A SYSTEM PROTOTYPE TO SUPPORT ACADEMICS' LIFELONG LEARNING: SELECTING A DESIGN CONCEPT AND THE ROLE OF THE DESIGN PROCESS

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ABSTRACT:

This paper focuses on a process to specify the conceptual model of a technological system that could support the learning and professional development of academics. We describe the methodology that was followed and the issues relevant to academics' learning that emerged during the requirement's analysis. Subsequently, we discuss the meaning of the conceptual model in the design process and we test the appropriateness of several alternative possible designs. We conclude with an evaluation of the outcome of the design process and a synopsis of further work.

Keywords: conceptual model, user-centred design, HCI.

1. INTRODUCTION

The rapid changes in the way we live our everyday lives have significantly influenced the ways we accomplish our everyday activities. Thus, learning is no longer restricted to a single place and time in which it will be acquired (school) and applied (workplace). People have the opportunity and the need to learn continuously, while passing through different social settings, such as home, school and work, and thus participate in a lifelong learning process [12].

Learning takes place within a socio-cultural environment, which affords particular technologies. Learners exploit the technological tools and resources that are available within the society, to acquire knowledge and solve problems [26]. Technological tools can not only provide a means to access information but also an environment in which information can be analysed, synthesized and represented in different contexts. Technology can provide an 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 [4].

This paper focuses on a process to specify the conceptual model of a technological system that could support the learning and professional development of academics. The next section describes the methodology that was followed and outlines issues relevant to academics' learning that emerged during the requirement's analysis. This methodology, of socio-cognitive engineering, is user-centred and 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 [27]. Subsequently, we discuss the meaning of the conceptual model in the design process and we test the appropriateness of several alternative possible designs. We conclude with an evaluation of the outcome of the design process and a synopsis of further work. The result should be a system that could provide academics with an environment to enhance the analysis and synthesis of information within a social context.

2. OVERVIEW OF THE DESIGN APPROACH

The approach followed to design the system is the methodology of socio-cognitive engineering proposed by Sharples et al. [27] (figure 2.1). It has two main parts: a specification of the system's requirements based on an analysis of users' activities and their interactions with people and current tools, and the design of the new technology. A detailed overview of the methodology procedures is available in Anastopoulou et al. [2].

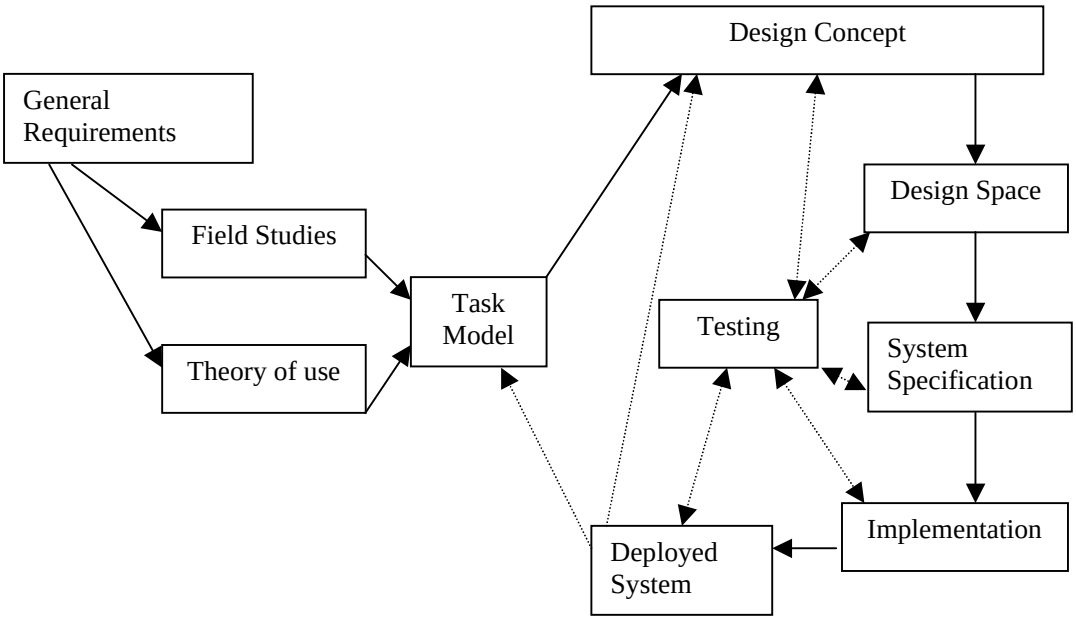

Figure 2.1. Overview of the socio-cognitive engineering approach

The General Requirements step specifies the activities to be supported by technology (such as lifelong learning activities), the general domain (such as academia) and other constraints (such as time or budget constraints) [27]. An intended context of use could provide some general recommendations for the system. With the advent of information technology, the place and time of learning process have been broadened. Learners can use technological tools to extend the facilities that an institution can provide (i.e. an on-line library). They do not have to be at the physical location of the institution to make use of it [16]. These tools allow learners to access learning material at any time, without 'office-hours' restrictions. Likewise, academics can accomplish their learning tasks while at the office; at home, on the train, etc., during day or night. Thus, a system capable of supporting them during their learning processes should be available wherever and whenever academics might need it.

The Field Studies step investigates how learning activities are performed in their normal contexts [27]. To explore academics' lifelong learning, data was collected from interviews and a survey. The data about academics learning difficulties are organised into groups to facilitate understanding and retrieval. A review of the collection procedures and data assembled is available in Anastopoulou [1].

The Theory of Use step analyses the data gathered about how academics learn from the perspective of several (learning) theories. In particular, experiential learning theory [17] describes the individual process of transforming experience; conversation theory [24, 18] analyses learning as a conversation between individual minds; the expansive learning model [9]

places learners in society where they interact with its members, rules and tools; the transformative model [20] indicates the self-development process that happens through time.

Through this analysis, issues arise that technology could address. The Task Model step provides a coherent account of how academics' learning activities are performed, the people they interact with and the tools and technologies they employ. It helps the designer to explore the particular ways that technology could support academics in overcoming breakdowns or difficulties whilst performing everyday learning activities [27].

The Design Concept step provides a system image (or guiding metaphor) and style of interaction appropriate to academics' representations of learning situations to inform the design of technology that can enrich the structure, process and content of their learning [27].

The Design Space step is a detailed investigation of design options for the proposed system. It is used to explore possibilities and record design decisions and rationale [8]. In specifying the design options and rationale it is important to focus on the proposed system image and to figure out the important activities that result in a useful learning outcome.

The System Specification, Implementation, Evaluation and Deployment steps follow the standard method for interactive system design [21] where prototype systems are produced and deployed in the workplace.

Evaluation takes place throughout the design process: to confirm that the task model is appropriate to the users' activities and perceptions; to check that the design concept matches the requirements and the task model, to ensure the appropriateness of the design space decisions; to certify that the system specification is complete; to ensure that the prototype implementation meets the requirements and agrees with the system specification; and to assess the usability and usefulness and cost-effectiveness of the deployed system. The outcome of each evaluation is fed back to the design process to improve each step [27].

2.1 Identification of issues relevant to academic's learning

A general outline of issues that emerged during these steps is provided below.

Discussions play an important role in academics' learning.

Academics often discuss with colleagues their difficulties in understanding or generating information in formal meetings (i.e. in conferences) or informal ones (i.e. in common rooms). Through discussions, different perspectives on the same topic might appear. Furthermore, academics learn from colleagues not only about new skills or knowledge but also informal facts, like tacit rules, intellectual trends or opportunities for grant proposals. Colleagues may also provide advice to academics about ways of presenting their work or the appropriate time to present it, according to opportunities of the environment. Thus, the outcome of this dialogue captures the meta-knowledge of the academic profession that helps them make professional choices and create career plans.

Moreover, dialogue can capture academics' learning while thinking. When questioned, academics mentioned that they specify questions about a problem (or descriptions of an object) and look for answers. It could be that two participants 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 concept descriptions (synthesis). They also use techniques to re-create 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.

Academics also learn through writing personal or lecture notes, articles, etc. Discussions 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.

The interactions of academics with other members of society, their roles, rules, and tools are significant in their learning.

Considering the example of a conference, we could interpret academics' learning activities within a society. For academics to participate in a conference (which provides the circumstances to learn), they need a series of social interactions. Bearing in mind the importance of conferences in academics' learning, this indicates the significance of social interactions in their learning.

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 that specifies the social roles, referees will interact with the conference secretariat to inform the authors about the result.

In a conference, academics 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 a spirit of discovery: they experience the power of the 'experiments' that the speaker reports, 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 subject under discussion in the context 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. 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 application of knowledge. Of course, each of these situations does 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 the application of the presented thoughts, etc. Therefore, the conference can be the situation that prompts academics to learn under the context of criticism, discovery and application.

What is more, everything that attendees use during the conference could be considered as tools. These include the notebook with the pen, the proceedings, the participant's list with their organisation name and research interests, the name card that they wear and see other people wearing, etc.

Field information is important to academics' learning and they often complain about insufficient access to it.

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.

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. 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 by the supportive tool (i.e. become 'Highlighted sites' to indicate 'Bookmarks' of Netscape).

The inability to find the original/appropriate information may also mean that the relation between academics and their communities is not efficient enough. For example, it seems that academics may not be able to gain the help they need. It might also be that the use of terminology differs among colleagues and impedes understanding. Academics could then 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 scientific events. Considering the advantages of becoming a member of scientific societies, a 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. Thus, academics would be provided with the environment to organize, coordinate and take part in discussions or other events. The supportive tool 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. Furthermore, 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.

Types of interaction

Considering the social structure of academic learning, it is quite important for academics to communicate and interact with people. Since people are not always available at the desired place and time, academics would need a tool to support asynchronous and synchronous communication of image, text and sound.

Asynchronous communication can help academics overcome restrictions on being physically present at the same place, at the same time. It can 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 [14].

On the other hand, synchronous communication can 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 [14]. 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 communication to use.

The type of communication can also indicate how informal or formal the interaction might be. Synchronous communication 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. If academics were able to talk to colleagues without time or place restrictions, their participation in activities of societies would be enhanced. What is also important (in order to establish societies to participate), is to match the relevant ‘members’ to their interests and to encourage them to join an appropriate society. Thus, technology should support academics in finding people with relevant interests.

Remembering is important to academics.

Considering that academics’ everyday life comprises many different activities, they often need to recall information or thoughts of one activity even if they are engaged with another. 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 (or learning activity). Thus, even after a long period of time, they could be able to find that information without delay.

2.2 The problem statement

The above issues reveal possible ways that academics could 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 objectives [21]. The problem statement should arise from the specific situation that needs support (situation of concern). In this case, the situation of concern is to ‘support academics accessing appropriate (field) information’.

What does it mean to achieve an adequate level of support? This can be defined as ensuring that academics are provided with efficient 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). It 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’ [21].

Therefore, the problem statement could be defined in a single sentence: “*Specify an interactive supportive tool for efficient and easy access to (field) information by academics*”. Thus, 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. Hence, 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.

3. DESIGN CONCEPT

The Design Concept translates the Task Model into a coherent design for new technology. It provides the system image and style of interactions. The design concept is important to the system's design, since it forms a basis for the creativity of the designing team that associates:

- a sound understanding of the representations that academics employ to externalise their understanding with
- the development of new ways to represent the structure, process and content of a learning task [27].

The Design Concept suggests a simplified rendering of the system's behaviour and interactions. The behaviour refers not only to the graphical user interface but also to the software functions that support that interface. The Design Concept helps the interface designer and the development team to make consistent decisions across the visible objects of the system and to relate these objects to the internal system view [13].

3.1 System Image

The system image refers to the specification of system's guiding metaphor [22]. Erickson [10] defines 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 [28; 11]. 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 the underlying symmetry is established, the designer can extend the symmetry and suggest familiar source concepts to the target [11]. However, according to Stubblefield [28] 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.

On the other hand, Copper [6] argues that it is hard to find metaphors to provide users with appropriate mental models. Metaphors are based on associations that are perceived similarly by both the designer and the user. If the designer and the user do not share common associations, it is easy for metaphors to fail. As a consequence inappropriate metaphors can constrict users' thinking and cause them great difficulties. In exact words, Cooper claims: "use 'em if you find 'em, but don't bend your interface to fit some arbitrary metaphoric standard" [6].

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 (such as to extend the 'desktop' metaphor to describe learning activities) [15; 23]. Therefore, the starting point of selecting a metaphor is the actual situations where academics learn and their conceptualisation of the relevant learning activities and tasks they perform. The aim is to discover the 'situation' that would provide academics with a proper conceptual aid in their effort to access field information while thinking, reading, interacting with colleagues and social structures in an evolving way. The requirement is that 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 [10]:

- 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 guiding metaphor should go beyond learning prerequisites and capture also learning processes and outcomes. Moreover, academics' learning activities are not confined 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 'learning assistant' metaphor

Considering the anthropomorphic dimension of the metaphor, the learning assistant could be proposed to guide academics in their learning explorations. It is consistent with the way in which users interact with computer software, whereby they tend to create anthropomorphic mental models (my computer 'reads' what I type and 'answers' me back with its response). It might be an effective way to resolve the complexity of the system and facilitate user's interactions [6].

However, the 'learning assistant' concept does not provide any clear structure to the system (i.e. in which situations to provide assistance). Also, academics are quite experienced self-directed learners with a high degree of freedom to their learning choices. According to the data collected, they do not have problems in guiding themselves to learn. Thus, a metaphor would also diminish the freedom of the learner by trying to define what they need to learn.

The 'university' metaphor

A university metaphor could present a two-dimensional learning situation (spatiotemporal). It has a space that is quite broad and can be extended to a world 'outside the campus'. 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 academic's 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 [29]. 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.

The 'conference' metaphor contains the implication of *rapid learning*. Academics become aware of the shared knowledge of the conference within a short time period. The conference also embraces *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 satisfactory 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 (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 (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 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-party. It has also the meaning of philosophical conversations and conferences [19]. Its meaning has associations with a combined context of informal interactions (drinking-party), argumentation, exchange of ideas (philosophical debate) as well as the formal activities of a conference. Thus, it can be a situation in which academics can discuss, share opinions and learn while they move from informal interactions to formal, according to their taste.

Several academics were asked to assess 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. The symposium metaphor appears to provide 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. Although it captures the experience of participating in a symposium, it does not 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 task model step, it was decided that the supportive tool would focus on providing support to access (field) information. The symposium metaphor is appropriate since it can capture and facilitate 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.

3.2 Style of interactions

Once the guiding metaphor was decided, the specific interaction styles also need consideration to provide the full design concept. Initially, the focus was on the informal-formal dimension of the symposium metaphor. Symposiums may swing between drinking-party and conferences. Which features of the drinking-party 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. 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. Therefore, the system could be a rehearsal for academics to test their ideas before entering more formalised events.

4. FURTHER WORK AND CONCLUSION

The Symposium was the design concept that the Design Space and System's Specification steps were based on. The outcome of this process was SALL: a system prototype to Support Academics' Lifelong Learning [1]. Prototyping 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 [25].

HyperStudio [3] was used to develop a rapid prototype of SALL. As well as testing the screen design, this prototype enables the designer to test the functionality of the proposed system. The rapid prototype was developed in order to collect information about the adequacy of possible designs [25]. This prototype cannot be developed into a final product. It will be discarded once

the requirements of a full prototype are determined. It served the purpose of validating an adequate design.

An evaluation of the prototype conducted with academics revealed encouraging comments to produce a deployed system that could be tested in academics' workplace. They reported that the metaphor helped them to produce a productive mental model without constraining the functionality of the system. Thus, the conceptualisation of academics' learning activities was quite successful, since users not only were supported in understanding the functionalities of the system but also they were provided with familiar and quite apparent means of learning. Therefore, the design process is worthy to be completed by implementing a full prototype of the system.

To conclude, this paper has focused on the process of selecting a design concept to guide a system's design that would support academics during their lifelong learning processes. The design concept selection is quite important to system's design not only for the user but also for the designer. It relies on a sound understanding of user's activities and proposes a set of functionalities and an interface that is consistent to user's mental model. The symposium is a design concept that produces the required mental model to academics to facilitate an efficient and easy access to field information. The evaluation results of the rapid prototype provided efficient support to this concept.

REFERENCES

[1] Anastopoulou, S. (2000). SALL: Specifying a system to Support Academics' Lifelong Learning. MSc Thesis, University of Birmingham

[2] Anastopoulou, S., Sharples. M., (2000). SALL: Designing a System to support Academics' Lifelong Learning: An application of the 'socio-cognitive engineering' methodology. Paper submitted to the CAL 2001 conference.

[3] Baird, T., Baird, P., (1997). *HyperStudio Software for a Mediacentric World*, Manual. Roger Wagner Inc., El Cajon, USA

[4] Bentley, T., (1998). Learning beyond the classroom: education for a changing world. London: Routledge.

[5] Bergqvist J., Dahlberg, P., Ljungberg, F., Kristoffersen, S., (1999). Moving out of the Meeting Room: Exploring support for mobile meetings. In the Proceedings of the 6th European Conference on Computer Supported Cooperative Work, Copenhagen, Denmark, 12-16 September 1999. pp. 81-98.

[6] Cooper, A., (1995). About Face: the essentials of user interface design. Foster City: IDG Books Worldwide, Inc.

[7] Davies, D., (1998). Towards a learning society. In Teare, R., Davies, D., & Sanderlands, E., The Virtual University, London: Cassel.

[8] Dix, A., Finlay, J., Abowd, G., Beale, R., (1998). Human-Computer Interaction. London, Prentice Hall International (UK) Ltd.

[9] Engeström, Y., (1991). Non scolae sed vitae discimus: toward overcoming the encapsulation of school learning. Learning and Instruction, Vol. 1, pp. 243-259, Great Britain.

[10] Erickson, D.,T., (1990a). Working with interface metaphors. In B. Laurel (ed), The Art of Human-computer interface design (pp. 65-74). USA: Addison-Wesley Publishing Company, Inc.

[11]Erickson, D., T., (1990b). Interface and the evolution of pidgins. In B. Laurel (ed), The Art of Human-computer interface design (pp. 11-17). USA: Addison-Wesley Publishing Company, Inc.

[12]Fischer, G. Scharff, E. (1998). Learning Technologies in Support of self-directed learning, Journal of Interactive Media in Education, 98(4) [www-jime. open. ac.uk/98/4].

[13]Graefe, T., (1998). Transforming Representations in user-centred design. In L., Wood (ed), User Interface design: Bridging the Gap from Usser Requirements to Design (pp. 57-79). USA: CRC Press LLC.
[14]Green, L. (1998). Online Conferencing: Lessons Learned http://www.emoderators.com/moderators/lessonse.pdf.
[15]Harris, J., Henderson, A., (1999). A better mythology of system design. In the CHI 99 Proceedings of ACM, Pittsburgh, PA, May 15-20 1999. pp.1-7.
[16]Jarvis, P., Holford, J., Griffin, C., (1998). The Theory and Practice of Learning. London: Kogan Page.
[17]Kolb, D., (1984) Experiental Learning, Experience as a source of learning and development, New Jersey, Prentice Hall.
[18]Laurillard, D., (1993). Rethinking University Teaching, a framework for the effective use of educational technology. New York, Routledge.
[19]Macdonald A., M., (1974) Chamber twentieth century dictionary. Edinburgh, Chambers.
[20]Mezirow, J., (1990). Fostering critical reflection in adulthood. San Francisco, Jossey-Bass Inc.
[21]Newman, M.W., Lamming, G. M. (1995). Interactive System Design. Great Britain, Addison-Wesley Publishing Company Inc.
[22]Norman, D., (1986). Cognitive Engineering. In Norman, D., Draper, S., (eds), User centered system design: New perspectives on Human-Computer Interaction (pp. 31-61). New Jersey: Lawrence Erlbaum Associates, Inc.
[23]Norman, D., (1990). Why interfaces don't work. In B. Laurel (ed), The Art of Human-computer interface design (pp. 65-74). USA: Addison-Wesley Publishing Company, Inc.
[24]Pask, G., (1976). Conversational techniques in the study and practice of education. British Journal of Educational Psychology, Vol. 46, pp.12-25.
[25]Preece, J., Rogers, Y., Sharp, H., Benyon, D., Holland, S., Carey, T., (1994). Human-Computer Interaction. Great Britain: Addison-Wesley Publishing Company, Inc.
[26]Sharples, M., (2000). The Design of Personal Mobile Technologies for Lifelong learning. Computers and Education, 34(177-193).
[27]Sharples, M., Jeffery, N., du Boulay, J., B., H., Teather, D., Teather, B., du Boulay, G.,H., (2000). Socio-cognitive engineering: a methodology for the design of Human-centered technology. European Journal of Operational Research (in press).
[28]Stubblefield, A.,W., (1998). Patterns of change in design metaphor: a case study. In the CHI 98 Proceedings of ACM 'Making the impossible possible', Los Angeles, April 18-23 1998. pp.73-80
[29]Xiao, D., Hubbold, R., (1998). Navigation Guided by artificial Force Fields. In the CHI 98 Proceedings of ACM 'Making the impossible possible', Los Angeles, April 18-23 1998. pp.179-186.