Project Deliverable Report

Deliverable nr 1.2 – Templates of informal idSpace pedagogical strategies for creativity v1

Work Package
WP1

Task
T.1.2

Date of delivery
Contractual: 31-12-2008 Actual: 13-02-2009

Code name

Version: 1.0 Draft Final X

Type of deliverable
report

Security (distribution level)
PU

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Abstract (for dissemination) Based on theoretical insight on the state of art D.1.1 this deliverable introduces a pattern based approach to systematically construct configurable recommendations of teams working in idSpace. The “collaborative flow patterns for creativity” are based on pedagogical insight offering pedagogical strategies to support collaborative creativity for idSpace new product design. We present the idea of flow patterns, and how use of the pedagogically based flow patterns can positively influence learning processes involved in collaborative creation of new products. The design patterns propose dedicated action scenario’s to enhance creativity and collaboration as well as suggesting the creation of affording circumstances to enable productive learning. The concept of “flow patterns” is introduced as well as the factors that need to be taken into account when applying such a pattern in the context of idSpace.

Keywords List
creativity, creativity support tools, design patterns, CSCL (computer supported collaborative learning), CSCW (computer supported collaborative work), PD pedagogical patterns, flow patterns
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1. Introduction

1.1. Aim & scope

For teams working in the context of new product development (NPD), the idSpace project develops an integrated web-based environment in which context sensitive tools and techniques together with pedagogically based recommendations enhance a team’s learning and collaborative creativity during the creative phases of NPD.

To invent and design new products requires collective creative performance: creative action in combination with collaboration. To achieve excellence in new product development, coordinated action of all team members is required in order to construct an innovative solution to a problem by making maximal use of the collective creative power of all team members.

Thus the scope of idSpace creativity support implicates integrated support of learning, creativity and collaboration in order to co-create new product solutions. Pedagogical support is aimed at improvement of learning and work processes for creative performance. Instantiations of idSpace learning might vary from organizational contexts, ranging from start-up companies, small and medium-sized enterprise (SME), to large multinational enterprises. Within all these enterprises, there are teams striving for radical or more incremental product innovations. The similarity across all these contexts is that creative product design builds on learning, whereby learning is part of work. Creative product design requires both individual and team competence development but not for competence growth per se but competence acquisition in function of the performance.

This deliverable concentrates on the development of adaptable, pedagogical strategies to systematically enhance collaborative creativity. It proposes to do so by improving all learning involved and making optimal use of the most appropriate creativity and collaboration strategies, based on existing pedagogical insight.

The overall aim of this deliverable is to present propositions for an effective and structured approach to both design and implementation of flexible pedagogical support strategies that integrate support of creativity, learning and collaboration for new product development.

The envisaged pedagogical support is aimed at supporting the main users of the idSpace environment:

1. First the end users, team members involved in the creative work for a new product design using idSpace to assist their work.
2. Second, the moderator, one of the team members fulfilling the role to organize and facilitate the team’s work processes.
3. The idSpace pedagogical designers developing and implementing the design patterns to support creative collaboration in idSpace.
In this deliverable we propose to configure recommendations fitting the needs of these users.

- Recommendations provide appropriate advice on applicable creativity methods, suitable ways of learning and collaboration. They do so based on theoretical insights from the domains of learning sciences, psychology, computer supported collaboration, systems design and HCI.

- Based on theoretical insights on which creativity method to use and how to apply it for a certain purpose, how to enhance collaborative meaning making etcetera we propose to make use of design patterns providing heuristics for the developers of idSpace support.

- The actual implementation of recommended activities and composition of the best strategy can be composed by the moderator based on the patterns available and his knowledge of the teams needs.

- Yet other recommendation suggestions can be “automatically” composed from available knowledge on the team derived from the idSpace awareness mechanisms. Based for example on awareness information on the phase (start phase) and the composition of the team (newbies), the system can compose recommendations on getting to know each other using profile information and provide the structured elaborate explanation version of the technique to fit the newbies needs.

In this way support suggestions to enhance learning, creativity, and collaboration needed for product design performance builds on

- theoretical insight translated into design patterns,
- which are implemented in IdSpace, in the form of use patterns. Use patterns are implemented design patterns or, put in another way, components for support presentation to the end user whether a moderator of the team or a team member.

For this purpose we:

- Propose a systematic pattern based approach using structured heuristics for both design and delivery of configurable recommendations that neatly fit the needs of the idSpace team-user working in a specific context and a team’s specific product design endeavour.

- Propose pedagogical support strategies for collaborative creativity of teams, tailored to the expected needs of the user(s) in their specific setting. Based on the awareness information in combination with principles of pedagogical guidance the best fitting recommendation script is configured.
Propose recommendations to the user, based on (underlying) design and use patterns. Theoretical considerations for the use of patterns and the method of composing these pedagogical recommendations will be explained, including reference to their rationale and expected functioning in the idSpace environment.

- The support propositions presented in this deliverable build further on the knowledge basis laid in first (D.1.1) State of Art deliverable.
- Finally we indicate how these patterns materialize in the idSpace environment by presenting an example.

1.2. **Outline**

To provide an overview of the pedagogical strategies and how they are created and implemented using design and use patterns, we have structured this deliverable into the following chapters:

- This 1st chapter presents an introduction into the objectives of this deliverable and the rationale for a pattern based approach.
- The 2nd chapter describes the concept of idSpace configurable support. It articulates the idea of working with design and use patterns to create recommendations for creativity, learning and collaboration needed in collaborative product development.
- The 3rd chapter illustrates the concept of design patterns in relation to pedagogical strategies, collaborative learning and creativity techniques.
- The 4th chapter describes the function of use patterns, creating a bridge between the design pattern and the actual configuration and use of recommendations in idSpace.
- The 5th chapter provides insight on how patterns will work by presenting an example.
- Finally chapter 6 summarizes our conclusions so far.
2. Configurable support for creativity, learning and collaboration

2.1. **Introduction**

Enhancement of creativity in collaborative product design requires effective learning and integrated team collaboration. This includes both personal learning, learning from peer team members and smart use of existing creativity methods.

The aim of pedagogical recommendations in idSpace is acceleration and improvement of collective learning processes and its outcomes of collaborative new product design. Suitable support of those learning processes requires a somewhat different approach than (routine procedures) in regular product engineering or in regular educational settings. Since creative product design isn’t characterized by a predictable linear learning process but by unpredictable inquiry and experimentation outcomes, straightforward generic prescription will not help. Complete human or agent based personalization on the other hand is not a balanced solution either. To develop appropriate support which supports both the individual and team in their context of project X or Y effectively, we propose the configuration of customized scenarios articulating learning strategies fit to enhance creativity and accelerate the creative design processes for the problems experienced by a specific team. Therefore we are looking for a smart method of customization as foundation for dedicated recommendations. Based on the awareness of the actual state of knowledge and creativity and collaborative capabilities in a specific phase of the design process, the idSpace environment has to generate appropriate recommendations to enhance the creative learning process of that team working on that new product design in that specific domain.
Since creativity consists of finding new possibilities, seeing new perspectives i.e. breaking existing patterns of doing and reasoning, the support of learners in the creative phase of product development has different characteristics compared to the execution of existing procedures in regular educational settings. Hence the support for new product development differs from working examples and “cookbook” recipes, procedure factsheets, workable methods to acquire certain procedures.

Think for example of the explorative iterations described as typical for creative work. Klaus Schmid (Weisberg, 1986; Schmid, 1996) points to the activity of creative worrying, Wallis and others state the importance in creative work of the incubation time (Wallas & Smith, 1926) and yet others emphasize the role of trial and error iterations characteristic of experimentation. It proves that to explore creative opportunities one has to learn as well as to unlearn. Unlearning old ways of seeing and skipping details are stated to be necessary to make space for the acquisition of new perspectives (Boland, & Tenkasi, 1995).

Novelty is crucial for creative processes. The recommendations point to opportunities to look for creativity techniques and types of learning that increase the chance of finding novel perspectives. This requires space for exploration, surprise, idiosyncrasy and “instructive failure”. IdSpace’s pedagogical recommendations have to take into account that the creative process and its outcomes are not predictable. Recommendations to support creativity typically offer dedicated suggestions for example to use various forms of exploration, provide guidance to cope with risk and failure, and suggest to take time for new iterations, create space for surprise.

**Figure 1.** Overview patterns for learning and creativity.

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**Learning**
- Theoretical concepts
- Pedagogical strategies

**Creativity**
- Theoretical concepts
- Creativity techniques

**(Design) Patterns**
- Collaborative Learning Flow Pattern (CLFP)
- Creativity Technique Flow Pattern (CreFP)

**Use patterns (in idSpace)**
- Combinations of (parts of) CLFP’s and CreFP’s
  - Based on
    - user selection
    - customized recommendations (awareness)
2.2. Designing of idSpace

For idSpace we need to design new methods to meet the learning needs of new product developers across all design phases providing configurable strategies in which educational guidance is combined with affording functionalities like congruent representation modes, dynamic structuration of artefacts, creation of a climate of openness and exploration necessary for creative improvisation during the initial stages of idea generation. To follow the dynamics of creative problem solving flexible structures are required, to facilitate all kind of transformations from initial vague expressions of ideas to artefacts which themselves have to evolve from the early to the final stages of inventive problem solving.

To achieve this we propose for idSpace, implementation of integrated educational scenarios to trigger and expand creativity, in service of inventive design. Stimulation of creativity followed by support to integrate creativity into a team’s shared design. Therefore we provide ideas in this deliverable for adaptive, collaborative learning scenarios that offer guidance to professionals via provision of appropriate recommendations for action. The focus thereby is on expanding the combined potential of all individuals to co-create an innovative design in a virtual team setting (cf. D.1.1).

Prime objectives are “configurable pedagogical scenarios that support professionals to perform and develop to their maximum.” They provide guidance to accelerate the team’s development, by learning from heuristics, using expert’s advice and advice from each other, all in function of the collective team performance (cf. D1.1).

In respective work packages (1, 2, 3) we already explored dimensions of creativity and innovation, workplace learning, team and collaboration and, groupware characteristics as well as pedagogical in creativity strategies that the idSpace environment should take into account to provide idSpace designer with heuristics and best practices to be used in creating IdSpace. In the initial phase of the project all participants worked on use cases and usage scenarios, and translated these into a storyboard. Many different creativity techniques were analysed (WP2) and the ideas on awareness mechanism for idSpace were developed (WP3) while other work packages worked on defining the integrating functionalities of the idSpace platform (WP4) and its evaluation (WP5).

Based on these insights into the variety of dimensions to be taken into account in idSpace for support of the developers of pedagogical support scenarios and implementation of these scenarios for the end users of idSpace we will have to describe in this deliverable

- The need for appropriate support for professional workers (learners while performing).
- A proper design method: how do we plan to take care of sound, appropriate and feasible use design patterns.
We present a solution of “lego like” composable customizable support by recommendations that present themselves to users in formats fitting into the work habits including expertise background, performance pressure etc of the idSpace users.

The actual recommendation for a specific instance depends on characteristics like team composition, domain, task type, phase, applicability of creativity technique. At the same time we have to keep in mind that a recommendation might also trigger user actions eventually generating feedback to the system. An example of this could be project information and user experiences which need to be fed back into the idSpace (project’s) memory and repositories, for re-use later.

Recommendations themselves might consist of learning to use a specific creativity method like Scamper, or use of appropriate visualization techniques like creating and processing a collective concept map of ideas generated. It might give advice on appropriate methods to organize the prioritization of generated ideas, deepen the inquiry, take a vote as to assess existing common ground or weight the variety of ideas generated, etc

2.3. The missing link: patterns

In order to make a connection between the different design aspects further exploration was needed to find a proven systematic approach to customization of idSpace support.

We propose a systematic pattern based approach to assure that we take into account all relevant dimensions and provide successful heuristics to achieve result. The patterns lay the foundations for composition and delivery of customized recommendations to the idSpace user, the creativity team’s team members. Based on the inspiration from design patterns, tailored composition and delivery of a recommendation can take place.

The patterns suggest which heuristics to apply under which conditions. So it not only presents the activity script itself it includes suggestions and criteria regarding content, actors and context. And further on it can provide guiding criteria to trigger its application in idSpace. The idSpace awareness mechanism applies these “rules” to decide. Based on the awareness information, it composes the recommendation for situation x, y, z. Eventually meta-information (tags) are connected to “lego like” building blocks for recommendations, to enable easy composition of ‘appropriate’ advice configurations for a specific instantiation.

Design patterns safeguard that relevant aspects are systematically taken into consideration that existing heuristics are known and suggestions are made for their application. Design patterns (DP) express the accumulated knowledge with respect to a specific problem and propose how this problem can be solved when someone deals with it. These design patterns together with the awareness engine lead in the end to composition of an optimal combination of “lego” components into an appropriate
recommendation for a specific instantiation. In the next chapter the origin of patterns and the construction of patterns are illustrated.
3. Design patterns for effective guidance of creativity and (collaborative) learning

In this chapter the concept of design patterns is illustrated and related to pedagogical strategies, collaborative learning and creativity techniques.

3.1. Design patterns

The concepts of design patterns (DPs) and pattern language originally introduced by architect Christopher Alexander and have been formulated in 70’s in two books, A Pattern Language: towns, buildings, construction (Alexander et al., 1977) and The Timeless Way of Building (Alexander, C., 1979). His patterns were an attempt to concentrate and codify generations of architectural wisdom. In DPs, Alexander expressed the accumulated knowledge with respect to a specific recurrent architectural problem and proposed in a consecutive manner how this problem can be solved when someone deals with it.

According to Alexander’s words a pattern “describes a problem which occurs over and over again in our environment, and then describes the core of the solution to that problem, in such a way that you can use this solution a million times over, without ever doing it the same way twice” (Alexander et al., 1977). A pattern language is a set of related patterns (in’s a patterns’ hierarchy) that work together in some context, towards a bigger problem’s solution.

DPs express the accumulated knowledge with respect to a specific problem and propose how this problem can be solved when someone deals with it. Within DPs the acquired experience from previous circumstances facing the specific problem, is concentrated and the way dealing with it is documented. This is especially useful for problems that occur repeatedly and have been assessed worth been documented, so that everybody dealing with that problem can apply the pattern in order to solve it.

A DP is an attempt to illustrate and disseminate “best practices” with respect to a problem or class of problems, to share the experience, to transfer knowledge from experts to novices. DP’s are all about reusability, which seems to be the keyword in achieving the economies of scale for developing affordable and usable technology enhanced interactive learning systems in an effective way (Goodyear at al, 2004). Patterns are not something created by a certain person. Pattern writing is in reality a team effort. These are usually drafted by someone and then shared, analyzed, commented, assessed (evaluated) in action and refined through an extended process of collaboration.

Design patterns are not just guidelines. They are richer resources since they contain well justifiable solutions and examples to design problems as well as the rational behind these
solutions. DPs due to their underlying emphasis on the reusability of good design practices can be a valuable resource not only for an inexperienced designer but even for an experienced designer, explaining not only how a problem can be solved but also why a design choice is appropriate to a particular context (Garzotto & Retalis, 2008). The other main advantage of DPs is that the solution is not prescriptive. On the contrary patterns give a descriptive solution to a design problem. Thus the actual implementation of the proposed solution could vary depending on the specific constraints that might be imposed. Last but not least, DPs can be grouped into patterns languages giving recommendations from a more holistic perspective. Especially in the IdSpace project, this is very crucial since for offering recommendations about the design and implementation of collaborative strategies for creativity design a variety of organizational, administrative, instructional and technological components need to be considered.

Dearden and Finlay (2006) distinguish between design advice in the form of heuristics, standards, guidelines, style guides, claims and patterns. They mention that “design patterns are potentially more general than existing examples of guidelines, use more specific examples, include the statement of a problem that they address, deliberately scope their context of application, and explicitly reflect particular design values.”

Furthermore, Borchers (2001) suggested that design patterns (DP’s) have more advantages than style guides, guidelines, and standards “through their structured inclusion of existing examples and insightful explanation not only of the solution, but also of the problem context in which this solution can be used, and the structured way in which patterns are integrated into the hierarchy of the language”.

DP’s could play the role of a “lingua franca” thus supporting discussions among people who are specialists in various disciplines (Fincher, 1999). DP’s express the accumulated & tacit design knowledge with respect to a specific problem either pedagogical or technical or organizational and propose how this problem can be solved when someone deals with it.

Especially, in the domain of technology enhanced learning, adopting a pattern approach in e-learning design offers five main advantages (E-LEN, 2004). One of these advantages is that patterns can facilitate communication within multi-disciplinary teams. Therefore, in the IdSpace project, DP are expected to reduce the conceptual gap among the fields of collaborative learning, innovation design, creativity process and the software development world. This could lead to the desired goal of obtaining reusable, customizable, and integrated tools that will be integrated into the IdSpace system.
3.2. The use of design patterns for describing pedagogical strategies and creativity techniques

The concept of patterns has been expanded to fields other than architecture such as software engineering, hypermedia engineering, human computer interaction. Identifying and collecting best practices in the educational domain and formulating them as design patterns are a rather new and promising approach in technology enhanced learning. There have been several EU funded projects that deal with e-learning DP’s such as (E-LEN, 2004; PPP, 2005; TELL, 2005) as well as several publications in scientific journals and international conferences proceedings. DP’s that have been proposed are based on sound research findings (Asensio et al. 2004; Strijbos et al., 2004).

According to Goodyear (2005), pedagogical as well as creativity techniques can be described via a set of various patterns. These type of patterns can be called flow design patterns (FDP). Since pedagogical and creativity techniques (brainstorming, debate, six-hats, SCAMPER, etc.) are considered to be task-oriented, the FDP are comprised of a set of tasks that are needed to be performed by people who participate into the creativity process (Goodyear et al., 2004). The term “flow” is used to portray coordination and sequencing of tasks of the learning ad creativity process. The FDP define the sequence of the tasks that the technique dictates as well as other elements needed for the various tasks, such as the duration of a task, the use of a particular tool for a given task and so on (Turani & Calvo, 2006).

Inspired by Hernandez-Leo (2005) these types are:

- Collaborative learning flow patterns (CLFP’s) referring to pedagogical strategies such as Think-Pair-Share, Jigsaw, Pyramid and Brainstorm (Hernandez-Leo et. al, 2006). Another CLFP which deals with the strategy of Electronic Debate can be found in (Marjanovic et al., 2007). These patterns, which are shown in Appendix III, have been specified and formalized by experts in the use of collaboration in the learning process and validated for specialized educators.

- Patterns for Computer-Mediated Interaction (PCMI) or Groupware Patterns (GroP) which deal with solve socio-technical problems of groupware technology that supports the group process and therefore include a technical and a social
aspect. A collection of 71 patterns (http://www.cmi-patterns.org) is presented in (Schümmer and Lukosch, 2007).

- Networked Learning System patterns (NLSP) which try to help designers in the difficult task to create usable and learning effective systems (Avgeriou, et al., 2003, Goodyear, et al., 2004). Some of these patterns are results of some research projects like ELEN (ELEN, 2003) which is a repository of e-learning patterns, TELL (TELL, 2005).

- Creativity Flow Patterns (CreFP) referring to creativity strategies like SCAMPER, Six Hats, etc. Such a pattern has been created for the needs of the idSpace project and especially for Six Hats. It is described in Appendix IV.

In this deliverable, we focus on the CLFP’s and CreFP’s without ignoring the other type of patterns as will be described in the sequence. Figure 1 shows the way that they will be used in IdSpace project. Starting from a more conceptual level which focuses on the pedagogical and creativity strategies (as described in deliverables D1.1 & D2.1), more specific designs in the form of flow design patterns can be created. DP’s play the role of lingua franca so that i) creativity teams can learn to use a specific collaborative and creativity strategy like Scamper, use of appropriate visualization techniques, give advice on appropriate methods to organize the prioritization of generated ideas, deepen the inquiry, etc; ii) the IdSpace system designing team can understand the functional requirements for the tools that will be incorporated into the IdSpace system. A similar concept of the way DP’s can be used for bridging the gap between instructional designers and software engineers can be found in (Turani & Calvo, 2006).

**Figure 2.** Bridging the gap between instructional design and software engineering

On the one hand, patterns are discovered or elicited after analyzing the way users (creativity team’s team members) collaborate or learn to collaborate for the development of innovative products as well as after studying in depth numerous implementations of creative scenarios in authentic places (Retalis, Georgiakakis & Dimitriadis, 2006).
Moreover, heuristics (Gutwin & Greenberg, 2000) and best design recommendations about collaborative learning and creative work that instructional and interaction designers have proposed need to be taken into consideration along with other related patterns such as Computer-Mediated Interaction (PCMI), the groupware patterns (GroP) and the networked learning system patterns (NLSP).

3.3. Format of the flow design patterns

The structure of a flow design pattern will include elements such as design problem’s description, the related context and a documented solution suggestion for this problem with concrete examples. Table 1 shows in detail the format of a FDP which is similar to the suggestion of CLFP by (Hernandez-Leo et al., 2006).

<table>
<thead>
<tr>
<th>Element</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Name of the FDP</td>
</tr>
<tr>
<td>Problem</td>
<td>Learning problem to be solved by the FDP</td>
</tr>
<tr>
<td>Example</td>
<td>A real-world learning activity capable of being structured according to the FDP</td>
</tr>
<tr>
<td>Context</td>
<td>Environment type in which the FDP could be applied</td>
</tr>
<tr>
<td>Solution</td>
<td>Description of the proposal by the FDP for solving the problem</td>
</tr>
<tr>
<td>Actors</td>
<td>Actors involved in the collaborative activity described by the FDP</td>
</tr>
<tr>
<td>Types of Tasks</td>
<td>Types of tasks, together with their sequence, performed by the actors involved in the activity.</td>
</tr>
<tr>
<td>Types and structure of Information</td>
<td>Description of the types of information identified in the collaborative activity and how they are related</td>
</tr>
<tr>
<td>Types and structure of Groups</td>
<td>Description of the types of groups of learners identified and how they are related</td>
</tr>
</tbody>
</table>

An example of a flow pattern which concerns a creative technique can be seen in Appendix IV. It is a Creativity Technique Flow Pattern (CreFP) and concerns the Six Hats technique. It tries to solve the following problem: “How can a problem be solved in a group or can a decision be made by examining possible solutions from several perspectives including true emotional aspects, using the Six Thinking Hats technique”. Similar CreFPs can be created for other techniques like SCAMPER and 5W1H which have been analytically mentioned in D2.1.
4. Guiding the idSpace user

4.1. **IdSpace & use: from design patterns to use patterns for configuration of useful advice**

The ambition of idSpace is the development of flexible integrated support enhancing learning, creativity and collaboration in function of professional teams working on new product design. In previous paragraphs we presented our ideas on the use of patterns to guide support.

In this section we will present ideas how useful pedagogical advice can be configured in idSpace based aimed at meeting the needs of the end-users of idSpace and making use of the possibilities of underlying design and use patterns.

Patterns provide a flexible way to help designer and (end) user to consider relevant actions. They point systematically to opportunities for application of successful heuristics.

Design patterns are developed for use by designers to define pedagogical strategies and system functionalities. The next step is implementation of these patterns in the idSpace environment resulting in presentation of recommendations and interactive dialogues with the end-user during their creative teamwork.

The design patterns provide the foundation for composition of the delivery of customized recommendations to the idSpace user, the creativity team’s team members as such or more specifically the idSpace user who fulfils the organizing role of “project facilitator” or “moderator”. The design patterns inspire tailored composition and delivery of recommendations. However the design patterns need to be operationalized to “use-patterns” The latter specify the instantiation and presentation of dedicated recommendations to the user.

The end user needs different information than the designer. The working professional in first instance asks for a solution to his problem. He will want to know what action to take (get a recommendation), why this would help (rationale and added value), get informed on how to apply the recommended actions (activity script) know which result he can expect from pursuing the recommendation (expected outcome).

At the same time a real user prefers a recommendation presentation matching their support needs. This implies different presentation elaboration to newly formed teams and newbies compared to experts and teams who worked earlier with each other. Use patterns provide principles for the instantiation for example depends on characteristics of team composition, domain, task type, phase, applicability of creativity technique.
From design pattern to use pattern; user recommendations

The aforementioned design patterns aim at support for the idSpace designers. From there onwards work is needed and decisions have to be taken to finally provide the actual user of idSpace with the appropriate recommendations. In this paragraph we address this issue: asking ourselves how recommendations are composed and presented to the user. What needs to be done to make this happen.

We assume that users of idSpace will be heterogeneous in more then one sense. They will come from various domains, have different domain expertise. Some users will be relative novices in the domain or new to virtual teamwork, while others are full experts. In yet other situations the applicable creativity technique is new to the users, etc.

A commonality of users will be the fact recommendations are welcome when they fit into the ongoing work methods and performance pressure of the ongoing NPD work. This implies that not all design pattern elements relevant for designers are relevant for use.

Users want to be able to find suggestions for the advancement of their creativity, work and collaboration processes and find a solution to their problems. For this they are interested in a recommendation preferably formulated in a way matching their needs. This implies that in the presentation of a recommendation: a recommended action scenario, (recommendation) information on the expected outcome (solution) added value of the proposed action (benefits) and eventually additional information on the recommendation constraints i.e. the contexts to which the proposed approach is applicable (context-constraints) are essential.

We foresee two types of use, (1) moderator composition of recommended action and (2) system composition of recommendation. In the latter the user gets a composed recommendation presenting the problem, the problem solving method recommendations, expected outcome and added value of the recommended strategy of action.

Each recommendation configured presents an optimal path to a solution (a next step in the creative problem solving/product creation). The recommendations present suggestions for activities, clever application of optimal learning, collaboration creativity strategies. In previous paragraphs we stated we assume that suggestions. The advice provided addresses relevant elements from the design pattern: information, task group type, complexity, actors involved.
### Table 2. Flow design and use patterns elements.

<table>
<thead>
<tr>
<th>Design pattern elements</th>
<th>Use pattern element</th>
<th>User support: configuration user recommendation: presentation relevant information &amp; interaction with user</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Name</td>
<td>Name for identification Name of the pattern, functions as keyword for user presentation and “tag” for steering (awareness) mechanism to compose recommendation</td>
</tr>
<tr>
<td>Problem</td>
<td>Problem</td>
<td>Problem to be solved. Problem statement expressed to the user for which problem the recommendation offers advice</td>
</tr>
<tr>
<td>Solution</td>
<td>Recommendation</td>
<td>Recommendation to solve problem. Activity scenario, configuration proposed to solve the problem.</td>
</tr>
<tr>
<td></td>
<td>Solution</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Benefit</td>
<td>Added value of recommended action</td>
</tr>
<tr>
<td>Context</td>
<td>Context</td>
<td>Provides information on the environment type to which the recommendation can be applied</td>
</tr>
</tbody>
</table>

**Actors**

**Types of Tasks**

**Types and structure of Information**

**Types and structure of Groups**

Information integrated in the recommendation text if relevant
4.2. Configuration of recommendations

Ultimate aim of this is implementation of the optimal pedagogical support recommendation for the collaborative creativity of teams, tailored to the expected needs of the user(s) in their specific setting.

For this purpose we will be able to use the capabilities of the idSpace awareness mechanisms and the capacities that underlying pedagogical design and use patterns offer.

Based on the repository information and meta-information in combination with the awareness component of idSpace the system can or will in combination with the person of the team’s moderator configure the appropriate recommendation set.

Presentation of recommendations to the end-user are based on (underlying) design and use patterns. The design patterns focus on the design of pedagogical sound solutions to creativity, collaboration learning problems.

The design patterns steer the use-proposition to the end-users. Design patterns steer the design of a proposition for the users (inter)activity in the IdSpace environment: for learning, collaboration and optimal use of creative techniques in a certain situation. The “use” pattern or genre presents the actual support composition for the user in IdSpace teamwork X,Y or Z. The configured recommendations are based on the design patterns and use tags to feed the recommendations and dialogue with the user accordingly. Thus the use patterns specify how these pattern translate into user information and activity propositions in the team’s workspace. It presents the actual support composition the type of information to be delivered to the end-user.

![Diagram](Figure 3. Hernández-Leo, (2005) COLLAGE, patterns for collaborative learning design.)

Dedicated recommendations are built on the basis of design patterns and use patterns. Certain recommendations can be composed automatically using the awareness information and engine to customize the recommendation to the phase of teamwork.
Take for example the case in which the awareness component observe that team X consist of novices in a new formed team at the start of the TV spot project at X.Ltd. Based on this it activates the Pexpi profiling pattern (Berlanga, Bitter-Rijpkema, Brouns, & Sloep, 2008) and configures the elaborated version of recommendation fitting the support needs of novices. This explains the personal information in combination to expertise information for a quick start and building swift trust. Additional explanation not needed for teams who already worked with the Pexpi’s. The same accounts for matching the recommendation presentation to teams of novices or experts to team’s who used a certain creativity technique or tool earlier or those who are new to the tool or technique.

In all cases idSpace generates advice, but in the end the users decide on its use.
5. Par example

In the previous paragraphs we described the need to support self-organizing professionals during their creative teamwork for new product design. In this chapter we will illustrate how the proposed type of customized recommendations, explicitly supporting collaborative learning and stimulating creativity, will concretely help new product design idSpace recommendations are based on state of art knowledge on enhancement of creativity and pedagogical insight on support of collaboration and learning of professionals in distributed team contexts.

Flow design patterns are valuable tools for configurable recommendations since they provide explanation and support for how and when to apply a design solution.

As stated earlier recommendations are configured based on flow design patterns or other types of patterns and heuristics. IdSpace end users (i.e. team members who collaborate for the innovative product development) are provided with suggestions of appropriate actions. They then decide for straightforward use, ignore them or adaptation of the context’s constraints.

A single design pattern is not adequate for giving recommendations to the user. The starting point is always a CLFP or a CreFP. However, the user (eventually represented by the team moderator) will make a configuration of a pattern and make use of other patterns and/or heuristics with which it is interrelated. The reason is that for the actual use of a creative strategy the users need to balance a variety of organizational, administrative, instructional and technological components. This is why the way of presenting the recommendations with FDPs is easily configurable to the context of each innovative product development project.

In order to illustrate this, we present an example of a collaborative creative process where flexible customizable design of the process is needed. The process will originally be based on a specific CLFP. But a phase of the CLFP will be structured using another CLFP (e.g. the second phase of a “pyramid CLFP” will be a “debate CLFP”)

The example of the X.Ltd advertisement company

X.Ltd is an advertisement company which has been asked to create a new TV spot for human cloning. In order to create a successful TV spot the project manager calls nine (9) talented colleagues who are advertisers which are geographically dispersed asking them to work on ideas for this spot.

This should be an innovative TV spot that has should be very appealing though its subject is very sensitive. She wants her colleagues to propose a TV spot after having examined the human cloning issue from a scientist, ethic and legislative perspective. Thus, the project manager (PM) wants to apply a collaborative strategy which will lead to a
successful end result accepted by all journalists as well as to foster discussion, positive interdependence and individual accountability. She wants to set the issue of TV spot creation for investigation and resolution as well as to provide her colleagues with the required instructions and guidance. Colleagues will be able to communicate and collaborate both via asynchronous and synchronous discussion tools offered by the idSpace system. PM also plays the role of and facilitator of the discussions and monitors the whole process.

The project manager decides to create her own process by adapting accordingly the Jigsaw strategy. Thus she uses the Jigsaw CLFP and decides to make some adjustments by changing phase two and using some elements from Pyramid strategy and the relevant CLFP.

The applied configured strategy is a combination JIGSAW and TPS CLFPs which is explained below. It is also shown in Figure 2.

During phase one, each colleague individually studies online resources that the PM has suggested, seek, collect and share information with their peers. The ultimate task is that each colleague submits a short essay with draft ideas about the TV spot. During the 1st phase, colleagues can communicate with each other and propose other online resources that could also be studied.

Then, in phase two, colleagues form three groups consisting of three members. They share the initial ideas that individually had been asked to create during phase 1. In a group each member undertakes a specific role: scientist, expert on ethics, legislator in order to examine the ideas of TV sports about the human cloning from all different perspectives in depth. Members of each group collaborate in order to jointly write and deliver a team’s TV spot. In parallel, colleagues who have undertaken the same role (e.g. scientists) can also communicate and exchange ideas/resources in a separate forum created for this specific role. Thus, there is not a competitive spirit but rather a cooperative one.

Finally in phase three, group ideas are circulated among all colleagues in order to be discussed at a plenary session. Voting for or against the candidate three TV spots will occur.
In order that the PM successfully applies this strategy she looks at two other patterns, namely the “Prepare fruitful discussions using questionnaires” in order to effectively facilitate the discussions and the “well chosen resources” in order to choose the most appropriate resources that her colleagues will use. She also has into mind that based on the groupware heuristics during the collaborative creative process awareness should occur.
6. Conclusion

The research on the systematic development and evaluation of CSCL and computer supported collaborative creative design systems is still scarce, and the results are not conclusive. In the IdSpace project, we are not trying to achieve a set of universal truths applicable to any situation of supporting collaborative development of innovative products, disregarding its context.

However, via the proposed flow patterns as well as systematic design, for development and evaluation of the IdSpace system, we will be better able to distinguish which kind of issues affect learning in technology enhanced collaborative creative design processes for innovative products as well as to provide solutions to the typical problems that might be found in schools, universities, corporate research labs and other learn places.

We have presented our ideas on design and configuration of recommendations. Providing advice for application of appropriate creativity techniques, methods to stimulate collaboration, support inquiry and reflective discussions.

For implementation in the idSpace prototypes, further work will be done to create and validate new patterns based on the guidelines from D.1.1. We can suggest patterns for other creativity techniques and pedagogical strategies. Examples could be patterns for expansive learning, suggestions to cross the zone of proximal development, specific inquiry and creativity techniques to stimulate creative thinking across nearby associations to new less proximate associations.

Design patterns focus on the design of pedagogical sound solutions to creativity, collaboration learning problems. Specifications for its presentation and use in idSpace require special attention to complement design patterns, use patterns specify systematically how these design patterns translate into user information and activity propositions. The latter present the transformation to actual support composition, the type of information to be delivered to the end-user.

Based on the repository information, meta-information and the activities of the awareness component of idSpace either by the system alone or in combination with user’s (moderator’s) input the appropriate recommendation set is configured. Together they bridge the world from idea on support to user support in action.
References


Appendix 1 Overview of possible use patterns for collaborative creativity

In order to get a concise overview of possibilities for pedagogical support and their relation with awareness and patterns appendix 1 presents a global insight into the relation between the phases of NPD (as described in D1.1) relevant user actions (derived from the use cases and the IPC model from Schmidt) possible type of recommendations and affordances and pointers to available patterns for idSpace.

<table>
<thead>
<tr>
<th>User activity/support need</th>
<th>Awareness of use and user situation</th>
<th>Recommendation dimensions</th>
<th>Design and use pattern availability</th>
</tr>
</thead>
</table>
| Activity the user is involved in | - Phase NPD  
- Person profile  
- Team composition  
- Task type  
- Creativity technique  
- Knowledge (re)sources) types  
- State of transformation: Problem solving process | - Type of learning enhancement: creativity methods, inquiry strategy, assessment of common ground, scaffolding dialogue, clustering/structuring generated ideas, reflection in action.  
- Customization of recommendation to constraints: team work context, expertise characteristics of team, optimization to the needed fluidity/flexibility or structuration  
- Application of creativity technique-use of tools  
- Collaboration dimension | Collaborative pattern e.g.  
- Pyramid  
- Jigsaw pattern  
Creativity pattern e.g.  
- Scamper  
- Triz  
-… |
## Appendix 2 Overview of possible use patterns for collaborative creativity

In this appendix we present each phase in the NPD process in more detail possible user actions and the support they require in the form of recommendations, their relation to patterns and needed implementation use patterns, specific tooling and idSpace functionalities.

Row 1: Phase in NPD process. Description/explanation of terms+dimensions
Row 2: User actions or “operations” the user performs.
Row 3: The recommendations suggest the user to do specific things, aimed at optimizing creativity, learning and collaboration. Recommendations can be translated into use patterns.
Row 4: Activation/presentation of appropriate recommendations for team/user in a specific phase/problem situation triggered through the awareness decision making mechanisms or to be selected by the user self.

<table>
<thead>
<tr>
<th>Phase in creativity process</th>
<th>Pre project phase</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Possible user actions</strong></td>
<td></td>
</tr>
<tr>
<td>Initial scan. Project manager/team members scan project conditions</td>
<td></td>
</tr>
<tr>
<td>(1) Project description: deliverable(s), project plan etc</td>
<td></td>
</tr>
<tr>
<td>(2) Team composition</td>
<td></td>
</tr>
<tr>
<td><strong>Possible recommendations to be translated (potentially) into “use patterns”</strong></td>
<td></td>
</tr>
<tr>
<td>Analysis of project description (1).</td>
<td></td>
</tr>
<tr>
<td>Check for (as clear as possible):</td>
<td></td>
</tr>
<tr>
<td>- Initial problem description</td>
<td></td>
</tr>
<tr>
<td>- Specification of project objectives</td>
<td></td>
</tr>
<tr>
<td>- Specification of outcomes: deliverables (demands by organization/customer), design/product.</td>
<td></td>
</tr>
<tr>
<td>- Description of project constrains (i.e. time and budget)</td>
<td></td>
</tr>
<tr>
<td>Analysis of team characteristics and the consequence of this with respect to creativity (2).</td>
<td></td>
</tr>
<tr>
<td>Recommendations to create teams, that :</td>
<td></td>
</tr>
<tr>
<td>- are diverse, inclusive and share knowledge and expertise and take care of the basic enabling processes.</td>
<td></td>
</tr>
<tr>
<td>- articulate their goals</td>
<td></td>
</tr>
<tr>
<td>- have clear and specific goals (goal-stability).</td>
<td></td>
</tr>
<tr>
<td>- have commitment and support of the organization (’s management).</td>
<td></td>
</tr>
<tr>
<td>Affording circumstances to take into account on team composition:</td>
<td></td>
</tr>
<tr>
<td>- necessary and desired disciplines,</td>
<td></td>
</tr>
<tr>
<td>- necessary levels of expertise</td>
<td></td>
</tr>
<tr>
<td>- individual characteristics</td>
<td></td>
</tr>
<tr>
<td>For example check:</td>
<td></td>
</tr>
<tr>
<td>o Myers-Briggs (MBTI) profile</td>
<td></td>
</tr>
<tr>
<td>o ‘openness’ towards others</td>
<td></td>
</tr>
<tr>
<td>o willingness to communicate with ICT</td>
<td></td>
</tr>
<tr>
<td>Affording circumstances to take into account on team context:</td>
<td></td>
</tr>
<tr>
<td>- ‘new team – new task’ or ‘same team – new task’</td>
<td></td>
</tr>
<tr>
<td>Possible implementation in IdSpace functionalities / tooling</td>
<td>Checklist functionality including a provision of (creativity) dimensions to be taken into account.</td>
</tr>
<tr>
<td>-------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>

### Phase in creativity process

| Preparation NPD: set up project setting |  |

### Possible user actions

| Appoint moderator |  |

### Possible recommendations to be translated (potentially) into “use patterns”

| Suggestions and guidance on: Information on leading / moderating creative teams |  |

### Possible implementation in IdSpace functionalities / tooling

| Affordances: awareness of status > setting in place functionalities: person, resources, tools etc |  |

### Phase in creativity process

| Preparation NPD: Get to know software |  |

### Possible user actions

| Get to now IdSpace, the software. |  |

### Possible recommendations to be translated (potentially) into “use patterns”

| Manual, (context sensitive) help |  |

### Possible implementation in IdSpace functionalities / tooling

<p>| Introductory “tour” if wanted “Help” + get acquainted functionalities |  |</p>
<table>
<thead>
<tr>
<th>Phase in creativity process</th>
<th>Preparation NPD: Activate idSpace workspace</th>
</tr>
</thead>
<tbody>
<tr>
<td>Possible user actions</td>
<td>Adjust IdSpace: fill in personal preferences/profile (1st time, then optional / individual user)</td>
</tr>
<tr>
<td>Possible recommendations to be translated (potentially) into “use patterns”</td>
<td>Check for:</td>
</tr>
<tr>
<td></td>
<td>Additional information on the design team composition and context</td>
</tr>
<tr>
<td></td>
<td>- Info regarding: work context, domain, team, (novices/experts, disciplines, prior design and team experiences etc), task (novelty of task), constraints (i.e. budget, assigned time), team role</td>
</tr>
<tr>
<td></td>
<td>- Information i.e. with respect to the design domain needed to present domain specific creativity suggestions (i.e. specific TRIZ creativity techniques for engineering &amp; sciences)</td>
</tr>
<tr>
<td></td>
<td>- Information with respect to work mode: i.e.</td>
</tr>
<tr>
<td></td>
<td>o individual or group mode</td>
</tr>
<tr>
<td></td>
<td>o virtual, hybrid or face to face setting</td>
</tr>
<tr>
<td></td>
<td>o verbal of visual mode.</td>
</tr>
<tr>
<td></td>
<td>Remark: this type of additional information can be used by idSpace to present relevant pedagogical advice, advice on creativity techniques and advice on collaborative learning/working techniques.</td>
</tr>
<tr>
<td>Possible implementation in IdSpace functionalities / tooling</td>
<td>Team profile functionality &gt; team composition recommendations</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Phase in creativity process</th>
<th>Preparation: Get to know the team members</th>
</tr>
</thead>
<tbody>
<tr>
<td>Possible user actions</td>
<td>Get to know the team members: meet them, scan their profiles</td>
</tr>
<tr>
<td>Possible recommendations to be translated (potentially) into “use patterns”</td>
<td>Suggestions and guidance on:</td>
</tr>
<tr>
<td></td>
<td>- Scanning profiles</td>
</tr>
<tr>
<td></td>
<td>- Introductory (F2F) meeting</td>
</tr>
<tr>
<td></td>
<td>- ‘Get-to-know-each-other’ techniques</td>
</tr>
<tr>
<td>Possible implementation in IdSpace functionalities / tooling</td>
<td>Profile functionality</td>
</tr>
<tr>
<td></td>
<td>Awareness functionality (Who’s online etc.)</td>
</tr>
<tr>
<td>Phase in creativity process</td>
<td>NPD: problem exploration phase</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>--------------------------------</td>
</tr>
<tr>
<td><strong>Possible user actions</strong></td>
<td>Exploring, clarifying the problem (gather data/facts)</td>
</tr>
<tr>
<td>Remark: can be done both individually and collectively. Should, in the end, be done collectively in order to get a complete understanding of all aspects of the problem. As a consequence - articulate - communicate - collaborate</td>
<td></td>
</tr>
<tr>
<td>Remark: basic operation mode of IdSpace is ‘collective’; however, users should be facilitated to work individually.</td>
<td></td>
</tr>
<tr>
<td>Users, - retrieve assignment (project plan / DOW) - ask questions (mainly aimed at diversity) - reframe questions - activate prior knowledge - retrieve knowledge - formulate metaphors - experiment - construct preliminary mental model - apply creativity techniques - apply collaborative learning/working techniques</td>
<td></td>
</tr>
<tr>
<td>In doing all this, the user takes notes, jots down aspects of the problem. All things generated (in the form of text, drawings, speech etc.) should be captured and stored by IdSpace.</td>
<td></td>
</tr>
<tr>
<td><strong>Possible recommendations to be translated (potentially) into “use patterns”</strong></td>
<td>Support mechanisms in this phase result in the stimulation of a person’s and team’s ability to explore, from all angles, the issue at hand.</td>
</tr>
<tr>
<td>Suggestions and guidance on: - use of collaborative learning/working technique (pattern: i.e. JigSaw, Pyramid) - use of creativity technique (pattern: i.e. De Bono, Triz, Scamper) - relevant associated knowledge - use of experimenting techniques / mental simulation techniques - use of modelling constructing techniques - use of metaphors All possible with patterns.</td>
<td></td>
</tr>
<tr>
<td>Basis of recommendations among others</td>
<td></td>
</tr>
<tr>
<td><strong>Scaffolding:</strong> providing additional knowledge / support on aspects of problem depending on level of expertise.</td>
<td></td>
</tr>
<tr>
<td>Example: Provide a pattern of steps for progressive Inquiry (PI) Like</td>
<td></td>
</tr>
</tbody>
</table>
### Problem Space Creation

- Create problem space
- Formulate question(s)
- Articulate working theory
- Externalize problem space dimensions (> visualization in concept/topic map)

Example: work along the De Bono 6 Hats pattern
http://en.wikipedia.org/wiki/De_Bono_Hats
White hat – Facts & Information
Blue hat – The Big Picture

### Possible implementation in IdSpace functionalities / tooling

Recommendations generation triggered by awareness info and decision mechanism to present appropriate recommendation based on patterns

Requires availability of patterns like the “De Bono 6 hats” design + use patterns

Workspace functionalities i.e. problem space exploration facilities

Knowledge retrieval facilities:
- Scan IdSpace idea database
- Scan organization’s databases (explicit knowledge)
- Scan user profiles (who possess the potential tacit knowledge)
- Scan the internet

Search facilities e.g. Google, idSpace project memory search functionality

Mental Modelling and representation facilities

Knowledge capturing facilities: including visual, text oriented tooling > drawing/sketch+ topic maps functionalities, wiki.

Communication facilities: chat

Collaboration facilities: knowledge exchange functionalities: debating tools, clustering, weighting - voting
<table>
<thead>
<tr>
<th>Phase in creativity process</th>
<th>NPD: Defining problem (-space): where are we now?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Possible user actions</td>
<td>Users</td>
</tr>
<tr>
<td></td>
<td>- ask questions</td>
</tr>
<tr>
<td></td>
<td>- reframe questions</td>
</tr>
<tr>
<td></td>
<td>- activate prior knowledge</td>
</tr>
<tr>
<td></td>
<td>- retrieve knowledge</td>
</tr>
<tr>
<td></td>
<td>- experiment</td>
</tr>
<tr>
<td></td>
<td>- refine mental model</td>
</tr>
<tr>
<td></td>
<td>- apply creativity techniques (through pattern)</td>
</tr>
<tr>
<td></td>
<td>- apply collaborative learning/working techniques (through pattern)</td>
</tr>
</tbody>
</table>

In doing all this, the user takes notes, jots down aspects of the problem. All this captured by IdSpace

<table>
<thead>
<tr>
<th>Possible recommendations to be translated (potentially) into “use patterns”</th>
<th>Support mechanisms in this phase result in the stimulation of a person’s and team’s ability to truly capture the issue at hand.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Suggestions and guidance on:</td>
</tr>
<tr>
<td></td>
<td>- use of collaborative learning/working technique</td>
</tr>
<tr>
<td></td>
<td>- use of creativity technique</td>
</tr>
<tr>
<td></td>
<td>- relevant associated knowledge</td>
</tr>
<tr>
<td></td>
<td>- use of experimenting techniques / mental simulation techniques</td>
</tr>
<tr>
<td></td>
<td>- use of modelling constructing techniques</td>
</tr>
<tr>
<td></td>
<td>- use of metaphors</td>
</tr>
</tbody>
</table>

Example: De Bono
White hat – Facts & Information
Blue hat – The Big Picture

<table>
<thead>
<tr>
<th>Possible implementation in IdSpace functionalities / tooling</th>
<th>See above</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge capturing facilities</td>
<td></td>
</tr>
<tr>
<td>Communication facilities</td>
<td></td>
</tr>
<tr>
<td>Collaboration facilities</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Phase in creativity process</th>
<th>NPD: Define solution (-space): where do we want to go to?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(basically the boundaries within which the solution has to fit and agreement on the prime objective)</td>
</tr>
<tr>
<td>Possible user actions</td>
<td>Users;</td>
</tr>
<tr>
<td></td>
<td>- Check known constraints: time, budget, target audience, juridical, ethical, environmental aspects etc.</td>
</tr>
<tr>
<td></td>
<td>- Formulate Prime Objective (awareness on getting agreement on a clear goal definition not only for the overall project but for each phase of the project).</td>
</tr>
<tr>
<td></td>
<td>- Generate glossary</td>
</tr>
<tr>
<td></td>
<td>- Formulate Plan B (minimal requirements/worst case solution) and Plan A (ideal/best solution)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Possible recommendations to be translated (potentially) into “use patterns”</th>
<th>Suggestions and guidance on:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- Checking/listing possible constraints</td>
</tr>
<tr>
<td></td>
<td>- Objective generating and weighing techniques</td>
</tr>
</tbody>
</table>
**Possible implementation in IdSpace functionalities / tooling**  
Prime objective facilities
Knowledge capturing facilities, Communication facilities, Glossary facilities

<table>
<thead>
<tr>
<th>Phase in creativity process</th>
<th>NPD: Generate solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Possible user actions</strong></td>
<td>Users:</td>
</tr>
<tr>
<td></td>
<td>- recall problem</td>
</tr>
<tr>
<td></td>
<td>- activate prior knowledge</td>
</tr>
<tr>
<td></td>
<td>- retrieve knowledge</td>
</tr>
<tr>
<td></td>
<td>- adapt, transfer knowledge</td>
</tr>
<tr>
<td></td>
<td>- apply thinking techniques (e.g. associative thinking, lateral thinking) complementing de- and inductive logics</td>
</tr>
<tr>
<td></td>
<td>- apply creativity techniques</td>
</tr>
<tr>
<td></td>
<td>- apply collaborative learning/working techniques</td>
</tr>
</tbody>
</table>

In doing all this, the user takes notes, jots down aspects of the problem. All this captured by IdSpace

<table>
<thead>
<tr>
<th>Possible recommendations to be translated (potentially) into “use patterns”</th>
<th>Support mechanisms in this phase result in the stimulation of a person's and team's creative ability.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Suggestions and guidance on:</td>
</tr>
<tr>
<td></td>
<td>- collaborative learning/working technique (pattern)</td>
</tr>
<tr>
<td></td>
<td>- applying methods (patterns) and tools for ideation (patterns for creativity and thinking techniques, e.g. visualizing / imaginative thinking)</td>
</tr>
<tr>
<td></td>
<td>- the use of idea articulation techniques using multi-modalities: words-graphics-sketches and links to artefacts;</td>
</tr>
<tr>
<td></td>
<td>- Sense making: adding semantics and structure in the generated articulations via associations defining relations between topics, annotating and tagging topics and relations; signalling relationships between concepts, retrieving additional information.</td>
</tr>
</tbody>
</table>

Affording circumstances to take into account:
   - Postponement of criticism; stimuli/enabling conditions to generate still more and new ideas; improve ideas; prevent jumping to conclusions
   - Learning from each other during the collective brainstorm: need for clear articulation, open minded listening, feedback, clarification and elaboration requests

Example pattern: apply steps of PI (see above)
   - Externalization of thoughts/ideas
   - Searching for new information

Example pattern: Evolving Artefacts (heuristics)

Example pattern: De Bono
Red hat – Feelings & Emotions
Yellow hat – Positive Judgement
Green hat – alternatives and creativity

<table>
<thead>
<tr>
<th>Possible implementation in IdSpace functionalities / tooling</th>
<th>Knowledge retrieval facilities (see above)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pedagogical-Creativity facilities</td>
</tr>
<tr>
<td>Phase in creativity process</td>
<td>NPD: Evaluate solutions</td>
</tr>
<tr>
<td>----------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>Possible user actions</td>
<td>Weigh the pro’s and con’s</td>
</tr>
</tbody>
</table>
| Possible recommendations to be translated (potentially) into “use patterns” | Suggestions and guidance on:  
  - Roles (e.g. introduce role of criticaster / ‘devil’s advocate’)  
  - Methods to timely, systematically evaluate and positively comment to the ideas brought forward  
  - Use of clustering and voting mechanism to gain insight in the collective perception of the outcomes ideation phase i.e. mechanisms to sort ideas (example: Pythagoras); mechanisms to filter out contradictions (example: Contradiction Matrix)  
  - Check solution space (retrieve Plan A, plan B and ‘match’ solution against goal and constraints)  
  
Example pattern de Bono  
Black hat – Critical Judgement  
Blue hat – The Big Picture |
Appendix II. Jigsaw & TPS CLFPs

**Jigsaw CLFP**

... within a collaborative learning scenario in which the use of collaboration scripts designed according to DESIGNING SCRIPTS BASED ON BEST PRACTICES IN CL STRUCTURING is seen as a solution for situations where forming groups does not lead necessarily to learning, these best practices should be identified and formulated.

**CONTEXT**

This pattern gives the collaborative learning flow for a context in which several small groups are facing the study of a lot of information for the resolution of the same problem.

---

**PROBLEM**

The collaborative learning flow must enable the resolution of a complex problem/task that can be easily divided into sections or independent sub-problems.

**DISTINCTIVE EDUCATIONAL BENEFITS**

Objectives regarding proceeding:

- To promote the feeling that team members need each other to succeed (positive interdependence)
- To foster discussion in order to construct students’ knowledge
- To ensure that students must contribute their fare share (individual accountability)

**COMPLEXITY**

High-risk: more appropriate for collaborative learning experienced individuals

**SOLUTION**

Each participant (individual or initial group) in a group (“Jigsaw Group”) studies or work around a particular sub-problem. The participants of different groups that study the same problem meet in an “Expert Group” for exchanging ideas. These temporary focus groups become experts in the section of the problem given to them. At last, participants of each “Jigsaw group” meet to contribute with its “expertise” in order to solve the whole problem. Each participant
The individual phase, the expert-group phase or the jigsaw group phase can be structured according to PYRAMID CLFP. The phases of the Jigsaw can also follow any pattern of the “(Collaborative) Learning Activity level” guidelines and recommendations for particularization / customization, instantiation and execution.

During particularization, several tasks should be performed: global problem definition, division of the problems in subproblems, provision of necessary resources (contents and tools), decisions about control of time.

Instantiation of the Jigsaw CLFP-based learning design (script):
- Being the only expert in a sub-problem in the “Jigsaw Group” can be a demanding experience for students. This can be mitigated if two group members share the same section of the problem.
- During instantiation, several tasks should be performed: creation of particular jigsaw groups, assignment subproblems to each member of the groups (and thus creating expert groups).
example: Collaborative understanding of a paper where each subsection (excluding the summary and introduction) is assigned to each member or every "Jigsaw Group". Face to face scenario, in which each person has available a PC.

Pyramid CLFP

(super-context and relations with other high-level patterns) … within a collaborative learning scenario in which the use of collaboration scripts designed according to DESIGNING SCRIPTS BASED ON BEST PRACTICES IN CL STRUCTURING is seen as a solution for situations where forming groups does not lead necessarily to learning, these best practices should be identified and formulated.

CONTEXT
This pattern gives the collaborative learning flow for a context in which several participants face the collaborative resolution of the same problem

***

PROBLEM
Complex problem, usually without a concrete solution, whose resolution implies the achievement of gradual consensus among all the participants

(DISTINCTIVE)
Objectives regarding proceeding:

EDUCATIONAL BENEFITS

o To promote the feeling that team members need each other to succeed (positive interdependence)

o To foster discussion in order to construct students’ knowledge

COMPLEXITY
Medium-risk

SOLUTION
Each individual participant studies the problem and proposes a solution. Groups (usually pairs) of participants compare and discuss their proposals and, finally, propose a new shared solution. Those groups join in larger groups in order to generate new agreed proposal. At the end, all the participants must propose a final and agreed solution

(diagram representing the solution)

---

Teachers

Individual or initial group (general representation)

Level N

Level i

Level 1

---

PHASE N: All must proposed a final and agreed solution

PHASE i: Compare, discuss and propose a shared solution

PHASE 1: Individual or initial group study of the problem. Proposes a solution

***
Each level of the Pyramid (except level N) can be structured according to JIGSAW CLFP.

The phases of the Pyramid can also follow any pattern of the “(Collaborative) Learning Activity level”

Particularization/customization of the pattern into a learning design:
- During particularization, several tasks should be performed:
  determination of the levels of the Pyramid, definition of objectives and prerequisites of design, specification of each (teachers’ and learners’) activity description (definition of global problem, etc.), provision of necessary resources (contents and tools), and decisions about completion of activities (e.g. control of time).

Example:
- Collaborative proposal of a computing system for a client with particular requirements where each participant contributes with a proposal that is compared with other contribution and consequently refined. Face to face scenario, in which each person has available a PC
Pyramid CLFP-based LD: Simple design of a computing system

ACTIVITY DESCRIPTION 1
Each individual read the requirements of the client and benchmark the machines available.

RESOURCES
- Document that presents the client's requirements
- Benchmarks documentation
- Machines' documentation
- Benchmarking tool

SERVICES: Asynchronous forum

ACTIVITY DESCRIPTION 2
Propose the best machine for the client.

RESOURCES
- (The same)

ACTIVITY DESCRIPTION 2
Propose an agreed machine for the client.

RESOURCES
- (the same)

OBJECTIONS:
- To learn the importance of requirements when designing computing solutions
- To know the role of benchmarks and how to use them
- To get used to manage different types of documentation

PREREQUISITES:
- To have previous basic knowledge about benchmarking

Appendix III. Patterns about the CSCL process (from TELL (2005))

Prepare fruitful discussions using questionnaires

(CONTEXT) Structuring of discussions (see pattern DISCUSSION GROUP [1]) as standalone activities or as part of more complex scenarios, e.g., those following the PYRAMID CLFP: “...Groups (usually pairs) of participants compare and discuss their proposals...”

CONTEXT Several students collaboratively discuss about the results of a previous activity or about a subject posed by the teacher/facilitator.

***

PROBLEM The exploration of contradictory views in a discussion can promote a deeper understanding of a subject. It can stimulate each participant to develop their own opinions and explore their reason for them. However, discussions are not sometimes much fruitful because of a lack of structure of the ideas to debate.

(ANALYSIS) As it is said in [1]:

EDUCATIONAL FORCES

- not getting going properly within the time available
- dissipating into a number of loosely related strands that fail to engage effectively with subject being studied
- dissolving into monologues or two-way conversations that fail to involve the whole group

SOLUTION Before the discussion takes place, prepare a questionnaire with questions related to the topics that should be particularly discussed. The students should answer the questionnaire thus enabling them to organize their ideas and helping them to find arguments to defend their opinions on the main topics.

***

FACILITATOR: “Prepare fruitful discussions using questionnaires” pattern may be used by the facilitator role as a way of potentially enhancing the learning outcomes of the collaboration (which is exactly the goal of the Facilitator pattern).

MANAGING OF ON-LINE QUESTIONNAIRES (pattern 18 from E-LEN WP3 report)
In the context of a course on Computer Networks, several students capture and analyse data network traffic composed of messages of the TCP (Transmission Control Protocol) traffic. After the analysis of that traffic, the students are requested to discuss on whether there are potential negative effects of the simultaneous activation of different protocol mechanisms. The teacher/facilitator prepares a questionnaire with questions such as:

- In a scenario of interactive traffic, what are the time intervals between the different segments? What are the mechanisms responsible for that time pattern? (This question helps the student to elaborate arguments on the effects of the “delayed ack” mechanism on interactive traffic scenarios).

- After establishing a TCP connection, why some TCP implementations start by sending two TCP segments instead of only one according to the slow-start mechanism? (This question helps the student to elaborate arguments on the effects of the “delayed ack” mechanism on the “slow start” mechanism).

- ...

The students should answer the questionnaire before starting the discussion. Tools for the management of questionnaires are very useful for the application of this pattern (e.g., see [2]).

Well-chosen resources

Patterns this completes: RESOURCE SELECTION

Students usually benefit from guidance about what they should read. Yet it is also a good idea to give them some choice about what they read. You would probably like them to read much more than they have time to read. So selection of reading matter involves a balancing act – and a realistic sense of what students will do.

*****

People can only read so much. People have different reading speeds. Sometimes one can skim-read, sometimes reading is hard and slow. But these variations are not an excuse for ignoring the fact that we should not overload students (or, for that matter, provide them with insufficient resources). The design problems falls into two parts. How much can they be expected to read in the time they have available? What should they read?

An important part of course planning is estimating the time that students will have available for different activities within the course. Only part of the time they have available will be for reading. They will have other important things to do. You can then think about how to help them budget their reading time. To do this, it is useful to classify the things you want them to read. Some will be things that will take a relatively short time to read (either because you think they are easy to read, or that the students only need to get a surface familiarity with them). Other things will need more time, because they are difficult or because you really want the students to master their contents. It’s rarely worth having more than a simple classification: perhaps two types of reading (easy, demanding) or three (easy, intermediate, demanding). Only use more than that if timing is a critical issue.

Now you need some rules of thumb for how long it takes for your average student to read an ‘easy’ and a ‘hard’ piece of text. Hartley (19xx) gives the following guidelines......[to be completed] – make sure we cover average length of papers/articles; variation about the mean (especially where students are having to read in a language that isn’t completely familiar to them; or if some of the students don’t have as much familiarity with the area as do students for whom the ideas and literature are more familiar.)

Once you have a good estimate of how much you can reasonably ask students to read, and it is often a surprisingly low figure, then you have to decide upon a strategy for selecting and/or guiding their reading.
reading. This depends a little on your policy about reading. There are a number of legitimate positions. For example, you can identify a core of ‘essential’ reading and then let students select at will from among a larger set of ‘optional’ readings. Or you can link subsets of reading material to tasks, such that it is the students choice of task that determines what they read. In any event, it pays to explain your choices to the students.

Note: what has been said here applies to other kinds of learning resources. In each case, you need a realistic estimate of how much time students will need, and be able, to spend on working with the resource, as well as a policy and strategy for selecting resources. Estimating the time needed is much more difficult with highly interactive resources, and with resources that offer multiple navigation paths, than it is with resources that are less interactive or which have a linear or near linear structure. Therefore, treat your students’ time as precious. Recognise that they have other legitimate calls on their time. Allow for the probability that they will only spend time on reading things that clearly connect with tasks that you have set them – especially, the tasks that you have indicated are valuable to you by making them part of your assessment regime.

*****

Patterns needed to complete this pattern:

READING POLICY, RESOURCE SELECTION STRATEGY (?), TEXTS, more??

Annex Pattern thumbnail for ‘Discussion Group’

This pattern ((adopted from (ELEN, 2003) is mainly concerned with the establishment of appropriate organisational forms for knowledge-sharing, questioning and critique.

Problem:
“Discussion groups are the most common way of organising activity in networked learning environments. The degree to which a discussion is structured, and the choice of structure, are key in determining how successfully the discussion will promote learning for the participants”.

Solution:
“Start any online discussion by establishing its structure. Make the rules and timetable for this structure explicit to all the members of the group. Where there is little time
available to the group for the discussion, and/or the members of the group are inexperienced at holding online discussions, the teacher/facilitator should set the structure. Where the students are to set their own structure, the teacher/facilitator should give them support and ideas about how to do this, and encourage them to do so in a fair and timely way”.

Related patterns:

DISCUSSION ROLE, FACILITATOR, DISCURSIVE TASK
# Appendix IV. Creativity Techniques Flow Patterns

This appendix contains flow design patterns for well-known creativity techniques. The first pattern that has been created (and its subject for reviewing) is about the Six Thinking Hats creativity technique. Other flow patterns for techniques like SCAMPER will be added.

<table>
<thead>
<tr>
<th>Name</th>
<th>Six Thinking Hats technique</th>
</tr>
</thead>
</table>

| Context            | In everyday life, problem solving and/or decision making is often a result of collaboration – within a group – of several people with different thinking and planning styles. This is evident in the academic, professional, or political context. Group members contribute according to their personality, inner strengths and thinking styles. Some people think strategically, methodically and with great discipline, trying to foresee possible consequences, while others people often “listen to their hearts”. Some people think from a very rational, positive viewpoint, showing resistance to change, while at the same time they don’t make creative leaps. Other people are used to a more intuitive approach to problem solving which makes them engage with passion into new ideas that might not be very realistic based on socio-technical constrains of the context. It is necessary, however, to hear all voices and examine a problem and possible solutions from various perspectives. As an example, let’s assume that a town council is trying to decide whether or not several local school buildings should be combined into a new one, and what the options are for the use of the old buildings if those become vacant. The decision makers have to analyze all options, critically determine the advantages and disadvantages of the suggested solutions, and do a risk assessment of the outcomes before ending up with creative final solutions. |
| Problem            | How can groups make sure that all possible (practical as well as emotional) perspectives have been examined during a problem solving or a decision making process? |
| Solution           | Use of the Six Thinking Hats technique, where each "Thinking Hat" represents a different thinking perspective. As Dr. de Bono stated, “Using this technique for looking at a problem, decisions and plans...” |
“will mix ambition, skill in execution, sensitivity, creativity and good contingency planning.” This technique assists groups in creating a complete and concrete view of the problem to be solved, by considering diverse thinking styles and incorporating multiple views. Groups are able to discuss the full complexity of their decisions, and identify possible drawbacks or benefits which might not, otherwise, be noticed.

### Types and structure of Information

The collaboration process is broken down into six “Divisions”, each corresponding to a thinking style and represented by a “Thinking Hat”. Members have to perform their thinking within each division. The guidelines for each division are:

- **White Hat**: be neutral, objective, and unbiased
- **Red Hat**: be intuitive, emotional, and instinctive
- **Black Hat**: be pessimistic & judgmental; think of disadvantages
- **Yellow Hat**: be optimistic, and hopeful; think positively
- **Green Hat**: be creative, think out-of-the box (new perspectives)
- **Blue Hat**: manage, coordinate, summarize, facilitate

### Divisions

**White Hat**: Members who are working on the problem under the White Hat need to collect data, group those, and interpret information objectively and accurately. The objectives of the White Hat are:

- Exposition of statistical data
- Concentration on actual facts (and not opinions or beliefs)
- Acknowledgement of incomplete or inaccurate knowledge
- Suggestion of solutions that logically result from the data

Questions asked from a White Hat’s perspective are:

1. What are known facts, data, and other information on hand?
2. What are the unknown facts, data, and other information on hand?
3. What additional information is needed?
4. What is there to be learned from this procedure?
5. What is the methodology for obtaining the facts and data needed to reach a solution?
6. Based strictly on the data and information collected, what are the possible, logically-derived solutions?

![The White Hat](http://blog.iqmatrix.com/mind-map/edward-debono-6-thinking-hats-mind-map)
**Read Hat:** Members who are working on the problem under the Red Hat think with their “heart”. They need to use their intuition and instinct to evaluate the situation, its outcomes, and the possible solutions (as those get proposed by the other divisions). The objectives of the Red Hat are:

- Adoption of intuitive reactions
- Awareness and evaluation of others’ feelings
- Promotion of emotional views
- Exposition of implied advantages of different approaches
- Exposition of implied disadvantages of different approaches
- Exposition of contradicting outcomes

Questions asked from a Red Hat’s perspective are:

1. What is my initial reaction to a suggestion?
2. How do I feel about a decision I might make?
3. Do I believe I am making the right choice?
4. Does anything inside me tell me there is a better option?

![Red Hat Diagram](source: http://blog.euromatrix.com/mindmap/design-thinking/hats-mind-map)

**Black Hat:** Members who are working on the problem under the Black Hat need to concentrate on the dangers and flaws of each approach, and emphasize the worst case scenarios for any proposed solution. The objectives of the Black Hat are:

- Identification of negative outcomes and their consequences
- Identification of flawed or weakly-supported contingency plans
- Consideration of inadequate resources
- Elimination of pitfalls and non-beneficial ideas

Questions asked from a Black Hat’s perspective are:

1. What is a serious flaw of this recommendation?
2. What is a major drawback to this way of thinking?
3. What are the odds of failure?
4. What could be potential worst-case scenarios?
5. Are necessary recovery resources in place?

![Black Hat Diagram](source: http://blog.euromatrix.com/mindmap/design-thinking/hats-mind-map)
Yellow Hat: Members who are working on the problem under the Yellow Hat need to bring forward optimistic ideas which may provide opportunities for success. The objectives of this division are:

- Identification of benefits of recommendations
- Evaluation of opportunities within proposed solutions
- Assessment of good-case scenarios
- Assessment of feasibility of recommendations
- Promotion of enthusiasm and motivation

Questions asked from a Yellow Hat’s perspective are:

1. What is the best way to approach the issue?
2. What is a reasonable and realistic way to make things work?
3. What are the positive outcomes of each idea?
4. What are the long-term benefits of each action?

Green Hat: Members who are working on the problem under the Green Hat need to vision the problem in a new, open and unrestricted
way, in order to generate creative and unusual ideas. The objectives of the Green Hat problem solving approach are:

- Promotion of expanded and elaborate thinking
- Application of extended rules (beyond reality restrictions)
- Envision of creative and non-habitual solutions
- Consideration of new perspectives

Questions asked from a Green Hat’s perspective are:
1. What alternative solutions are possible?
2. Could a recommendation be done in another way?
3. What is an unusually unique way of looking at the issue?
4. What would constitute “outside-the-box” thinking in this case?
5. What if…?

Blue Hat: Members who are working on the problem under the Blue Hat need to maintain focus. They act as arbitrators between divisions, directors of the problem solving process, and coordinators of the group. The objectives of the Blue Hat are:

- Maximization of efficiency and effectiveness of thinking
- Facilitation and direction of the thinking process
- Determination of agenda, goals, and responsibilities
- Organization of ideas and recommendations

Questions asked from a Blue Hat’s perspective are:
1. What is the best way to define the actual problem?
2. What are the goals?
3. What are the desired outcomes of the solution-seeking process?
4. What is the most effective way of moving forward?
5. What is the optimal way out of the current circumstances?
| Types of Tasks | The Six Thinking Hats technique can be used effectively in group meetings, as it provides a way of understanding and accepting different thinking styles that people approach problem solving with. Usually the order of thinking would transition in the following manner: |

Source: http://blog.iqmatrix.com/mind-map/edward-de-bono-6-thinking-hats-mind-map
<table>
<thead>
<tr>
<th>Phase</th>
<th>Blue Hat thinker</th>
<th>Thinking Hats</th>
<th>White Hat – Try to reach a set of possible logical neutral solutions by utilizing the information collected by all data, facts, and statistics relevant to the problem.</th>
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<tbody>
<tr>
<td>1</td>
<td>Blue Hat – Try to outline the problem, define its parameters and guide the thinking process of the other hats.</td>
<td>Blue Hat thinker</td>
<td>White Hat think(s)</td>
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<td>2</td>
<td>Blue Hat – Try to outline the problem, define its parameters and guide the thinking process of the other hats.</td>
<td>Blue Hat thinker</td>
<td>White Hat think(s)</td>
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<tr>
<td>3</td>
<td>Blue Hat – Try to outline the problem, define its parameters and guide the thinking process of the other hats.</td>
<td>Blue Hat thinker</td>
<td>Red Hat think(s)</td>
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<tr>
<td>4</td>
<td>Blue Hat – Try to outline the problem, define its parameters and guide the thinking process of the other hats.</td>
<td>Blue Hat thinker</td>
<td>Black Hat think(s)</td>
</tr>
<tr>
<td>5</td>
<td>Blue Hat – Try to outline the problem, define its parameters and guide the thinking process of the other hats.</td>
<td>Blue Hat thinker</td>
<td>Yellow Hat think(s)</td>
</tr>
<tr>
<td>6</td>
<td>Blue Hat – Try to outline the problem, define its parameters and guide the thinking process of the other hats.</td>
<td>Blue Hat thinker</td>
<td>Green Hat think(s)</td>
</tr>
<tr>
<td>7</td>
<td>Blue Hat – When every hat stated it’s point of view the Blue Hat tries to continue and synchronize the thinking process having in mind that at the end of the discussion the ideal solution may arouse. The idea is to obtain a global perspective about the problem and have the 6 Thinking Hats agree to it.</td>
<td>Blue Hat thinker</td>
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<td>the MiddleWeb Listserv: Turn a Sad Goodbye into a &quot;Problemtunity&quot;</td>
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