Learning Contexts: a Blueprint for Research

António Dias de Figueiredo

Centro de Informática e de Sistemas
Departamento de Engenharia Informática
Universidade de Coimbra

adf@dei.uc.pt

Abstract

Most research efforts in online learning tend to concentrate on the delivery of *content* relegating to a lesser role the *contexts*, the activity-rich, interaction-rich and culturally-rich learning environments that the use of technology is making possible and where new principles and practices apply. We illustrate some of the threads of this emerging research field: What are learning contexts? How do they interact with contents? How can they be managed? What philosophical perspectives and social theories frame and support their use? Can they be designed? How do they shape the platforms of the future?

Keywords

Actor Network Theory, assessment, community of practice, content, context, learning environment, online learning, pattern, portfolio, social networking.

Introduction

This paper gives an account of the research carried out at the Centre for Informatics and Systems of the University of Coimbra (CISUC) in the field of "learning contexts", a subject that gained shape and strength in the course of our thirty five years devoted to ICT and Education. Learning contexts are still little understood and investigated worldwide. We have been participating in various European Community projects with the aim of contributing to greater awareness of learning contexts and we have just published in the United States a book on the subject, with contributions by authors from various parts of the world, entitled *Managing Learning in Virtual Settings: The Role of Context* (Figueiredo & Afonso, 2005a). In the present paper, we start by summarizing some key issues of learning contexts, as we have presented them in that book, before we describe the research we have under way, part of it already published, but some of it still in progress and never transposed to text or presented elsewhere.

The paper starts with the clarification of the concept of learning context and with the proposal of a simple definition that links context to content within a learning event. It then moves to the clarification of the philosophical dimension of learning contexts, which leads to a distinction between two radically different worldviews that, when not recognised, may seriously impair the understanding of the subject. Next, it covers the main theoretical foundations for the study of learning contexts, after which it examines the challenges of designing them. The following paragraph is devoted to the issue of contextual assessment. In a final paragraph, before the conclusions, the paper concentrates on the specification of contextual platforms. The conclusions summarize the essence of the paper.

Understanding learning contexts

We may say that a learning context is the set of circumstances that are relevant when someone needs to learn something. Up until the 18th century, before school systems were created in response to the requirements of mass education, most people learned with each other in the context of their daily activities, whenever problems and difficulties arose. Even when they wanted to become professionals, they started out as apprentices who learned a craft in the context of their master's workshop. Thus, learning took place in context. When mass schooling started to materialize, at the dawn of the Industrial Age, the ruling values were those of the mechanical world. It was the time when the management principles of Frederick Taylor transformed the factories into machines, and the workers into parts of those machines. The same principles applied to schools, which became the assembly-lines that mass-produced manpower for the Industrial Society. This mechanistic vision of education saw knowledge, not as something that could be built by the learners, themselves, in appropriate contexts, but as "content", or subject "matter", some sort of material fluid that could be "transferred" from the minds of the teachers into the minds of the learners. Knowledge was broken up into disparate subjects, most of them with little visible application, and started being "transferred", largely by telling and questioning. As this happened, real learning contexts gradually disappeared from education (Figueiredo & Afonso, 2005b).

Unfortunately, the mechanistic vision of learning as the "delivery of content" still dominates the educational scene of the present day, and it is massively extending into

online learning. One of the major thrusts of our research is to stress that beyond the delivery of content we need to take systematically into account interaction and activity, the learning "contexts", the completely renewed social and cultural frameworks that our education is calling for and technology is now capable of offering us. We do not deny that part of the future of learning and education is to be found in the production of content, that is, of chunks of structured information that can be stored and delivered across networks. We argue, however, that a significant part of the future of learning and education – the most important part of it – is to be found on context, that is, on making learning happen within activity rich, interaction rich, and culturally rich social environments that never existed, that the intelligent use of technology is making possible, and where completely different paradigms apply (Figueiredo & Afonso, 2005b).

Our research on learning contexts departs from a simplified model that relates the learner with content and context in a learning event (Figure 1). On the model, we postulate three definitions (Figueiredo & Afonso, 2005b):

- A *learning event* is a situation where an individual learns.

- *Content* is information that has been structured and encoded as text, multimedia materials, the spoken word of the teacher, or any other means.

- *Context* is the set of circumstances that are relevant for the learner to build knowledge when referring to content.
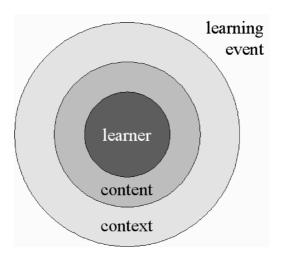

Figure 1 – Model relating learner, content and context in a learning event

In this simplified model, the action of the teacher or moderator, if there is one, will be seen partly as content and partly as context, and the technological infra-structure, if there is one, will be seen as belonging to the context. A learning event can be of any length and intensity, and may be intentional or non-intentional. A course, a lecture, the discussion of a case, the instant insight sparked by a serendipitous incident, will all be considered learning events. Understood as encoded information, content can be transferred and exchanged. The learner may learn in the absence of content, just by interacting with context (which happens, informally, most of the time, outside the school). In the small world represented by Figure 1 the learner is engaged in *activities* involving content and context. This small world is normally inhabited by other actors,

besides the learner, such as colleagues or partners, when the learning event takes place in a classroom or in a community of practice (Figueiredo & Afonso, 2005b).

With context understood as the set of circumstances which are relevant in a learning event, a classroom, for instance, is a learning context. A Web site offering online courses is also a learning context. Within a classroom, a lecture, a laboratory assignment, a shared project, the discussion of a case study, all are learning contexts. All kinds of teaching and learning strategies correspond to learning contexts. Many of the most dynamic fields of current research in learning and education, like Computer Supported Cooperative Learning (CSCL), Situated Learning, or Learning Communities are concerned with learning contexts. Hundreds of expressions currently used in education – such as project based learning, action learning, learning by doing, case studies, scenario building, simulations, Socratic dialogues, panel discussions, role playing – pertain to the issues of learning contexts. The advantage of concentrating on context, as a whole, rather than on the multiplicity of its manifestations currently studied by disparate research groups and communities is that, by doing so, we are able to articulate that multitude of distinct concepts, theories and practices into a single, coherent and operational world (Figueiredo & Afonso, 2005b).

The philosophical dimension

To what extent do the ontological, epistemological, and methodological dimensions of the learning processes impinge on the issues of learning contexts? This issue has been extensively argued in Figueiredo & Afonso (2005b) with reference to a philosophical framework far too involved to be reproduced here. Here, we will attempt to summarize the more relevant outcomes of what has been argued there. Within the positivist paradigm, context is viewed as occurring in a realist world, so it is external and independent from the learner and the activities in which the learner is engaged. It is, thus, seen as the environment where the activities take place. If, for instance, the learner is learning in a classroom, the context may be seen as the room, with its desks and other equipment, the learner's colleagues, the teacher and the rules that determine how activities must progress in class, which are all viewed as external and surrounding the activities of the learner. In this positivist worldview, context is delimited, in the sense that we feel capable of recognizing where it begins and where it ends. It is also seen as stable and driven by immutable laws, so that we can predict its evolution over time and space, even if it changes. Thus, when developing content for a given course, we take context in account beforehand, in the elaboration of our materials, and then forget about it, trusting that its behavior will always be as expected. The role of the various students and classroom equipment (such as computers and Internet connections), for example, are seen as predictable, previously planned and properly taken into account. Activities occur within the context, but independently from it and following a trajectory that has been planned. For instance, when the learners participate in the discussion of a case study, they are not seen as likely to drive the discussion to any unanticipated direction leading to the need of new contents or changes of context (Figueiredo & Afonso, 2005b).

Turning to the constructivist paradigm, we notice that context cannot be located and delimited. Context is only perceived through its interactions with the learner, the interactions organizing the context as much as they organize the learner's experience. To a large extent, context is the interactions. The notion of context as environment does

not make any sense in a constructivist world, and this is why the use of the word "context" is relevant. Indeed, "context" comes from the Latin origin *contexere*, "to weave together". In the case of learning, this stresses that context is seen as being woven together with the act of learning, rather than around it, as conveyed by the word "environment". In the constructivist worldview, context is not stable, but permanently changing. It changes because it is a network of interactions that happen, in spite of us, under the influence of other actors in the context and it changes as a result of the interactions we maintain with it. The way in which we perceive it, in its changeability, is the way in which it helps building our learning experience. Thus, context is dependent from the activities of the leaner. Activities do not occur inside the context, as was the case for the positivist paradigm: activities are part of the context. A constructivist context can be predicted and characterized in advance only to some extent. The more open-ended or socially complex the activity is, the less we can predict its development. In fact, as stated in the definition proposed for the model of Figure 1, context is what is relevant for the learner to build his/her knowledge, and that may change from moment to moment and from learner to learner (Figueiredo & Afonso, 2005b).

If we concentrate on the two outer layers of the model of Figure 1, we are left with content and context. In the positivist perspective, these are two distinct entities. In the constructivist perspective, however, the boundary between the two becomes fuzzy. In fact, part of the content may be consigned to the status of context, and vice-versa. An inspiring metaphor for this process of co-generation is the yin-yang duality of the old Chinese Book of Changes, representing the archetypal opposites that guide change (Figure 2) (Figueiredo & Afonso, 2005b).
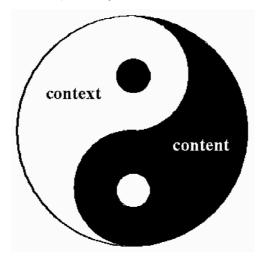

Figure 2 – The duality between content and context

This means, in our case, that context holds in itself the seed of content and content holds in itself the seed of context, so that, like day and night, one generates the other and one may not exist without the other. To illustrate this notion, we may think of a community of learners, scattered across the country, following an online course that supports collaboration and gives them access to a large digital library. During the course, they have to carry out various assigned individual and collective activities. The context, in this example, is, for each learner, a complex set of items, activities and people, such as the collaboration mechanisms of the platform (email, mail lists, weblog, whiteboard,

mind-map editors), the digital library (its multimedia materials, books, journals and papers, plus access protocols), the activities assigned to the learners, the other learners in the community, with whom collaboration is maintained, the protocols and netiquette supporting the collaboration, and the coordinator and e-moderators of the course. The content is, for each learner, the materials produced to support the course, plus any materials the learner decides to download from the library. As the learners may choose from the library any materials they wish, this means that what is seen as content by one learner may be seen as context by the others. Also, what is seen as content by one leaner will very likely become context when he/she puts it away, after use, and may become content again if the learner decides to use it again (Figueiredo & Afonso, 2005b).

Theorizing learning contexts

Many theoretical schools, concerned both with face-to-face and with online learning, have been used to understand learning contexts and make them operational. Some concentrate on the concept of *community of practice* (Lave & Wenger, 1991; Brown & Duguid, 1991; Wenger, 1998). Others, inspired by the work of Lev Vigostky and his colleagues, are concerned with the relationships between contextual constraints and the acquisition of knowledge (Light & Butterworth, 1992), as well as with the social and cultural foundations of the developmental process (Forman, Minick and Stone, 1993). Building on the foundations of the former, but exploring additional threads, namely the utilization of *Activity Theory*, other theoretical combinations have gained favour, following the proposal, by Michael Cole (1996), of a new concept of Cultural Psychology and the publication, by Chaiklin and Lave (1996) and Bonny Nardi (1996), of influential books with contributions by various prominent authors.

We are actively engaged in the thread centred on communities of practice as contexts for learning (Figueiredo, 2000; Afonso, 2001; Figueiredo, Afonso & Cunha, 2002; Paiva, Lima, Afonso & Figueiredo, 2004), but we are strengthening it with dimensions not usually associated with the topic. One such dimension regards the *sustainability of collaboration*, which we define as the ability to keep collaboration going successfully for a desired length of time. This is taking us to the investigation of the key critical factors for successful collaboration, such as the *value proposal* for its continued existence, the *lifecycles of collaboration*, the challenges posed by *reluctant contexts* (contexts where some of the parts may not be willing to collaborate), and the *adaptive leadership* styles required to match the different stages in the lifecycle. As we do not share the belief, held by some authors, that communities of practice should be mere self-organized spaces for the random discovery of meanings and missions, softly managed by group animators, we have been proposing the exploration of communities of practice as contexts of prescription and production of results, requiring direction, effectiveness and creativity in their design and management (Figueiredo, 2003).

Our concern with the design and management of learning contexts, and not just with their understanding, has been taking us to additional theoretical frameworks not traditionally associated to learning and education (Figueiredo & Afonso, 2005b). One such framework is provided by *Actor Network Theory* (ANT), a sociological theory used to help understanding social networks made up of human and non-human actors that create relationships of mutual dependence, mobilize other actors and resort to artifacts to reinforce their alliances and satisfy their interests (Callon & Latour, 1981; Callon, 1986; Law, 1992). Another inspiring framework that brings additional meaning

to the former is what we call the *Theory of Wholeness*, proposed by Christopher Alexander in his book "The Timeless Way of Building" (Alexander, 1979). Originally described as an innovative approach to the theory and application of Architecture, it offers, however, a most inspiring model for the development of any complex socio-technical system.

Designing learning contexts

If learning experiences can be made more successful in favorable learning contexts, can those contexts be designed and managed? This is indeed, a central issue in our research agenda: we are not just interested in understanding how learning contexts function but also in the *design and management of learning contexts* (Roque & Almeida, 2000; Figueiredo & Afonso, 2005b; Roque & Figueiredo, 2005). We have been developing extensive work in this direction, leading to an ontology named *Context Engineering* (Roque, 2004), and we keep strengthening this research thread by resorting to Actor Network Theory and to the Theory of Wholeness.

As explained elsewhere (Figueiredo & Afonso, 2005b), in the perspective of Actor-Network Theory the design of a learning environment is a process of *translation* (Monteiro, 2000). The designers start by translating the learning objectives into a number of requirements. The requirements are then translated into a combination of activities and materials that make up the context. The design process attaches to the various actors (learners, teachers, protocols, contents) specific roles that they are expected to play during the learning process. In other words, the designers perform the *inscription* into the learning context of a *program of action* that is supposed to be fulfilled by the actors. This can be done by various means, such as the four phases of a translation process proposed by Callon (1986): problematization, interessement, enrolment, and mobilization. In *problematization*, the focal actor (the designer) defines, for the other actors, identities and interests consistent with his/her own and creates a context that encourages their acceptance. This context is called an *obligatory passage point*. In the example of a community of learners following an online course, a regular online meeting that everyone must attend, or the organization of a learning portfolio that everyone must build, are examples of obligatory passage points. *Interessement* is the set of activities and processes that attempt to persuade the actors to accept the roles that have been assigned to them by the focal actor. *Enrolment* is the acceptance, by an usually small part of the actors, of the commitment to carry out a set of tasks, recognizing the interests that have been assigned to them by the focal actor. Finally, *mobilization*, is the generalization of adherence of all the other actors to the commitment to carry out their tasks, so that that their acting becomes generalized, predictable and in agreement with the intents of the focal actor (Figueiredo & Afonso, 2005b).

The use we have been making of the Theory of Wholeness rests to a large extent upon the concept of design *pattern*, proposed by Alexander, Ishikawa & Silverstein (1977) to describe a problem that occurs over and over again and for which a solution has been established. These authors propose a standard format for the characterization of any pattern, which includes the description of the corresponding problem, its solution, and the clarification of the relationships between that pattern and the other patterns to which it is related. Once a pattern is created, which means that a problem/solution pair has been established, it can be used over and over again whenever that problem occurs.

Each pattern can only exist to the extent that it is articulated with other patterns: the larger patterns in which it is embedded, the patterns of the same size that surround it, and the smaller patterns which are embedded in it (Alexander et al., 1977, p.xiii). This means that "when you build a thing you cannot merely build that thing in isolation, but must also repair the world around it, and within it, so that the larger world at that one place becomes more coherent, and more whole" (Alexander et al., 1997, p.xiii). The solution in a pattern is always stated as an instruction, so that you know exactly what to do when the corresponding problem arises. Also, the explicit presentation of problem and solution in a given pattern lets you replace an existing solution when you devise a better one. In fact, when you have built a collection of patterns, you can classify them according to the degree of faith you put on the soundness of the solutions you have established for them: some may be seen as stable, while others may remain exploratory for a long time. Patterns are also considered to be "much alive and evolving" (Alexander et al. 1997, p.xv), so that you can get an organic and evolutionary vision of them.

Contextual assessment

Contextual assessment corresponds to what is currently referred to in the literature as "authentic assessment", an approach to assessment that operates by engaging the learners in tasks and procedures where they apply their skills and knowledge in the solution of real-world, authentic, problems rather than in artificial and de-contextualized testing tasks (Wiggins, 1993). The most current kinds of authentic assessment are: learning portfolios, projects, essays, and presentations (Johnson, 2002).

A *learning portfolio* is a collection of the assignments produced by a student, in a given course, to demonstrate success in satisfying the learning objectives of the course (Cunha, Afonso & Figueiredo, 2004). A *project* is broadly seen as covering any activity that has a clear purpose, a beginning and an end, and is aimed at producing a visible result. *Essays* are seen as extended written texts enabling the learners to display their command of learning objectives while cultivating higher order thinking skills; they may occur in a wide range of formats, such as scientific or technical papers, user manuals, feasibility studies, research essays, short essays, brochures, or letters (Johnson, 2002, p.171). *Presentations*, or performances, are ways of demonstrating publicly, before an audience, the knowledge and competencies gained by the learners (Johnson, 2002, p.170); they can also occur in many formats, such as slide presentations, poster presentations, or focused debates. These four kinds of authentic assessment can often be mixed together, such as when a learner carries out a project and then describes its results by writing a paper, supported by a presentation, which are both uploaded onto an electronic portfolio.

Our research is concentrating on a variety of challenges posed by the use of contextual assessment in online and blended learning contexts. We are doing it in a perspective where assessment is seen, not just as a means to analyse learners' performance, but also, and above all, as a core element in the teaching-learning process. On one hand, we are exploring, both online and off-line, the multiple advantages of learning portfolios (Klenowski, 2002), while experiencing the difficulties and overload of managing them with the poor software tools of the present day. Is parallel, we are exploring the apparently still untapped potential of combining learning portfolios with a distinct mechanism currently used to support adult learning, *learning contracts* (Knowles, 1980; Knowles, 1986). This effort is leading us to the establishment of detailed pedagogical,

social and technical requirements and specifications for electronic portfolio tools capable of transforming the management of portfolios and learning contracts into an easy, pleasurable and very effective task (Henriques, Mendes, Figueiredo & Cunha, 2004).

We are also investigating student *cross-assessment*, which we see as a central component of assessment in adult online learning environments, with quite encouraging preliminary results. If we bear in mind that a significant part of present day scientific progress is similarly supported by the peer reviewing processes of scientific publications, we might say that these encouraging results seem to make sense. We have been exploring both double-blind and non-blind assessment mechanisms in the context of electronic portfolios, projects, essays, and presentations, with the results obtained so far favouring the double-blind modalities. To enhance peer-assessment, we have also been looking into the development of software tools that automatically construct full ordered ranks from multiple comparisons of the achievements of pairs of students.

Specifying the contextual platform

What specific features should learning platforms include to strengthen the creation, exploration and management of learning contexts? Two distinct kinds of learning platforms are popular today: the so called *Learning Management Systems* (LMSs), used to manage the learners and keep track of their progress, and the *Learning Content Management Systems* (LCMSs), which enable content (or "learning objects") to be effectively managed by authors and learners. These two kinds of platforms, which often coalesce into a single LMS, tend to be driven by visions of online learning that are strongly attached to the concept of content. Our research interests go into a different direction, toward the specification of what we call LXMSs, *Learning Context Management Systems*. An LXMS is, above all, a platform for the creation of learning communities and for the management of collaboration. Of course, it can be made to integrate, in addition, the features of conventional LMSs and LCMSs, in which case it becomes a platform satisfying both the content and context needs of online learning.

The socio-technical specification of contextual platforms is an important thread of our research agenda. We have already developed a prototype, Favela, a context management platform that has been used to support collaboration in one of our blended learning post-graduate courses (Figueiredo, 2004). Favela is the Brazilian word for the settlements of jerry-built shacks which lie on the outskirts of some big Brazilian cities, growing as somewhat unstructured but very organic and sociologically rich communities. The metaphor of Favela is that of a big territory where each community member is given a square piece of ground for his/her virtual home. Once the owner of a square, a member can customize it and fill it with documents of various kinds. The documents in each cell, which may be uploaded from the outside, in any format, or built inside the platform – blogs, web pages, mind maps, notes – are kept in the repository of the cell. The owner of a given cell can decide which documents shall be visible and which ones shall not be visible to the other members of the community. The system also lets the owner decide which documents can be changed and which ones cannot be changed by other community members, thus making room for the creation and management of shared documents. The visibility of the content of each cell can be made very flexible by permitting the fine choice of which members can see (and change) what. Also, members or groups of members wanting to create a space for some new initiative only need to

move into an empty square and take ownership of it, customizing it and defining its membership and the access rights to each one of its documents (Figueiredo, 2004).

The collaboration mechanisms adopted by Favela include email and discussion forums, a web log editor, a web page editor, a mind-map editor, an email composer and reader, and a synchronous chat. A typical collaborative context built with Favela usually starts with: a welcome page; a main meeting place, configured as forum or as a blog, where debates take place; a library where reference documents supporting collaborative work are collected; a place for news and announcements; an archive of the documents produced within the community; and various places, usually in the form of blogs, where the projects carried out by the community are incubated (Figueiredo, 2004).

The concepts of collaboration originally explored in Favela are now being extended to include more powerful collaboration mechanisms, such as social networking and filtering, social visibility, and contextual means to support coordination and negotiation. The mechanisms for the management of user created metadata now available in *social networking and filtering* systems can greatly improve the contextual access to content in large, organically growing, repositories of information, which simultaneously facilitates the creation of community. An interesting example is offered by Del.icio.us (http://del.icio.us), a site that presents itself as "a social bookmarks manager [that] allows you to easily add sites you like to your personal collection of links, to categorize those sites with keywords, and to share your collection not only between your own browsers and machines, but also with others"(Del.icio.us, 2005). A similar solution is provided by Sebentas.com (http://sebentas.com), an organically growing repository of links to contents for students, where Portuguese speaking students create their personal spaces and upload and tag the links to their preferred contents, which are then classified, indexed, and made available to the whole community with various associated indications of popularity.

Some social networking mechanisms, such as Orkut (http://www.orkut.com), an online community connecting people through a network of trusted friends, include rudimentary means of letting members express the nature of their emotional feelings toward other community members. This is a suggestive way of integrating in LXMSs specific procedures for automated sociographic analysis (Moreno, 1951), which, in turn, can be used to help steer adaptive leadership throughout the lifecycles of sustainable collaboration. A variety of other recommendation systems and collaborative filtering solutions (Liberman, 2001) can also be explored in LXMSs. *Social visibility mechanisms*, such as social translucence, a means of making the participants in a community and their activities visible to one another, are also being investigated (Erikson & Kellogg, 2000; Erikson, Halverson, Kellogg, Laff & Wolf, 2002). In addition, we are equating the exploration of methods capable of inducing serendipitous insights, a thread of research we have been exploring for some years, albeit in contexts not directly related to learning and education (Campos & Figueiredo, 2001; Campos & Figueiredo, 2004; Campos & Figueiredo, 2005).

The balanced integration of all these kinds of facilities into the specification of the ideal LXMS is being carried out in light of the theories described above, with particular reference, for the technical component of the specification, to the Theory of Wholeness. Indeed, the specification is being expressed as a network of design *patterns* that interact with each other to form the whole specification of the platform. Concepts with different degrees of generality – such as collaboration, learning portfolios, learning contracts, peer assessment, project assessment, essay assessment, or external annotation – are being organically combined into a growing network of patterns which is becoming our

specification of the ideal LXMS, as well a rich ground for reflection and discussion on the multiple issues pertaining to the improvement of learning.

Conclusions

Hoping that it could inspire other research groups and spark future collaboration, we have described the research agenda on "Learning Contexts" of the Centre for Informatics and Systems of the University of Coimbra (CISUC). We believe that some points of this agenda should be stressed before we close. First of all, our proposed *theoretical approach for learning contexts*, that has been leading, so far, to very encouraging results. Next, our argument in favour of the principle that *learning contexts can be designed* and the approaches we have outlined, within the contained limits of this paper, to explain *how that design can be carried out*. A third point relates to the issues of *contextual assessment*, which lay, in our view, at the very core of any attempt to improve constructivist teaching and learning. Finally, the question of *contextual platforms*, or *Learning Context Management Systems* (*LXMSs*), which we view, not just as a technical question, but as a comprehensive ground for debating the multitude of socio-technical dimensions that underlie the improved learning contexts of the XXI Century.

References

Afonso, A. P. (2001). Models for the Management of Knowledge in Educational Sites. In *Procedings of the 12th Information Resources Management Association International Conference*. Toronto, Canada.

Alexander, C. (1979). *The Timeless Way of Building*, Oxford: Oxford University Press.

Alexander, C., Ishikawa, S., & Silverstein, M. (1977). *A Pattern Language: Towns, Buildings, Construction*. Oxford: Oxford University Press.

Brown, J. & Duguid, P. (1991). Organizational Learning and Communities of Practice: Toward a unified view of working, learning, and innovation. *Organizational Science*, 2 (1), pp. 40-57.

Callon, M. & Latour, B. (1981). Unscrewing the big Leviathan: How Actors Macro-Structure Reality and How Sociologists Help Them to Do So. In K.D. Knorr-Cetina and Cicourel (eds.). *Advances in Social Theory and Methodology: Towards an Integration of Micro and Macro- Sociologies*. London: Routledge and Kegan Paul.

Callon, M. (1986). Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen. In J. Law (ed.). *Power, Action and Belief: A New Sociology of Knowledge*. London: Routledge & Kegan Paul, London, pp. 197-225.

Campos, J. & Figueiredo, A. D. (2001). Searching the unsearchable: inducing serendipitous insights. In *Proceddings Workshop Program at the Fourth International Conference on Case-Based Reasoning -Technical Note AIC-01-003*. Washington, DC: Naval Research Laboratory, Navy Center for Applied Research in Artificial Intelligence.

Campos, J. & Figueiredo, A. D. (2004). Method and System for Supporting Symbolic Serendipity, *US Provisional Patent Nº. 60/520,447*, US PATENT OFFICE, November 2004.

Campos, J. & Figueiredo, A. D. (2005). A Divergent Engine for Serendipity Induction", in A. Abe & Ohsawa, Y. (eds.). *Readings in Chance Discovery*. International Series on Advanced Intelligence, Adelaide, Australia: Advanced Knowledge International.

Chaiklin, S. & Lave, J. (eds.) (1996). *Understanding Practice: Perspectives on Activity and Context*. Cambridge: Cambridge University Press.

Cole, M. (1996). *Cultural psychology: A once and future discipline*. Cambridge, MA: The Belknap Press/Harvard University Press.

Cunha, P. R., Afonso, A. P. & Figueiredo, A. D. (eds.) (2004). Alternative Assessment in Information Systems Engineering Education, *Proceedings of the International Conference on Engineering Education and Research (ICEER 2004)*, Olomouc, Czech Republic.

Del.icio.us (2005). Retrieved 23/09/2005 from http://del.icio.us/doc/about.

Erikson, T. & Kellogg, W. A (2000). Social translucence: an approach to designing systems that support social processes. *ACM Transactions on Computer-Human Interaction*. 7(1), pp. 59–83.

Erickson, T., Halverson, T., Kellogg, W. A., Laff, M. & Wolf, T. (2002). Social translucence: designing social infrastructures that make collective activity visible. *ACM Transactions on Computer-Human Interaction*. 7(1), pp. 59–83.

Figueiredo, A. D. (2000). Web-based Learning - Largely Beyond Content. In *Proceedings of the European Conference on Web-Based Learning Environments, WBLE'2000*. Porto, Portugal.

Figueiredo, A. D., Afonso, A. P., & Cunha, P. R. (2002). Learning and Education: Beyond the Age of Delivery. *Proceedings of the International Conference of Engineering Education (ICEE'2002)*, Manchester, UK.

Figueiredo, A. D. (2003). Gestão do conhecimento e economias de inovação intesiva. In R. V. Silva and A. Neves (eds.). *Gestão de Empresas na Era do Conhecimento*. Edições Sílabo.

Figueiredo, A. D. (2004). *Context & Learning Basic Information Portal*. Kaleidoscope Deliverable D.10.1.1. Kaleidoscope Project. Commission of the European Communities, June 2004.

Figueiredo, A. D. & Afonso, A. P. (2005a). *Managing Learning in Virtual Settings: The Role of Context*. Information Science Publishing, Hershey, USA.

Figueiredo, A. D. & Afonso, A. P. (2005b). Context and Learning: A Philosophical Framework. In Figueiredo, A. D. & Afonso, A. P. (eds.). *Managing Learning in Virtual Settings: The Role of Context*. Information Science Publishing, Hershey, USA, pp. 1-22.

Forman, E. A., Minick, N., and Stone, C. A. (1993). *Contexts for Learning: Socio-Cultural Dynamics in Children's Development*, New York: Oxford University Press.

Henriques, N.F., Mendes, A.J., Figueiredo, A.D. & Cunha, P.R. (2004). An e-Portfolio Tool for LearningOnWeb. *Actas del VII Congreso Iberoamericano de Informatica Educativa*, Monterrey, Mexico, Octubre 13-15.

Johnson, E. B. (2002). *Contextual Teaching and Learning*. Thousand Oaks, CA: Corwin Press.