrelevance of information	
Lack of full reference guide	
Insufficient knowledge of the work of relevant field	
<i>Lack of Time to</i>	
Practice	
Time limits due to extra administrative/managerial work	
Lack of face to face communication	
Tiredness	
<i>Hard to understand because of</i>	
Poor representations of conceptual material (lack of clarity)	
Lack of brainpower	
Boredom	
Limited time	
<i>Stressed everyday life</i>	
Difficulties in sleeping	
Pressures from pending deadlines	
Too much work to do	
Vaguely defined goals	
<i>Memory</i>	
Ability to recall new information (even after long periods)	
Lack of closure between thoughts in head	
<i>Distributed locations of learning</i>	
Learning happens to different locations with different resources availability	

Lack of (computing/internet) skills	
Emotional resistance	
Errors/lacunae on addressing lists	
Secretary failed to remind a duty	

SECTION II

Please, rank the top **ten** tools/resources you use while learning

Tools/resources Usage while learning

<i>Communication tools</i>	
<i>Phone</i>	
Office phone	
Home phone	
Mobile phone and message system	
Voicemail	
WAP phone	
<i>Messaging system</i>	
Decent unifying messaging system	
Discussion lists	
<i>People</i>	
Colleagues	
Secretaries	
Clerical support	
A tutor to teach computer skills	
<i>PC</i>	
Office PC	
Home PC	
Mobile PC	
Voice recognition	
<i>Thinking tools</i>	
Computer based ideas outliner	
<i>Getting Information tools</i>	
Automated research tools (ie web-search)	
Clear indexing of web content	
Automated language translation service	
Desktop filter to provide visually interesting new information	
Online reference guide, manuals and textbooks	
Online help/advise service	
High speed wireless internet connection	
Books-papers	
Access to e-libraries	
Access to relevant recordings of music	
Multimedia Books	
Paper and pen	
<i>Techniques to aid understanding</i>	
Skip hard bits	
Breaks	
Reproduce understanding (reverse engineering of techniques in papers)	
Attempt to forget about worry about the relevance of material	
<i>Tools to aid understanding</i>	
Translator from written (and handwritten) to sound i.e. music	
A finder of key papers for more detail	

A tool to gain access to authors	
A guarantee of a quick and informative response from authors of papers	
Data to test what is read	
Data simulators of learning models	
More time	
Personal e-organiser as an assistant to balance the administrative loads	
A handheld learning resource (ie e-logbook)	
An organiser for reading e-mail	
A market where academics can exchange theories and get paid	
Home for reading/working	
Cup of coffee	
Closed door	
Greater clarity of mind	
More purity of motive	

SECTION III

Please specify **five** important ways by which any of the tools above might help you to learn (e.g. how might a secretary help you to learn, or how might a mobile PC help your learning).

Ways of getting help from tools

Now you have completed the questionnaire and reviewed your colleagues' comments, are there any other any other tools that might help while learning and in which way?

Please mail your response to msc53sxa@cs.bham.ac.uk
 Alternatively you can send your responses to my pigeonhole
 (St. Anastopoulou, School of Psychology).

Thank you for your time and assistance,
 Stamatina Anastopoulou

Combined data from interviews and survey

How do academics learn?

Learning activities:

reading,
writing
teaching (and lecture preparation)
discussing-interacting with people, society, nature
thinking and problem solving
attending seminars and/or conferences,
observing nature
experiencing everyday life
keep up-to-date with changes in technology
watching at videos

In particular, while **reading** (practices)

- They try to find access to information and gain knowledge
- To find interesting references or key papers
- To clear out the rubbish information
- to overcome difficulties in understanding
(=> they may have a break or skip the hard bits)

The learning objects are

- *books* to get established knowledge and wider discussions about these issues
- *conference papers* to get new prototype knowledge (what is going on to current research)
- *journal papers* to get deep information about issues
- *magazines* and newspapers to get an overview of the world and social knowledge
- *Internet* to see what is new in the field,
 - *search engines/web browsers* to find cues/solutions where to find information, addresses to approach people;
 - *e-libraries* or *journals* to find references-mostly abstracts but they don't get real information from it ,
 - *e-encyclopaedia* to get broad views of human's achievements
- *highlighters, pens etc* to underline the important issues
- *cup of coffee*
- *home*
they wish to have
 - *more time*
 - *online reference guide, manuals and textbooks*
 - *access to e-libraries*
 - *automated language translated service*
 - *data to test what is read*
 - *a finder of key-papers for more detail*
 - *high speed wireless Internet connection* to have access to WWW whenever the location
 - *online help/advice* to find key material to specific learning needs

They learn while **writing** (how the leaning activity might occur-**practices**) since they

- take notes thus, they
 - reproduce reading material that seems important
 - capture/remember their own ideas
 - capture what they discuss with colleagues or students
 - specify the resources needed and where can be founded
- write articles, thus they
 - revise their knowledge and
 - back up their ideas

The learning objects are

- paper and pens,
- e-notebooks, logbooks
- text processors at home PC/office PC/mobile PC
- mind maps
- diagrams

They wish to have

- more time
- a tool to gain access to authors

They learn while **teaching** (how the leaning activity might occur- **practices**) since they

- experience the effects of meta-learning:
 - ✓ show how to do things/explain issues
 - ✓ teach how to learn
- reflect on prior knowledge: they check how well they know the subject and revise
- interact with students that might 'see' issues differently

The learning objects are

- Paper, pen, markers
- Transparencies and projector
- Slide projector
- Presentation software applications
- Mobile pc and video projector

They learn while **thinking** and solving problems

(how the leaning activity might occur- **practices**) since

- learning provides the building blocks through which thoughts get a structure
- they set questions and seek for answers
- they set a problem –they read in order to understand how to solve it -they write down the solution -they learn it-they teach it
- they exercise synthetic and analytic abilities to understand and/or produce knowledge
- they resolve anomalies (e.g. set of data that don't fit together, conflicting constraints that produce related problems which need solving)
- they think about issues and data read in research literature

The learning objects are

- paper and pen
- notebooks
- PCs
- Closed door
- Mind maps
- Experiences from everyday life
- tools to remember: iteration

What they wish to have

- Greater clarity of mind
- Computer based ideas outliner

They learn while **interacting** with individuals:

(how this leaning activity might occur- **practices**)

1. students help them see ideas differently
 - discover new preferences (ways of approaching people/ideas)
 - get an overview/ introduction in new topics while supervising

They are a huge resource of getting things done

2. colleagues: they exchange ideas through discussions about
 - a. their work and other issues they want to talk about
 - b. difficulties in understanding/retrieving information
 - c. ways of finding the desirable information or similar subjects
 - d. new topics (they provide overview/introduction)
 - e. staff that is not written in papers-it is informal
 - f. They learn about new equipment
 - statistical techniques
 - conferences or other meetings
 - restaurants and other social events

They provide support to their work

They are a resource of getting things done

They get the 'spirit of the time', the current intellectual trend

They discuss about political issues like who is the decision maker in committees, opportunities for grant proposals, etc.

3. Research assistants:
 - they deal with project management
 - they understand the needs of the research team, deadlines of projects,
 - they foresee problems in cash flow when project is about to end.
4. secretaries (and other administrative staff):
 - They assist them to handle interruptions of door and telephone
 - they help them organise blocks of time and thus learn more effectively
 - they deal with administrative work and thus academics would have more time to learn
 - they might filter rubbish information
 - they remind them appointments, phone calls, social and other duties
 - +they provide desired documents
 - they typewrite

The learning objects are:

- office/home/mobile computer through which they exchange emails and participate in discussion lists
- office/home/mobile/wap phone
- voicemail
- conferences
- common rooms

What they wish to have

- a guarantee of a quick and informative response from authors of papers
- a market where academics can exchange theories and get paid
- decent unifying messaging system
- an organiser for reading e-mail

How these interactions take place?

face-to-face communication: get the 'mood' of certain issues

telephone: on time deals

e-mail: engagement to issues without time concurrence

discussion lists: they can get references from them, answer questions, get broad ideas about fields but they do not get huge amount of information because it is difficult to read it. They provide no nuance of concepts.

New methods cannot be explained by the discussion lists: they need the paper.

They learn through attending **conferences** and other meetings

practices:

they get fresh ideas that is not delayed like journal papers.

They hear somebody talking about his paper, they make notes and discuss with him/her. Their understanding is deeper and more productive since they combine their thoughts with the presenter's and/or other attendees.

They learn through **everyday activities**

practices: e.g. they learn how

- to operate household equipment
- to use a consuming product
- they should behave with relatives and friends

They learn while they keep up-to-date with **changes in technology**

practices:

they have to devote time to get informed about technological products
to learn how to use them

The learning objects are:

- discussions with colleagues
- browsing the internet
- broadcasting media
- advertisements
- conferences

They learn while watching at **videos**:

videos in web: they search issues about visual objects, movement and sound issues

videos at home: they get an overview from a scientific documentary

videos at airplane: they learn how to bent their seatbelt

Where do they learn?

At work (office, classroom, labs, common rooms, corridors, around shared devices such as printers, fax machines, photocopiers)

home

conferences

while travelling

When do they learn?

They can learn during any time of a day because learning stimuli might be available anywhere. They have more time to reflect on experiences during the evening, weekends, holidays. These are the times that they face less interruptions and pressures from the working environment.

What difficulties they face while learning
(ranked difficulties with interviews)

Management of learning projects

1. Interleaved tasks and Interruptions
 - Competitive demands of tasks (i.e. family in the evening, marking)
 - Too much work to do
 - Time limits due to extra administrative/managerial work
 - Vaguely defined goals
 - Conflicting professional priorities

 - Interruptions From e-mail
 - Interruptions From telephone
 - Interruptions From students
 - Interruptions From door
 - Learning happens to different locations and they have to switch between different contexts.
 2. Time related
 - Pressures from pending deadlines
 - Lack of Time to Practice
 - Hard to understand because of Limited time
 - Lack of Time to Think through ideas
 - Lack of Time to Do informal meetings
 3. Physical/emotional
 - Tiredness
 - Hard to understand because of Lack of brainpower
 - Hard to understand because of Boredom
 - Emotional resistance
 - More purity of motive
 - Difficulties in sleeping
 - Stressed everyday life: there are restrictions and obligations
 4. Skills/cognitive processing shortcomings
 - Ability to recall new information (even after long periods)
 - Lack of (computing/internet) skills
 - Lack of closure between thoughts in head
 - Nature of information
 - Overload of detailed information
 - Learning happens to different locations with different resources availability
 - Lack of face-to-face communication
 - Hard to understand because of poor representations of conceptual material (lack of clarity)
 - Hard to understand because of difficult concept
 - Worry about the validity/appropriateness of information
 - Lack of information
 - Insufficient knowledge of the work of relevant field (background knowledge)
 - Accessing information
 - Correct information
 - Interesting information
 - Useful information
 - Language problems
 - With translation you loose information about philosophical and cultural issues
 - Access to non-English printed material
- Special Needs-related

Colour-blindness

Blindness

Tools/resources Usage while learning (ranked difficulties with interviews)

Office PC

colleagues

Breaks

Home for reading/working

Books-Conference and Journal papers

Paper and pen

Online reference guide, manuals and textbooks

More time

Cup of coffee

Mobile pc

Closed door

A tool to gain access to authors

A market where academics can exchange theories and get paid

Skip hard bits

Office phone

Secretaries

Conferences

Access to e-libraries

Discussion lists

Students

Tools to remember-Iteration

A handheld learning resource (ie e-logbook)

Home phone

Automated language translation service

Data to test what is read

A guarantee of a quick and informative response from authors of papers

A finder of key papers for more detail

Mobile phone and message system

Greater clarity of mind

Home PC

Voicemail

Clerical support

Reproducing information (reverse engineering of techniques in papers)

High speed wireless internet connection

Analytic and synthetic abilities to understand and produce knowledge

Common Rooms for discussions

Libraries

Bath

Internet

Software applications

Video

folders to organise information in chronological order

Mind maps and diagrams

Translator from written (and handwritten) to sound i.e. music

More purity of motive

An organiser about reading e-mail
Automated research tools (web-search)

Tools that were not mentioned at the second part of DELPHI:

Communication tools

- WAP phone
- Decent unifying messaging system
- A tutor to teach computer skills

PC

Voice recognition

Thinking tools

- Computer based ideas outliner
- Desktop filter to provide visually interesting new information
- Online help/advice service
- Access to relevant recordings of music
- Multimedia Books
- Analyse and compose knowledge
- Attempt to forget about worry about the relevance of material

Tools to aid understanding

Data simulators of learning models

Clear indexing of web content

Personal e-organiser as an assistant to balance the administrative loads

Ways of getting help from tools/resources (data from interviews)

Accessing information

- I have access to right sort of things while focusing on a specific area and browsing in searching
- I find key papers through subscribing in journals where I pick up interesting articles in terms of subject or author.

Memory tools

- To capture everyday things I use a device where I write memos of things that I want to do, new ideas and resources where I can find them and other notes
- To remember and recall what I have read I highlight the text, I write notes beside the text and at my device.

Colleagues

- Discussions with colleagues about difficulties in understanding information
- Discussions with colleagues to help me find correct information or similar subjects
- I tend to get an overview/ introduction in new topics through discussing with colleagues (mainly supervising)
- Colleagues may support my work
- Delegation to colleagues and students

Social groups

- As tools of informal meetings I use discussion lists and e-mail
- Attending conferences
- In common rooms I get informed about decision makers, opportunities for grant proposals

Special needs

- Use of a software to avoid differences in colour but if there is a bad design, I fail

Understanding

- Background reading if it is a difficult concept or older papers of the author

- When I can't find correct information, I look for similar subjects, or I do it by myself
- Mind maps help me to find new ways of saying the same thing (and, eg find new ways to search in www)
- To solve problems, I make concrete examples to explain it and try to solve the example

Ways of getting help from tools (data from DELPHI)

Better Reference Materials

more helpful colleagues

better computing facilities

better secretaries to print out papers

better maths software

Colleagues to advice me what to read

mobile PC to make notes wherever I am

multimedia books for learning about music

translator from written music notation to sound

discussion lists for asking questions and trying out ideas

Handheld learning resource might help me to gain access to learning materials whatever the location

An organiser for reading email might help me to organise my material better

a finder of key-papers might help me to organise my bibliography (better than EndNote does currently)

Online help/advice service might help me to find key material relateds to specific learning needs

High speed wireless internet would allow me to communicate with colleagues and internet whatever the location

I get my learning needs met by going out and finding a way of solving the learning problem I have. This very often happens through conversations with a colleague or my secretary who either gives me a way of solving/learning or points me the direction of someone who can.

Translator from written to sound gives me access to print

Books and papers give me access to the thought of others, especially from the past

Office PC enables me to communicate with others and provide information

Purity of motive would increase my confidence in the objectivity of my work

Office phone gives me access to rapid information and to subtleties of personal response

Other tools:

Tape recorders, which are fundamental to blind persons

Attending conferences

Better translation software that gives access to non-English print materials

Appendix B

Screens Design

Appendix C

HyperLogo scripts

Function to appear more information on the first screen

```
IF VISIBLEP [] "info "text [SHOWITEM [] "HIDE "graphic SHOWITEM [] "busiest  
"text SHOWITEM [] "my "text SHOWITEM [] "latest "text HIDEITEM [] "info "text]
```

Function to minimize the ‘more information’ button on the first screen

```
IF VISIBLEP [] "HIDE "graphic [HIDEITEM [] "HIDE "graphic HIDEITEM [] "busiest  
"text HIDEITEM [] "my "text HIDEITEM [] "latest "text SHOWITEM [] "info "text]
```

Function to choose whether to see past symposiums or not

```
IF VISIBLEP [] "past "text [HIDEITEM [] "past "text SHOWITEM [] "current "text]
```

```
IF VISIBLEP [] "current "text [HIDEITEM [] "current "text SHOWITEM [] "past "text]  
[HIDEITEM [] "past "text SHOWITEM [] "current "text]
```

Function to minimize the ‘Steps’ window

```
IF VISIBLEP [] "HIDE "graphic [HIDEITEM [] "HIDE "graphic SHOWITEM []  
"SHOW "text HIDEITEM [] "steps "text]
```

Function to maximize the ‘Steps’ window

```
IF VISIBLEP [] "SHOW "text [HIDEITEM [] "SHOW "text SHOWITEM [] "HIDE  
"graphic SHOWITEM [] "steps "text]
```

Function to minimize the ‘Help’ window

```
IF VISIBLEP [] "HIDEit "graphic [HIDEITEM [] "HIDEit "graphic HIDEITEM [] "help  
"text HIDEITEM [] "Watch "graphic SHOWITEM [] "SHOWit "text]
```

Function to maximize the ‘Help’ window

```
IF VISIBLEP [] "SHOWit "text [HIDEITEM [] "SHOWit "text SHOWITEM [] "HIDEit  
"graphic SHOWITEM [] "Watch "graphic SHOWITEM [] "help "text]
```

Function to minimize the ‘participants’ list’ window

```
IF VISIBLEP [] "HIDE1 "graphic [HIDEITEM [] "HIDE1 "graphic HIDEITEM []  
"participants "text SHOWITEM [] "list "text HIDEITEM [] "profile "text HIDEITEM []  
"Cilesis "text HIDEITEM [] "Smith "text]
```

Function to maximize the ‘participants’ list’ button

```
HIDEITEM [] "list "text SHOWITEM [] "participants "text SHOWITEM [] "HIDE1  
"graphic
```

Function to link the ‘Cilesis’ name to its profile

```
IF VISIBLEP [] "Smith "text [HIDEITEM [] "Smith "text HIDEITEM [] "participants  
"text SHOWITEM [] "Cilesis "text SHOWITEM [] "HIDE1 "graphic] [IF VISIBLEP []  
"profile "text [HIDEITEM [] "profile "text HIDEITEM [] "participants "text SHOWITEM  
[] "Cilesis "text SHOWITEM [] "HIDE1 "graphic] [SHOWITEM [] "Cilesis "text  
SHOWITEM [] "HIDE1 "graphic HIDEITEM [] "participants "text]]
```

Function to link the ‘M.Costa’ name to its profile

```
IF VISIBLEP [] "Cilesis "text [HIDEITEM [] "Cilesis "text HIDEITEM [] "participants  
"text SHOWITEM [] "profile "text SHOWITEM [] "HIDE1 "graphic] [IF VISIBLEP []  
"Smith "text [HIDEITEM [] "Smith "text HIDEITEM [] "participants "text SHOWITEM  
[] "profile "text SHOWITEM [] "HIDE1 "graphic] [SHOWITEM [] "profile "text  
SHOWITEM [] "HIDE1 "graphic HIDEITEM [] "participants "text]]
```

Function to link the ‘M.Costa’ name to its profile

```
IF VISIBLEP [] "Cilesis "text [HIDEITEM [] "Cilesis "text HIDEITEM [] "participants  
"text SHOWITEM [] "Smith "text SHOWITEM [] "HIDE1 "graphic] [IF VISIBLEP []  
"profile "text [HIDEITEM [] "profile "text HIDEITEM [] "participants "text SHOWITEM  
[] "Smith "text SHOWITEM [] "HIDE1 "graphic] [SHOWITEM [] "Smith "text  
SHOWITEM [] "HIDE1 "graphic HIDEITEM [] "participants "text]]
```

Function to view the next transparency at the presentation card

```
IF VISIBLEP [] "trans3 "text [HIDEITEM [] "trans3 "text SHOWITEM [] "trans1 "text]
```

Function to appear the paper’s discussion

```
SHOWITEM [] "mess "text SHOWITEM [] "SHOW "text SHOWITEM [] "close  
"graphic HIDEITEM [] "act "text HIDEITEM [] "article "text HIDEITEM [] "Review  
"button HIDEITEM [] "preview "graphic HIDEITEM [] "save "graphic HIDEITEM []  
"steps "text HIDEITEM [] "HIDE "graphic
```

Function to show the article at the presentation card

```
IF VISIBLEP [] "HIDE "graphic [HIDEITEM [] "HIDE "graphic HIDEITEM [] "mess  
"text HIDEITEM [] "close "graphic HIDEITEM [] "steps "text SHOWITEM [] "SHOW  
"text SHOWITEM [] "article "text SHOWITEM [] "Review "button SHOWITEM [] "act  
"text SHOWITEM [] "save "graphic SHOWITEM [] "preview "graphic] [HIDEITEM []  
"mess "text HIDEITEM [] "close "graphic SHOWITEM [] "SHOW "text SHOWITEM []  
"article "text SHOWITEM [] "Review "button SHOWITEM [] "act "text SHOWITEM []  
"save "graphic SHOWITEM [] "preview "graphic]
```

Function to appear the ‘chat area’ window

```
IF VISIBLEP [] "HIDEit "graphic [HIDEITEM [] "HIDEit "graphic HIDEITEM [] "help  
"text HIDEITEM [] "Watch "graphic SHOWITEM [] "SHOWit "text SHOWITEM []  
"chatbox "text SHOWITEM [] "chat "text]
```

Function to minimize the ‘chat area’ window

```
IF VISIBLEP [] "SHOWit "text [HIDEITEM [] "SHOWit "text SHOWITEM [] "HIDEit  
"graphic SHOWITEM [] "Watch "graphic SHOWITEM [] "help "text HIDEITEM []  
"chatbox "text HIDEITEM [] "chat "text]
```

Function to appear the ‘discussion history’ on the discussion screen

```
SHOWITEM [] "start "text SHOWITEM [] "New_Discussion "button SHOWITEM []  
"mess "text SHOWITEM [] "ref "text SHOWITEM [] "summary "text HIDEITEM []  
"steps "text HIDEITEM [] "HIDE "graphic SHOWITEM [] "SHOW "text
```

Functions to select the appropriate number on the evaluation screen

```
IF VISIBLEP [] "A4 "graphic [HIDEITEM [] "A4 "graphic SHOWITEM [] "A5  
"graphic]
```

IF VISIBLEP [] "A5 "graphic [HIDEITEM [] "A5 "graphic SHOWITEM [] "A1 "graphic]

IF VISIBLEP [] "A3 "graphic [HIDEITEM [] "A3 "graphic SHOWITEM [] "A4 "graphic]

IF VISIBLEP [] "A1 "graphic [HIDEITEM [] "A1 "graphic SHOWITEM [] "A2 "graphic]

IF VISIBLEP [] "A2 "graphic [HIDEITEM [] "A2 "graphic SHOWITEM [] "A3 "graphic]

Function to select ‘Yes’ button

IF VISIBLEP [] "A3 "graphic [HIDEITEM [] "A3 "graphic SHOWITEM [] "A0 "button
IF VISIBLEP [] "C3 "graphic [SHOWITEM [] "next "button] [HIDEITEM [] "next "button]]

Function to select ‘No’ button

IF VISIBLEP [] "A0 "button [HIDEITEM [] "A0 "button SHOWITEM [] "A3 "graphic
SHOWITEM [] "next "button]

Function to select the irrelevant-colour button

IF VISIBLEP [] "A0 "button [HIDEITEM [] "A0 "button SHOWITEM [] "A1 "button]

Function to select the least-relevant colour button

IF VISIBLEP [] "A1 "button [HIDEITEM [] "A1 "button SHOWITEM [] "A2 "button]

Function to select the relevant colour button

IF VISIBLEP [] "A2 "button [HIDEITEM [] "A2 "button SHOWITEM [] "A3 "button]

Function to select the most-relevant colour button

IF VISIBLEP [] "A3 "button [HIDEITEM [] "A3 "button SHOWITEM [] "A0 "button]

Function to appear the invitation letter

IF VISIBLEP [] "close "graphic [HIDEITEM [] "close "graphic HIDEITEM [] "steps "text
SHOWITEM [] "open "text SHOWITEM [] "inv_text "text] [SHOWITEM [] "open "text
SHOWITEM [] "inv_text "text]

Function to link the ‘Adam’ name to its profile

IF VISIBLEP [] "Cilesis "text [HIDEITEM [] "Cilesis "text HIDEITEM [] "participants "text
SHOWITEM [] "profile "text SHOWITEM [] "close1 "graphic] [IF VISIBLEP [] "Smith "text
[HIDEITEM [] "Smith "text HIDEITEM [] "participants "text SHOWITEM [] "profile "text
SHOWITEM [] "close1 "graphic] [SHOWITEM [] "profile "text SHOWITEM [] "close1 "graphic
HIDEITEM [] "participants "text]]

Function to link the ‘Smith’ name to its profile

IF VISIBLEP [] "profile "text [HIDEITEM [] "profile "text HIDEITEM [] "participants "text
SHOWITEM [] "Smith "text SHOWITEM [] "close1 "graphic] [IF VISIBLEP [] "Cilesis "text
[HIDEITEM [] "Cilesis "text HIDEITEM [] "participants "text SHOWITEM [] "Smith "text
SHOWITEM [] "close1 "graphic] [SHOWITEM [] "Smith "text SHOWITEM [] "close1 "graphic
HIDEITEM [] "participants "text]]

Function to link the 'Cilesis' name to its profile

```
IF VISIBLEP [] "profile "text [HIDEITEM [] "profile "text HIDEITEM [] "participants  
"text SHOWITEM [] "Cilesis "text SHOWITEM [] "close1 "graphic] [IF VISIBLEP []  
"Smith "text [HIDEITEM [] "Smith "text HIDEITEM [] "participants "text SHOWITEM  
[] "Cilesis "text SHOWITEM [] "close1 "graphic] [SHOWITEM [] "Cilesis "text  
SHOWITEM [] "close1 "graphic HIDEITEM [] "participants "text]]
```

Function to simulate 'drag& drop' in relation with 'move_text' procedure

```
IF VISIBLEP [] "session2 "text [HIDEITEM [] "session2 "text SHOWITEM [] "ses_trans  
"text]
```

```
IF VISIBLEP [] "session4 "text [HIDEITEM [] "session4 "text SHOWITEM [] "session2  
"text]
```

```
IF VISIBLEP [] "ses_trans "text [HIDEITEM [] "ses_trans "text SHOWITEM []  
"session4 "text]
```

Appendix D

Evaluating a supportive learning system

This is an attempt to specify a supportive system for academics' lifelong learning. Potential users will be academics from every discipline. They could employ the system daily, either at home or at the office.

During the design process we made the decision to focus on particular learning activities of academics due to the time constraints of the project. Thus, the system focuses on organising and become involved in research activities. It attempts to promote communication through scholarly (formal and informal) activities i.e. discussions. It also attempts to provide the required information about new areas through key-papers' presentations, background references, experts, lab tours, etc.

The outcome of these activities would be not only to learn about a particular area but also to establish e-societies and/or network of alliances throughout the world. Therefore, the system would be useful for academics since it offers a collaborative work environment and present background and advanced information in formal and informal ways.

In the following pages you will find several heuristics categories:

Metaphor evaluation

Learning outcome

Overall user interactions

Screen design

Aesthetics & minimalist design

Navigation

Terminology: Consistency & Standards

HELP

System's Learning

You are asked to use those heuristics to evaluate the proposed system.

Thank you very much

Stamatina Anastopoulou

Evaluation of Screen Design:

Please circle the numbers that most appropriately reflect your impressions about using the system. Not Applicable=NA

Metaphor evaluation:

Does the 'symposium' metaphor capture academics' learning activities?						
inadequate 1	2	3	4	5	adequate	NA
Does the 'symposium' metaphor produce a productive mental model?						
never 1	2	3	4	5	always	NA
Does the 'symposium' metaphor constrain the functionality of the system?						
never 1	2	3	4	5	always	NA

Overall learning support

dull 1	2	3	4	5	stimulating	NA
-----------	---	---	---	---	-------------	----

Overall user interactions

frustrating 1	2	3	4	5	satisfying	NA
------------------	---	---	---	---	------------	----

Screen design

Characters on the computer screen						
hard to read 1	2	3	4	5	easy to read	NA
Highlighting the screen						
unhelpful 1	2	3	4	5	helpful	NA
User freedom: Support undo and redo						
never 1	2	3	4	5	always	NA

Aesthetics & minimalist design

Screen layouts were pleasing						
never					always	

1	2	3	4	5	NA
Amount of information that can be displayed on the screen					
inadequate				adequate	
1	2	3	4	5	NA
Arrangement of information can be displayed on the screen					
illogical				logical	
1	2	3	4	5	NA

Navigation

Sequence of screens						
confusing					clear	
1	2	3	4	5	NA	
Next screen in a sequence						
unpredictable					predictable	
1	2	3	4	5	NA	
Going back to the previous screen						
impossible					easy	
1	2	3	4	5	NA	
Progression of work related tasks						
confusing					clearly marked	
1	2	3	4	5	NA	
Please write your comments about the screens here:						

Terminology: Consistency & Standards

Use of terminology throughout the system						
inconsistent					consistent	
1	2	3	4	5	NA	
terminology relates well to the work you are doing?						
never					always	
1	2	3	4	5	NA	
terminology on the screen						
ambiguous					precise	
1	2	3	4	5	NA	
position of instructions on the screen						
inconsistent					consistent	
1	2	3	4	5		
Please write your comments about terminology:						

HELP

Amount of help given						
inadequate					adequate	
1	2	3	4	5	NA	
Help is focused on user's task						
inadequate					adequate	
1	2	3	4	5	NA	
Placement of help messages on the screen						
inconsistent					consistent	
1	2	3	4	5	NA	
Please write your comments about HELP						

Learning

Availability of instructions of how to use the system						
never					always	
1	2	3	4	5	NA	
Visibility of objects						
never					always	
1	2	3	4	5	NA	
Exploration of features by trial and error						
discouraging					encouraging	
1	2	3	4	5	NA	
Please write your comments about learning here:						

Appendix E

Evaluation Results

	1	2	3	4	5	Total
Metaphor evaluation:						
Does the 'symposium' metaphor capture academics' learning activities?	3	5	3	4	4	3,80
Does the 'symposium' metaphor produce a productive mental model?	4	5	4	4	3	4,00
Does the 'symposium' metaphor constrain the functionality of the system?	4	2	3	4	3	3,20
Does the system provide a useful means of learning	5	4	5	5	5	4,80
Overall user interactions	4	4	4	4	4	4,00
Screen design						
Characters on the computer screen	4	5	5	4	4	4,40
Highlighting the screen	4	4	4	4	4	4,00
User freedom: Support undo and redo	4	3	4	4	4	3,80
Aesthetics & minimalist design						
Screen layouts were pleasing	4	5	4	4	4	4,20
Amount of information that can be displayed on the screen	4	4	5	3	3	3,80
The arrangement of information displayed on the screen	5	5	3	4	5	4,40
Navigation						
Sequence of screens	4	5	5	4	4	4,40
Next screen in a sequence	3	4	4	4	5	4,00
Going back to the previous screen	5	5	4	4	5	4,60
Does it capture the proper sequence of scheduling/exploring a symposium?	5	5	5	4	4	4,60
Terminology: Consistency & Standards						
Use of terminology throughout the system terminology relates well to the work you are doing?	5	5	4	4	4	4,40
position of instructions on the screen	4	4	3	3	5	3,80
HELP	5	5	4	5	4	4,60
Amount of help given	4	4	4	3	5	4,00
Help is focused on user's task	4	5	5	5	5	4,80
Placement of help messages on the screen	5	5	5	4	5	4,80
Learning						
Availability of instructions of how to use the system	4	4	4	5	2	3,80
Visibility of objects	5	5	3	4	4	4,20
Exploration of features by trial and error	5	3	3	4	4	3,80
Total						4,20