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Abstract

This paper proposes a new approach to engaging and stimulating users in the requirements analysis process when developing a new information system – an ICT innovation for business. The approach is based on a synthesis of a constructivist learning theory and a creativity education theory. In contrast to previous approaches in which the systems analyst elicits requirements from the user, in the proposed approach, the user is engaged and stimulated to become a proactive and creative learner in the process of identifying and discovering their business problem as well as exploring opportunities to apply ICT innovations to solve the problem

Two experiential digital simulations are described as a proof of concept to demonstrate the proposed approach a learning environment. Learning from the case study suggests that both systems analyst and business users can be stimulated to be active learners in their discovery of problem, creative ideas and problem solutions in requirements elicitation and discovery.

Keywords: ICT innovation, user, constructivist learners, requirements analysis.

1 PROACTIVE USERS IN APPLYING ICT INNOVATIONS

1.1 Shaping ICT innovations during the requirements process

New technologies are rapidly introduced with a view to addressing the changing needs of individuals and organisations. As a result, they also present new opportunities for individuals and organisations to innovate and improve their business products, processes and life activities to create values, compete and reap potential benefits of technologies. Recently, creativity has become an emerging topic in research into requirements analysis. Various authors have argued that systems analyst should be creative as well as analytical in envisioning future business products, services and processes and discovering and developing the user's requirements (Robertson, 2005; Hoffmann et al., 2005; Maiden et al., 2006). Studies have been conducted to understand creativity in the requirements process (Nguyen and Shanks, 2006; Cybulski et al., 2003; Nguyen et al., 2000), to support the systems analyst's creativity during the requirements process (such as Maiden and Robertson, 2005; Blackburn et al., 2006; Regev et al., 2006; Schmid, 2006; Nguyen and Swatman, 2006), and to improve the systems analysis education and training (Armarego, 2004; Dallman et al., 2005).

We propose an alternative approach to promoting and supporting the user's creativity (as well as analyst's) in the requirements discovery and analysis process. First, users have rich knowledge and expertise in their application domain, hence, they should play a critical role in innovating their business products and processes in order for the ICT innovations to be useful and deliver value rather than become an obstacle in their business practice. Second, users have rich contextual, organisational knowledge, hence they should play a critical role on introducing ICT innovations which fit and will be adopted by them. Therefore, the requirements specification for a new information system should be a creative co-product of the collaboration between the systems analyst and users. In this paper, we describe the proposed approach and report findings from a simulated environment through a case study.

1.2 Requirements Elicitation and Requirements Discovery requiring an Activated User

Popular development methodologies, such as Structured Systems Analysis and Design Method (SSADM) (DeMarco, 1978; also described in Avison and Fitzgerald, 2003), Rational Unified Process (RUP) with Unified Modelling Language (UML) (described in Dennis et al., 2002; Kroll, 2003; Booch et al., 1999), Rapid application development (RAD) (described in Ramesh and Luqi, 1993; Dennis et al., 2004) often involve the user in requirements elicitation, an activity during the requirements engineering process. The systems analyst elicits requirements from the users and represents their real word problem. The problem representation becomes the basis for other systems development activities including analysis, modelling, designing, coding, testing, and so on. There exist different elicitation techniques, such as interviews, questionnaires, ethnographic observations, task analysis, prototyping and joint application development workshops. From the user's perspective there are two issues in promoting and supporting ICT innovations. First, with the exception of joint application development (JAD) (Carmel et al., 1993; Dennis et al., 2004) such elicitation techniques tend to treat the user as playing a rather passive role in describing and manifesting their problems and requirements embedded in their current business practice. The systems analyst takes a proactive role in gathering requirements from the users, analyses the requirements, and later validates them with the user. While JAP educates and promotes users and supports their collaboration with systems developers, the JAD process focuses on analytical skills in problem identification and representation which would become inputs for the systems analysts and systems developer to come up with an ICT enabled solution. Second, all these techniques vary in details, they tend to aim at describing and representing the current problem situation rather than forward thinking and inventing opportunities for future business practice (Robertson, 2005). Kaufmann (2004, p. 160) asserted proactive creativity as interesting and challenging as it refers to "envisioning a possible, desirable future state of affairs" and "proceeding through the gates of new and smart problem finding". Therefore, we contend that the existing elicitation techniques do not adequately engage and support the user in proactively identifying problems, envisioning future business practice and suggesting ICT innovations to solve problems and create values.

There has been a call for discovering and inventing the requirements in the systems development literature (Maiden and Robertson, 2005; Robertson, 2005). Recent studies (Maiden and Robertson, 2005; Schmid, 2006) suggested integrating creativity techniques, for example combinational creativity, domain analogy analysis, open brainstorming sessions, scenarios, Walt-Disney-Technique, and using a trigger list, within the requirements process. Nevertheless, the user's creativity in the requirements process has not been adequately researched and promoted.

To develop ICT innovations which deliver value and fit with the context of use, users need to be engaged - collaborative with the systems developers, proactive and creative in understanding problems, forward thinking to shape solutions and create opportunities. Indeed, recent social software applications and trends show that users are creative and collaborative: Wiki, Blog, SecondLife, Youtube, Facebook and SecondLife provide ample examples of user engagement with the community of developers - developers of systems, knowledge structures, information content and media artefacts. In these cases of social software and Web sites, the distinction between developers, knowledge owners and knowledge consumers has been dramatically blurred. The creation of artefacts on such Web sites can be characterised with emergent behaviour, collaborative effort and creative participation. Using the Wiki application, new topics are introduced to various public as well as corporate Wiki libraries as new knowledge needs emerge. Knowledge needs emerge as individuals, communities and organisations look into the past events, inventions, theories, biographies, search for solutions to current problems in different areas, health, education, engineering, etc, and search and collect information about current events, sports, or movies etc. Wiki's giant knowledge libraries, written in different languages and addressing different subject matters, grow continuously. These libraries are created and edited by their users - the creators, editors and the readers. Such library systems and their contents are creative and transform the classic concept of traditional libraries and in many different ways: development paths, presenting materials and stories in text, pictures, using and creating hyperlinks and references, multiple roles of the creators/editors rather than the interface between borrower and the librarian,… Facebook.com is another example of creative collaboration by users. Now and then, more and more new applications in Facebook are developed and added to address the evolving communication and interaction needs by the users: to share photos, to view photos in different ways, to share audio video contents, to support group building processes, to create and send growing gifts, to create and maintain social events, etc…. These applications show that engaging users in the construction of information systems leads to the emergent, collaborative and creative development effort.

Based on the above analysis of the current elicitation techniques and the creative potentials of the ICT user, we propose a new approach to engaging users and stimulating them during the requirements process. In the proposed approach, users play a proactive role in solving their problems and envisioning the desirable future business practice (and life activities), in collaboration with systems' analysts. The approach enables the user to experience technologies, enhances their problem solving, and stimulate them to learn and investigate their problems collaboratively and creatively.

2 CONCEPTUAL DEVELOPMENT

Considering recent development in social software, we forged a strong view that users no longer should be viewed as mere information (and requirements) sources but rather as active participants in the complex and continuous process of learning and information (and requirements) discovery. During the requirements process, the user describes, as well as, learns about their problem situation by developing awareness of the problem and by reflecting upon the issues surrounding the problem area. This learning process can be characterised with:

- Emergence. The emergence of the problem situation suggests that the requirements process itself is a learning process, more specifically, a constructivist learning process during which the leaner constructs his or her knowledge by structuring and reflecting upon the emergent problem (Gero, 1996; Schön, 1996; Armarego, 2004; Robillard, 2005).
- Collaboration. The problem in RE is of a technical as well as social nature (Conklin, 2005). The learning process takes place in a socio-organisational and collaborative context. Users

with a common passion, interest and needs come up with applications to share views/thoughts, videos/audios such as Youtube, MySpace, Napster, blogs, etc

- Creativity. Creativity plays an important role for the exploration, construction and expansion of the problem space. Indeed, creativity is defined as an internal process of exploration and transformation of the conceptual space in an individual mind (Boden, 1991; 1998).
- Domain specificity. Learning usually takes place in a specific domain. In this domain users learn about their problems, the problem context, and learn to discover solutions which are domain specific. For example, a retail outlet's employees and customers generate ideas and any improvements to the store's services in the complex domain of suppliers, products, prices, store shelves and display tables, shopping, payments and customer satisfaction (see the case study in the later section).

A constructivist learning theory and a creativity learning theory inform the emerging approaches to developing new types of information systems. This section therefore briefly synthesises these two theoretical foundations, i.e. Constructivist Learning (Vygotsky, 1978; Moshman, 1982) and Amusement Park Theoretical model for creativity education (Baer and Kaufman, 2005). The following paragraphs also propose to incorporate user's constructivist learning and creativity learning within the requirements process.

2.1 A Constructivist Learning Theory

Based on Piaget's theory (1950), the constructivist learning refers to the authentic and personal building up of knowledge. This knowledge building process occurs in the individual learner's mind through two mechanisms: assimilation and accommodation. Assimilation occurs when the learner interprets and incorporates new learning into an existing conceptual framework representing his or her knowledge of a topic area. Accommodation occurs when the learner could not fit the new learning into his or her existing framework, as a result he or she reframes (restructures) the existing conceptual framework. These two mechanisms are consistent with the structuring and restructuring activities in RE (Nguyen and Swatman, 2006). Vygotry (1978) stressed the important role of a combination of collaboration amongst learners (through which the learner receives feedback and coaching) and practical exercises (through which the learner constructs knowledge and gain skills). These underpinning theories of the constructivist learning were synthesized into the three dimensions of endogenous, exogenous, and dialectic constructivism (Moshman, 1982):

- Endogenous dimension: The learner learns through an individual construction of knowledge. Accommodation and assimilation are two mechanisms which enable the endogenous construction of knowledge. The teacher can play a facilitator role, but the learner takes on a more active role and ownership of his or her learning and building up of knowledge.
- Exogenous dimension: The learner learns from a combination of formal instructions and realistic and relevant exercises through which he or she refines knowledge through instructions and feedback received from the teacher when undertaking practical exercises.
- Dialectic dimension. The learner learns through collaboration and interaction with teachers (experts) and peers through realistic experiences. The scaffolding provided by the more capable collaborators is especially important.

Dalgarno (2005) developed a 3D learning environment which incorporated elements from the above three different dimensions of constructivist learning. His successful application of this learning environment in teaching chemistry encouraged us to pursue a rich RE learning environment in which the learner should be supported with elements from the above constructivism dimensions. The learning

should take place through a range of learning activities: knowledge acquisition from formal instructions, practical exercises and project-based realistic experiences, as well as, collaborative and individual construction of knowledge.

2.2 A Creativity Learning Theory

There has been an argument about whether creativity is a domain specific or domain general ability. There has been a strong view that creativity is inherently associated with a certain type of intelligence and that domain expertise is required to identify to which extend a creative product extends a domain knowledge boundaries (Gardner, 1993; Solomon et al., 1999). Therefore, creativity should be seen as domain specific and creativity education should be adapted to a specific domain. However, Root-Bernstein and Root-Bernstein (2004) argued that creativity should rather be seen as domain general because is inherently associated creativity with commonly intuitive and meta-cognitive capabilities, therefore creativity education should target intuitive and meta-cognitive learning. Baer and Kaufman (2005) argued that creativity includes both domain general as well as domain specific capabilities. They developed the Amusement Park Theoretical (APT) model for creativity education. Their APT integrates both domain general and domain specific creativity elements. Based on this theory, domain general creativity elements (intelligence, motivation and environment) as well as domain specific creativity elements (categorically through a general thematic area, to a domain and micro-domain) need to be supported. APT has been suggested as having potentials in creativity education in RE (Nguyen and Shanks, 2006) because it supports the inclusion of general creativity techniques and tools as well as specific application domain knowledge.

2.3 A Framework for Supporting Users during the Requirements Process

Having synthesized and adapted the above constructivism dimensions and APT theory to the requirements process, we proposed and created an environment capable of stimulating user creativity during requirements elicitation and discovery. Such an environment includes the support for constructivist learning which incorporates creativity learning for the user.

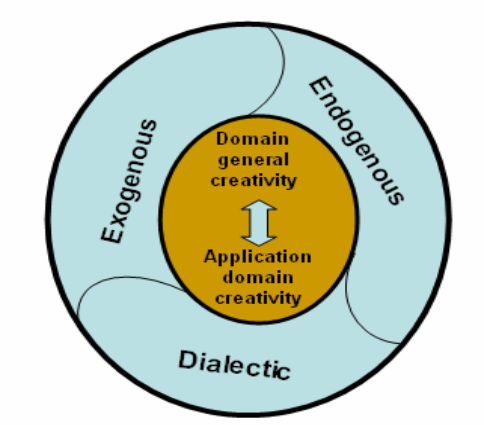


Figure 1. Incorporating user's creativity learning within constructivist learning

A number of distinct levels of (domain general and domain specific) creativity elements are integrated within the constructivist learning environment (see Figure). In terms of different constructivist dimensions, the approach includes:

- Endogenous learning elements. Users should be encouraged to reflect on their own knowledge, skills and expertise. Capture, preservation and transfer of users' prior experience may prove difficult without some formal training in critical problem solving and analysis, which may be provided and endorsed by the employer organisation. However, exposing users to situations, problems and issues commonly encountered by the users in their domain often triggers reflection and some response to problem-solving scenarios. Stimulating user imagination and creativity in this process assists requirements elicitation efforts by allowing users to search for and obtain domain expertise through an individual learning process. On-line or off-line simulation programmes may include knowledge of some business domain (banking and finance, healthcare, traffic management, engineering) and/or various requirements and business analysis processes and techniques.
- Exogenous learning elements. One of the most effective ways of triggering creative behaviour in users is to confront them with information outside their expertise, to break their entrenched dogmas and to force them into pursuit of new knowledge and insights. Stimulating workplace environment will commonly encourage workers to proactively search for knowledge and expertise through everyday work experiences, to seek feedback on and formal approval of newly acquired knowledge. Absence of such stimulation, however, is unfortunately common. Simulation of complex knowledge domains may provide opportunities for proactive knowledge seekers to further explore their inner realms. In requirements elicitation, such proactive users can be considered as naive analysts, and so access to expert analysts may be essential. Based on the feedback from expert analysts and their collaboration, the user should reflect on the knowledge received by applying the accommodation and assimilation mechanisms.
- Dialectic learning elements. Discussion and debate are an excellent ways of challenging users into re-evaluation of problem solving options, assessment of self-knowledge, peer learning, and of course speculation and reflection, and eventually assist generation of creative outcomes. The mere act of forming utterance, listening and observation assist verbalisation of tacit knowledge. Collaboration with peers and analysts leads to formalisation of skills and ultimately its transfer. To assist these phenomena, we suggest the construction of social mechanisms to facilitate peer interactions, which may occur in the real and virtual space. Ensuing, stimulation of user creativity in requirements elicitation and discovery should also support various forms of communication and collaboration, perhaps with the help of social software which can support formation of discussion forums, collaborative document creation with the use of Wikis, and reflection via blogs.

As different constructivism dimensions are integrated within our proposed environment, the learner needs to recognize them and take advantage of their integration.

In terms of adopting the APT theory (Baer and Kaufman, 2005), there are two levels of creativity in our proposed approach: general problem solving and domain specific creativity. At the level of general problem solving creativity, our proposed approach includes:

- Elements for building mental capacity and flexibility, such as problem understating and solving capabilities (for example problem recognition, strategy planning, idea generation and brainstorming, solution formulation and evaluation, etc).
- Elements for identifying and communicating motivations. Individual learner's motivations and learning objectives need to be identified and communicated with the teacher (or coacher) to align reward mechanisms to suite individual learning objectives and motivations.
- An environment to support collaboration and team creativity. This is in-line with the dialectic learning dimension. Social interactions and collaboration can be problem-based, project-based, within and cross team communication, and with facilitator(s). A combination of social software and face-to-face interactions can be used to facilitate electronic communication and

collaboration to allow the leaner to acquire social, communication skills (team building, negotiation, exchange of information, group collaborative support etc) and creative team processes (idea brainstorming, idea dissemination, and idea evaluation).

At the domain specific level, our proposed approach integrates:

- The business domain knowledge and skills. Creativity techniques and tools should be integrated to support the business user in generating creative ideas and to recognising and evaluating novelty and value of creative products within this specific domain, for example retailing, banking and finance, traffic management, healthcare and so on...
- Requirements elicitation, discovery and analysis. Creativity techniques, such as brainstorming, imagination, search for ideas, idea association, analogical thinking and play, as well as, the use of creativity tools will be integrated with various requirements activities including requirements discovery and elicitation, analysis, modelling and validation.
- Support for the user to enact the role of a *naive analyst* and learn through relevant experiences (small exercises, scenarios, case studies and projects) by exploring their existing knowledge, extending the horizons and creating procedures and instructions for the new solutions. In doing so, we engage the users to participate in domain specific *processes* (such as selecting goods at a retail store, payment or returns of unwanted items) and teach them participative analytic *techniques* (especially those used in meetings and workshops).

Our goal is to further develop and apply the proposed approach in a workplace learning environment to assist the business user in their proactive, collaborative and innovation participation in the requirements process and introducing ICT innovations to their business practice. At this stage, we apply the proposed approach in a University course delivery environment in which business and commerce students learn and apply ICT knowledge in shaping innovative solutions to various simulated business problems in their assignment projects. At the current theory building stage, a number of case studies take place to refine and extend the proposed approach. The next section will illustrate two cases in which creativity was incorporated within a constructivist learning approach demonstrated by students undertaking an introductory subject in various Bachelor degrees including management, commerce and IS. A quantitative evaluation of the proposed approach is beyond the scope of this paper.

3 STIMULATING CREATIVITY VIA SIMULATED CASE STUDY

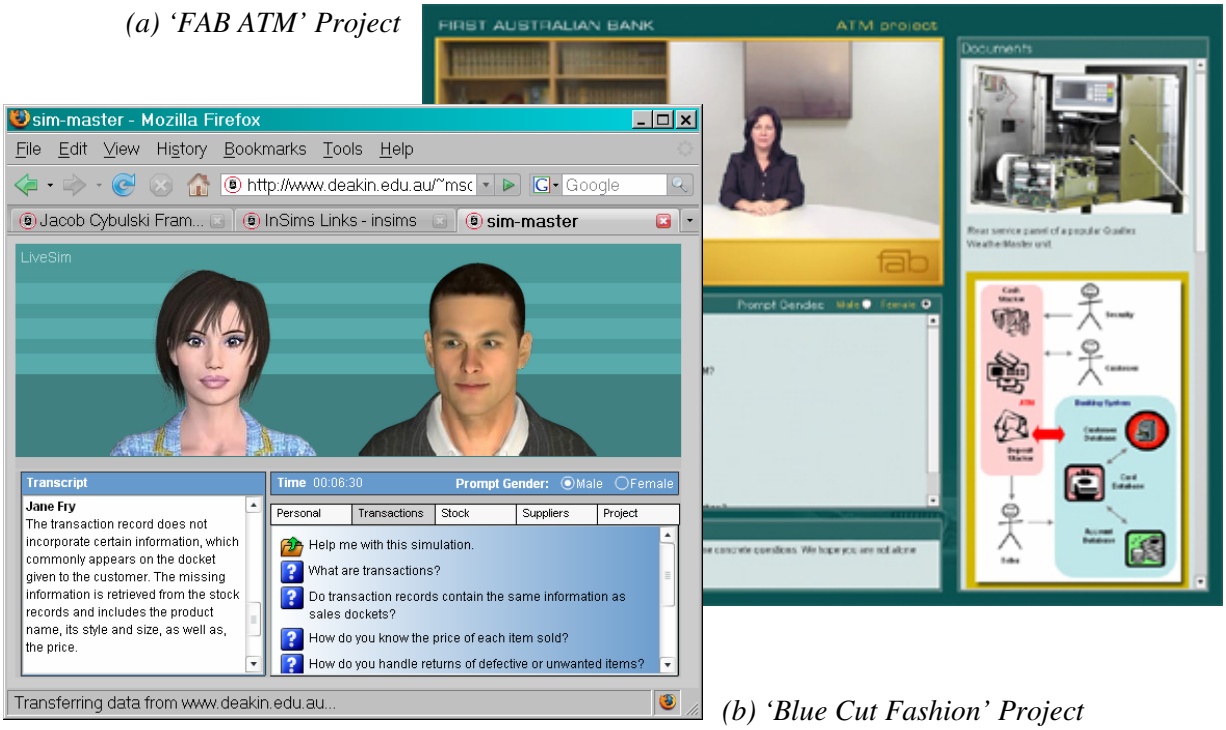
In our approach to stimulating creativity in users, we embraced a basic premise that flows from the constructivist view of the creative process (described above):

- In order to be creative, both analysts and users have to breach the boundaries of their past experience, knowledge and skills.
- In order to be creative, both analysis and users have to become learners in their application domain and in the domain of general problem solving.

We will illustrate these two points by describing two cases of analyst and user (naive analyst) training in requirements elicitation.

Case 1. Over the last few years, at Deakin University, we have been running a project-intensive course in requirements engineering at a post-graduate level. The subject was designed to provide students with authentic experience in discovering user requirements in business settings. Interviews, observation, analysis and specification of information systems requirements have been essential activities undertaken by the students. An innovative ingredient of our projects was reliance on a simulated virtual environment in which students could practice their ‘soft skills’ in questioning

simulated interviewees, observing their body language, applying different meeting strategies, and trying out alternative selection of business participants. They also have to collaborate with their real team members and with business participants role-played by the teaching staff. The essential ingredient of all these activities was student exploration, trial, error and correction - the elements which are impossible to replicate in real-life environment, such as work placement and practicum.



(a) 'FAB ATM' Project

(b) 'Blue Cut Fashion' Project

Figure 1. Sample screens of two student projects involving experiential e-simulations

In the initial years (2006-2008) of using simulated interviews, senior (post-graduate) students would take on the role of a requirements analyst investigating an extension to information systems in a bank (FAB ATM Project - see **Error! Reference source not found.**a). In their role, the students were involved in various requirements elicitation activities, analysing and specifying requirements, and then reporting the outcomes. All performed tasks had qualities of professional undertaking; while the virtual environment provided students with the safety of the university environment, it also offered them the excitement and engagement characteristic of games and role playing. In their roles, students viewed themselves as elicitation process experts and focussed their efforts on challenges in acquiring domain knowledge.

Case 2. This year (2008, Summer Semester and Semester 1), in addition to training analysts, we have also used a similar simulation to involve junior (first year) students in requirements analysis (via Blue Cut Fashion Project - see **Error! Reference source not found.**b). Most of them are commerce and management students. In this project, students are taking on the roles of *naive analysts* who reflect on their prior experience as consumers conducting business transactions (shopping) in typical business settings (fashion store). Subsequently, students are confronted with domain knowledge outside their immediate experience (both in business and technology domains) to provide them with both the requirements and some guidance for a simple development task (using Microsoft Excel). In their roles, students face problems and issues that are common for the modern user of social software (such as

Wikis, Blogs and SecondLife), i.e. they view themselves as domain experts and they usually struggle with the technology that will ultimately disseminate their domain knowledge.

The experience gathered in the process of running these two projects have important implications for the roles of analysts and users in eliciting and discovering their problem and requirements. It is interesting to reflect on the learning and creative processes invoked by both groups of project participants - in doing so, we will apply the constructivist framework described above and remark on the domain in which learning has actually taken place.

(1) Endogenous behaviour supports reflective and introspective analysis of objectives, tasks and processes. Surprisingly, without proper training naive analysts (users) rarely venture outside the comfort zone of their personal experience and domain knowledge. This causes serious problems for self-motivated innovation. Formal training in creative problem solving (as available to experienced analysts) supports the accommodation and assimilation learning mechanisms through assisting development of self-awareness, reflection, ability to formalise and re-evaluate own knowledge and insights, and assertion of new hypotheses and conclusions.

(2) Exogenous behaviour that focuses on seeking knowledge from external sources, allows individuals (both users and analysts) to confront their personal biases and knowledge, to create opportunities for breaking established personal dogmas and to seek new knowledge outside their prior experience. In this way, existing domain-specific knowledge can expand and be reconciled with newly observed facts and experiences. Experienced analysts actively seek a broad spectrum of knowledge outside their personal and organisational boundaries. Interestingly, naive analysts (users) seem to be mainly preoccupied with their self-perceived lack of technical prowess and tend to attach little importance to deficiencies in their own domain expertise. It is not known whether this behaviour is the result of (student) immaturity or inexperience as a domain user. Nevertheless, placing such inexperienced problem solvers in the simulated environment of their own application domain helps them re-assessing their basic assumptions, restructuring their accumulated knowledge and thus gain new domain experience.

(3) Dialectic behaviour that invokes communication, collaboration and negotiation provides with opportunities for both analysts and users to reach shared understanding and objectives. Questioning each other's fundamental premises, generation and analysis of alternatives, argumentation, establishment of common viewpoints, seeking synergy and intersubjectivity, are all processes characteristic of creative problem solving. While face-to-face encounters (in meetings, workshops and brainstorms) allow more focused pursuit of creative solutions (as in FAB ATM project), the simulated dialogue with business and technical participants offers a valuable substitute for the absent group dynamics (as in Blue Cut Fashions project). We find that engagement in any form of dialogue and collaboration (whether real or simulated) helps both analysts and users in transforming their tacit knowledge into more explicit knowledge forms, assists them in consolidating their own knowledge, identifying absence of knowledge, and subsequently, enabling them to seek new knowledge.

The simulations discussed above use a blended approach, which means that they mix real and simulated activities. Blending allows blurring the boundaries between real and virtual worlds, which ultimately brings an ingredient of believability and acceptance of the simulated events.

While this blended simulated environment cannot completely replace solving problems in a real organization, it provides its users with a safe environment, in which they can experiment with different (and potentially dangerous) outcomes (Cybulski et al., 2006; Cybulski et al., 2006). The simulated project adopts a partial view of reality, which can be referred to as 'circumscribed' reality. Such circumscribed reality simulations attach only key aspect of authenticity to their objects and environment. While they sacrifice some degree of reality, at the same time, they never cross the threshold of acceptability to the user (here analyst and user). They tend to be interactive, real time and cast live people (virtual or real). Media form and interaction are simple for the user, and the complexity is created in the mind of a user rather than in the technology used to support the

environment. In such e-simulations, learners while playing their roles as a systems analyst or a domain user are stimulated into exploration, invention and learning.

From the educational stand point, the blended approach to educating creative systems analyst and users provided us with an opportunity to arrive at a compromise between educational outcomes (acquiring knowledge, developing skills, embracing creativity and gaining experience) and environmental constraints (time, costs, labor and quality). We relaxed the confines of the problem settings to foster students' creativity and then confronted them with reality of which rigidity could only be overcome by breaking technical and business dogmas in the creative fashion. By circumscribing learner's reality, we used a combination of simulated reality and virtuality, immersed individuals in the authentic and believable problem situation and yet we were able to control educational outcomes and provide the safety of the protected educational context. We used the above described e-simulation cases together with a variety of media and learning approaches not only to facilitate students to gain skills, knowledge and creativity but also to achieve these educational objectives creatively.

DISCUSSION AND CONCLUSION

This paper reflects upon the changing role of users in requirements elicitation. While in the past users were treated as a passive source of requirements information, the emergence of new social information systems (such as YouTube, Wikis and Blogs), contributed to the creation of a new type/generation of users, comfortable with contents creation and with many development tasks. Such a new class of users ought to be viewed as a 'naive analyst'.

In the new and dynamic (emergent) environment of social computing, both expert analysts and naive analysts follow a winding path of domain (contents) and technological (systems) discovery. To sustain their participation in the creation of information systems, they both need to become active learners. In this context, requirements elicitation process relies on the ability of analysts and users to closely collaborate and be part of a wider learning community, which is creative, imaginative and often opportunistic.

This paper has therefore argued that constructivist and creativity learning theories provide excellent lens for informing modern practice in requirements engineering. The framework derived from the two foundation theories, explains different knowledge seeking behaviours of all participants in requirements elicitation and discovery process. In particular, the paper argues that creative system users cycle through the endogenous, exogenous and dialectic dimensions of knowledge construction, which gives them opportunities to reflect on the prior experience, seek new knowledge from external sources and engage in interaction with the domain and problem-solving experts. For these naive analysts, training, guidance and supportive collaborative environment, whether real or simulated, are essential for the quality contribution to the requirements process.

The paper finally briefly discusses examples of two experiential digital simulations, which have been designed to stimulate expert analysts, and even more so, the naive users-analysts into search for knowledge, creative ideas and problem solutions in requirements elicitation and discovery.

In the shifting grounds for the roles of analysts and users in information systems development, we discover the limits for the passive user participation in requirements process and we encounter the real barriers to creative solutions in the analyst-lead requirements elicitation. Analyst and user creativity and learning are the two cornerstones of the new requirements process - to paraphrase Arthur Koestler,

creativity in requirements elicitation is a type of a learning process where the user and analyst are located in the same individual.[1]

References

Armarego, J. (2004). Learning Requirements Engineering within an Engineering Ethos. Proceedings of 9th Australian Workshop on Requirements Engineering AWRE'04, Adelaide, Australia.

Avison, D. E. and G. Fitzgerald (2003). Information Systems Development: Methodologies, Techniques and Tools, 2nd edition. Berkshire, UK, McGraw-Hill.

Baer, J. and J. C. Kaufman (2005). "Bridging Generality and Specificity: The Amusement Park Theoretical (APT) Model of Creativity." Roeper Review **26**: 158-163.

Blackburn, T., P. Swatman and R. Vernik (2006). Cognitive Dust: Linking CSCW Theories to Create Design Processes. Proceedings of CSCWD'06, Nanjing, China.

Boden, M. A. (1991). The creative mind: myths and mechanisms, Basic Books, Inc.

Boden, M. A. (1998). "Creativity and artificial intelligence." Artificial Intelligence **103**: 347-356.

Booch, G., J. Rumbaugh and I. Jacobson (1999). Unified Modelling Language (UML) User Guide. Reading Massachusetts USA, Addison-Wesley Publishing Company.

Carmel, E., R. D. Whitaker and J. F. George (1993). "PD and Joint Application Design: A Transatlantic Comparison." Communications of the ACM **36**(4): 40-48.

Conklin, J. (2005). Dialogue Mapping: Building Shared Understanding of Wicked Problems, John Wiley and Sons Ltd.

Cybulski, J., L. Nguyen, T. Thanasankit and S. Lichtenstein (2003). Understanding Problem Solving in Requirements Engineering: Debating Creativity with IS Practitioners. Proceedings of Pacific Asia Conference on Information Systems PACIS'2003, Adelaide, Australia.

Cybulski, J., C. Parker and S. Segrave (2006). Touch it, feel it and experience it: Developing professional IS skills using interview-style experiential simulations. in the Proceedings of the 17th Australasian Conference on Information Systems, ACIS 2006, University of South Australia, Adelaide, South Australia.

Cybulski, J., C. Parker and S. Segrave (2006). Using constructivist experiential simulations in RE education. the Proceedings of the 11th Austra1lian Workshop on Requirements Engineering, AWRE'06, University of South Australia, South Australia. Best Paper Award.

Dalgarno, B. (2005). "The Potential of 3D Virtual Learning Environments: A Constructivist Analysis." e-Journal of Instructional Science and Technology (e-JIST) **5**(2).

Dallman, S., L. Nguyen, J. Lamp and J. Cybulski (2005). Contextual Factors which Influence Creativity in Requirements Engineering. To appear in the Proceedings of 13th European Conference on Information Systems ECIS 2005, Regensburg, Germany.

DeMarco, T. (1978). Structured Analysis and System Specification, Yourdon Press.

Dennis, A., B. H. Wixom and D. Tegarden (2002). Systems Analysis and Design An Object-Oriented Approach with UML. USA, John Wiley & Sons, Inc.

Dennis, A., B. H. Wixom and D. Tegarden (2004). Systems Analysis and Design with UML Version 2.0: An Object-Oriented Approach, John Wiley & Sons.

Gardner, H. (1993). Frames of Mind: the Theory of Multiple Intelligences. New York, Basic Books.

Gero, J. S. (1996). "Creativity, emergence and evolution in design: concepts and framework." Knowledge-Based Systems **9**(7): 435-448.

Hoffmann, O., D. Cropley, A. Cropley, L. Nguyen and P. Swatman (2005). "Creativity, Requirements and Perspectives." Australian Journal of Information Systems(September).

Kaufmann, G. (2004). "Two Kinds of Creativity - But which Ones?" Creativity and Innovation Management **13**(3): 154-165.

[1] See: http://www.wisdomquotes.com/001494.html

Kroll, P. (2003). The rational unified process made easy : a practitioner's guide to the RUP. Boston, USA, Addison-Wesley.

Maiden, N., C. Ncube and S. Robertson (2006). Can Requirements be Creative? Experiences with an Enhanced Air Space Management System, Forth coming.

Maiden, N. and S. Robertson (2005). Integrating Creativity into Requirements Engineering process: Experiences with an Air Traffic Management System. 13th IEEE International Conference on Requirements Engineering (RE'05), Paris France.

Moshman, D. (1982). "Exogenous, Endogenous and Dialectical Constructivism." Developmental Review **2**: pp. 371-384.

Nguyen, L., J. Carroll and P. A. Swatman (2000). Supporting and Monitoring the Creativity of IS Personnel during the Requirements Engineering Process. Proceedings of 33rd Hawai'i International Conference on System Sciences HICSS-33, Maui, Hawaii.

Nguyen, L. and G. Shanks (2006). A Conceptual Approach to Exploring Different Creativity Facets in Requirements Engineering. the proceedings of 17th Australasian Conference on Information Systems, ACIS 2006, Adelaide, Australia.

Nguyen, L. and P. A. Swatman (2006). Promoting and Supporting Requirements Engineering Creativity. Rationale Management in Software Engineering. A. H. Dutoit, R. McCall, I. Mistrik and B. Paech, Springer-Verlag / Computer Science Editorial.

Piaget, J. (1950). The Psychology of Intelligence. New York, Routledge.

Ramesh, B. and Luqi (1993). Process Knowledge Based Rapid Prototyping for Requirements Engineering. Proceedings of the IEEE International Symposium on Requirements Engineering: RE'93, San Diego California USA, IEEE Computer Society Press.

Regev, G., D. C. Gause and A. Wegmann (2006). Creativity and the Age-Old Resistance to Change Problem in RE. 14th IEEE International Requirements Engineering Conference RE'06, Minneapolis, Minnesota, USA.

Robertson, J. (2005). "Requirements Analysts Must Also Be Inventors." IEEE Software **Jan Feb**.

Robillard, P. N. (2005). "Opportunistic Problem Solving in Software Engineering." IEEE Software: 60-67.

Root-Bernstein, R. and M. Root-Bernstein (2004). Artistic scientists and scientific artists: the link between polymathy and creativity. Creativity: from Potential to Realization. R. J. Sternberg, E. G. Grigorenko and J. L. Singer, American Psychological Association (APA).

Schmid, K. (2006). A Study on Creativity in Requirements Engineering. Softwaretechnik-Trends.

Schön, D. A. (1996). Reflective Conversation with Materials. Bringing Design to Software. T. Winograd. New York USA, ACM Press**:** 171-184.

Solomon, B., K. Powell and H. Gardner (1999). Multiple Intelligences. Encyclopedia of Creativity. M. A. Runco and S. R. Pritzker, Academic Press. **2:** 273-283.

Vygotsky, L. S. (1978). Mind and society: The development of higher mental processes. Cambridge, MA, Harvard University Press.