Creative Emotional Reasoning Computational Tools Fostering Co-Creativity in Learning Processes

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CREATIVE EMOTIONAL REASONING

C^{2}LEARN PROJECT DELIVERABLE NO. D2.1.2

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FIGURES IN THE DOCUMENT

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ABBREVIATIONS USED

A) Abbreviated names of the project consortium partners

Abbreviation	Explanation
EA	Ellinogermaniki Agogi, Greece (coordinator)
UEDIN	The University Of Edinburgh, UK
OU	The Open University, UK
NCSR-D	National Center For Scientific Research "Demokritos", Greece
UoM	Universita ta Malta, Malta
SGI	Serious Games Interactive, Denmark
BMUKK	Bundesministerium Für Unterricht, Kunst Und Kultur, Austria

B) Other abbreviations

Abbreviation	Explanation
C²Learn	Acronym of the project (full title: Creative Emotional Reasoning Computational Tools Fostering Co-Creativity in Learning Processes)
DoW	Description of Work (Annex I of the Grant agreement no. 318480)
EC	European Commission
FP7	The Seventh Framework Programme for Research and Technological Development (2007-2013)
ICT	Information and Communications Technologies
M#	#th month of the project (M1=November 2012)
TEL	Technology-Enhanced Learning
CER	Creative Emotional Reasoning
WHC	Wise Humanising Creativity
LDS	Living Dialogic Space
MI-CC	Mixed-Initiative Co-Creation

EXECUTIVE SUMMARY

C²Learn *at a glance*

C²Learn (www.c2learn.eu) is a three-year research project supported by the European Commission through the Seventh Framework Programme (FP7), in the theme of Information and Communications Technologies (ICT) and particularly in the area of Technology-Enhanced Learning (TEL) (FP7 grant agreement no 318480). The project started on 1st November 2012 with the aim to shed new light on, and propose and test concrete ways in which our current understanding of creativity in education and creative thinking, on the one hand, and technology-enhanced learning tools and digital games, on the other hand, can be fruitfully combined to provide young learners and their teachers with innovative opportunities for creative learning. The project designs an innovative digital gaming and social networking environment incorporating diverse computational tools, the use of which can foster co-creativity in learning processes in the context of both formal and informal educational settings. The ***C²Learn*** environment is envisioned as an open-world 'sandbox' (non-linear) virtual space enabling learners to freely explore ideas, concepts, and the shared knowledge available on the semantic web and the communities that they are part of. This innovation is co-designed, implemented and tested in systematic interaction and exchange with stakeholders following participatory design and participative evaluation principles. This happens in and around school communities covering a learner age spectrum from 10 to 18+ years.

Deliverable 2.1.2 is the second instalment of a document explicating the key concepts and principles relating to **Creative Emotional Reasoning**. CER is a non-linear thinking methodology, developed primarily by UEDIN, to be implemented in *C²Learn*'s computational tools. We first explore the notion of co-creativity within the context of *C²Learn*. We then we move on to a detailed presentation of CER. The presentation of the theory consists of three parts: The first deals with its conceptual foundations, definition and basic terminology; the second develops CER's group-creativity enhancing techniques, i.e. Brainstorming; and the third consists of an analysis of the three kinds of non-linear thought comprising CER, i.e. Sematic, Diagrammatic and Emotive Lateral Thinking.

0. INTRODUCTION

Deliverable 2.1.2 seeks to explicate the key concepts and principles constituting ***Creative Emotional Reasoning*** (**CER**). This introductory note offers a brief overview of D2.1.2's main sections and subdivisions:

Section 1 consists of a brief presentation of *C²Learn*'s Co-Creativity Framework. **Section 2** presents CER's conceptual foundations, definition and basic terminology. **Section 3** develops CER's group-creativity enhancing techniques, i.e. Brainstorming. **Section 4** consists of an analysis of the three kinds of non-linear thought comprising CER, i.e. Sematic, Diagrammatic and Emotive Lateral Thinking. Lastly in the **Appendix** we include a brief overview of the CER Workshop, which took place during the *C²Learn* Summer School 2013 *Creativity and Games in Education*, along with some interesting conclusions that have guided our research since then.

1. *C²LEARN* CO-CREATIVITY FRAMEWORK

The goal of *C²Learn* is to foster co-creativity through Creative Emotional Reasoning (CER, theorised by UEDIN) and generating Wise, Humanising Creativity (WHC, theorised by OU). To achieve our objective we aim to harness the tools and strategies of CER to generate WHC activity between participants in *C²Learn*'s games and environment.

WHC will occur in C²Learn as an active process of change guided by compassion and reference to shared values derived from users' collaborative thinking, shared action, gameplay and social interaction. WHC will manifest in four intertwined ways shown in the highlighted box within the WHC section of the graphic. Users will:

- Generate, explore and enact new ideas with a valuable impact on the community, discarding other ideas that lack such potential (**ethics and impact**);
- Pose questions, debate between new ideas, find ways to negotiate conflict or to go in a different direction to others if conflict is not resolved (**dialogue**);
- Take charge of different parts of the creative process, understanding the rules of the system[1] and how decisions have consequences, making decisions around new ideas and taking action(s)[2] through various scenarios and/or quests (**control**); &
- Be immersed in the game and its environment, and possibly addicted to gameplay and/or the interactive drama played out in the gameworld and in real-world spaces. Such immersion will sometimes lead to taking risks and generating surprising individual or collaborative ideas (**engaged action**).

Such activity is co-creative because it is about **new ideas** which are captured or selected because they are **valuable to the community**, and are generated with shared control in an immersed dialogic gamified learning contxt which encompasses a digital gaming and social networking environment, fostering **ethical awareness** arising from the experience and action.

Over time, noticeable changes in users' dispositions, even small incremental personal changes, will result from their WHC. This is because there is a core reciprocal relationship within WHC between

[1] Walsh, C.S. (2010). Systems-based literacy practices: Digital games research, gameplay and design. Australian Journal of Language and Literacy Education. Vol 33, No 1, pp. 24-40. http://search.informit.com.au/documentSummary;dn=731555751906684;res=IELHSS ISSN: 1038-1562

[2] Apperley, T., and Walsh, C.S. (2012). What digital games and literacy have in common: A heuristic for understanding pupils' gaming literacy. *Literacy*, Vol 46, pp. 115–122. DOI:10.1111/j.1741-4369.2012.00668.x ISSN: 1741-4369

creativity and identity in which as creators make, they are also being made. And so users undertake **journeys of becoming**[3]. This is represented on the figure as an embedded ongoing process from the 'how' of the enablers of co-creativity to the 'what' of the co-creativity.

CER can be best understood as a core manifestation of the more comprehensive creativity framework of WHC. It is an umbrella term and refers to:

- a principled, unifying theory of non-linear thinking techniques that foster co-creativity
- and the theory's implementation within C²Learn's computational tools.

Premised on a notion of creativity as an **intervention resulting in reframing**, CER's set of core creative learning tools support the manifestation of WHC. They do this by providing methods for the disruption of established routines and patterns. Hence CER's positioning in the box emerging from the centre of the WHC box.

By embedding CER's creativity enablers (i.e. the different techniques implemented in C²Learn's computational tools) within WHC we seek an organic fusion that will provide

- WHC with additional structured techniques taking advantage of and further enabling WHC's creativity opportunities: and
- CER with much needed ethical and cultural dimensions and the most appropriate conditions for fulfilling its potential.

As CER heavily relies on brainstorming activities structuring the core parts of its techniques, there is a particular relation with LDS (Section 3). LDS' flattened hierarchies and open spaces of dialogue are an ideal environment within which to embed and evolve these brainstorming techniques, providing the opportunity to experiment with dynamic group management methods.

Ultimately, WHC, with CER's set of core creative learning tools support the manifestation of WHC making this the 'what' of C²Learn's co-creativity. This fuels the potential for **quiet revolutions**[4]. Hence the quiet revolutions arrow emerging from the top right hand corner of the figure. Such revolutions aim to be critical, yet ethically grounded and align personal with wider values. A quiet revolution has the potential to be a form of collaborative and collective endeavour that assumes commitment to excellence and engaged involvement by adults and children alike.

Below we provide the ***C²Learn* Co-Creativity Conceptual Diagram**. For a full and detailed explanation of the diagram, please consult *D2.2.2 C²Learn Learning Design for CER*.

[3] Chappell K., Craft A., Rolfe L. & Jobbins, V. "Humanising Creativity: valuing our journeys of becoming", *International Journal of Education and the Arts*, *13(8) 1*-35, 2012, retrieved 11.01.13 from http://www.ijea.org/v13n8/

[4] Chappell, K., Craft, A., with Rolfe, L., & Jobbins, V. (2011). Not just surviving but thriving. In *Close Encounters: Dance Partners for Creativity* pp143-159 . Stoke on Trent: Trentham Books.

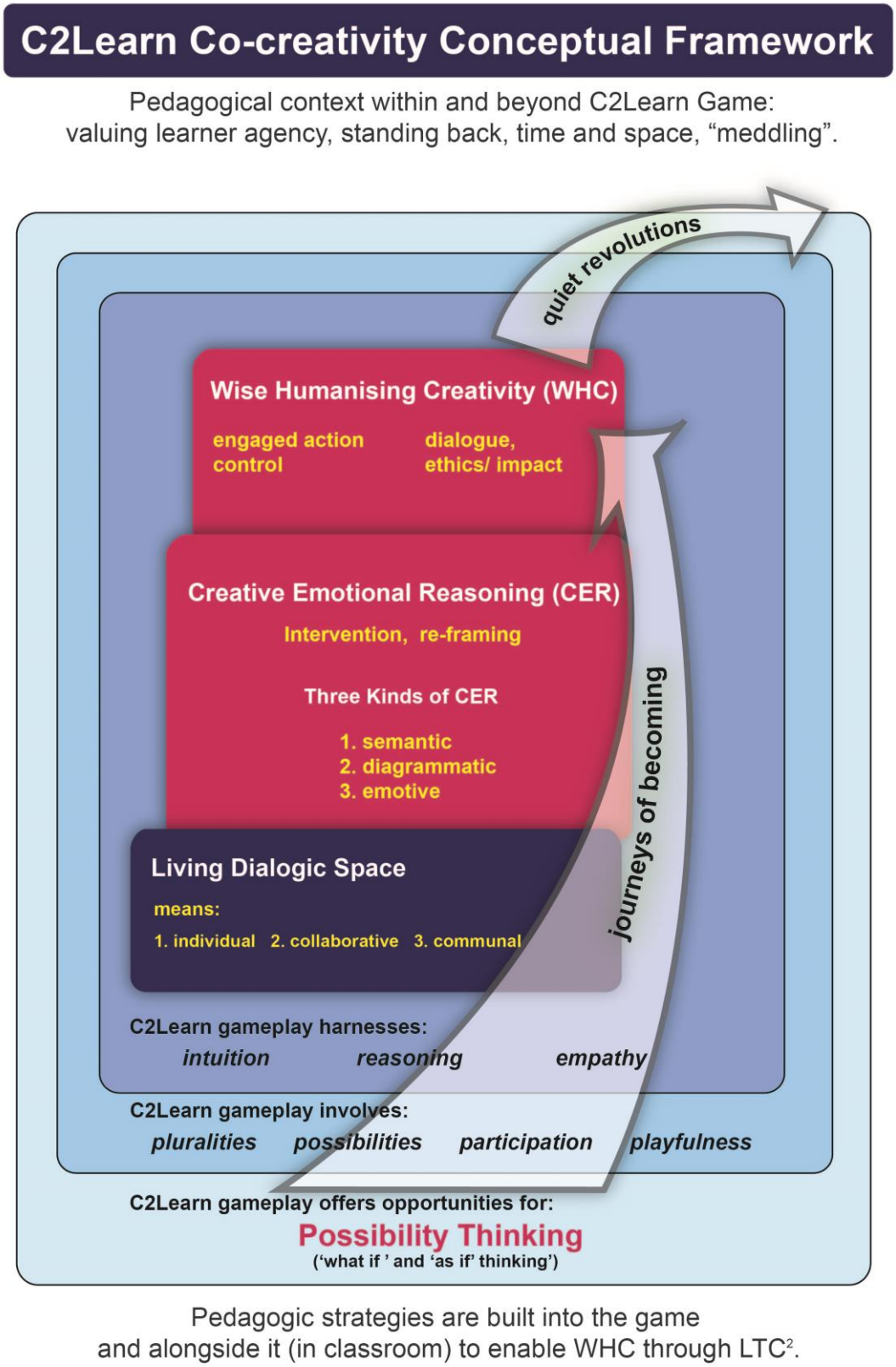

Figure 1: C2Learn Co-creativity Conceptual Framework

2. CREATIVE EMOTIONAL REASONING

As stated above (Section 1) **Creative Emotional Reasoning** (**CER**) is an umbrella term and refers to:

- a principled, unifying theory of non-linear thinking techniques[5] that foster co-creativity, and
- the theory's implementation within C²Learn's computational tools.[6]

We begin by premising CER and situating it within the broader framework of non-linear thinking. We then move on to CER's conceptual foundations/basic terminology, and conclude with a presentation of a CER technique's basic process scheme.

2.1 CER: PREMISING

Non-linear thinking is a rather broad genus, encompassing different types of thinking processes, connected more through family resemblances, rather than a single over-arching feature shared by all. For our purposes though, we can give a possible description as follows:

- Thinking characterized by the use of imagination, spontaneity, flexibility, attention to intuitions, perceptions, and feelings, construction of associations, in order to arrive at an insight or understanding, relying less on reasoning that can be classified as logical/deductive.[7]

For *C²Learn* we are creating a particular type of non-linear thinking methodology, which constitutes the theoretical part of CER. In creating it we are using de Bono's **Lateral Thinking**, as a starting basis. We are developing them further by providing a more rigorous categorization, unifying techniques in more comprehensive wholes and doing away with redundancies, tailoring them to suit *C²Learn*'s educational needs, and also, most crucially, expanding this kind of analysis to incorporate diagrammatic and emotive reasoning processes.

Lateral thinking, in its original form, means thinking oriented towards solving seemingly insoluble problems, through an indirect, creative approach. The term was coined in 1967 by Edward de Bono. Lateral Thinking is closely related to humour, insight and creativity.[8]One of its main contentions is that it is a skill that can be taught.[9]

[5] Developed primarily by the University of Edinburgh (UEDIN), with important contributions and support from our partners in the Open University (OU), Ellinogermaniki Agogi (EA) and the National Centre for Scientific Research "Demokritos" (NCSR-D).

[6] Developed primarily by NCSR-D with contributions by the University of Malta (UoM), Serious Games Interactive (SGI) and support by UEDIN.

[7] See for example De Bono E., *Serious creativity: Using the power of lateral thinking to create new ideas*, New York: HarperCollins Publishers, 1992, and Csikszentmihalyi M., *Creativity: Flow and the psychology of discovery and invention*, New York: HarperCollins Publishers, 1996. Of course, as in most human thinking processes, the boundaries between non-linear/deductive are blurred, and usually one will deploy a mixture of both. See e.g. Katz A., "Creativity in the cerebral hemispheres", in Runco M. A. (Ed.), *Creativity research handbook*, Cresskill, NJ: Hampton Press 1997.

[8] De Bono E., *Lateral thinking: creativity step by step*, New York: Harper & Row, 1970.

[9] Ibid.

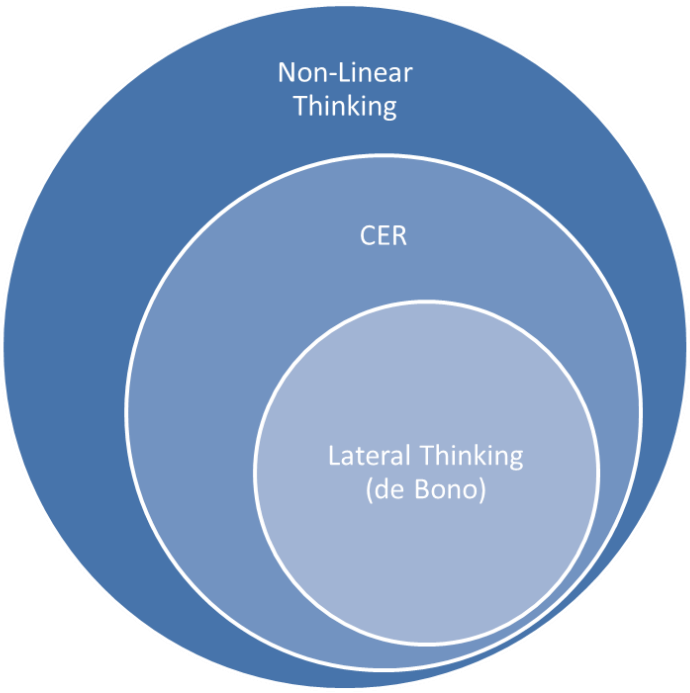

Figure 2: Non-Linear Thinking - CER - Lateral Thinking relation

2.1 CER TECHNIQUE: DEFINITION

Within the local context of CER[10] the **creative act** is understood as **an intervention that results in re-framing**. Frames are everywhere, and can be loosely understood as systems of established routine, that divide the world into bounded, meaning-bearing sub-worlds. As frames depend on a notion of routine, re-framing can be understood as **a disruption to an established routine**. The threshold that distinguishes a creative act is not fixed, and depends on an evaluation of the disruption produced.[11] The notion of disruption is thus central to CER.

We call the disruption of an established routine: **a lateral path**. More precisely a lateral path is a cognitive process that promotes deep **exploration of a possibility space**, whilst satisfying stated (or implicit) conditions, i.e. **under constraints**.

It is important here to stress the significance of the second clause: **under constraints**. A lateral path is not a free-form exploration of a possibility space, but is structured through conditions, that act as constraints. These conditions may stem from the exploration's stated objective(s), the lateral path medium, constraints imposed upon the lateral path itself (e.g. that the lateral path must satisfy conditions of novelty, surprise etc.), the social (or ethical) dimensions within which the exploration takes place, etc.

A disruptor is the basic constituent element of all CER techniques. It is an abstract notion, and can refer to any number/kind of tools that perform closely related functions, of disrupting established routines; i.e. **a disruptor opens up a lateral path**.

In developing CER techniques we are experimenting with disruptors primarily along 3 dimensions:

[10] Which is only one consituent of the comprehensive fused WHC/CER creativity framework (Section 1)
[11] For more information please consult D2.3.1 Co-Creativity Assessment Methodology

- The **kind** of disruptor.
- The method of **introduction**.
- Subsequent **use** of the disruptor.

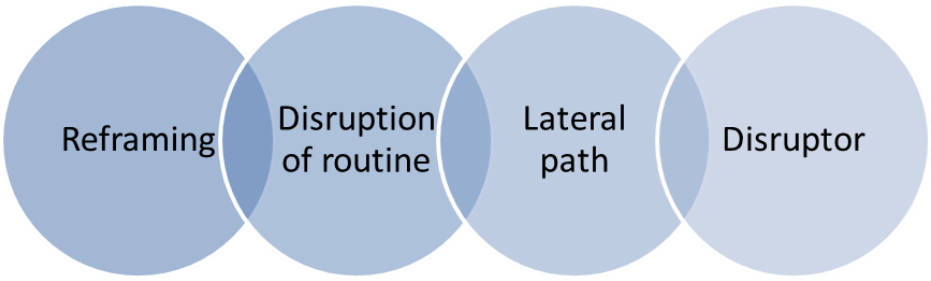

Figure 3: CER - Basic terms

Combining all the above definitions we can define a CER technique:

A **CER technique** is a **method** to foster (co-)creativity by utilizing **disruptors** in order to open **lateral paths**, thus promoting deep exploration of **a possibility space** - under **constraints** - with the aim of achieving a **reframing**.

CER techniques are divided into 3 broad kinds based on the kind of disruptors each uses:[12]

- **Semantic Lateral Thinking**
- **Diagramatic Lateral Thinking**
- **Emotive Lateral Thinking**

2.2 CER TECHNIQUE: BASIC PROCESS-SCHEME

All CER techniques follow the same basic process-scheme presented below. It is important to stress that this process-scheme is purely **an abstraction**. In any actual case we are most likely to encounter iterated instances of this basic process, defused, integrated and re-interpreted within *C²Learn*'s creative activities and gameplay. The process-scheme-below is of a strictly heuristic nature, as it allows us to view the basic parts that constitute any CER technique in isolation, as well as the basic sequential order of the phases comprising an idealized/abstract CER technique. As *C²Learn* has a core social/communal element, it is assumed in the presentation below that a **group** is engaged with the technique.[13]

[12] Section 4 covers this in detail.

[13] Though the process-scheme presented would still be valid in the case of an individual agent, with minor alterations. (e.g. Brainstorming activity would denote an internalized structured creativity facilitating activity, sharing many of the characteristics present in the group version/form.)

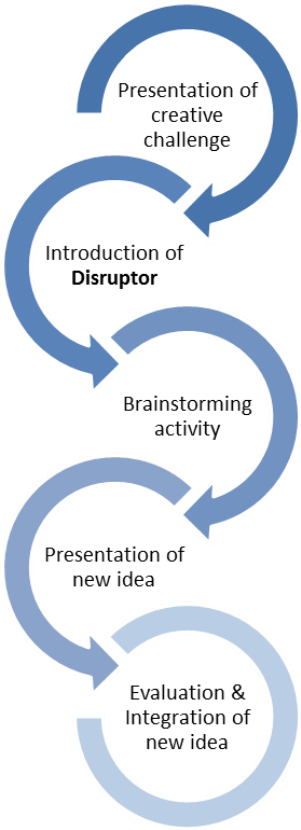

Figure 4: CER - Basic process

The [**Presentation of the creative challenge**] phase orients the creative process to follow, by providing objectives, context and any other initial set of conditions that will act as constraints.

The [**Introduction of Disruptor**] provides the crucial disruptive element, upon which all subsequent creative actions will depend.

- The kind of disruptor.
- The method of introduction.
- Subsequent use of the disruptor.

The disruptor is engaged with during the [**Brainstorming activity**] phase, which denotes a structured group activity, facilitating creative output.[14]

During the next phase, [**Presentation of new idea**][15], the results of the previous activity are presented.

The last step is the [**Evaluation & Integration of new idea**] phase, during which the idea presented is taken up by the group evaluated[16] and integrated for subsequent use.

[14] Section 3 covers this in detail.
[15] We use the term 'idea' here as loosely as possible.
[16] Which may include discussion, debate voting etc

3. *C²LEARN*'S BRAINSTORMING

We begin by grounding *C²Learn*'s Brainstorming within the Co-Creativity framework and in particular Living Dialogic Spaces (LDS). We then present the principles underlying the construction of Brainstorming techniques, which lead us to the development of a Brainstorming guide for use within *C²Learn*.

3.1 LIVING DIALOGIC SPACES

Within *C²Learn* the research team methodologically seeks to develop ***Living Dialogic Spaces***[17] that enable high participation and shared control. LDS involve high participation by students and adults, debate and difference, partiality, openness to action, working from the 'bottom up', emancipation, as well as embodied and verbalised idea exchange. Such LDS should enable a dynamic of both standing back and stepping forward pedagogically with acute sensitivity[18] within and outside *C²Learn*'s educational gaming environment. Drawing on all of the above will mean the *C²Learn* team valuing learner agency, standing back, offering time and space and also at times engaging with learners by 'meddling in the middle' to co-conceptualise and co-construct. [19]

The main mechanisms via which living dialogic spaces are produced are creative learning conversations. The conversations were developed by university researchers as distinct from the usual hierarchical, top-down power conversations expected within schools and in their relationships with Universities. Their purpose within *C²Learn* will be to flatten out hierarchies and to open up spaces that promote a sense of equality. The aim is to allow practitioners, students and others to become researchers and game-players oriented toward action.[20] Opportunities to engage in LDS will, of course, need to infuse the scenarios embedded in the game.

The 'living' in LDS requires open shared spaces where potentiality is extrapolated, shaped and constructed.[21] We refer to space created by the learning conversations as Living Space, acknowledging the inhabiting, the embodiment, openness, lack of closure and thus capacity for change inherent in the creative learning conversations which will be used within *C²Learn*. Applying Wegerif's [22] interpretation of Bakhtin's ideas it will be important that shared enquiry is encouraged in which answers give rise to further questions, thus forming an iterative chain of questions and answers. *C²Learn* participants will be nurtured into dialogues which include the ability to really listen to others, and even change your mind and argue against your own position by identifying with the space of dialogue.

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[17] Chapell K. & Craft A., "Creative learning conversations: producing living dialogic spaces", Educational Research, 53, 3, p. 363-385, 2011.

[18] Cremin T., Burnard P. & Craft A., "Pedagogy and possibility thinking in the early years", *Thinking Skills and Creativity* 1(2), 2006.

[19] Craft A., Chappell K., Rolfe L. & Jobbins V., "Reflective creative partnerships as 'meddling in the middle': developing practice", *Reflective Practice: International and Multidisciplinary Perspectives*, 2012, http://dx.doi.org/10.1080/14623943.2012.670624.

[20] Apperley T. & Beavis C., "Literacy into Action: Digital Games as Action and Text in the English and Literacy Classroom", *Pedagogies* 6 (2), 2011.

[21] Lefebvre H., "The production of space", Oxford/Cambridge, MA: Wiley-Blackwell, 1991.

[22] Wegerif R., *Mind expanding: Teaching for thinking and creativity in primary education*, Maidenhead: Open University Press, 2010.

All CER techniques[23] are situated within such open spaces. LDS type of communication is of course essential and completely in tune with the fundamental tenets/methods of CER. Furthermore, LDS presents us with the opportunity to creatively construct new brainstorming structures tailored to *C²Learn*'s needs. LDS is embodied in fluid hierarchies, which can be a very interesting new tool to introduce in the traditionally more rigid brainstorming organizational structures. In conjuction with the scenarios, and type of game environment(s) being created, we are constructing more original organizational structures to make full use of the LDS environment, as well as facilitate and expand the use of CER techniques.

3.2 BRAINSTORMING: PRINCIPLES

Brainstorming refers to a family of group-creativity enhancing techniques/methods, facilitating the production of solutions to some specific problem or creative challenge, by structuring group interaction and regulating the flow of ideas.

These kind of techniques originated in the work-environment, specifically the advertising sector. Alex Faickney Osborn was an advertising executive who delineated the core principles of brainstorming in his book *Applied Imagination*.[24]

We can simplify the principles that direct Brainstorming techniques into the following:

- A Brainstorming technique structures a creative dialogue by **clearly defining phases** for the formulation/production and articulation/presentation of ideas.
- A Brainstorming technique aims to **facilitate the creative process** of each individual by setting up micro conditions and restrains that coax the individual to contribute.
- A Brainstorming technique's structure aims for **everyone to contribute** in the process. Traditionally this is achieved primarily by ensuring that all input is articulated/presented in a standardised fashion and all input receives equal amount of attention (in principle) from the group. Due to the need for gamification (see below) this practise may be altered, but the underlying principle/aim remains the same.

We can similarly formalise LDS into the following interrelated principles:

- **Structure** creative learning conversations utilising **fluid hierarchies**.
- **Reposition participants into different roles**, promoting the acquisition of different perspectives.
- **Cultivate an open space of dialogue**, promoting the comprehension of different perspectives and a sense of equality between participants.

To the above we must add three further important caveats; the first two stemming from *C²Learn*'s game oriented nature[25], and the third from the research teams' findings through *C²Learn*'s Workshops with teachers and students[26]:

[23] Formally the correct term here is CER as this section takes implementation into account. To avoid unnecessary confusion, and as the two terms are practically equivalent, we retain the use of LTC².
[24] Osborn A. F., *Applied imagination: Principles and procedures of creative problem solving*, New York: Charles Scribner's Sons, 1963.
[25] See D4.4.1: C2Learn Game Prototyping for more
[26] For a CER specific Workshop see the Appendix, for a more C2Learn comprehensive approach see D5.3.1.

- Brainstorming is based on dialogue. Dialogue is not necessarily the most game-friendly medium, and thus care must be shown and more effort expended to make sure that BTs are **re-envisioned as constituents within a game**.
- Any activity must **simplify** or at least **not further complicate** the educator's job and responsibilities. If a game or creative activity ends up over-complicated, tedious and hard to manage/comprehend the educators (and most probably the students) will reject it or not make it part of their standard curriculum.
- **Time** is of the essence. In educational environments time is a limited and precious resource. This caveat is crucial for the design of any and all *C²Learn* creative activities that structure the educational gaming environment.

3.2 BRAINSTORMING: MATRIX RULES

Taken together the above nine principles define a grid, based on which we can formulate a number of general rules that can be used to structure the Brainstorming part of *C²Learn*'s game-based learning environment.

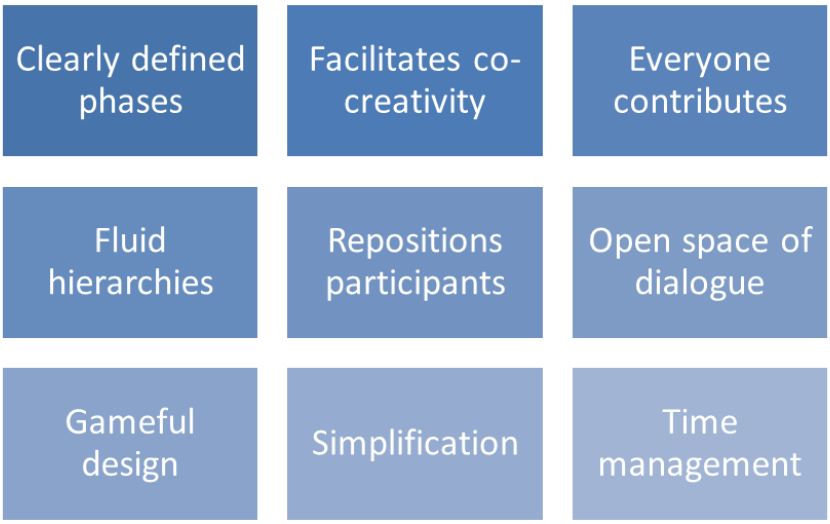


Figure 5: Brainstorming - Principles

These rules represent **matrices** out of which concrete sets of rules can be extrapolated and adjusted/developed for use in the *C²Learn* games, currently under development. The matrix rules are subdivided into categories, according to their function:

3.2.1 BRAINSTORMING PROCESS FOUNDATIONS

1. A Brainstorming process is divided into distinct units of timed-activities. Each unit of timed-activities represents a round.

2. The length and number of rounds of a given Brainstorming process must be kept proportionate to the overall timeframe of the creative activity the process is embedded into.

- Given the usual 40-45 minute length of a standard class-period, and taking into account the time needed for other activities integral (presentation of the problem, presentation of the

solution, elucidations etc.) or not (time lost/wasted etc.) to the creative activity, the recommendation would be no more than 3-4 rounds per brainstorming process.

3. Each round follows a similar abstract structure: [i] An input is given. [ii] Students engage with the input. [iii] An output is generated.

- Between [ii] and [iii] a group decision-taking process takes place.
- The input at any given round may be the output of the previous one.
- The output of the last round counts as the final product.

4. After the completion of the brainstorming process the final product is presented.

5. The educator acts primarily as facilitator throughout the process. (Primarily by providing clarifications and general type assistance to the groups.)

3.2.2 POSSIBLE GROUP DECISION-TAKING PROCESSES

1. Through **voting**

- Majority wins.
- Unanimous decision needed.
- A temporary voting privilege is given to a minority or single individual for a number of rounds. (See Brainstorming process gamification below.)

2. Through **discussion**

- A decision is reached naturally as part of the discussion.
- A (semi-)formal debate is set up to decide between alternatives. (Note: This rule may lead to over-complication and is time demanding.)

3. Through a **scoring system**

- A scoring system may be implemented as part of the Brainstorming process or the creative activity as whole. At a given point a decision is taken based on the scores accumulated by an individual or team.

4. Through a **random selection**

- The decision is based on a random selection (through the use of a dice, picking a number, coin tossing etc.). This can either be used as a standalone rule or as a last resort if no decision is possible.

5. Through a **creative activity related challenge**

- To reach a decision a challenge is set based on another aspect of the creative activity (e.g. another mini-game or part of). The winner of the challenge gains power of decision. (Note: This rule may lead to over-complication and is time demanding.)

3.2.3 BRAINSTORMING PROCESS WITHIN GAMEFUL DESIGN[27]

1. A particular individual or team is bestowed some privilege(s) for a number of rounds. These privileges may include:

- Voting privileges during decision-taking process for a number of rounds. (E.g. For Group A, Participant X's vote counts double for the next 1 round.)
- Beneficial score multipliers during decision-taking process. (E.g. For Group A, Participant X's score counts double for the next 2 rounds.)
- Power/control over some aspect of the Brainstorming process or creative activity for a number of turns is bestowed upon a group or participant. (Participant X gains e.g. extra actions; ability to prevent other participants from taking action; ability to change a specific/any Brainstorming process or creative activity rule; discard/enforce an idea/element/rule etc. for 1 round)

2. A particular individual or team is allocated some penalty(ies) for a number of rounds. These penalties may include:

- Voting penalties during decision-taking process for a number of rounds. (E.g. For Group A, Participant X's vote counts as half for the next 1 round.)
- Adverse score multipliers during decision-taking process. (E.g. For Group A, Participant X's score counts half for the next 2 rounds.)
- Loss of power/control over some aspect of the Brainstorming process or creative activity for a number of turns is enacted upon a group or participant. (Participant X loses e.g. an action; any privileges gained from another round; the right to use a specific idea/element, which must now be discarded etc. for 1 round)

3. Members of a group must brainstorm following a specific meta-rule (instruction) for a number of rounds. (e.g. Group A can only use X type of ideas/elements in as input/output for 2 rounds; Group B must think as if X for 1 round; Group C must draw all output; Participant X must think/use an element as Participant Y would and vice versa; Participant X and Y must merge ideas etc.)

- A more specific application of this rule can be the implementation of a mini role-play game within the Brainstorming process. Participants must then brainstorm according to the roles they personify. (Note: Given the danger of over-complication and time issues, it would probably be best if such a rule was applied from the beginning to the whole Brainstorming process, rather than individual rounds.)

3. One or more participants change group for a number of rounds. (E.g. Participant X of Group A exchanges place with Participant Y of Group B for the rest of the Brainstorming process.)

4. Input (including any/all products from the Brainstorming process or creative activity) is exchanged between groups. (e.g. Group A now has to continue work using Group B's work and vice versa.)

3.2.4 POSSIBLE GROUP DECISION-TAKING PROCESSES

[27] Any selection and development of these rules will of course adhere to the principles stated above, especially the ones concerning over-complication and time management.

1. Ideas are exchanged freely as part of the conversation. (A member of the group can be assigned the role of noting everything or important milestones down.)

2. Round divided into 3 distinct and (strictly) timed phases: Idea generation - Discussion – Decision.

3. Each participant writes their idea(s) on pieces of paper/digital medium and passes it on to the next. (Strict time limits are applicable.)

4. Each participant writes their ideas on pieces of paper/digital medium. (Strict time limits are applicable.) All ideas are collected and read (can also be organised in relation to one another); discussion follows in order.

5. Participants contribute in a specified order based on some X characteristic of theirs. (E.g. age, name etc.) (Strict time limits are applicable.)

6. Participants contribute in a specified order based on some X which has been attributed to them for the purpose of the Brainstorming process or creative activity. (E.g. a role, score etc.) (Strict time limits are applicable.)

7. The group uses a large piece of paper/digital medium as a collective mapping of all ideas.

8. The group uses an additional large piece of paper/digital medium to note down rejected ideas. (Note: This may help both in organisation and later with the evaluation process. May be slightly more time consuming.)

4. CER TECHNIQUES

CER techniques are classified into three kinds, corresponding to the tripartite division of CER into **Semantic**, **Diagrammatic** and **Emotive Lateral Thinking**. All three kinds of techniques make use of disruptors. We can therefore distinguish between **conceptual**, **diagrammatic** and **emotive disruptors**.

The challenges a player will face within the *C²Learn* environment can take many forms, the specifics of which are still under development. We can draw, though, a vague, yet important distinction between **problems** and **tasks**. This distinction is, of course, not in any way rigorous, but what it gestures at is a distinction in the forms a gaming challenge can take. Under **problem** we can include the most common sense understanding of the term, i.e. a challenge that requires concrete reasoning, and has a terminus that may be classified as a solution (e.g. "Build a structure that can house x number of villagers, using only z number/type of material"); whereas a **task** may be understood as a more loosely defined recreational challenge, with a terminus that cannot be classified unambiguously as a solution (e.g. "Create and manage a prosperous rural settlement" or even more loosely defined "Given these tools, let's see what you can create"). Obviously a problem can be broken down into tasks, and vice versa, and from a purely conceptual standpoint, each term can be understood as subsumed under the other. In a gaming environment, though, the distinction becomes more concrete. A game, that poses a specific problem to be solved, amounts to a very different experience, to a game presenting one with more loosely defined tasks to fulfil or explore. CER techniques are defined in such a way as to encompass both, but clearly as they require the challenges to be reasoning-friendly, they are most suited for challenges that fall somewhere in the middle of the spectrum.

The techniques assume as default the existence of a **group** and a coordinator, which is customarily identified as the **educator**. (It is important, that other members of the group may occupy this position.)

We will begin with Semantic techniques (Section 4.1) which form the basis of the other too. We will then move to Diagrammatic (Section 4.2) and conclude with Emotive (Section 4.3) which are still the least developed of the three.

4.1 SEMANTIC LATERAL THINKING

Semantic Lateral Thinking denotes a family of techniques that utilize conceptual (linguistic) disruptors, in order to reason creatively via the use of conceptual associations, analogies and counterfactuals.

Semantic Lateral Thinking forms the basis for the other two kinds of *C²Learns*'s lateral thinking.

4.1.1 RANDOM STIMULUS

The main principle of the ***Random Stimulus*** technique is the introduction of a ***foreign conceptual element***, acting as a disruptor, by forcing the user/participant to ***integrate/exploit*** the foreign element in the production of a solution/idea, and bringing together disparate domains.[28]

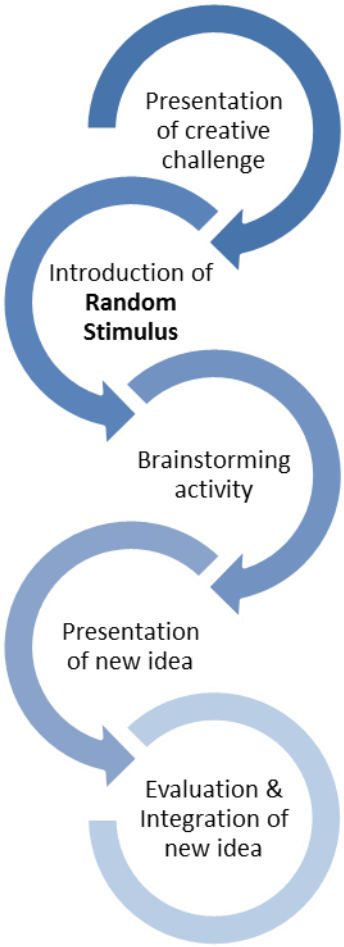


Figure 6: Random Stimulus - Basic process

Randomness is the main guarantor of foreignness and hence of stimulation of creativity. The use of an impartial generator of random stimuli is important here. The stimulus can consist of a random ***word***, ***rule***, ***fact*** (piece of information), ***text***, ***web-site***, ***analogy***. (Note that by introducing a **picture** we can turn this technique into a Diagrammatic one.) Foreignness in this context has two main dimensions:

- It is important that the player feels that he/she has to somehow integrate/exploit an element which is introduced completely from without, whose introduction is in no way under the player's control. In some ways an intruder has to be reconceptualised as a friendly aid.
- The new element should, at least initially, be as unconnected as possible to the subject/type/structure of the problem. Randomness gives us the best chances of achieving that by making sure that no unconscious-unobserved pre-established analogies, preferences and connections creep in the selection of the stimulus.

Control over the pool of available stimuli is the main means for scaling the difficulty of this type of exercises/tasks.

After the introduction of the problem, a **random stimulus** is provided and the participants are asked to use it creatively in their reasoning/imaginative processes. The process is usually understood to involve an intermediary step consisting of a (or a number of) **bridging idea**(s). This idea is not the

[28] Beaney M., *Imagination and Creativity*, Milton Keynes: Open UP, 2005.

final solution/idea one seeks, but constitutes the analogical stepping-stone between the stimulus and the problem/task, to be exploited in the production of a new solution/idea.

Example:

"A mountainous village is frequently ravaged by heavy snowstorms. The challenge is to devise ways to deal with this."

We get [**poetry**] as a random word. This is the initial stimulus. The bridging idea could be that **a poem has structure**. The notion of **structure** can then lead us down different paths, which we may later combine to advance our research:

- We may view the natural event as **a structured occurrence**, and thus one that may be studied methodically. We then begin by examining the patterns inherent in it, in the hopes of finding useful data that will help us predict future snowstorms and more effectively deal with their consequences.
- Another way to go is to view the village itself as a poem. There are often **sub-structures** in poems, such as riming, which create bonds between verses. We may then get the idea of exploiting the existing sub-structures or creating new ones within the village, in order to deal with the damages caused by the snowstorm. So if we take riming as our model, we may think of linking two houses or two sub-groups of houses by making one responsible to provide help and care for the other, in case of another emergency.
- By combining the above we come to see the inherent properties of the problem i.e. that it concerns **a structured event, calling for a structured and possibly structural solution**; a concise view of the matter that we can then transfer onto other catastrophic natural phenomena such as earthquakes, floods etc.

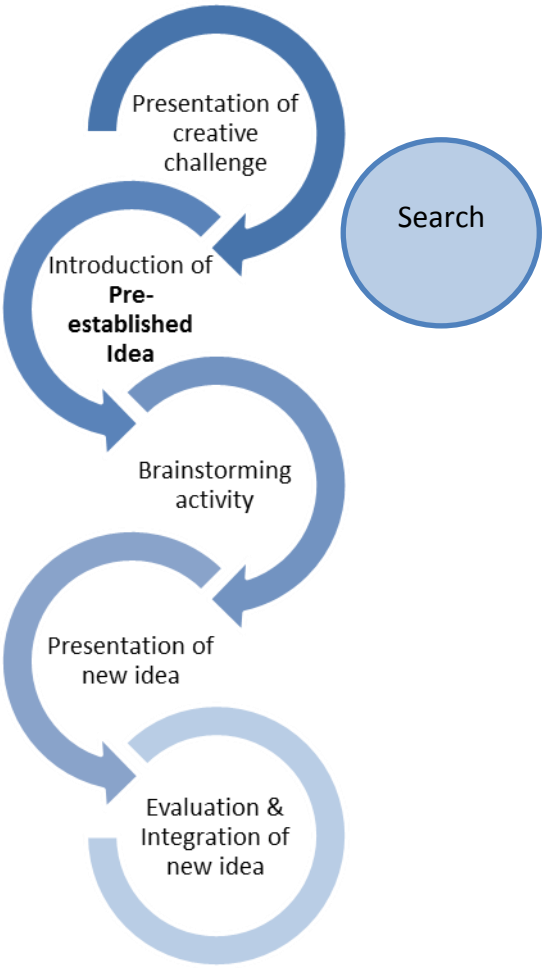
4.1.2 RE-CONCEPTUALISATION

Re-Conceptualisation involves the use of **already established solutions and ideas** in **new environments**, the purpose being to exploit the potential of **familiarity**[29] in the production of novel ideas. The familiar features of the established solution/idea will re-inscribe themselves on the unfamiliar environment, or conversely these same familiar features will appear in a new light.

After the introduction of the problem, a **pre-established solution/idea** is provided (this may involve a ***search*** beforehand). This solution/idea is taken from a field whose relation to the problem/task at hand is up to the educator's discretion. The **core element** of the solution is then subjected to a process of **conceptual transformations** and **exploration of possible extensions**[30], the aim being to create **links** to the problem/task at hand. These links will then lead to the production of a solution/idea.

[29] Bailin S., *Achieving Extraordinary Ends: An Essay on Creativity*, Norwood: Ablex, 1994.

[30] This is in many ways forms part of the origin for Diagrammatic techniques (Section 4.2). A diagram is created with a particular aim in view. Understanding the mapping process which establishes the connections between diagram and what is represented, is similar to understanding the structure of a particular solution/idea, in connection to the problem it addresses. The process of conceptual transformations also has its equivalence in Diagrammatic Lateral Thinking.



The search for a pre-established solution/idea can be conducted on the spot or it may have already been assigned by the educator. This is an optional step. Pools (or the capability of producing such pools) can be provided containing possible candidates along with a classification of their relevance to the problem/task at hand. The educator may scale the exercise/task either by directing the search-phase, or by choosing the pools of pre-established solutions/ideas to be presented to the group, based on their relevance to the problem/task at hand.

Figure 7: Re-Conceptualisation - Basic process

Example:

"A mountainous village is frequently ravaged by heavy snowstorms. The challenge is to devise ways to deal with this."

In searching for an established solution we come across the idea of **a greenhouse**. What is constitutive of a greenhouse as a solution is the idea of regulating the environmental conditions within it, thus making the sustenance/cultivation of plants possible in environs otherwise unfavourable. Our task now is to create sufficient links that will turn this idea into a crisis-solver and possibly beyond:

- The first idea might be to somehow **enclose the whole village within some sort of protective frame**, thus in effect treating it as a plant within a greenhouse. Of course the logistical and practical difficulties/impossibilities of such an endeavour will almost immediately become evident.
- The general idea of a protective frame, though, should not be as easily discarded. We cannot protect the whole village in this way, but we may be able to protect all of the villagers. What if we built some sort of structure within the village or in any case somewhere easily

accessible by all the villagers that can serve as **a shelter**? We concentrate the whole village in one space and focus on that.

- But the greenhouse has more to offer. The sun and water make a greenhouse into **a self-sustained micro-ecosystem**. The same should hold for our shelter. It must be equipped with everything needed for sustenance. Important here is also power. The greenhouse regulates sunlight. Why not use sunlight as a source to power up generators (as well as back-up ones for in a snowstorm sunlight is not an option)? This may lead to even further developments such as using the same **eco-friendly technology** in other areas of the village, as well as possibly turning it into a source of income for the community by selling the power thus acquired.
- What else can we do with our investment? Apart from the direct advantages to crisis management and economic benefits, how deeply can the community profit from this? The notion of **cultivation** plays a crucial role here. Greenhouses are an excellent way to import foreign, exotic life forms and experiment with local ones. Seen this way, it becomes easy to reconceptualise the greenhouse as **a cultural centre**. Why only shelter the villagers' lives in a time of crisis and not shelter the village's spiritual and cultural life in constant crisis in our day and age? And of course why not introduce new and exotic elements to the life of their spirit that will serve as sources of inspiration and provocation, much needed stimuli if a culture is to evolve and avoid staleness.

4.1.3 ESCAPISM

Escapism is a general term for the use of **[what if] counterfactuals**,[31] in the production of new solutions/ideas. The main principle is that **temporary emancipation from the given** (in a variety of forms) will not only facilitate the production of new and unusual ideas[32], but will also **localize and bring more into focus the conditions** within which the problem is situated.

After the introduction of the problem the player is asked to imagine **some element of the world**, within which the problem/task is situated, as being completely/significantly different or unrestrained in nature. A **provisional idea** is constructed which will serve as a model or basis for further processing, that will eventually lead to the final solution/idea.

The elements of the world (*the give'n*) to be imaginatively reconstructed, abolished, ignored or just tweaked can range from **simple facts** (e.g. historical counterfactuals situations or fictional ones) up to **fundamental natural principles and laws** (e.g. no death and decay or no gravitational force) or **basic ethical and social norms** (e.g. "What if it is ethically commendable to murder your kids?" or "What if it were socially acceptable to use violence rather than argument in debates?"). Another possible variant of the same basic type of technique is to **take a certain outcome or condition as fixed** and then develop ideas on its basis, e.g. "What if everything that could turn up well did so?" (or the opposite). Here the counterfactual is used to restrain reality in some way.

[31] The distinction between [what if] and [as if] counterfactuals, originates in the work of the OU team, and is part of the theory of "Possibility Thinking". E.g. see Craft, A., "Teaching for Possibility Thinking: what is it, and how do we do it?", *Learning Matters*, Melbourne, Catholic Education Office, 15(5), 2010 and Craft, A., "Possibility Thinking and Fostering Creativity with Wisdom: opportunities and constraints in an English context", in Bhegetto R. & Kaufman J. (Eds), *Nurturing Creativity in the Classroom*, Cambridge: Cambridge University Press, 2010.

[32] Gaut B., "Creativity and Imagination", *The Creation of Art: New Essays in Philosophical Aesthetics*, Gaut B. & Livingston P. (Eds), Cambridge: Cambridge UP, 2003.

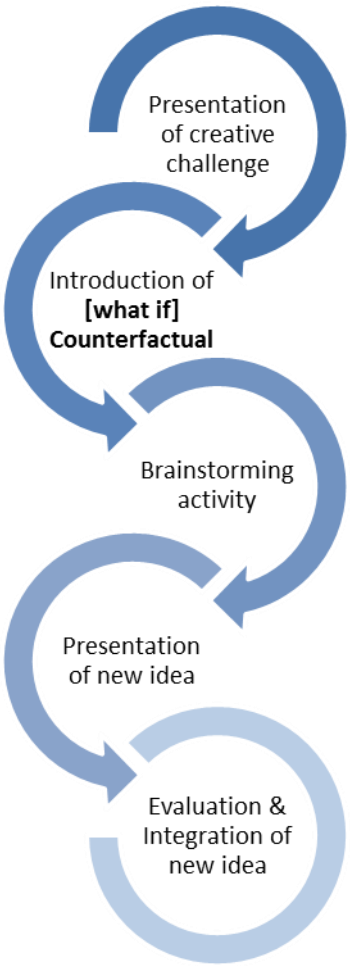


Figure 8: Escapism - Basic process

One may scale the creative challenge by a careful selection of the type and token of the counterfactual to be introduced. An alternative simple fact may be easier to understand than an alteration in some fundamental law of physics, for example. Also one fact altered may be easier to manage than an alteration in another fact. Pools (or the capability of producing such pools) can be provided containing possible candidates along with a possible classification of their conceptual difficulty.

Example:

"A mountainous village is frequently ravaged by heavy snowstorms. The challenge is to devise ways to deal with this."

We begin by posing an escapist type of counterfactual, for example: **What if we could control the weather?** Well then the solution seems clear: Control over the weather means control over the phenomenon (snowstorms in this case), which means the crisis can be easily dealt with. But how are we to use this? Here are some possible suggestions:

- The first idea might be to **take it literally**, and attempts have and are being made to do just that, i.e. find means to control the weather. They are still of course at the level of hypotheses and research programs (unless certain conspiracy theories are to be believed) and in any case even if they eventually are successful it will take years by which time our little mountainous village will be completely ruined.
- Let us take another look at our original idea: Controlling the weather (through the use of some sort of magical powers or super-technology) seems quite straight-forward and definitive as a solution. But is it? The climate forms an extremely delicate system. Micro changes in one area can have major consequences in another. Arbitrarily changing the weather patterns over our village can have unknown (and possibly) disastrous effects in

other parts of the world (even if just at the level of the wider community surrounding the village). Well then, what if we could create a loop-hole, a sort of spatiotemporal bubble around the village and thus any changes in the climate will only affect this village? So now we have these two new insights into our problem: [a] **the local natural phenomenon is just a part of an interconnected whole** and thus [b] **we need to isolate the village in order not to accidentally affect anyone else**.

- A new path is now emerging. The new holistic conception of the snowstorm in condition [a], mirrored in the need for isolation in [b], reveals a subtle yet important underlying aspect of our way of thinking up till now: We tend to think of the natural phenomenon and of our village as something isolated. Why not try and involve the wider community surrounding the village (consisting of other settlements in the area etc.), into forming **a united holistic approach towards a solution**? The interconnectedness of the phenomenon, points towards the need for interconnectedness in the wider community, and thus in the solution to be taken.
- Let us take another look at our first idea: Control over the climate means control over the phenomenon. But a phenomenon has many dimensions. **We can then reapproach the notion of control as well as that of a phenomenon**. Control does not just mean magically ordering the clouds to stop doing whatever it is they are doing. Our understanding of a snowstorm as a disastrous event primarily consists of our understanding of its consequences. So control may very well mean controlling the consequences, by for example creating the necessary infrastructure to deal with them. And the notion of a phenomenon can extend to include its reception by the public. In this case control may mean to try and influence the public's perception/reception of it. If we combine this approach with the findings in section [3] we may decide on a mass media/internet campaign to raise awareness of the problem our village is facing, which can lead to the accumulation of help in the form of funds, expertise etc. coming from all over the world.

4.1.4 ROLE-PLAY

Role Play is a general term for the use of **[as if] counterfactuals**,[33] in the production of new solutions/ideas. The technique builds upon the everyday experience/intuition of a perspective. A **change of perspective** is meant to reorient us within a given problem revealing new paths to be explored, but also to **make us aware of unobservable limitations** in our habitual way of seeing.[34]

The term **role** has been left vague on purpose. There are many different dimensions in which to understand the concept of a role. We can follow the standard route and conceive of a role as a person/profession/occupation e.g. a fireman, a dwarf wizard or we can be more abstract in our conceptualisation e.g. play the part of the victim, play someone who has is scared of heights etc. We can even understand a role as some principle/virtue/vice e.g. justice, benevolence, greed etc. or basic attitude/approach such as optimism, pessimism, neutrality etc. There really is no limit as to what can constitute a role, as essentially **a role is a tool to effect a perspectival change**. One can even create a sort of meta-role in which each player is asked to reason according to one of the types

[33] See note [30].
[34] Carruthers P., *The Architecture of the Mind: Massive Modularity and the Flexibility of Thought*. Oxford: Clarendon Press, 2006.

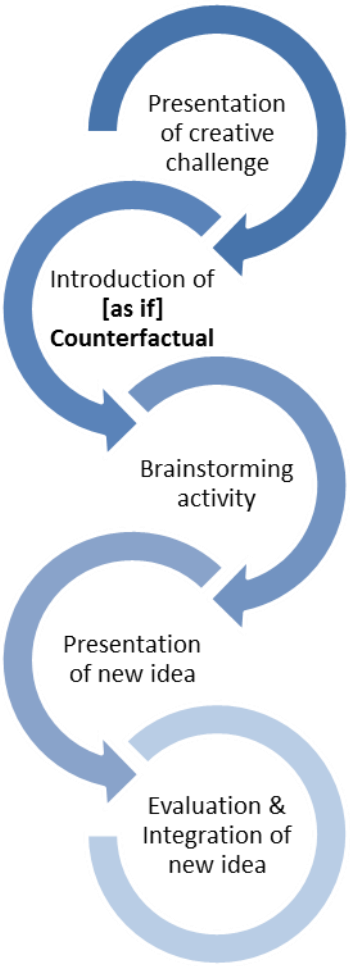


Figure 9: Role-Play - Basic process

of conceptual lateral techniques expounded in this document. The type of technique is then treated as a role.

It is interesting to note a particular connection that exists between this technique and **Escapism**. We can re-conceptualize **Escapism** as a **Role-Play** technique in which the player is asked to play God. Instead of the world, it is now the **agent** that embodies counterfactuality.

Example:

"A mountainous village is frequently ravaged by heavy snowstorms. The challenge is to devise ways to deal with this."

Let us take as our roles those of **the believer**, **the secularist** and **the environmentalist** and see some possible expositions of each one's approach to the problem:

- **The believer** will view the catastrophe as an act of God (a mandate of Heaven, the dictates of Fate, the necessity of pain in the veil of illusion that is life etc.). Man abides by the will of God by examining himself and accepting his environment, within a world of divine provenance. The religious community is vital in such proceedings. So the believer **will focus on strengthening the cohesion of the local community**, through for example the creation of support groups and public events, centred on some sort of inspirational doctrine that **will lead to emotional and spiritual healing**.
- **The secularist** will view the catastrophe as a natural event (no deeper meaning other than one you yourself give, if there is any kind of governance it belongs to the laws of physics and probabilities etc.). Man makes his own fate by adapting himself and controlling the environment, within a world of chance and change. The scientific community (the community of experts and problem solvers) will play a crucial role here. The secularist **will**

focus on amassing and implementing the relevant information and technology, such as forecast models, snowmobiles for transport, innovations in the food supply system etc. that **will lead to the prediction and management of such crises**.

- **The environmentalist** will also view the catastrophe as a natural event but embedded within the holistic framework of an ecosystem (everything is interconnected, the environment is not an enemy but an ally etc.). Man makes his own fate by adapting himself and respecting/working with the environment, within of a world of interdependencies and fragile balances. The activist community will be the base of operations. The environmentalist will focus on **amassing, disseminating and implementing eco-relevant information and eco-friendly technologies,** such as new techniques for cultivation and alternative power supplies better suited to the local climate that **will lead to more long term solutions through a community more aware and embedded within its natural habitat**.
- Any of these perspectives may be followed, or a more comprehensive approach may be pursued, by examining and comparing the weaknesses and strengths of each perspective, which may in turn lead to a their **integration in an overarching scheme**.

4.2 DIAGRAMMATIC LATERAL THINKING

Diagrammatic Lateral Thinking denotes a family of techniques that utilize diagrammatic (imagistic/pictorial) disruptors, in order to reason creatively via the use of visual representations.

In particular under **diagrammatic** we want to include:

- **Analogue representations**: The emphasis here is on strong resemblance to the object(s) represented. Paradigmatic cases include photographs and detailed depictions of objects, mechanisms, organisms etc.
- **Abstract representations**: Like analogue representations without the emphasis on resemblance. Paradigmatic cases include icons, abstract drawings, shape-configurations etc.
- **Schematic representations**: Less resemblance, the aim is to depict the essence of an object or phenomenon. Paradigmatic cases include maps and architectural plans.
- **Conceptual representations**: The aim is to depict interrelations of non-visual features (processes, ideas). Venn diagrams are paradigmatic in this case.

Diagrammatic Lateral Thinking techniques are predicated by 6 principles:

1. Exploiting the two-dimensionality of diagrams one can express **complex relationships** without resorting to the complexities of sentential syntax, which are sequential in nature.[35]

2. The use of colour (or other pictorial devices) can provide more syntactical resources and thus enhance clarity and expressive power. This may be termed as a **representational shift**. Systematic use of such devices (for example pairing concepts and colours together) can help solve problems.[36]

3. The use of linguistic/algebraic marks can enhance the representation power of diagrams. (This holds for schematic, analogue and abstract diagrams too[37], not just conceptual ones.) Most diagrams will consist of a **mixture** of linguistic and graphical elements. In a digital environment like *C²Learn* we can expand this principle to include audio elements too.

4. Diagrams can indeed help cognitive processes but care must be taken that the users are acquainted with the domain of the information presented in the diagram. This is important when building any creative activity. It is important the diagrams be **group appropriate** (age, level of education, other characteristics of the particular group etc.), and that everyone is comfortable and able to use whatever information is present.

5. Diagrams are not merely signs communicating concepts, but **socially constructed toolkits** for the collaborative creation of knowledge, through mutual interactions. The process of constructing a diagram is more important that the final product.[38] Both the processes of understanding and creating a diagram are understood as iterative consisting of more than one cycles. [39]

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[35] Stenning K. & Lemon O., "Aligning Logical and Psychological Perspectives on Diagrammatic Reasoning", *Thinking in Diagrams*, Blackwell A.F. ed., Kluwer Academic Publishers, Dordrect, 2001.
[36] Kaplan C. A. & Simon H. A.," In Search of Insight", *Cognitive Psychology* 22, 1990.
[37] Herbert D. M., *Architectural Study Drawings*, New York, Van Nostrand Reinhold, 1993.
[38] Vile A., Polovina S., "Thinking of or Thinking Through Diagrams? The Case of Conceptual Graphs", Thinking with Diagrams Conference, Aberystwyth, 1998.
[39] See for example Epstein S. L., Thinking through Diagrams: Discovery in Game Playing, *Spatial Cognition IV: Reasoning, Action, Interaction*, International Conference Spatial Cognition 2004, Frauenchiemsee, Germany, 2004 for a very interesting

6. The possibilities one sees for **transforming** a given diagram, are part of one's comprehension of the diagram itself. The functions of the diagram both on the semantic and pragmatic level are determined in part by these possibilities.[40]

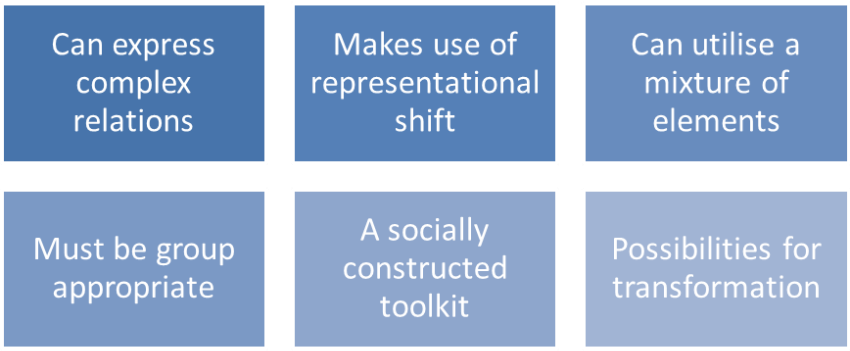


Figure 10: Diagrammatic Lateral Thinking - Principles

Three processes comprise the core of all diagrammatic techniques:

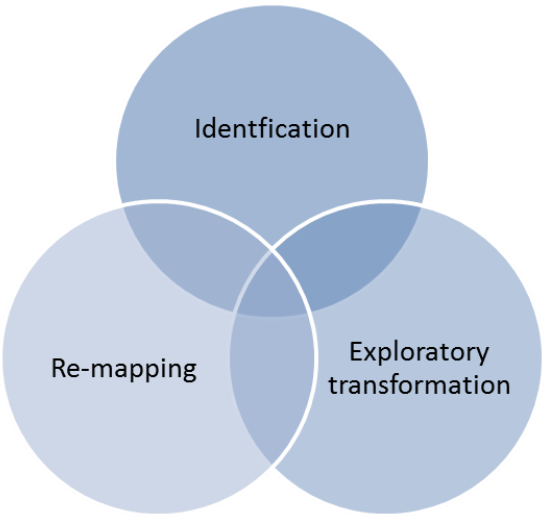


Figure 11: Diagrammatic Lateral Thinking - Basic processes

1. **Identification**: This process is crucial in that it will allow both the educator and group to arrive at a shared understanding of the diagram they are to work with, by identifying the elements of the disruptor to be used in opening up lateral paths. What is to count as an element is not fixed, and will emerge through the discussion. This process also helps the educator to form a better understanding of any possible difficulties the group may have in understanding the diagram.

2. **Re-Mapping**: This does not refer to what is customarily understood as mapping though it does rely on that concept. Within the context of Diagrammatic Lateral Thinking, re-mapping means to

case study involving the construction of a conceptual diagram of the solution space, for traditional Chinese game *Pong hau k'i*.

[40] Sloman A., "Diagram in the Mind?", Thinking with Diagrams Conference, Aberystwyth, 1998.

abstract from a given diagram's pictorial elements, and re-apply them onto a problem or task, as lateral paths.

3. **Exploratory Transformation**: Comprehension of a diagram entails an understanding of its inherent possibilities for change. The aim is to further sensitize the agent in exploring these possibilities. A diagram has potential, and thus more possibilities for lateral path-finding are inherent within it, than at first evident. The new forms of the diagram[41] and/or the particular operations (processes) used in transforming it are then used as lateral paths.

It is important here to note that apart for identification, which is present at the ground level of all diagrammatic techniques, re-mapping and exploratory transformation can **jointly** or **independently** be constituents of a technique. A technique ay require that one uses the results (or operations) of an exploratory transformation for re-mapping, or it may be based solely on either of the two. There can of course be much iteration of all three processes present in a technique.

In the overall CER process-scheme all three core diagrammatic processes take place (primarily) during the **Brainstorming activity** phase. (Identification can be understood as beginning at the introduction of the diagrammatic disruptor.)

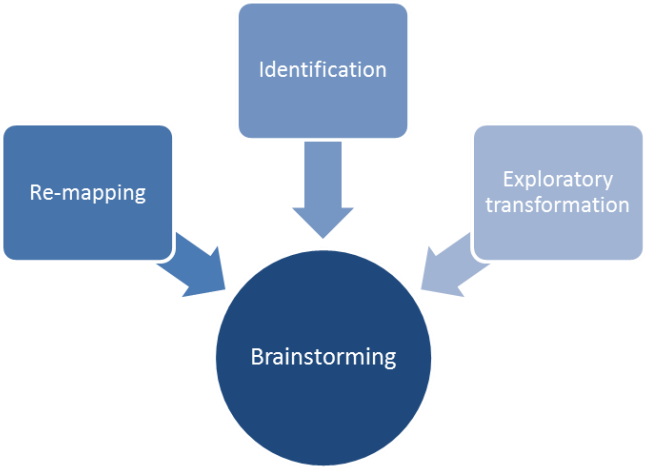


Figure 12: Relation to Brainstorming activity

Below we present the Diagrammatic Lateral Thinking techniques, stemming from the principles detailed above, and utilising the 3 core processes:

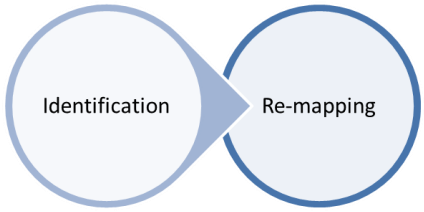
4.2.1 CREATIVE RE-PRESENTATION

A. Simple form:

In its simple form **Creative Re-presentation** is the most basic of the diagrammatic techniques. Following the standard CER process, a diagram is introduced as a disruptor.[42] After identification, the

[41] It is important here to note that as a percentage of *C²Learn* users will be of a younger age the transformations will not necessarily consist of strict topological processes. A more open-ended, imaginative process is here envisioned. Whether the resulting form can still count as a variant of the original one or whether it has become a completely different entity, will be decided by the group and educator. It may be possible though, that particular constraints will be implemented by the computational tool itself.

[42] This can be randomly generated, or specific diagrams chosen for the particular creative activity.



group proceeds with re-mapping, using the diagram to address the challenge at hand. The particular features of the diagram, its visual grammar, will form the basis of any subsequent idea/solution.

Figure 13: Creative Re-presentation (Simple form) – Basic process

Let us assume that this technique is introduced in a story-telling game. The group is presented with the following diagrammatic disruptors:

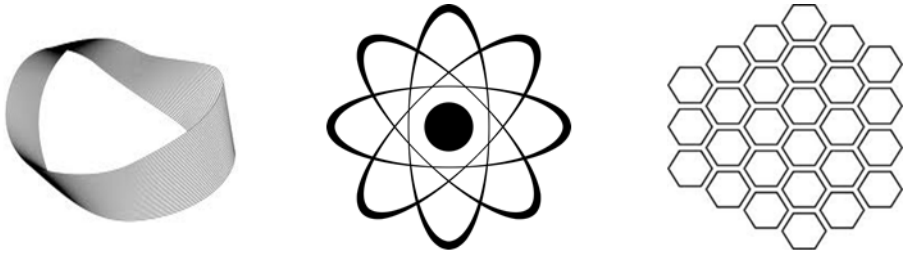


Figure 14: Diagrammatic disruptors

Example 1:

The group is asked to use the above disruptors in designing the core characteristics of the society their characters live in. The disruptor here works at the level of **content**. Possible ideas may include:

1. The **moebius strip** seems like an ordinary strip with two sides but actually if we follow one of them we end up on its opposite; meaning that in reality it only has one side. This may lead the group to question the notion of difference and hierarchy, by questioning whether seemingly oppositional or antithetical relationships actually are so. They envision a society where opposite social castes change into one another at regular time-intervals.

2. The image of the **atom** may lead the group to question the classification into social groups and instead focus on one element of society, be that the individual, the family or some principle, as the nucleus around which everything does or should revolve. They envision a strict theocratic society with a central priestly-caste bureaucracy.

3. The picture of a **hive** may prompt the group to review the notion of comprehensive and rigidly defined hierarchical levels and instead view man as a unit occupying a cell within a vast network of relationships. They envision a casteless society, where social rank is constantly changing as clusters of cells/individuals band together and disband.

Example 2:

The group is asked to use the above disruptors as pictorial paradigms of how narrative time works their story.[43] The disruptor here works on the level of **narrative structure/rules**. Possible answers may include:

[43] Most of us have a standard picture of time as a line, implying a linear progression.

1. The **moebius strip** seems like an ordinary strip with two sides but actually if we follow one of them we end up on its opposite; meaning that in reality it only has one side. The group may be led to view narrative events as following the same logic. Although the characters' understanding is that of a linear progression, they are actually traversing a moebius time-strip, which will lead them back to what they did not do (opposite side) the first time.

2. The image of the **atom** may lead the group to question linearity, and instead focus on one event (singularity), with many possible time-continuations circling in uncertainty around it.

3. The picture of a **hive** may prompt the group to discard linearity, and view time-fabric as an intricate arrangement of cells. Each cell contains alternate seeds of the same basic type of time-line, forming a hive that contains all alternate realities. Characters acquire the ability to travel through.

B. Advanced form

In its advance form[44] mmm is enriched by adding the process of exploratory transformation. Following the standard CER process, a diagram is introduced as a disruptor.[45] After identification, the group proceeds with exploratory transformation.[46] The result of the transformation phase will be a new diagram, which will then be used for the production of a solution/idea.

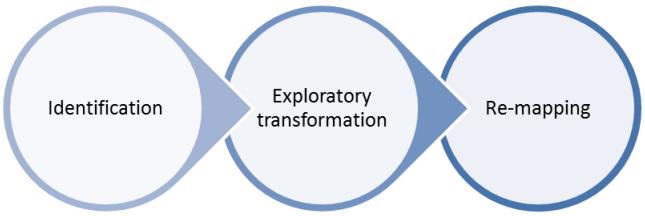


Figure 15: Creative Re-presentation (Advanced form) – Basic process

Let us assume this technique is introduced as part of a creative challenge. The group is presented with the following diagrammatic disruptor:

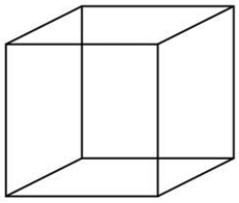


Figure 16: Initial diagram

Example:

The task they are given is to propose solutions to the problem of hunger in a particular country. They cannot use the diagram as it is, though, but must find ways to transform it.[47] Possible solutions may include:

[44] Note that **simple** and **advanced** do not necessarily correlate with levels of difficulty. E.g. the advanced exercise presented here is in many ways much easier than the ones presented for the simple form.
[45] This can be randomly generated, or specific diagrams chosen for the particular creative activity.
[46] This may of course end up being an iterative process.
[47] This is actually very similar to the sort of creative activity we engaged with the teachers during the *C²Learn* Summer School 2013. (Appendix)

1. The group imagines the cube as a **rubix-cube**. The haphazard arrangement of squares represents the equally haphazard way the country's food resources are scattered. Mentally rearranging the cube (imagine it solved) we come to a more ordered arrangement, with every facet of the rubix-cube made of one colour.

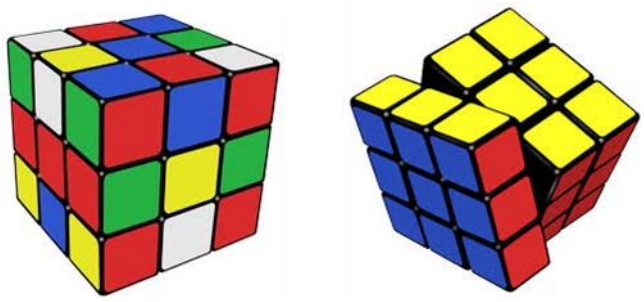


Figure 17: Rubix cube

2. The group imagines the cube opening up, and they turn it into a **box**. The box can then be understood as a kit containing everything one needs (guides, seeds, tools etc.) to be able to help out in the cultivation of the impoverished country's fields. A social program is envisaged, where students from more prosperous countries, donate their time through their school, by going over to the country in need for a period of time to work to help with the agricultural production, or some similar type of activity.

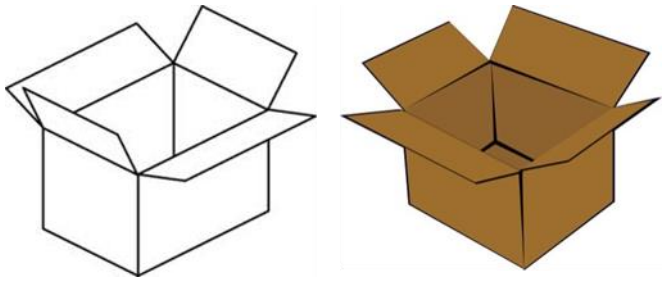


Figure 18: Box

Note that **Creative Re-presentation** can be used in reverse; i.e. one can provide the group with a description, sentence, idea, concept, rule etc. and task the creation of a diagram, using the provided input as a base.

4.2.2 CREATIVITY ICONS

This technique is different than the rest as it essentially requires the participants to internalise the logic of a disruptor, and then produce one. A concept, a rule, a phrase etc. can under certain circumstances receive a pictorial representation. This technique tasks the participants to produce a diagram (icon, simple abstract image) out of a given input (usually linguistic, but not exclusively). The creativity (disruptive) part comes in through the way this icon is then evaluated.[48] Usually signs or icons are meant to convey unambiguously whatever message, notion, idea etc. they represent. Thus a common measure of success is their having conveyed their message (notion etc.) as accurately or fully, to as many people as possible, with 'all of them' being the ultimate goal. In **Creativity icons** the

[48] This mechanic is a modification of *Dixit*'s (a board-game) excellent core scoring mechanic.

diagram produced has achieved its purpose if it has conveyed the idea to as many people as possible, but **not all**. So an icon **fails** if:

- It communicates its intended message (notion etc.) to everyone.
- It communicates its intended message (notion etc.) to no one.
- It communicates its intended message (notion etc.) to fewer people than another competing icon.

The educator provides the group with some input (e.g. a small number of concepts), and an initial diagram. Each member of the group[49] chooses in secret which part of the input to use in order to produce a new diagram out of the initial one, which expresses (communicates) the input, albeit with the above evaluation constraints in mind. After creating the new diagrams, the players try to guess what part of the input each diagram represents. The diagram that satisfies the above conditions wins. Alternatively one can keep playing more rounds and whoever has the higher score at the end wins (everyone=no one=score 0).[50]

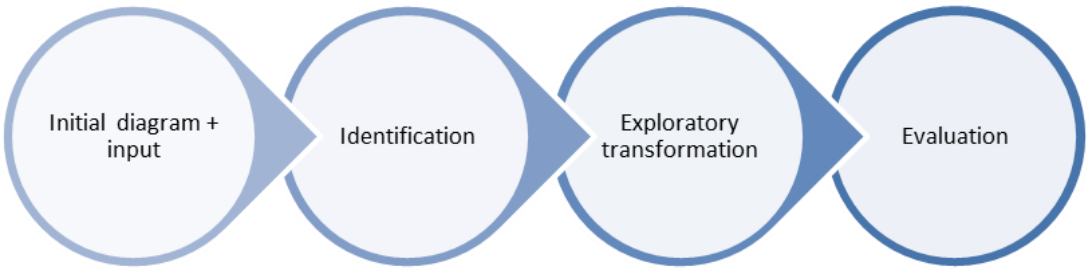


Figure 19: Creativity Icons - Basic process

Example:

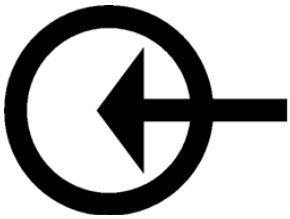


Figure 20: Initial diagram

The educator presents a group of 4 with the input: **[Love]**, **[Success]** and **[Balance]**; then provides the diagram to the left.

At the evaluation phase each participant presents his/her diagram to the rest. The other 3 try to guess which one of the 3 notions the diagram stands for.

The scoring functions as follows:

- If all 3 guess correctly, the participant presenting the diagram receives 0 points.
- If none do, the participant presenting the diagram receives 0 points.
- If some do but some don't, the participant presenting the diagram receives 2 points for each successful guess.
- Any participant who guesses correctly what the diagram stands for receives 1 point.

After the identification and exploratory transformation phases, the participants enter the evaluation phase, each in turn presenting their diagrams:

[49] The group can also function as a unit, competing with other groups.
[50] The scoring system requires further tweaks to be playable. See Example below.

Participant A chose [Love] and created:

All 3 participants guess (correctly): [Love]

Figure 21: Player A diagram

Participant B chose [Success] and created:

Participants A and D guess (wrongly): [Love]

Participant C guesses (correctly): [Success]

Figure 22: Player B diagram

Participant C chose [Balance] and created:

All participants guessed (wrongly): [Success]

Figure 23: Player C diagram

Participant D chose [Balance] and created:

Participants A and C guess (wrongly): [Love]

Participant B guesses (correctly): [Balance]

Figure 24: Player D diagram

At the end of this round the scores are: **A[0]**, **B[4]**, **C[2]** and **D[3]**

4.2.3 PICTURE-TALK

Picture-talk relies on the idea of using diagrams as speech acts. We often use diagrams (pictures, maps, realistic abstract drawings) in storytelling. These diagrams can be supportive or play a primary role in developing and communicating the story. The idea here is to advance this basic function of diagrams into a form of pictorial speech-act. This is of course not something new, marketing (to name just one example) use this all the time. The purpose here is to turn this basic/common idea, into a creative activity using core CER principles.

Equivalences: The idea here is to utilise a series of diagrams, not in terms of their content, but in terms of their visual grammar. The links from one diagram to the next are visual equivalences. The

object of the technique is to express meaning through developing these visual equivalences, which become paths from one diagram to the next. So the participant is doubly constrained: both by the meaning-objective and the relation of equivalence.

A **meaning/message** to be communicated is stipulated.[51] Also the **relation of equivalence** that will allow the passage from one diagram to the next is stipulated. Lastly the **initial diagram** and **number of equivalences** allowed or required are stipulated.

This technique is essentially a repeated application of the identification, re-mapping couple, over the number of steps specified.

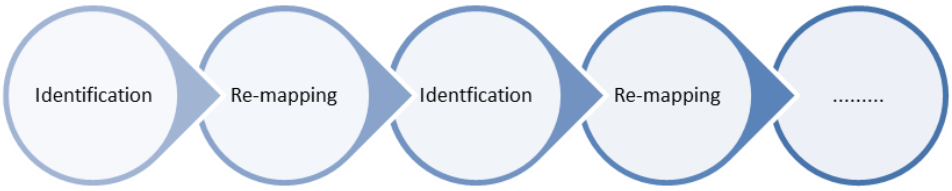


Figure 25: Picture Talk - Basic process

(Note that this technique can be developed further, where instead of the progression of diagrams acting as a sort of visual metaphor, communicating a particular meaning, one can assign a different sort of visual speech-act, like e.g. arguing for something.)

Example:

The educator specifies the intended meaning to be **[Freedom]**. The relation of equivalence is **[colour]**, and 3 equivalences are required. The initial diagram is:

Figure 26: Initial diagram

Possible ideas may include:

1. Base colours breaking free.

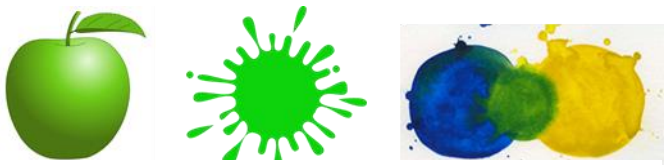


Figure 27: Colours break free

[51] One may also stipulate whether the meaning is to be communicated through the last diagram or through the whole progression.

2. A worm breaking free.

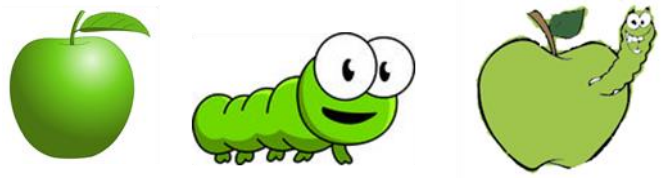


Figure 28: Worm breaks free

4.2.4 JUXTAPOSITION

Juxtaposition is a technique for enhancing diagrammatic disruptors. Based on principle [3] we can enhance any diagrammatic disruptor by adding linguistic or audio elements to it. The core idea here is that as opposed to adding these extra elements as complementary to the dominant diagrammatic element,[52] these extra elements are added with a view to further enhance the **disruptive element** of the diagram; i.e. the elements are juxtaposed one to the other. When confronted with any kind of stimuli we tend to strive for unity of experience. The purpose of juxtaposing these elements is to resist this tendency for unity.

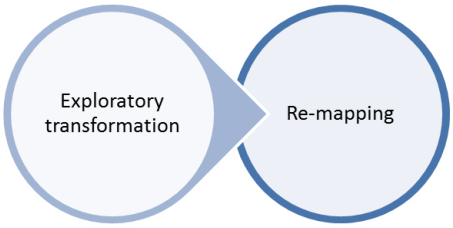


Figure 29: Juxtaposition - Basic process

We can categorise the process of producing such enriched diagrammatic disruptors as a kind of exploratory transformation (albeit a limiting case), which leads to a re-mapping of the original disruptor.

This technique can be used by the educator in order to produce more elaborate disruptors which then be used as building blocks in other activities (e.g. in a story telling game)

Alternatively this technique can be applied as a creative activity for a group.[53] The educator in this case specifies the **initial diagrammatic disruptor** to be used, as well as the **kind** and **number of elements** that can be used to enrich it. In addition the educator has the option of specifying the **relation** that is to hold between the elements of the disruptor, e.g. antithesis. Alternatively the educator may provide a **pool** of such elements created based on some condition, e.g. randomness.[54] Apart from the inherent value in creating these enhanced disruptors - as they are excellent little exercises for creativity – they can also later be used as **props** for other creative activities.

Example:

[52] The paradigm here would be a children's book, e.g. with an image of a cow, the word cow written underneath, and a button that emits the sound a cow makes.
[53] **Juxtaposition** can also be used as a meta-technique to enhance any of the previous ones.
[54] When designing their own enriched disruptors, educators can also choose elements based on a specific relationship, or other conditions such as randomness.

The educator tasks the group with creating an enriched disruptor and provides the following initial diagram:

Figure 30: Initial diagram

The group is allowed to use up to one linguistic or audio enhancement. The stipulated relation is: **[antithesis]**

Possible ideas include:

1. Focusing on **colour**, the group chooses [white] as the antithesis. The white colour leads them to think of milk, dark barns and cows. They decide to enhance the diagrammatic disruptor with **the sound of [a cow mooing]**.

2. Focusing on **colour**, the group chooses [light] as the antithesis. Light coming out of darkness leads them to think of explosions, creation out of nothing and the Big Bang. They decide to enhance the diagrammatic disruptor with **the sound of [an explosion]**.

3. Focusing on **shape**, the group chooses [circle] as the antithesis. A circle leads them to think of the expression "squaring the circle" as an expression of impossibility. They decide to enhance the diagrammatic disruptor with **the word [sun]**.

4.2.5 MIXED-INITIATIVE CO-CREATION (MI-CC)

MI-CC, as realized within the context of *C²Learn*, constitutes a type of Diagrammatic Lateral Thinking. MI-CC offers visual (diagrammatic) alternative paths that satisfy a number of conditions. These define non-linear lateral paths within the creative (possibility) space, as they promote deep exploration of the space of possibilities which is, in turn, a core lateral thinking characteristic. Diagrammatic lateral thinking, as MI-CC, does not necessarily embed transformational creativity processes.[55] In its most potent form a lateral path can result in a transformation of the possibility space, but exploration itself can actually be paradigm shifting, resulting in reframing. An innovative move in chess, i.e. a move staying within the horizon of exploratory creativity, can become the basis for a deeper understanding of a given piece's functionality and tactical prowess, which in turn may have important ramifications on the strategic level.[56] In military history exploratory advances in technology can lead (or play an important role) in RMAs (Revolutions in Military Affairs).[57]

As the creative process unfolds, the user is constantly guiding the MI-CC tool as it, in turn, guides the human user. The notion of co-creation is key here. The suggestions (and consequent selections) are a product of a human-machine interaction, and they have meaning as links within a chain, that takes us from the user's initial designs/ intentions to the final creative product. The human user is not "merely choosing" but shaping the space which generates the suggestions themselves. Even if we

[55] Boden M. A., *The Creative Mind: Myths and Mechanisms*, London: Routledge, 2004.
[56] Pease A., Winterstein D., and Colton S., "Evaluating machine creativity", in *Workshop on Creative Systems*, 4th International Conference on Case Based Reasoning, 2001.
[57] Gray, S. C., *Modern Strategy*, Oxford University Press, USA, 1999.

disregarded this and use choice in a very way, we still find a place for “merely choosing" in our commonsensical notion of a creative process. A significant part of any creative process consists of choosing between alternatives. What makes it creative is how we further exploit this choice and the reasons for choosing as we choose. In a group, for example, one is often labeled creative if he/she stirs the group's creativity by making the right choices between alternatives produced by the group as a whole. In most co-activities the individuals participating in it are not expected to perform the same functions, yet the co-activity is defined by their mutual interaction. In “co-authoring” for example one individual may write the initial ideas in free form, another take these ideas clarify and express them in a more coherent format, and a third make corrections and suggestions. All three of them would be labeled “co-authors” yet would be performing quite different functions.

4.3 EMOTIVE LATERAL THINKING

Today there is good evidence, from neuroscience and psychology/psychiatry that emotions function in both conscious and unconscious ways to affect judgment, reasoning process and overall cognitive behaviours. Emotions are understood as more primitive than concepts, and the most ancient, yet still fully active, guides in decision making.[58] The limbic system of the brain, which is older in evolutionary terms, can guide action almost completely, before the higher cognitive centres of the brain, assume conscious control.[59]

Indirect evidence of the primacy of emotion can also be found in cases of emotional impairment, which can exert many kinds of pressures to decision making process. For example, making a decision involves accepting a certain degree of uncertainty, i.e. one is emotionally able to end the inquiry/search phase and proceed to action. Emotional impairment can inhibit this process by leading to an endless iteration of the search phase, and a constant sense of un-readiness to take action.[60] On the other hand positive emotional feedback can lead to performance enhancement, improved risk management and overall creativity boost.[61] This is premised on the fact that emotive conscious and unconscious processes help navigate and sort the an otherwise overwhelming amount of data and interrelations, one id faced with especially in complex situations demanding high performance decision making.[62] An understanding that emotions play a role in lateral thinking is already present in the literature.[63] Our approach is based on the type of evidence briefly surveyed above, including current work in cognitive science.[64]

Emotive Lateral Thinking is an explication and expansion of the fundamental insight that one may approach the creative act and in particular the rarest kind, i.e. transformational creativity, [65] through the notion of an emotive lateral judgment (an emotive disruptor). An **emotive lateral judgment** is premised on a sensitization in ascribing *emotive value*. A transformational creator is in a sense a predictor, an evaluator of the public's emotive reaction to the disruption, caused by his/her creative act. An exploratory creator, though, can also make use of an emotive lateral judgment. To this end we distinguish between two levels of judgment, which constitute the two basic processes of Emotive Lateral Thinking:

4.3.1 BASIC PROCESSES

First-order Emotive Lateral Judgments are premised on an awareness of one's emotive state(s) in connection to objects (understood to include items, people, and situations) in the world, an awareness of how the world impacts one emotively. That means one is able to ascribe ***emotive value*** to objects. The notion of *emotive value* is essential, as it allows one to explore analogical

[58] See e.g. Damasio A. R., *The Feeling of What Happens: Body and Emotion in the Making of Consciousness*, New York: Harcourt, 1999, and Damasio A. R., *Looking for Spinoza: Joy, Sorrow and the Feeling Brain*, New York: Harcourt, 2003.
[59] LeDoux J., *The emotional brain*, New York: Touchstone/Simon & Schuster, 1996.
[60] Goleman D., *Emotional intelligence* at work, New York: Bantam, 1998.
[61] See e.g. Losada M. & Heaphy E., "The role of positivity and connectivity in the performance of business teams: A nonlinear dynamics model", *The American Behavioral Scientist* 47(6), 2004.
[62] See e.g. Goleman D., *Emotional intelligence* at work, New York: Bantam, 1998, and Damasio A. R., *Descartes' error: Emotion, reason, and the human brain*, New York: HarperCollins Publishers, 1994.
[63] See e.g. De Bono E., *Serious creativity: Using the power of lateral thinking to create new ideas*, New York: HarperCollins Publishers, 1992.
[64] Stenning K., *Seeing Reason: Image and Language in Learning to Think* (Oxford Cognitive Science Series), Oxford: OUP Oxford, 2002.
[65] Boden M. A., *The Creative Mind: Myths and Mechanisms*, London: Routledge, 2004.

equivalences. It is important here to note that *emotive value* is understood here as interconnected with cultural, social and ethical sensitivities.

The basic type of question underlying this type of judgment is: "What has an equivalent *emotive value* to this object?"

The answer to this question comprises the **emotive disruptor** to be used in constructing a new solution/idea to a given creative task. We sensitise the player to emotive value, by asking him/her to build analogical equivalences, based on it.[66] The new object, carrying the equivalent *emotive value*, can then be used in different ways in the challenge. The object itself can become part of the solution, or associations connected with it can play that role. We thus create a lateral path that moves through the 'side-streets' of an emotive equivalence, by-passing any obstacles of non-similarity in form or logical structure, that may prevent us from reaching the alternative we need.

Second-order Emotive Lateral Judgment: This the second level at which emotive techniques can work. It is here that we encounter transformational creativity. Second-order judgments can depend upon first-order, but this is not necessary. They do necessarily depend, though, on a sensitization in ascribing *emotive value*.

The basic type of question underlying this type of judgment is: "What can be emotively accepted as a solution by the public (others, the group etc.)?"

To reach the rare moments of transformational creativity, the rules governing a field of discourse or conceptual space must be changed. A Second-order judgement allows us to transcend the given rules formulating a given problem/task, by opening up a space of possible solutions/ideas maintained by the emotive reaction (understood to carry cultural, social and ethical interconnections) of the public. The lateral path in this case works essentially as a short-circuit letting us by-pass the resistance offered by the (implicit or explicit) rules themselves, in order to reach a creativity conducing space. Here we are not looking for an alternative through equivalence, but seek to temporarily bracket the rules, in order to bend or alter them, by successfully predicting the emotive acceptance of our act as a solution, by the public.

The most famous example of such Second-order judgement comes from history. Alexander the Great was faced with the most masterfully constructed knot in history, a knot that no man could untie. H chose to do the most obvious thing in the world: He cut it. The revolutionary character of the act was its obviousness, or rather the difficulty of registering the obvious as a solution. His act *felt* as a solution. We *feel* he was right, that he solved the Gordian Knot. It opened new paths as to what "solving" is. Or to be more precise, it cut into a whole new space, allowing us to *feel* our way around for new possibilities of what a solution can be.

Figure 31: The Gordian Knot

[66] This is similar in spirit to the diagrammatic **Picture-Talk** technique (Section 4.2.3).

In terms of the above Gordian Knot scenario, Alexander was acutely aware of the emotive register (*emotive value*) of him by the public. The public were emotively prepared, even expected for this super-human, sword-wielding conqueror to bend the rules. In a sense, the space for cutting the Gordian Knot was already prepared. What Alexander needed was the right type of question to get him there. The answer consisted in one of the most famous emotive lateral judgments of all time.

Note: Emotive Lateral Thinking techniques are still under development and will be added in an updated version of the current document. The two basic processes outlined above guide and structure the design of these techniques.

APPENDIX

Workshop 5 - *C²Learn* Summer School 2013 ***Creativity and Games in Education***

Creative Emotional Reasoning (CER) Techniques

(July 3rd 2013)

OVERVIEW

Within the context of the *C²Learn* Summer School 2013 ***Creativity and Games in Education***, held in Crete (Greece) - between June 30th and July 5th - the UEDIN team conducted a Workshop on *Creative Emotional Reasoning (CER) Techniques*.

The participants consisted of 12 teachers (mostly from secondary education) and 2 educational content designers.

The Workshop was divided into two parts:

1. **Concise presentation of CER**

- Creativity within CER's framework
- Core principles of CER
- Brainstorming explained – Presentation/Explanation of the tools at the participants' disposal [cartons, papers etc.]
- CER techniques explained:
    - Semantic Lateral Thinking
    - Diagrammatic Lateral Thinking
    - Emotive Lateral Thinking

2. **A Creative challenge**

The participants were presented with a challenge: "A faraway country is being ruled by corrupt oligarchs. As a result its people are starving. Find a way to help the populace."

The participants were divided into 3 groups. Each group would use one type of CER technique, drawn from the 3 types of CER respectively (i.e. one group would use *only* Semantic, the other *only* Diagrammatic and the last *only* Emotive to tackle the same challenge). Apart from the restriction on the techniques used, the participants were free to tackle the challenge as they thought

Each group was given pens (of different colour), sticky-notes, papers and 2 big pieces of carton to serve as their mind maps (they were advised to use the second piece to record the ideas they rejected during the process).

The only instructions for the Brainstorming activity were: [i] That it be divided into rounds and [ii] that at each round participants write down their idea(s) on a piece of paper and present it to the group. (The reason for minimalism in instructions was to see how the group spontaneously handled the rest of the decision making process.)

Figure 32: *C²Learn* Summer School 2013 *Creativity and Games in Education*

The creative process lasted for about 45 minutes (to simulate a typical classroom timeframe). After the conclusion of the creative process each group presented their results to everyone, with some discussion

At the end of the Workshop the participants were given time to fill in the *Workshop 5 – CER Questionnaire*.

AIMS

The participants of the Workshop were all adults with a background in education, predominantly teachers. As teachers are *C²Learn*'s most valued allies, their input on our techniques plays an essential role in their further development.

Going into the Workshop we had 4 interrelated aims:

- Test the use of different CER techniques in a real life context, with an actual creative challenge.
- Test whether CER techniques can be adequately explained in a short time, using simple instructions.
- Acquire feedback on the CER techniques.
- Acquire feedback on Brainstorming activities.

QUESTIONNAIRE

The questionnaire consisted of 3 multiple-choice questions, and 4 open-ended questions. Participants were asked to write down which of the three groups they participated in on the questionnaire sheet.

The multiple-choice questions were:

A. Was the task fun?

B. Was the task challenging?

C. Was the task clear?

Participants used a rating system from 1 (most) to 5 (least) in answering the questions.

The following diagrams provide an overview of the results:

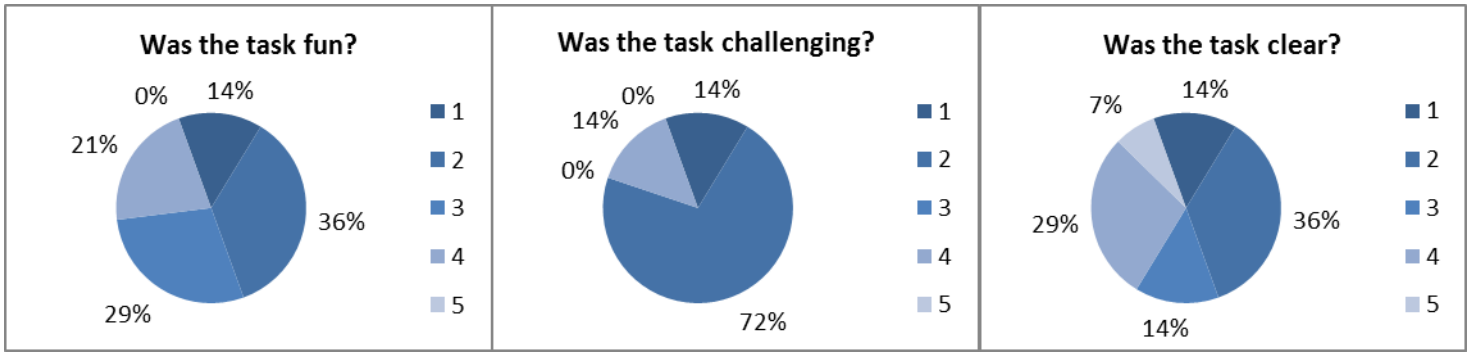


Figure 33: Breakdown of the questionnaire results

Semantic Lateral Thinking scored intermediate/low in questions [A] and [C] (mostly 3 and 4), and high in [B] (mostly 2)

Diagrammatic Lateral Thinking scored high in all three questions (mostly 1 and 2)

Emotive Lateral Thinking scored high in question [B] (mostly 2), with more mixed results in questions [A] and [C] (mostly 3 and 4 but also 1 and 2)

The 4 open-ended questions were:

D. Describe the decision making process during brainstorming. Do you feel your voice was heard?

E. What element of the task worked best?

F. What element of the task worked least?

G. Any additional comments?

(The conclusions drawn from the open-ended questions are embedded in the general conclusions presented in the next section.)

CONCLUSIONS

A number of interesting conclusions were drawn from this Workshop:

- A major concern reported by most of the participants was time. Many felt that the time was not enough to reach a satisfactory conclusion. This is a concern that we have taken to heart as we further develop our techniques and the game(s) associated with them.
- Taking into account certain language barriers (the Workshop was conducted in English, which was not the mother tongue for the majority of the participants), the groups responded quite well to the instructions provided. The Semantic and Diagrammatic groups were able to work with their respective techniques productively. The Emotive group faced more problems, but that was expected as Emotive was still in its early phase of development.
- In all three groups the participants recorded that they were able to voice their opinion, and used mostly dialogue to negotiate through the different phases of the Brainstorming activity. The Emotive group reported that they eventually had to resort to voting in order to reach consensus.
- Out of the three groups the Diagrammatic group seemed to have capitalized on the experience more. Of course group chemistry/dynamics played an important role in this, but there were also indications that the visual elements (drawings, manipulations of shapes etc.) played a major role in this group's experience.
- It is interesting to note that despite the simple structure of the challenge, the majority of the participants rated the experience as challenging (giving it a 2). Time, group interaction and unfamiliarity with the techniques were amongst the prime reasons alluded to in the commentary.

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