HOW CAN ELECTRONIC PORTFOLIOS FACILITATE COLLABORATIVE PROBLEM-FINDING IN THE INNOVATION PROCESS?

Mikko Ahonen
University of Tampere, Hypermedia Laboratory
Kanslerinrinne 1, 33014 University of Tampere, Finland
mikko.ahonen@uta.fi

Antti Syvänen
University of Tampere, Department of Education
Ratapihankatu 55, 33014 University of Tampere, Finland
antti.syvänen@uta.fi

ABSTRACT

Problem-finding is a complex part of the innovation process. The growth path from motivation to an idea and finally to an innovation requires communication of different viewpoints. This research aims to answer how mobile learning tools could facilitate creativity by supporting both individual reflection and collaboration around ideas. The use of portfolios and web logs in this context is discussed. A mobile portfolio artifact is introduced and the building process is described using design research framework. Data from an SME case is provided to illustrate practical requirements. The discussion part illuminates some confidentiality and trust related issues.

KEYWORDS

Innovation process, creativity, learning, electronic portfolio, collaborative learning, weblog.

ACKNOWLEDGEMENTS

We hereby thank Professor Pertti Järvinen (University of Tampere) for valuable comments.

1. INTRODUCTION

When McAdam and McClelland (2002) made a survey of published creativity and innovation process literature, their finding was that the idea generation literature tended to focus on the mechanics of idea generation to the detriment of the underlying knowledge creation philosophy.

The original interest behind this research lies in motives and interests of actors which participate the innovation process. “Motivation that stems from the individual’s personal involvement in the work is crucial for high levels of creativity in any domain” (Amabile, 1999, 297). Creativity is the ability to produce work that is both novel (i.e. original, unexpected) and appropriate (i.e. useful, adaptive concerning task constraints) (Sternberg and Lubart, 1999).

Motivation is also linked to interests and problem finding, as Csikszentmihalyi (1996, 53) notes: ”Without a good dose of curiosity, wonder, and interest in what things are like and in how they work, it is difficult to recognize an interesting problem”. So, how does authors’ earlier work match these challenges?

One of the authors has built a creativity support tool for the innovation process. Early findings from an SME (small and medium-sized enterprise) case suggest that interests and their reflection processes should be supported and mobile tools have potential in this area (Ahonen 2005). Ahonen and Murto (2004) have inspected electronic portfolios and their conclusion was that especially the evaluation phase is challenging when innovation process is integrated in the use of electronic portfolios. Korhonen *et al*. (2006) have inspected how the individuals could be able to manage the manifold experiences of education and the career into a whole with the help of electronic portfolio tools. The time management and lifelong learning issues have emerged. The section 2 will next illustrate the design research framework. The section 3 will illuminate the role of creativity in the innovation process. In the section 4 the challenges of developing tools to support creativity and problem-finding are shown. In the conclusion section and in the whole article the novelty and value of electronic portfolios and weblogs are discussed in a corporate innovation process setting.

2. METHODOLOGY

Design means "to invent and bring into being". Thus, design deals with creating something new that does not exist in nature. Design research can be seen as set of analytical techniques and perspectives that complement positivist and interpretive perspectives. Design research involves the analysis of the use and performance of designed artefacts to understand, explain and very frequently to improve on the behavior of aspects of Information Systems (Vaishnavi and Kuechler, 2004).

Research question here is: how to build an integrated electronic portfolio-innovation management artifact. From this starting point the authors build various mobile prototypes, evaluate them and gradually improve them using a design science research framework (Hevner *et al.* 2004, Järvinen 2004). Other research outputs of authors' building process will include improved models and design rules. The design science research framework used in this research is fundamentally a problem-solving paradigm. Design science seeks to create an innovation that defines the ideas, practices, technical capabilities and products through which the analysis, design, implementation, management, and use of information systems can be effectively and efficiently accomplished (Hevner *et al.*, 2004). These need to be constructed with scientific rigor and practical relevance in mind to create a functional architecture and a tool to support earlier described creativity, learning and problem solving processes. The utility of the prototype is evaluated in three case organizations (an SME, a global company and a faculty). The evaluation has proven challenging: usability of the artifact can be rather easily evaluated, but the novelty of ideas processed through the artifact is difficult to evaluate. Evaluating motivation as a basis of creativity is similarly challenging as Work Preference Inventory WPI has shown (Amabile *et al.*, 1994). Therefore, next our focus will be on those resources that can support creativity, not in the individual characteristics of individuals.

3. CREATIVITY IN THE INNOVATION PROCESS

Creativity is often seen as the generation and emergence of new ideas. It is thinking outside the box, coming up with novel ideas through divergent, tangential thinking. Conversely, innovation is turning ideas into products, services and processes. (Couger, 1995) The following figure illustrates creativity as an integral element in the whole innovation process.

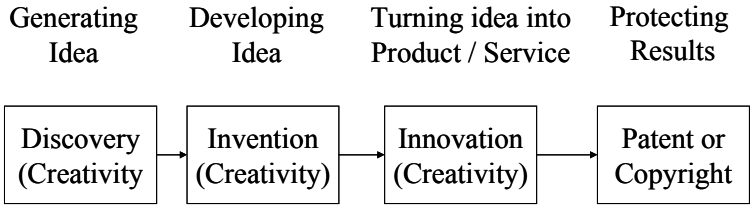

Figure 1. Creativity in the innovation process (Couger, 1995)

These macro-level phases by Couger can be broken down to even smaller micro-level particles. Creative Problem Solving (CPS) is originally based on work of Wallas (1926) and Osborne (1963) and is related to applied imagination. CPS means a step-based approach to define a problem and find solutions to it. Treffinger and Isaksen (1992) have for example defined a 6-phase category, which are illustrated below:

CPS phase	**Process examples**
1. Mess-finding	Identifying and selecting a broad goal.
2. Data-finding	Many general goals or starting points for problem solving are considered.
3. Problem-finding	An effort to identify all the possible problem statements and then to isolate the most important or underlying problem.
4. Idea-finding	An effort to identify as many solutions to the problem statement as possible.
5. Solution-finding	Ideas are selected, analyzed, or developed through the use of possible criteria and application tools.
6. Acceptance-finding	Making every effort to gain acceptance for the solution, determine a plan of action, and implement the solution.

Table 1. Creative Problem Solving (CPS) phases with electronic portfolio and weblog examples.

When an artefact which is e.g. a mobile tool is built to support innovation process, authors see that all these CPS phases should be supported. In our SME case the users requested proper process for idea management because many ideas were discussed in meetings, but there were no means to systematically advance ideas to the level of innovation. Therefore, CPS phases can provide this kind transition. The question here is how these individual-based CPS phases can also support motivation. Therefore, next will be illustrated one specific creativity model with strong motivational emphasis.

Amabile's (1983) componential theory of creativity proposes that anyone of normal capability can be creative, and that the work environment influences the level and frequency of this creativity.

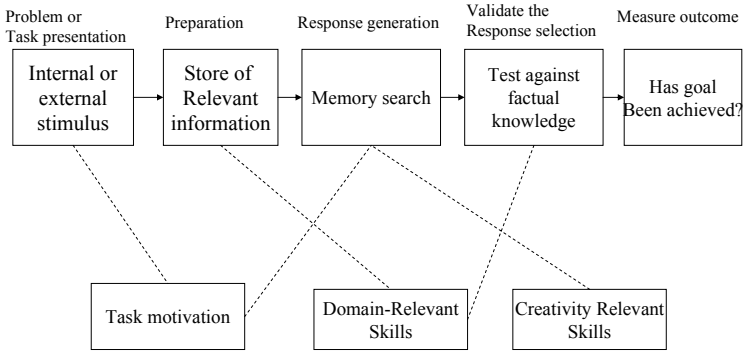

Figure 2. Componential theory of creativity (Amabile, 1983)

In the picture above there are three components that affect individual creativity: Domain relevant skills (expertise), creativity relevant skills and task motivation. Task motivation means both intrinsic and extrinsic motivations. In our case interests and related ideas are part of intrinsic motivation. The picture also includes a problem-solving cycle. This cycle provides a more structured view than the CPS view in figure 1.

The componential model of creativity (Amabile, 1983) suggests that creativity will be highest in that area where the three components share their greatest overlap with the individual's strongest intrinsic interests and creative-thinking processes.

The assumption that creativity is a natural, human resource leads to the educational practice of dealing with the concept in three basic ways. The applications include weaving creativity into the existing curriculum, teaching creative thinking and problem solving skills directly, and using creativity in the process of planning for learning. (Isaksen, 1989, 173) The third element, 'using creativity in the process of planning for learning' seems to us suitable, when creative problem-solving tools and work of creativity are integrated into a portfolio. Next portfolios and weblogs are described in detail with definitions.

4. BLOGS AS PORTFOLIOS FACILITATING CREATIVITY AND LEARNING PROCESSES

A digital portfolio or ePortfolio is a collection of learner's work that can include text, pictures, hyperlinks and different multimedia elements. It has a certain navigation structure, which makes it easy to the learner to show the contents of the portfolio. Initially the idea of the portfolio or digital portfolio is to simply look at the learner's working and learning process rather than the final grade (Niguidula, 1993). The digital portfolio displays an exhibition of individual work: efforts, project and achievements in certain areas (Wiedmer, 1998). It can be defined as a collection of learner's work that demonstrates achievement or improvement (Barrett, 1994).

Kankaanranta and Linnakylä (2002) see digital portfolios as vehicles of reflecting and communicating the knowledge of individual to group and organization. As Dewey (1939) already put it: "We do not learn from experience, we learn from reflecting on experience." Therefore we have had interest on latest electronic portfolio and lifelong learning organiser (Vavoula, 2004) research and utilised these research results while building our prototype further. Vavoula and Sharples (2002) introduced criteria for a lifelong learning organiser (LLO). Their criteria can be seen from the authors' point of view as one sort of utility of usability criteria: 1) A LLO should be easily transferable between places: it should be either implemented on a device that is easy to carry and use around, or it should be designed so as to run on a single computer system and be accessed remotely, via any system. 2) LLOs should be available and functional anytime, during any day of the week. 3) LLOs should provide a smooth transition between learning topic areas and support the user to construct meaningful, integrated knowledge. (Vavoula et al., 2002) Furthermore, Vavoula (2004) has demonstrated this LLO criteria in connection to organising learning from activities to episodes and finally to projects. These requirements are very appropriate in authors' building work.

Kainulainen et al. (2004) were among the first to introduce a problem-solving tools included in a portfolio: Their main function of a problem solving tool was to give students a fresh stimulus for processing the occurring problems. Below is described a set of tools they used in their portfolio.

The Problem-Solving Tool	Explanation
Random Thinking Models Page	Random Thinking Model Pages provide a random stimulus for learners' to associate new perspectives on acute problems. The web is used as a repository of seeds to associate with. Tool is implemented by giving a link to a new web page. Standard web search engines do the search by randomly picking a seed word. The tool can be modified to use words that are distantly or closely related to the problem. At the different phases of the problem-solving process there might be a need for a different type of stimulus.
Question Lists	Question Lists are standard problem solving methodology. With the questions lists the system can irritate the students to think about their problem from different perspectives. Question List function includes several categories of predefined question lists.
BruteThink Tool	BruteThink tool gives problem solver a fixed word to work with. The idea is that the student should relate the problem with the word. By using different viewpoints, the student can process the step from various perspectives. BruteThink allows skipping the given word and ask for another to get new insight.

Figure 3. Elements of the Problem Management Assistant (Kainulainen et al., 2004)

In overall the above mentioned tools are based on divergent thinking versus convergent thinking metaphor. These in turn are linked to biological bases of creativity: the left and right hemisphere of brains activation (Guilford, 1953). This division has also been criticized (Sternberg and Lubart, 1999).

One of the authors did not have resources to integrate very sophisticated tools into the prototype. Therefore, the Question List approach was used. The manager in the SME case pointed out that business requirements and related question lists could guide the problem-definition and solving phases. This would also maximize the fit of ideas to corporate strategy (Ahonen, 2005).

Electronic portfolios can be integrated or built on other technologies, like weblogs (blogs). The use of weblogs that started as writing on-line diaries has in the recent years taken new forms. Wikipedia on-line encyclopedia (2006) presently has the following definitions for weblogs:

> "A weblog (now more commonly known as a blog) is a web-based publication consisting primarily of periodic articles (normally in reverse chronological order). Although most early weblogs were manually updated, tools to automate the maintenance of such sites made them accessible to a much larger population, and the use of some sort of browser-based software is now a typical aspect of "blogging". (Wikipedia, 2006)

Blogs have been considered to be a new hybrid of web pages and web forums in which the use of different media elements (text, pictures, animations, video clips) is combined with the dialogical nature of web forums. The RSS (Really Simple Syndication, an XML dialect) offers a possibility to use blogs also as aggregators of information or as Wijnia (2005) sees them as "communication hubs", offering readers multiple communication channels to choose from to enter into conversation and participate in or start a discourse.

What user requirements have come up concerning the information system? Within the first case (SME) users expressed the need for ad-hoc idea input and related data gathering on the road. Therefore, mobile java (J2ME) clients were constructed with support for off-line functionality. Surprisingly, users in the SME case indicated that many ideas come up collaboratively in meetings and unofficial discussions. This was contradictory to original assumption about individual origin of ideas and the prototype was altered to support group problem definition tasks. Within the other case (global company) users requested that the prototype should be functional also for users who are not used to type with their mobile phones.

Therefore, idea gathering in picture format will be enabled through camera-phones and only indexing words will be added. The global company emphasised multi-device support, therefore browser access through PCs and Macs will have different functionality than J2ME access through mobile phones. An open issue is how RSS-readers could be implemented *inside* mobile java clients. (Ahonen, 2005)

The following architecture has been implemented based on user feedback:

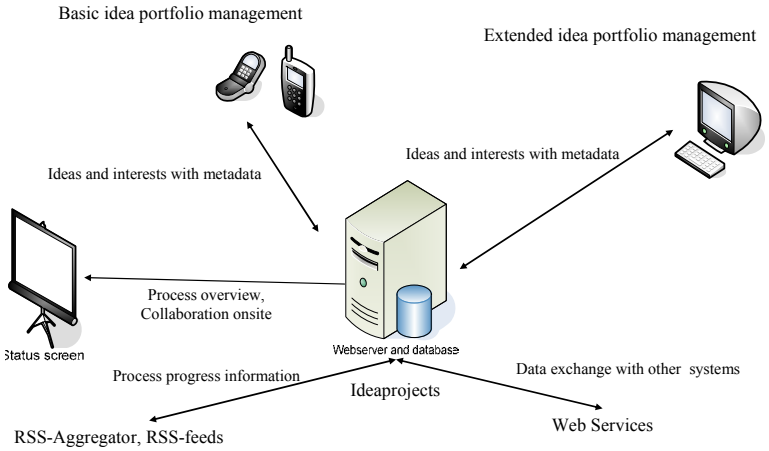

Figure 4. The artifact and the architecture. (Ahonen, 2005)

In the figure above the portfolio is actually a collection of weblogs and other media elements. The word portfolio was not very familiar in the business context, therefore in the SME case the system was called idea and interest management system. Learning was associated in collaborative knowledge-creation (Ahonen, 2005).

How is work-based learning related to creativity and use of portfolios? Marsick and Watkins suggest three personal characteristics which, if present, make work-based learning more likely, or may enhance it. These are:
(1) Proactivity - a readiness to take the initiative in situations. (2) Critical reflection - a tendency to reflect, not just on events, but on underlying assumptions. (3) Creativity - to enable a person to think beyond their normal point of view. (Marsick and Watkins, 1990)

The terms 'informal learning' and 'mobile learning'seem to be more suitable here than the term 'work-based learning'. The reason is that learning that supports creativity takes place often outside work settings. The facilitating of informal learning is, however, difficult. Livingstone (2000, 54) sees major challenges in recognizing incidentally initiated learning and irregularly timed learning. According to Nyiri (2002) there seems to be two dominant approaches to mobile learning with consequences to the design of mobile learning application. The first points out that since the dominant mode access to the Internet will soon be through wireless devices, e-learning simply becomes m-learning, without any remarkable changes in content. The second approach stresses that mobile learning will characteristically aim at specific kinds of knowledge, namely knowledge that is location-dependent and situation-dependent. (Nyiri, 2002)

When thinking about groups, within collaborative learning individuals often learn better by co-operating with others than they would on their own. (Cheetham & Chivers, 2001). Eraut et al. (1997) suggest that this results from a combination of observation, consultation, mutual exchange of information and a process of osmosis. Hargadon (2002, 58) describes these four distinct activities: (1) learning about the existing resources of each new domain; (2) learning the related problems in that domain; (3) learning what others in their own firm know and (4) learning how to learn. This example is a business specific and it illustrates that learning process needs to be integrated in the problem-finding and problem-solving processes.

5. CONCLUSION

The traditional evaluation view of electronic portfolios requires a second thought when electronic portfolios are inspected within the innovation process (Ahonen and Murto, 2004). Amabile has radically claimed that "Evaluation kills creativity (Amabile, 1998, 77). Portfolios have traditionally been a vehicle for evaluating outcomes and performance. When electronic portfolios are used as collections of findings and idea seeds, timeframe is longer. As Hargadon and Sutton (1997, 717) put it: "Valuable solutions seldom arrive at the same time as the problems they solve, they seldom arrive to the people working on those problems, and they seldom arrive in forms that are readily recognizable or easily adaptable." For this reason, oversimplified evaluation phases may destroy the growing idea seeds. The electronic portfolio literature has focused on educational setting while authors here inspect corporate innovation process. Therefore, generalizations should be avoided in this context. The ownership and transferability of an electronic portfolio is also problematic, the user might wish to utilize electronic portfolios for lifelong learning, while employer would like to have closed, corporate specific electronic portfolio and blog platforms. This ownership issue has a direct link to the portfolio maintenance and blog writing motivation. An independent authority that could provide electronic portfolios and blogs for corporate settings might prove useful in the future.

The introduced Creative Problem Solving (CPS) phases have also met critique. Sternberg and Lubart (1999, 6) saw that CPS or pragmatic approaches "lack any basis in serious psychological theory, as well as serious empirical attempts to validate them". When authors continue their work, the problem-finding and problem-solving phases in the research cases (Ahonen, 2005) need to be observed more thoroughly. The motivational and curiosity related aspects (Olson 1986, Byman 2001) need to be investigated. More data and structured interviews need to be gathered. It will be interesting to see if electronic portfolios and weblogs can provide, not only technical, but mental tools to illuminate these problem-finding and knowledge creation processes in the future.

REFERENCES

Ahonen, M., 2005. Building a Ubiquitous Artifact that Integrates Problem-Solving and Learning Processes to Support Creativity. In Sorensen, C., Yoo, Y., Lyytinen, K. & DeGross, J. I. (Eds.) *Designing Ubiquitous Information Environments: Socio-technical Issues and Challenges,* Springer, USA.

Ahonen, M. and Murto, H., 2004. Building a Digital Portfolio that Supports Informal Learning, Creativity and Mobility - A Design Science Viewpoint. *Eportfolio 2004 conference Proceedings*. La Rochelle, France.

Amabile, T., 1998. How to kill creativity. *Harvard Business Review*. September-October 1998, pp. 77-87.

Amabile, T., 1983. *The Social Psychology of Creativity*. Springer Verlag, USA.

Amabile, T., Conti, R., Coon, H., Lazenby, J. & Herron, M. 1996. Assessing the work environment for creativity. *Academy of Management Journal*. Vol. 39, No. 5, pp. 1154-1184.

Barrett, H., 1994. Technology Supported Assessment Portfolios. *The Computing Teacher*, Vol. 21, No. 6, pp. 9-12.

Byman, R., 2001. *Curiosity and exploration: A conceptual overview and structural modeling*. Research in Educational Sciences 5. Finnish Educational Research Association, Turku, Finland.

Cheetham, G. and Chivers, G., 2001. How Professionals Learn in Practice: an Investigation of Informal Learning Amongst People Working in Professions. *Journal of European Industrial Training*, Vol. 25, No. 5, pp. 248-292.

Couger, J. D., 1995. *Creative Problem Solving and Opportunity Finding*. Boyd and Fraser Publishing Company, USA.

Csikszentmihalyi, M., 1996. *Creativity: Flow and the Psychology of Discovery and Invention*. Harper Collins, USA.

Dewey, J., 1939. *Theory of Valuation*. University of Chicago Press, Chigaco, USA.

Eraut, M. et al, 1997. Development of knowledge and skills in at work. in Coffield, F (Ed.) *Differing visions of a Learning Society*, Policy Press, Vol. 1, pp. 231-262

Hargadon, A. & Sutton, R. I. 1997. Technology Brokering and Innovation in a Product Development Firm, *Administrative Science Quarterly*, Vol. 42, pp. 716-749.

Hevner, A.R., 2004. Design Science in Information Systems Research. *MIS Quarterly*, Vol. 28, No 1, 75-105.

Isaksen, S. G. 1989. Educational Implications of Creativity Research: An updated Rationale for Creative Learning. In: Gronhaug, K. & Kaufmann, G. (Eds.) *Innovation: A cross-disciplinary perspective*. Norwegian University Press. Oslo, Norway.

Järvinen, P. 2004. *On Research Methods*. Opinpajan kirja, Tampere, Finland.

Kainulainen V., Suhonen, J., Suhonen, E., Goh and Kinshuk 2004. Mobile Digital Portfolio Extension. In. Roschelle, J., Chan, T. W., Kinshuk & Yang, S. (Eds.) *Proceedings of the 2nd IEEE International Workshop on Wireless and Mobile Technologies in Education*, Los Alamitos: IEEE Computer Society, pp. 98-102.

Korhonen, V., Kohonen, V., Tolkki, L., Syvänen, A. & Ahonen, M. 2006 Forthcoming. Life-wide Professional Learning: ePortfolios and weblogs Bridging Education and Work Life. In Linnakylä, P. , Kankaanranta, M. and Kaisto, J. (Eds.) Perspectives of ePortfolios. University of Jyväskylä, Jyväskylä, Finland.

McAdam, R. and McClelland, J. 2002. Individual and team-based idea generation within innovation management: organisational and research agendas. European Journal of Innovation Management, Vol. 5, Issue 2, pp. 86-97.

Mumford M.D., Scott G.M., Gaddis B. and Strange J.M. (2002). Leading creative people: Orchestrating expertise and relationships. The Leadership Quarterly 13, pp. 705–750.

Olson, E., 1986. Measurement of curiosity in junior high school students. Unpublished doctoral dissertation, Iowa State University, Iowa, USA.

Sternberg, R. J. and Lubart, T.I., 1999. The Concept of Creativity. In Sternberg, R. (Ed.) *Handbook of Creativity*. Cambridge University Press.

Treffinger, D.J. and Isaksen, S. G., 1992. Creative problem solving: An introduction. Center for Creative Learning, Sarasota, USA.

Vaishnavi, V. and Kuechler, W., 2004. Design Research in Information Systems. http://www.isworld.org/Researchdesign/drisISworld.htm. Visited : 13th March 2006.

Vavoula, G. 2004. KLeOS: A Knowledge and Learning Organisation System in Support of Lifelong Learning. Doctoral dissertation. University of Birmingham.

Wijnia, E. (2005). The Educational Potential of Weblogs. elearningeuropa.info http://www.elearningeuropa.info/index.php?page=doc&doc_id=6145&doclng=6&menuzone=0&focus=1. Visited : 13th March 2006.

Wikipedia (2006) Weblog –definition. http://en.wikipedia.org/wiki/Weblog .Visited: 13th March 2006.