Knowledge Management and decision making based on informal learning activities in business

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Abstract

The application of the Information and Communication Technologies to everyday life activities facilitates the availability of lots of information and knowledge which can be used for multiple purposes. One of them is learning processes within organizations. However, there are two questions which must be addressed: first, that people do not only learn in organizational contexts; and second, that not all the data gathered from learning systems is useful. This makes it necessary to find a way to gather information about informal learning activities in the workplace and to facilitate visibility of what employees learn outside the organization so that such knowledge may be accessed from within the organization and be used for decision making. In order to do so this study proposes a methodology based on the identification of informal learning instances by the employee and their recognition by the organization. The methodology is supported by a technological framework based on a Personal Learning Network, a Portfolio, a Catalog of Competences and an institutional system which includes tools for optimization of decision making. The methodology has been implemented and evaluated in the context of a pan-European project. The main findings from this study suggest that, although decision making from informal learning instances is possible, both the methodology and tools used should be flexible enough to satisfy the needs of the organization.

Keywords: Decision making, informal learning, competences, knowledge management

1. Introduction

Information is an essential element in decision making processes and, from a theoretical point of view, the more useful the information available is, the easier decision making becomes. Information and Communication Technologies (ICTs), which are now so common in everyday activities, can generate a vast amount of information. However, not all of that data is really meaningful and can be used within organizations. To solve this problem, data mining or information visualization techniques may be used, but it may be difficult to apply them in every possible context. An especially

complex case is business decision making based on employees' informal learning activities.

This is a longstanding modality of training, since individuals –as social animals– learn in different contexts from their interaction with other people, their experience, etc. The concept of informal learning in the workplace was coined long ago; since the first half of the twentieth century there are several definitions (Dewey, 1938; Knowles, 1950), with more appearing at the end of the century (Coombs, 1985; Watkins & Marsick, 1990). Today, informal learning is becoming again the center of discussion due to several reasons: 1) the recognition given by the Bologna process to informal learning (European-Union, 1999) as a basic element in lifelong learning; 2) the pressing need to be able to apply learning that in many cases is obtained by observation and experience (Attwell, 2007b); and 3) the emergence of the Internet, mobile devices and 2.0 Web tools which facilitate informal learning (Ajjan & Hartshorne, 2008; Casquero, Portillo, Ovelar, Romo & Benito, 2008; Fielding, 2000).

In particular, the recognition of informal learning in the workplace is specially relevant as a result of different factors (Hager, 1998); for example, it enhances employability and produces positive benefits for managers and companies; it may help to develop task-oriented skills and know-how, and to communicate "social" norms and preferred patterns of behavior; it also gives employees the opportunity to learn and keep their skills up-to-date, while being part of the overall workplace culture rather than just a training regime (Dale & Bell, 1999; Halliday-Wynes & Beddie, 2009). These issues lead to an interest in informal learning in the corporate world (García-Peñalvo, Colomo-Palacios & Lytras, 2012), driven by the desire to capitalize on the intellectual assets of the workforce, to manage organizational knowledge and in recognition that informal learning may prove a cost effective way of developing competence (Attwell, 2007b).

Informal learning takes place in the context of everyday experience, especially among young and older adults in both Higher Education (HE) and in workplace contexts. One relevant characteristic of informal learning is that it emerges from the activity rather than from a planned activity, a fact which has raised increasing attention to this aspect of learning. Some examples of this are the CEDEFOP "European Guidelines for validating informal and non-formal learning" (CEDEFOP, 2009) contains experiences of more than 20 countries in the validation of informal and non-formal learning, the ECOTEC Inventory of validation of non-formal and informal learning (Otero, McCoshan & Junge, 2005) provides a catalogue of good practices in the area of validation for policy-makers, or the OECD Recognition of informal learning (Werquin, 2010). There are also several initiatives concerning competence recognition in the EU, such as National Qualification Systems and the EQF (European Qualifications Framework) (Bjornavold & Coles, 2008).

ICT may enable such recognition, just by providing support to make informal learning evident; some projects in this sense are the Tencompetence Project (Berlanga, Sloep, Brouns, Bitter-Rijpkema, & Koper, 2008), TENCompetence project [1] (García-Peñalvo, González-González & Murray, 2012) –which

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[1] http://tencompetence-project.bolton.ac.uk

provides a set of tools to support lifelong learning–, Open Badges[2], etc.

These initiatives show that the recognition of informal learning is something important and that they count with technological and institutional support, but the main focus should lie on how to make it possible to obtain a strategic advantage of such informal learning, both for organizations and employees. Recognition of informal learning implies a dialogue among decision makers and the person who carried out the informal learning activity. Such interaction allows checking what kind of competences have been achieved, and to what degree, so that such information may be used to facilitate decision making in the institutional environment. For instance, managers could base their decision of promoting someone in the skills acquired in the informal space, or detect learning needs of employees in advance. This dialogue among employees and decision makers would enable the creation of a common portfolio of competences from which both the organization and the employees may benefit.

This paper proposes a methodology to articulate such dialog. In order to empirically test the methodology, it has been implemented as a proof of concept in the TRAILER project, a pan-European initiative, which includes the evaluation of experts to test if the proposed methodology really facilitates decision making and to what extent may the implementation be implemented and used as a reference for application in different organizations.

The paper is structured as follows: section 2 presents the research methodology; section 3 is focused in one of the components involved in

the methodology: the Decision Support System (DSS). The DSS is next evaluated to check the adequacy of different design decisions made based on the methodology, and how the implementation works. Finally, some conclusions and implications from the experiment are detailed.

2. Research methodology

In order to be able to make decisions based on informal learning, this learning must first be somehow identified by the employee and then recognized by the organization, through a dialogue process between employee and organization.

The identification by the employee implies the need to consider the different tools used by him or her to carry out informal learning activities which lead to effective training. These tools are not just related to an employee training platform but also to the tools the employees use in their everyday life to learn and manage knowledge. This kind of learning is close to the concept of Personal Learning Environment (PLE) or Personal Training Environment (PTE). PTEs facilitate the users' training process by allowing them to use the tools they want, freeing them from the constraint of being bound to the use of a specific institutional context or training schedule (Adell & Castañeda, 2010). A variation of this is the PKN, the personal online networks which allow management of tacit and explicit knowledge (Chatti, Agustiawan, Jarke, & Specht, 2010). Moreover, the identification of informal learning also implies to store and classify the informal evidences. This can be done by using a portfolio system, as a place to store and manage knowledge (Attwell, 2007a), and using a competence-based model to classify the

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[2] http://openbadges.org

evidences, as recommended by the European Union and other organizations which stress the commitment to recognize competences and informal learning (CEDEFOP, 2009; European-Union, 1999; ISCO08, 2012).

Once the identification process is complete, the organization should be able to recognize the informal evidences identified by the employees, and this requires being able to process the information from the PTN published in the system by employees.

In order to address this requirement, a methodology based on a technological framework is defined in this study. The methodology comprises a framework with several different components and interfaces to enable the level and type of interaction required. The framework is described in Figure 1.
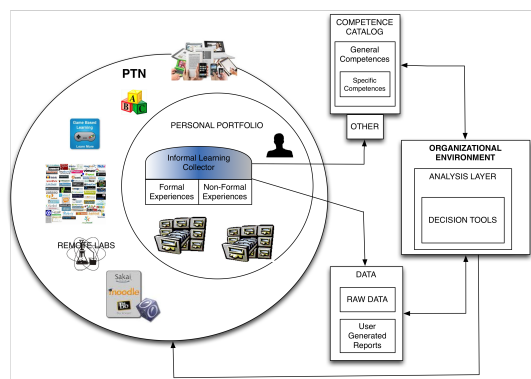

Figure 1. – Research framework

The PTN groups the tools with which the user interacts in their informal learning. Some examples of these tools include Wikipedia, Youtube, games, social networks, LMS, Remote Labs, expert forums, microblogging sites, etc. One of the tools included is the TRAILER portfolio, in which informal, non-formal and formal learning experiences can be stored and published.

The portfolio has an interface to facilitate gathering of informal learning activities. This

interface is called Informal Learning Collector (ILC). In addition, there are several organizational tools: a Competence Catalog which facilitates the categorization of informal learning experiences –taking into account both trainee and organizational perspectives–; an Organizational Environment which enables the analysis of the published information, gives support to the dialog with employees concerning their informal training, and facilitates decision-making by organizational agents related to organization-wide training issues (for example, in internal and external certification processes); and a Repository used to store the information which will be analyzed, and with reporting capabilities to generate useful reports for both organization and employees.

In this framework a methodology (Figure 2) to make informal training experiences transparent to workers and organizations, in such a way that both of them will benefit, has been defined in the context of the TRAILER project.
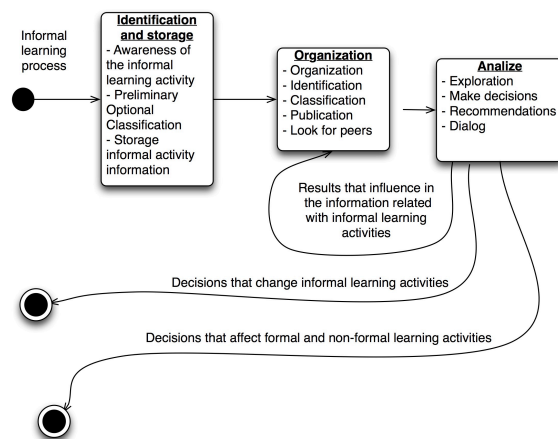

Figure 2. – Methodology description

The starting point of the TRAILER methodology is the moment in which the user performs an online activity which may have an impact on a competence defined in the Competence Catalog.

The employee may then identify and match an activity with the set of possible competences from the catalog, or store it for later identification. The processes of collection, inspection and reflection results in a methodology with three stages:

1. **Identification and storage:** in this initial stage, the user classifies the activity taking into account the competence catalogue which includes general competences, organizational competences and user-defined competences. After that, the identified activity is recorded in the portfolio.

2. **Organization:** once the information of the informal learning activity is stored, it can include information about the associated competences, or else require further classification in the catalog. In addition, once it is stored, it is subject to classification into the portfolio in different categories or views. When the information is properly organized, it may be published and made available to the organization, with the employee deciding what is published and who has access to that information. This information allows organizations to perform analyses on competencies, and workers to find peers with similar interests.

3. **Analysis:** the published information, once made available, may be analyzed for making decisions about the training needs of workers, the tools and contents used by the organization and the specific skills each user has, both at the individual and group levels. The publication of information and the views of the portfolio facilitate a common analysis of the gathered information, which

can facilitate a dialogue among the different stakeholders. The system, after the analysis, can give recommendations regarding organizational skills, knowledge gaps or personal recommendations for the learner/employee.

One of the critical elements of the framework to make decisions is the DSS, which is described in detail in the following section.

3. The Decision Support System

As it is evident from the methodology and the framework proposed, there is a component which becomes critical for decision-making: the DSS. The DSS is defined in the organizational environment, and it comprises an analysis layer and a set of decision tools.

The analysis layer will be in charge of gathering the information provided by the portfolio and published by the workers, as well as of facilitating a preliminary analysis of data to allow for presentation of this information.

The analysis layer accesses the data through two interfaces. One of them is an interface implemented by the portfolio called PersonalPortfolioView, which gives information about the informal activities and competences published by the employee. The other interface provides information about competences and it is implemented by the competence catalog. The information provided by these two interfaces may be related to:

- **Informal Learning Activities (ILAs)** gathered by each user or the organization, including specific information about the activity (URL, title, content, comments) and the competences associated to the activity.

- **Information about competences associated to a user or the organization.**

This information about the competence includes data such as the ID in the catalog, if it is associated to an ILA –and to which ILA–, the associated working areas, the last time it was used or accessed, etc.

- **Information about the nature of the relation of the users with the organization**.

- **Information about competences, working areas and tags,** which includes competence names, associated tags, associated working areas, types of competences (general, organizational, user-defined), whether the competence needs validations or not, etc.

All this information may be used for decision making at personal and organizational levels. However, in order to make it easier this process, it may be helpful to have this information shown in a more convenient way for managers and other agents involved in decision making.

In this sense, the information might be presented in several ways:

- **Text-based.** This is the traditional way to show information, be it as a list, a table or just a number. For example, decision makers might have the need to see a list of the employees who published to have achieved a specific competence through some informal training activity, and this information would be shown textually as a list with links to the information of the ILAs.

- **Chart-based.** For example, by using the Google API Chart. Some information may be presented in a chart so that managers may have, at a glance, useful information. An example of this may be the number of organizational, user-defined and general

competences used by the learners/workers (Figure 4) to classify their work. If employees are not selecting any organizational competence, this might mean that their informal training is not properly focused or that the training strategy of the organization is not clear.
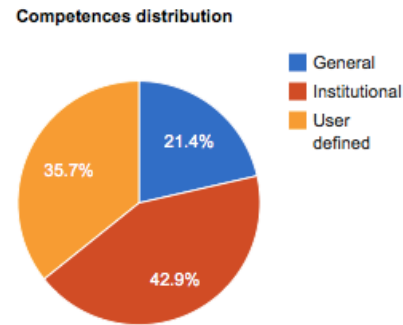

Figure 3. – Competences distribution chart

- **Data visualization techniques.** This includes advanced visualization shows, such as tag clouds. Tag clouds (Figure 4) may give a quick and "eye candy" insight of the competences used by the workers in their informal training, so that it might possible to see which is the most popular for them at a glance.

Figure 4. – Tags tagcloud for a worker/learner

4. Evaluation

As mentioned before, the research methodology has been empirically implemented as a proof of concept in the TRAILER project. The main components (the competence catalog, the organizational environment, ILC and portfolio) were developed and have been integrated in the

system. All of these components are to be tested through two pilot actions –one focused on the users (workers) and the other on the organization–. But before these tests are carried out, it was necessary to check if the system really facilitates the dialog between employees and the organization, and therefore the subsequent decision making process, and what design errors might arise that would have to be corrected before the pilots and final release of the system.

In order to do so, several scenarios were considered and tested. The methods for testing include different techniques. Thus, a Cognitive Walkthrough (CW) (Polson, Lewis, Rieman, & Wharton, 1992) has been used to explore the scenarios within the project and the potential experience of completing project tasks in an early prototype of the system. The CW results have been complemented with a Think Aloud (TA) technique (Lewis, 1982). Screen and voice-capturing software were used to support these methodologies.

In addition, surveys were used to gather the users' perception of the system, and a System Usability Scale (SUS) form (Brooke, 1996) was delivered to assess the final user satisfaction, and Perceived ease of use (PEOU) was also measured following Venkatesh and Bala's adaptation of TAM, TAM3 (Venkatesh & Bala, 2008).

Finally, system testers had to answer some open questions which were used for a qualitative evaluation. The answers of the text have been analyzed classified depending on the topic of the answer; results are shown in two matrixes and conclusions are extracted from that information (Miles & Huberman, 1994).

From all these techniques, some interesting results were extracted. For instance, 58 moments or breakdown were identified and classified according to Nielsen's severity classification, none of which were associated to the DSS. The SUS survey returned a result of 49,6 percent, far from the 68 percent recommended satisfaction levels. PEOU returns an average of 4 (neutral value). These values are not desirable, but are normal for a proof of concept.

Regarding the DSS, specific information was retrieved from the answers of experts to the open questions. This information was analyzed in a qualitative way, with the opinions classified in three different categories: "easy to understand", "usefulness" and "improvement suggestions".

As for the question asking if the DSS provided easy to understand information, several of the experts suggested that more tips and options were needed, while other thought that the system was quite straightforward so it was easy to use and others suggest the need for more training in the use of the tool in order to assess the potential of the system. This might be solved by celebrating workshops focused on system use before the organization begins the implementation stage.

Most of the experts found the system useful for decision making, while a minority considered that there are too many data and it is not easy to understand. This implies that, while for most organizations it is desirable to have lots of data available at a glance, others may need very specific information about competences, informal activities, employees, etc.

Finally, experts were asked for ways to improve the system. Several suggestions were made related to the inclusion of more options, or a

wizard for data interpretation, new kinds of representations and more info about the data shown. This fact highlights the need for new and more filters so that the information shown reaches high levels of customization.

Following this discussion, it becomes evident that for most of the experts the information given by the DSS is easy to understand, although it would be convenient to include more training for decision makers and users, as well as better explanation of its features and functionalities. DSS then are useful in informal learning settings but some of the experts consider that there should be less information available.

It is noteworthy that, for future successful implementations of such systems, each organization may define very specific indicators and presentations of data based on their needs. Then, it would be possible to define a scalable system of atomic indicators that the user of the DSS may combine to satisfy their needs. In this way, the DSS can fulfill the needs of each organization regardless the way in which the methodology is implemented.

5. Conclusions

In this paper we have presented a methodology for decision making based on informal training, as well as the technological framework necessary to support it. The methodology aims to facilitate knowledge management both for employees and for organizations. Based on this framework, employees would be able to identify and classify the different informal training activities they carry out in their everyday life outside the organization, and then make it visible for the organization, which might use this information for making training-related decisions. In addition the framework allows organizations to begin a dialogue with employees about the knowledge they are acquiring and their training needs, and use this information to formulate or evaluate the organizational strategy. The methodology has been implemented as a proof of concept during the TRAILER project, and several findings related to the potential use of the system for decision making have been found.

As a conclusion, it can be said that by applying this methodology it is possible to manage knowledge achieved from informal evidences. However, each organization has different needs and requires different information to use as input for decision making. This implies a need to redefine the DSS in order to be able to work with atomic indicators which can be combined to satisfy the organizations information needs. It is also necessary to be able to easily create new indicators to solve specific organizational needs.

In this direction, future lines of work would be directed towards the reorientation of the DSS. In addition, the different breakdowns detected will be addressed before the beginning of the project pilots, and more feedback is expected from those activities, which will be analyzed and used for further improvements of the system before final implementation.

References

Adell, J. & Castañeda, L. (2010). Los Entornos Personales de Aprendizaje (PLEs): una nueva manera de entender el aprendizaje. In R. Roig Vila & M. Fiorucci (Eds.), *Claves para la investigación en innovación y calidad educativas. La integración de las Tecnologías de la Información y la Comunicación y la Interculturalidad en las aulas. Stumenti di ricerca per l'innovaziones e la qualità in ámbito educativo. La Tecnologie dell'informazione e della Comunicaziones e l'interculturalità nella scuola.* Alcoy, Spain: Marfil – Roma TRE Universita degli studi.

Ajjan, H. & Hartshorne, R. (2008). Investigating faculty decisions to adopt Web 2.0 technologies: Theory and Empirical Tests. *The Internet and Higher Education, 11*(2), 71-80.

Attwell, G. (2007a). e-Portfolios – the DNA of the Personal Learning Environment? *Journal of e-Learning and Knowledge Society, 3*(2), 39-61.

Attwell, G. (2007b). The Personal Learning Environments - the future of eLearning? *eLearning Papers, 2*(1), 1-8.

Berlanga, A. J., Sloep, P. B., Brouns, F., Bitter-Rijpkema, M. E. & Koper, R. (2008). Towards a TENCompetence ePortfolio.

International Journal of Emerging Technologies in Learning, 3, 24-28.

Bjornavold, J. & Coles, M. (2008). Governing education and training; the case of qualifications frameworks (Vol. 42/43, pp. pp.203-235). Thessaloniki: CEDEFOP.

Brooke, J. (1996). SUS: A Quick and Dirty Usability Scale. In P. W. Jordan, B. Thomas, B. A. Weerdmeester & I. L. McClelland (Eds.), *Usability Evaluation in Industry*: Taylor & Francis.

Casquero, O., Portillo, J., Ovelar, R., Romo, J. & Benito, M. (2008). *iGoogle and gadgets as a platform for integrating institutional and external services*. Paper presented at the Mash-Up Personal Learning Environments - 1st Workshop MUPPLE'08, Maastricht, The Netherlands.

CEDEFOP. (2009). *European guidelines for validating non formal and informal learning* Luxembourg: Office for Official Publications of the European Communities.

Chatti, M. A., Agustiawan, M. R., Jarke, M. & Specht, M. (2010). Toward a Personal Learning Environment Framework. *International Journal of Virtual and Personal Learning Environments, 1*(4), 66-85. doi: 10.4018/jvple.2010100105

Coombs, P. H. (1985). *The World Crisis in Education: A View from the Eighties.*: New York: Oxford University Press.

Dale, M. & Bell, J. (1999). *Informal learning in*

the workplace: Dept. for Education and Employment.

Dewey, J. (1938). *Experience and Education*. New York: Touchstone.

European-Union. (1999). *Towards the European Higher Education Area*. Conference of Ministers responsible for Higher Education in 29 European countries, Bologna, Italy:

Fielding, R. T. (2000). *Architectural styles and the design of network-based software architectures.*, University of California, Irvine.

García-Peñalvo, F. J., Colomo-Palacios, R. & Lytras, M. D. (2012) Informal learning in work environments: training with the Social Web in the workplace. *Behaviour & Information Technology, 31*(8), 753-755.

García-Peñalvo, F. J., González-González, J. C. & Murray, M. (2012). MyElvin: A Web-Based Informal Learning Platform for Languages Practice. *International Journal of Knowledge Society Research, 3*(1), 26-39.

Hager, P. (1998). Recognition of informal learning: challenges and issues. *Journal of Vocational Education & Training, 50*(4), 521-535. doi: 10.1080/13636829800200064

Halliday-Wynes, S. & Beddie, F. (2009). *Informal Learning. At a Glance*. Adelaide, Australia: National Centre for Vocational Education Research Ltd.

ISCO08. (2012). International Standard Classification of Occupations. In I. L. Office (Ed.), (Vol. 1). Geneva.

Knowles, M. S. (1950). *Informal Adult Education*: New York: Association Press. Guide for educators based on the writer's experience as a programme organizer in the YMCA.

Lewis, C. H. (1982). Using the "Thinking Aloud" Method In Cognitive Interface Design.
Miles, M. B., & Huberman, A. M. (1994). *Qualitative Data Analysis: An Expanded Sourcebook*: Sage Publications.

Otero, M. S., McCoshan, A. & Junge, K. (2005). European Inventory on Validation of non-formal and informal learning. Birmingham: ECOTEC Research and Consulting Limited.

Polson, P. G., Lewis, C., Rieman, J. & Wharton, C. (1992). Cognitive walkthroughs: a method for theory-based evaluation of user interfaces. *Int. J. Man-Mach. Stud., 36*(5), 741-773.

Venkatesh, V., & Bala, H. (2008). Technology Acceptance Model 3 and a Research Agenda on Interventions. *Decision Sciences, 39*(2), 273-315. doi: doi: 10.1111/j.1540-5915.2008.00192.x

Watkins, K. & Marsick, V. (1990). *Informal and incidental learning in the workplace.*: London: Routledge.

Werquin, P. (2010). Recognition of Non-Formal and Informal Learning: Country Practices: OECD (Organisation for Economic Co-Operation And Development).