Web-Enabled Creativity: A Social Process

Shiona Webster, Konstantinos Zachos, Neil Maiden
Centre for Human Computer Interaction Design
City University London
Northampton Square, London, EC1V 0HB
shiona.webster.2@city.ac.uk
k.zachos@city.ac.uk
N.A.M.Maiden@city.ac.uk

ABSTRACT
This paper reports an emerging computational model of flow spaces in social creativity and learning that can be applied to guide human-centered creative cognition in social groups. In particular we are planning for the model to be applied to inform creative goal setting, creativity technique selection and adaptation, and guided social interaction during creative problem solving and learning. We will seek to take advantage of the wealth of information made available through the advancement of Web 2.0. to inspire creativity and idea generation in individuals and groups.

Author Keywords
Social creativity; Creativity Support Tools.

ACM Classification Keywords
HCI, Design.

General Terms
Flow; Zone of Proximal Development.

INTRODUCTION

Social creativity and learning are increasingly important and related phenomena. Indeed, fostering creativity in learning is seen as a key direction with which to transform promising ideas into new processes, products or services [10]. The explosion of information made available through the advancement of Web 2.0 has resulted in publicly available content that is continuously (re)created over the social media universe at an ever-increasing speed [8]. Such rich content resources can provide a wealth of useful information that can support creativity and learning in both informal and formal social groups. We aim to take advantage of this wealth of available information to support social creativity and learning in the workplace.

Shneiderman [12] stated that one of the greatest gifts of the internet is being able to find people with shared interests who are at work on similar problems, thereby being able to draw on the experiences of others. Today, Web 2.0 technology allows users to create, collaborate, share and publish content, enabling information sharing and the rapid dissemination of new ideas. Social creativity can be supported by harnessing diversity, providing mechanisms to turn individual contributions into collections, enabling people to be aware of and access each other's ideas and to be able to contribute the results of creative work back to the community [5].

We are researching and developing a new conceptual model within COLLAGE, an EU-funded Integrated Project, to inform and enable the design of effective web enabled social creativity and learning technologies and services. COLLAGE's focus is to design, develop and validate an innovative cloud-enabled Social Creativity Service-set that will support the interlinking of learning processes and systems with (i) social computational services for inspiring learners, (ii) social affinity spaces for leveraging expression and exploration, and (iii) social game mechanics for supporting social evaluation and appreciation of creative behaviour.

In this paper we report a first version of a model that describes the relationship between social creativity and learning, with a focus on creativity as search and idea discovery. This model will enable the design of effective social creativity and learning technologies and computational services with which to inform the selection and use of different creativity techniques and support tools. The model explicitly describes important concepts such as the creativity and learning goals that are being sought, creative flow as well as creative search activity.

The following sections present the general ideas, principles, and concepts of the COLLAGE Social Creativity and Learning model.

THE COLLAGE SOCIAL CREATIVITY AND LEARNING MODEL (SCL)

The Social Creativity and Learning (SCL) model uses Shneiderman's GENEX framework and Boden's concept of conceptual space to support social creativity and collaborative learning in workplaces. The SCL model is a descriptive model that reasons about the space of ideas in

WebSci'13, May 2–4, 2013, Paris, France.

order to support learning using social computing services for exploration, experimentation and play.

GENEX Framework

The SCL Model is based on the GENEX framework [13] – an established situationalist model of social creative processes. The GENEX framework identifies four key processes during social creativity: (i) collecting information from public domain and available digital sources; (ii) relating, interacting, consulting and collaborating with colleagues and teams; (iii) creating, exploring, composing, and evaluating solutions; and (iv) disseminating and communicating solutions in a team and storing them in digital sources. These phases may occur in any order and may repeat and cycle iteratively.

Boden's Theory of Search Spaces

In COLLAGE we use Boden's model of creativity [2] to support creative work by exposing novel information spaces to problem solvers and in turn, recommend creativity techniques that can be used to discover novel ideas to solve for example automotive-related problems.

The SCL model extends both the GENEX framework and Boden's concept of conceptual space to incorporate three capabilities that are critical to support social creativity and learning: (i) to reason about a new solution in order to discover the spaces in which novel and useful ideas are most possible; (ii) to guide the use of creativity techniques to search these spaces in order to discover novel and useful ideas; (iii) to engage the problem solver in such a way that he is fully immersed, feeling involved and successful in exploring the space of possible ideas.

To deliver these capabilities the SCL model includes: *(a) a theory of goal-driven creative search spaces* that computes novel search spaces and recommends creativity techniques to discover novel ideas and *(b) a collaborative learning model for creativity* that exploits a problem solver's real learning capacity in a collaborative and creative setting. The next section briefly describes our use of the theory of goal driven creative search and our collaborative learning model, that combines Csíkszentmihályi's notion of 'flow' with Vygotsky's Zone of Proximal Development, which make up the COLLAGE Social Creativity and Learning model:

a) Theory of Goal-driven Creative Search Spaces

We see the SCL model as a search-based creative process, i.e. a process of breaking down an initial, bigger problem into sub-problems, and working out how those sub-problems fit together, and then tackling those sub-problems; as we go through this process, learners also acquire knowledge about common sub-problems and solutions thereto, so they accumulate a knowledge-base about the problem. Since the space is too large to search in a single creative search activity, the space is searched through a series of creative search activities, each of which searches the local part of the space expressed by the current goal, related to the ideas already discovered in the space. Therefore, we can express a creative search activity in terms of a current subspace in a wider design space, and apply search-based techniques and theories to it.

b) Collaborative Learning model

The fundamental idea of how a subspace is traversed can be illustrated through an approach that combines Csíkszentmihályi's [3] and Sawyer's [11] notion of 'flow' with Vygotsky's [14] notion of the Zone of Proximal Development. By combining both ideas, we introduce the concept of the collaborative learning model, which describes how an overall search space as well as a subspace is traversed.

In Figure 1, the concentric circles represent the subspaces and goals that make up the larger overall search space. The horizontal axis represents a problem solver's domain-specific knowledge of the task at hand and the vertical axis represents the level of the task challenge. As the acquisition of knowledge of the learners advances in response to challenges, an ideal path in the flow region would progress from the origin to the upper right. The transition from a starting point (A) to a destination point (B) indicates the increase of knowledge and challenge that naturally traverses the ZPD, but under control and with the expectation that learners will return to the flow zone again. At the same time, we can see how an individual or group can move from bored (when their domain-specific knowledge exceeds their challenges) into the flow zone (where everything is in balance), but can easily move into a space where they need some help. Most importantly, if we move upwards and out of the ZPD by increasing the challenge too soon, we reach the point where an individual or group starts to realize that they are well beyond their comfort zone.

We propose to use the idea of the ZPD as guidance for when individual learners or a group of distributed individuals who are collaborating asynchronously should be creative inside or outside a learning environment, i.e. interact with specific creativity support tools or collaborate with other people in a social context.

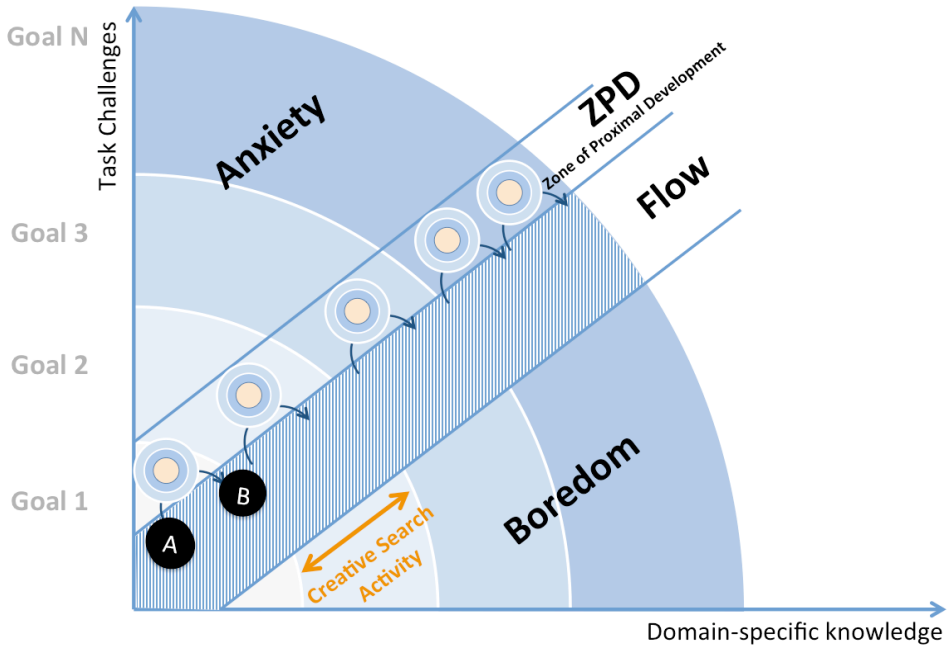

Figure 1: Emerging SCL Model as used within COLLAGE

We seek to characterize each path connecting the knowledge/challenge needed to encourage flow through the application of three game mechanics traits:

- Goal – Goals are what attract and guide learners.
- Rules – There must be a good balance between learner's perceived domain-specific knowledge/skills and the perceived challenge of the task. To realize this we use rules to challenge learners as well as define how learners go about achieving the goals.
- Feedback – Here specific COLLAGE creativity-supported feedback services can provide this clear and immediate feedback that engage learners. They present a continuous flow of information that shows people how they are doing and whether they are getting closer to or further from accomplishing the goals.

The next section discusses how creativity-supported feedback services can support the navigation of the knowledge/challenge space.

Creativity-supported Feedback Services

According to Amabile and Kramer [1], one of the single most important factors that induce creativity is a sense of making progress on a meaningful task. We propose that the creativity-supported feedback component will provide catalysts that induce progress, for example by setting achievable goals, providing resources, offering help and enabling users to search for and learn from knowledge gained during previous creative activities.

The creativity-supported feedback component incorporates all four processes from the GENEX framework and guides users along the path connecting a knowledge/challenge starting point (A) with destination point (B) in the collaborative learning model (Figure 1). We see the creativity-supported feedback component as a process with which to direct the problem solvers to effectively use the different creativity techniques, dependent on the situation, to bring balance to the knowledge/challenge.

The creativity-supported feedback services are based on the GENEX framework due to two key distinctive principles that other creative processes and models lack that are key to COLLAGE:

- Dissemination: knowledge 'does not count' until it is available to others.
- Collaboration: illumination moments when ideas are found are often personal, but the processes that lead up to them are highly collaborative.

In order to emphasize the social nature of this process, we have positioned the 'relate' phase of GENEX framework in the outer circle of the creativity-supported feedback component (Figure 2), indicating that interacting and collaborating with others can, and should, take place during all phases. The COLLAGE tools and services will facilitate this activity, which is demonstrated with the directional arrows.

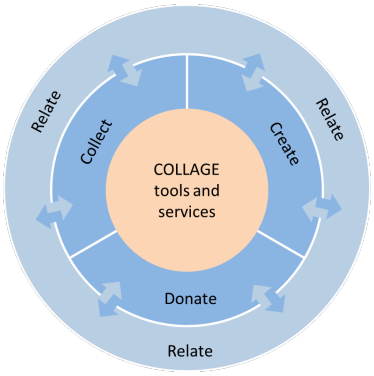

Figure 2: COLLAGE's creativity-supported feedback service that is based on Shneiderman's GENEX framework

We propose that, as problem solvers (an individual or group) interact with the COLLAGE system using one of the feedback services, they may engage in short periods of collect, relate, create and/or donate activities as they interact and collaborate with others, for example by interacting with peers in an affinity space, consulting with domain experts, or using a recommender service or one of the creativity support tools.

For example, during the collect phase, users could insert a text description of a problem into the service, which would search for and return existing answers to similar problems using analogical domains as a first step, e.g. cases or descriptions from other problem domains. This new knowledge could then be related to the users' peers. Additionally, users could be prompted to collaborate with more knowledgeable others in this field, or to make use of a creativity technique in order to search for and create ideas from these descriptions.

Creative Search Activity

The creative search activity becomes the organizing structure that allows problem solvers to explore the subspace for creative ideas using goal-specific feedback services. Figure 3 depicts an example of one instance of a creative search activity.

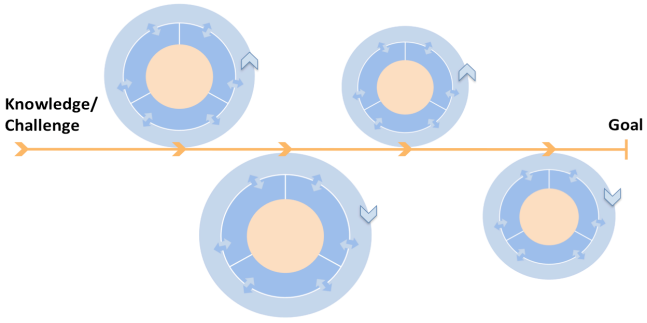

Figure 3: Detailed view of a creative search activity used to traverse a subspace

The creative search activity changes based on the goal, the defined task challenge, the current domain knowledge (initial knowledge plus knowledge gained from previous creative activities), and feedback services available. The length of the creative search activity and the size of the circles may change depending on the duration of the search activity.

In this context, the COLLAGE service set can be a digital tool used to search for information and get inspiration, or a service used to facilitate access to human actors (experts, colleagues, peers) via affinity spaces.

DESIGNING INTERNET-ENABLED CREATIVITY SERVICES

Although the current first version of the SCL model is primarily intended to describe social creativity and learning processes based on established theories of creativity and learning, our eventual aim is to use such an accurate descriptive model to guide these processes. In this section, we outline our initial thinking about how the SCL model will inform such guidance, and demonstrate the guidance using creativity techniques that support important characteristics of social creativity and learning.

Iterative processes of collecting, relating, creating and donating

Any creativity service and affinity space should afford:

- As a pre-condition, members of the social group to collect and relate inputs to the creative and learning process;
- As a post-condition, members of the social group to donate new ideas to others members of the group for use in the creativity and learning process.

An example of an established creativity service that can afford iterative collecting, relating, creating and donating is *constraint removal* [9]. Such a service searches for constraints that people have not thought of about the problem at hand, then promotes their removal. One pre-condition to creating new ideas is the collection and relating of existing constraints to remove or relax during the creation of new ideas. For example, the constraint removal service leverages popular online content and lexical databases such as Wikipedia and WordNet [4] to search for relevant facts about a domain that are assumptions and/or constraints, that are in turn challenged. If there is a concept *X*, the service finds concept *X* from these sources, takes the definitions, extracts phrases, and encourages users to imagine *X* is not true. Taking the Fiat 500 as an example concept and Wikipedia as the target online source, the service analyses the following text:

"Launched as the Nuova (new) 500 in July 1957, it was a cheap and practical town car. Measuring only 3 metres long, and originally powered by an appropriately sized 479 cc two-cylinder, air-cooled engine, the 500 redefined the term "small car" and is considered one of the first city cars. In 2007, the 50th anniversary of the 500's launch, Fiat launched the new Fiat 500, stylistically inspired by the 500

but considerably heavier and larger, featuring a front-mounted engine and front-wheel drive."
The constraint removal service generates prompts such as:
1. Imagine that the car is not measuring only 3 metres long;
2. Imagine that the car is not considered one of the first city cars.

These prompts are used to generate new ideas that can then be donated to the social group, prior to a new iteration of collecting and relating constraints on the new ideas.

Defining and searching conceptual spaces of possible ideas
Any creativity service and affinity space should afford:

- One or members of the social group to undertake explicit information search and idea discovery in a conceptual space of possible ideas;
- These members to explicitly implement creativity services and affinity spaces that support different forms of transformational, exploratory and combinational creativity in a conceptual space.

An example of an established creativity service that affords exploratory information search and idea discovery is a creativity trigger. A creativity trigger is a generic desirable quality of a future solution that the social group is directed to discover new ideas to deliver – in software-based solutions, these qualities can include convenience, choice and trust. For example, use of the creativity trigger convenience guides one or members of the social group to undertake explicit information search and idea discovery in a space of ideas that can deliver the convenience of quality – and the search can be supported through the retrieval of information related to the quality of convenience.

The setting of goals that render effective periods of individual and group flow achievable
Any creativity service and affinity space should have assigned to it:

- A rating of the prototypical distance between the current set of ideas and the set goal that can be achieved through effective application of the creativity service or affinity space – the creative potential of the service or space;
- A rating of the prototypical distance between the content of the current set of ideas and the set goal content that can be achieved through effective application of the creativity service or affinity space – the creative potential of the service's or space's content;
- A difficulty rating indicating the potential level of difficulty that one person or a social group might encounter when learning and/or applying the service or space.

An example of a creativity service that demonstrates goal setting for individual and group flow is analogical reasoning. Analogical reasoning is the systematic transfer of a network of related information from a source domain to a target domain in order to generate new ideas in the target domain based on the transferred information [3]. Analogical reasoning has considerable potential to reconceptualise problem and solution spaces, hence the service's creative potential is high. Key to its success is the selection of source domain(s) from which to transfer knowledge for idea generation. Source domains semantically close to the target domain are easier for people to map to, but can lead to less new idea generation, and can risk boredom. In contrast, source domains semantically further from the target domain can lead to greater idea generation, are more difficult for people to map to and risk anxiety. Moreover, empirical evidence has revealed that people find analogical reasoning difficult [7], hence they are likely to encounter difficulties during its use compared with creativity services that are easier to use such as creativity triggers.

The maintenance of group flow in groups of distributed individuals
Any creativity service and affinity space should afford

- Collaborative creativity and learning by the members of the social group;
- The externalization of new ideas and knowledge that can be shared effectively with the members of the social group as part of a creative process;
- Explicit support for turn taking by members of the social group during the collaborative creative process.

An example of an affinity space that can afford the maintenance of group flow is design storyboarding. A storyboard is a graphic organizer in the form of illustrations or images displayed in sequence for the purpose of pre-visualizing a motion picture, animation, motion graphic, interactive media sequence or, for COLLAGE, a business or service design. Developing a storyboard from a set of existing concepts and ideas can afford collaborative creativity and learning by members of a social group through focused work on individual storyboard frames – the new ideas and knowledge generated from this creative work are shared with other members of the social group through the emerging storyboard, which acts as common ground in the collaborative creative process. Moreover, the development of discrete storyboard frames by individual members of the social group can afford turn taking based on game mechanics.

Guiding individual learners into zones of proximal development to encourage then support learning
Any creativity service and affinity space should afford:

- The acquisition and learning of new knowledge in order to achieve flow as part of the individual and collaborative creative processes;
- The adaptation of any creativity service and affinity space in real-time to guide one or members of the social group

into the zone of proximal development to support learning during creative flow.

An example of a creativity service that guides learners into zones of proximal development to encourage learning is the constraint removal service reported earlier. During the create activity, one or more members of the group are required to envision a future version of the domain in which a constraint no longer applies, or has been significantly relaxed. For example, during the exploration of new, more environmentally friendly operational concepts for an airport management system, one constraint that was removed was the variability of the weather. To generate new ideas, each member of the social group was required to envision an alternative reality of the domain in which weather was predictable; this required learning by the social group

CONCLUSIONS AND FUTURE WORK

This position paper reports an emerging computational model of flow spaces in social creativity and learning that can be applied to guide human-centered creative cognition in social groups. It draws on established cognitive theories of creativity and flow, and zones of proximal development in learning to propose a new computational model of information search spaces that can be navigated more effectively during social creativity and learning. However, as a position paper, the emerging model and its implementation to guide social activities remain to be validated, and there is substantial future work.

The next stages of the research are to complete a first description of the model and build a first computational model of creative search spaces that the model will be applied to. We have a set of available computational creativity services that can be applied to search the space, as a basis for prototypical development of first versions of the computational model.

Once the first version of the model is complete, we will embark on an iterative process of model validation and refinement through studies of and support for social creative processes in 3 selected application domains. These application domains are: (i) creative conceptual design work in leading design consultancy based in the Netherlands; (ii) early product design and generating new resolutions to health-and-safety risks in automotive production in Italy, and; (iii) executive business Masters education at a French business school. Not only will social creative and learning processes in these 3 application domains provide important insights into creative search, flow, relating and donating, and learning, but each will enable possible model refinements to different sectors. Moreover, each model refinement will enable the design and implementation of computational creativity services that utilise the web in more effective, domain-specific ways.

Acknowledgements

The research reported in this paper is supported by the EU-funded COLLAGE integrated project 318536, 2012-15.

REFERENCES

1. Amabile, T., Kramer, S. T*he progress principle : using small wins to ignite joy, engagement and creativity at work*. Harvard Business School Press (2011).
2. Boden, M.A. *The creative mind: myths and mechanisms*. Routledge, London; New York, 1990.
3. Csikszentmihalyi, M. *Creativity: Flow and the psychology of discovery and invention*. HarperCollins, New York, N.Y, 1996.
4. Fellbaum, C. WordNet: An Electronic Lexical Database. Cambridge, MA: MIT Press, 1998.
5. Fischer, G., Shipman, F. Collaborative design rational and social creativity in cultures of participation. *Human Technology: An Interdisciplinary Journal on Humans in ICT Environments 7* (2011), 164–187.
6. Gentner D. Structure-Mapping: A Theoretical Framework for Analogy, *Cognitive Science 5* (1983), 121-152.
7. Gick, M.L., Holyoak, K.J. Schema Induction and Analogical Transfer. *Cognitive Psychology* (1983), 1–38.
8. Kaplan, A.M., Haenlein, M. Users of the world, unite! The challenges and opportunities of Social Media. *Business horizons 53* (2010), 59–68.
9. Onarheim, B. Creativity from Constraints in Engineering Design: Lessons Learned at Coloplast. *Journal of Engineering Design 23* (2012), 323–336.
10. Retalis, S., Sloep, P. idSpace: A groupware system for supporting collaborative creativity. *IEEE Learning Technology Newsletter 12(2)*, (2010) 24-26.
11. Sawyer, K. Group Genius: *The Creative Power of Collaboration*. Basic Books, 2008.
12. Shneiderman, B. Creating creativity: user interfaces for supporting innovation. *ACM Transactions on Computer-Human Interaction (TOCHI) 7* (2000), 114–138.
13. Shneiderman, B. Creativity support tools. *Communications of the ACM* 45 (2002), 116–120.
14. Vygotsky, L.S. *Mind in Society: The Development of Higher Psychological Processes*. Harvard University Press, Cambridge, Massachusetts, 1978.