ProActive

Fostering Teachers' Creativity through Game-Based Learning

Deliverable 3.3

PSYCHO-PEDAGOGICAL FRAMEWORK FOR FOSTERING CREATIVITY

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EXECUTIVE SUMMARY

ProActive is a two years EU project focusing on games in education and training. Its goal is to stimulate the creativity of the educators of various levels, i.e. schools, universities and vocational training within Europe. The chosen approach is through the design of educational games and with the help of five metaphors used in natural learning.

This document - Psycho-pedagogical framework for fostering creativity aims at describing the psycho-pedagogical approach of ProActive. It is a public deliverable and will be available on ProActive web site (www.proactive-project.eu).

The development of the psycho-pedagogical framework is based on several previous tasks performed in earlier project stages. First, it is rooted into extended literature reviews on the topics of creativity, Game-Based Learning, games design for educational purposes, and learning theories. Secondly, it is based on the outcomes from fifteen focus groups organised by the ProActive consortium in which teachers' / trainers' current practices, interests, expectations, attitude and opinion towards creativity, Game-Based Learning and teaching methodologies were explored. The workshops allowed gaining deeper understanding on target users' needs and taking them into account for the further activities of the project.

ProActive's psycho-pedagogical framework links the concepts of creativity, Game-Based Learning, game design and the five learning metaphors in an integral whole. A constructivist approach to Game-Based Learning adopted, where teachers and trainers will develop innovative learning artefacts that are interesting and engaging for their students. The game design process will foster educator's creativity. The metaphors of learning will work as guidelines for the project participants in the creation of educational games as they raise awareness and promote reflection on different learning models and guide the game construction. Furthermore, as a result of the situated design process, a creative product will be obtained – a learning artifact (i.e. an educational game), tailored to the learning needs, institutional and curricular constraints and which can be shared with students. Such creative product is pedagogically innovative, useful and adapted to a specific teaching / learning context.

The psycho-pedagogical framework will be central in several future tasks in ProActive. First of all, it provides basis for the organisation of the training and implementation that will take place in eighteen pilot sites in four European countries (Italy, Romania, Spain and UK) in the beginning of 2011. Moreover, training materials for the teachers and trainers are being developed to correspond to the proposed approach. Finally, the ProActive evaluation framework and appropriate evaluation tools are designed as consequence of the elicited methodology.

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INTRODUCTION

In 2009, the European Year of Creativity and Innovation aimed to raise awareness of the importance of creativity and innovation for personal, social and economic development. The initiative addressed a wide spectrum of related themes such as fostering artistic and other forms of creativity through pre-school, primary and secondary education including vocational streams, as well as non-formal and informal education, ICT as media for creative self-expression, and promoting innovation as the route to sustainable development.

Traditionally, teachers and trainers used in their practice a dominant learning paradigm: the instructional, thus limiting their creative potential and inhibiting learning. Recent studies instead show that in normal situations learners combine different metaphors to a lesser or greater degree simultaneously: Imitation, Participation, Acquisition, Exercising, and Discovery (Simons, 2003, 2004, 2008).

ProActive is a two years project in the EU LLL program (Project Number: 505469-LLP-1-2009-1-ES-KA3-KA3MP) which started on 01/01/2010. The project tackles creativity in the context of lifelong learning by stimulating creative teaching practices through the use of different learning metaphors in various educational levels. Moreover, the project will use the concept of Game-Based Learning (Game-Based Learning) in order to support creativity in teaching / learning processes.

Concretely, the project will create learning contexts where teachers from schools (Comenius), higher education (Erasmus) and vocational education and training (Leonardo da Vinci), can apply creativity in designing their own Game-Based Learning scenarios using digital tools. Within training workshops, teachers will use two main game editors: a free of charge 3D virtual environment allowing collaborative interaction of the learners (EUTOPIA) and an Open Source framework for implementing 2D user-centred adaptable scenarios (<e-Adventure>). ProActive will adapt the five learning metaphors mentioned above and the tools, in order to foster creativity and support the flexibility of the teachers in designing their learning sessions in 18 pilot sites covering different areas and levels in four countries (Italy, Romania, Spain and UK).

More specifically, the main objectives of ProActive are:

1. To stimulate the creativity of teachers / trainers working in LLP sub-programmes, developing a conceptual framework for integrating different learning metaphors;
2. To introduce innovative ICT-based experiences in teaching / training practice, adapting and enhancing the game editors, integrating five learning metaphors;
3. To implement co-design creativity sessions and pilot sites for addressing school, university and vocational education scenarios;
4. To validate the proposed approach as a means of learning and evaluate its impact on teachers' creativity and students' outcomes.

As final results, ProActive will produce guidelines on creativity enhanced by Game-Based Learning and disseminate a database of Game-Based Learning scenarios and related active learning culture within EU education.

The project is carried out by a consortium of six partners from four countries in Europe (as shown in Table 1), covering various education and training systems and learning cultures.

Table 1: ProActive consortium

Partner Nº	Acronym	Organisation Name	City	Country
P1	UB	Universitat de Barcelona	Barcelona	Spain
P2	DPPSS	Sapienza Università di Roma	Roma	Italy
P3	CAST	CAST Limited	Bangor	United Kingdom
P4	UNINA	Università di Napòli Federico II	Naples	Italy
P5	UCM	Universidad Compultense de Madrid	Madrid	Spain
P6	UNIBUC	University of Bucharest	Bucharest	Romania

The project work is organized according to eight work packages (WPs), as depicted in table 2.

Table 2: Summary of ProActive work packages

WP N°	WP Title
WP1	Project Management
WP2	Quality Assurance
WP3	Pedagogical Framework for Creativity and Game-Based Learning
WP4	Adaptation of the Game-Based Environments
WP5	Implementation of Learning Scenarios
WP6	Evaluation
WP7	Dissemination
WP8	Exploitation of Project Results

The work described in this report is part of WP3 – "Pedagogical Framework for Creativity and Game-Based Learning", which sets the pedagogical concepts for building ProActive teaching / learning experiences. It aims at revealing the last trends regarding Game-Based Learning and creativity in educational settings. Furthermore, it presents in details the psycho-pedagogical approaches related to the five learning metaphors which are central in ProActive:

- *Acquisition* - objective facts, transmission, knowledge from experts, theories;
- *Participation* - dialogue with others, collaboration, discourse, trust, communities of practice;
- *Discovery* - meaning, deep understanding, inspiration, self regulation, knowledge creation;
- *Imitation* - role models, best-practice, real-life, implicit learning;
- *Experimentation* - safe environment, practising, attitudes, explicit learning, role playing.

This document summarizes the psycho-pedagogical framework developed for ProActive. It is based on the results of a previous theoretical research conducted by the consortium on Game-Based Learning (internal report "D3.1 – Success Factors for Game-Based Learning") and on a user needs analysis performed within

an earlier stage of the project (internal report "D3.2 – User Needs Analysis"), summaries of which are respectively given in section 2 and 4. Furthermore, a deep study on the five metaphors of natural learning is presented in section 3.

The psycho-pedagogical framework will serve as a basis for further activities to be conducted in the context of the project: the organization of training workshops for teachers / trainers, the implementation in pilot sites and the evaluation of the selected approaches.

The document is organized in the following manner:

- Section 1 presents a literature study on creativity concepts. It first defines what creativity is, and then focuses on the teaching and the learning perspective of it. The section points out the creativity viewpoint adopted in ProActive;
- Section 2 provides a summary of the literature review on Game-Based Learning and lists success factors for educational games, which were identified earlier in ProActive. The review justifies ProActive expectation for the success of the adopted strategy, while the success factors that have been elicited will also serve as guidelines within the games design process in further project steps;
- Section 3 gives details about the five learning metaphors that are central to ProActive. Analysis of each metaphor is made. ProActive position on each metaphors is stated;
- Section 4 summarises the results of the user needs analysis performed in ProActive through focus groups conducted in four different countries. These results have been taken into consideration in the design of the psycho-pedagogical framework, its use in the game design process and in the planning of training and implementation activities;
- Section 5 is dedicated to ProActive's psycho-pedagogical framework that integrates the five learning metaphors into the game design process and elicits the relation between Game-Based Learning and creativity;
- Finally, section 6 gives directions on how the psycho-pedagogical framework will be used within ProActive training workshops and implementation.

The document also provides a Conclusions and References sections. Furthermore, a number of Appendixes are included which give additional more detailed information on the topics of creativity, Game-Based Learning and game design tools.

1. CREATIVITY IN EDUCATION

The main objective of ProActive is to stimulate the creativity of teachers / trainers from different lifelong learning levels, through providing them a context for creating Game-Based Learning scenarios.

In order to develop a framework for fostering creativity in lifelong learning settings, this section aims at defining the concept of creativity, specially applied to educational contexts.

First, creativity is defined in general, and a small discussion is provided considering the changes in the view of the society towards it. Afterwards, the different components of creativity are discussed, namely creativity as personal characteristics, as a process, as a product, and as characteristics of the environment. Later on, creativity is discussed as applied to teaching / learning settings. Two different approaches are identified: "teaching for creativity" and "teaching creatively". Within ProActive context, the latter would be mostly tackled, as the project concentrates on the instructor's creativity and innovative pedagogical practices.

1.1 General definition of Creativity

'Creativity' is a term that might be understood by different people and in different contexts in many different ways. Commonly, people relate it to arts and crafts, such as visual arts (e.g. ceramics, drawing, painting, sculpture, etc.) and music, or more recently with performing arts or photography.

In (NACCCE, 1999) creativity is defined as an "*imaginative activity fashioned so as to produce outcomes that are both original and of value*". Furthermore, according to the Manifesto "European Ambassadors for Creativity and Innovation"[1], *"to be creative means to imagine something that didn't exist before and to look for new solutions and forms"*.

A detailed review of approaches to creativity, categorized into five groups, has been provided by Ferrari et al. (2009). An extraction of the review is available in Appendix 1.

1.1.1 Recent changes in the view of creativity

NACCCE (1999) points out that creativity is seen by some "*as the preserve of a gifted few, rather than of the many; others associate it only with the arts*". This myth that people are born creative or uncreative is also underlined by Plucker et al. (2004). According to the authors, *"The root cause of these stereotypes is the lack of adequate precision in the definition of creativity".* However, the scope has been changing in the recent years, so *"there has been an acknowledgement of the creative potential of all individuals in different knowledge domains, or subjects not confined to traditional definitions of the 'arts' or 'sciences'"* (Loveless, 2002). Moreover, according to Loveless (2002), *"Creativity can now be recognised and valued at the level of individuals, peer groups or the wider society and considered as an essential element in participating in and contributing to the life and culture of society" (Ibid).* Thus, creativity is present in each person and can be involved in all fields and areas.

Craft et al. (2001) introduced the concepts of "big C" and "little c" creativity. Big C creativity (BCC) refers to extraordinary accomplishments of unusual people, such as renowned artists, scientists and inventors. Their creative achievements are exemplary and comprise novelty and excellence in their domain, as well as social recognition and valuation. Little c creativity (LCC), on the other hand, is not for an extraordinary few. Rather, it refers to personal creativity, as the ability to find new and effective solutions to everyday

[1] http://create2009.europa.eu/fileadmin/Content/Downloads/PDF/Manifesto/manifesto.en.pdf, p. 1

problems. According to the author, LCC is based on 'possibility thinking', described as refusing to be stumped by circumstances but being imaginative in order to find a way around a problem.

1.1.2 The 4 Ps (dimensions of creativity)

Rhodes (1961) developed a four-component model which is helpful in understanding the subject of creativity. The model is known as "the four P's of creativity" model where the four Ps stand for 1) Person (personality characteristics, cognitive abilities, etc.), 2) Process (steps, stages and strategies within the creative process), 3) Product and 4) Press (environmental factors that facilitate or inhibit the creative performance). This model has been adopted by other authors, such as Plucker et al. (2004).

Category	Associated dimensions
Person	Active imagination, flexibility, curiosity, independence, acceptance of own difference, tolerance for ambiguity, trust in own senses, openness to subconscious material, ability to work on several ideas simultaneously, ability to restructure problems, ability to abstract from the concrete
Process	Fluency of ideas, uncensored perception and encoding of information, problem recognition and construction, unusual combination of ideas, construction of broad categories, recognizing solutions, transformation and restructuring of ideas, seeing implications, elaborating and expanding ideas, self-directed evaluation of ideas
Product	Originality, relevance, usefulness, complexity, understandability, pleasantness, elegance
Press	Supervisory encouragement, workload pressure, freedom of choice, sufficient resources, organizational impediments

Table 3: The four P's of creativity[2]

Since the introduction of the four P's model, some authors focus separately on some of these characteristics of the creativity, i.e. *process, product* or *person,* while others considered them in combination.

In the next subsections we give a short overview of each of the four components.

Person

As summed up by Ferrari et al. (2009), creativity is the ability to see possibilities that others haven't noticed (Craft, 2005), the critical process involved in the generation of new ideas (Esquivel, 1995), the possibility to make connections that are not common. It requires cognitive and creative thinking skills, in other words divergent thinking (Runco, 1990) and imagination (Craft, 2005), and also evaluation (Runco, 1990). Creativity also demands a set of personality traits which can be enhanced or modified by the environment.

Creative individuals can come up with many different ways to solve problems. Creativity might be also related to the freedom to innovate, and take risks (see NACCCE report, p. 10).

Creativity requires the simultaneous presence of a number of traits. According to Sternberg and Lubart (1999) creativity involves the ability to offer new perspectives, generate novel and meaningful ideas, raise

[2] Sourse: Horn and Salvendy (2006)

new questions, and come up with solutions to ill-defined problems. Furthermore, according to the same authors, creativity requires six elements: intellectual abilities, knowledge, specific styles of thinking, personality and motivation. Three intellectual abilities are seen as particularly necessary: creative or synthetic (the ability to see a problem in new ways and to escape conventional thinking); analytic (see which ideas are worth pursuing); and practical contextual (persuading others that one's ideas are of value).

Cropley (2001) sees the creative people as a cause in the development of a product through a creative process. He discusses the psychological factors within individuals that give the potential to produce creative outcomes. This psychological constellation involves abilities, knowledge, skills, motives, attitudes and values, as well as personal properties such as openness, flexibility, courage. Some of these can be acquired through experience and training (domain specific knowledge, special cognitive strategies).

Maruja Gutiérrez Díaz (2009) links individual creativity to the following personal characteristics: autonomy, flexibility, preference for complexity, openness to experience, sensitivity, and playfulness.

Russ (1996) assumes that creativity is manifested in the interplay of three processes: a) personal traits (i.e. tolerance of ambiguity, openness to experience, independence of judgment, unconventional values, curiosity, preference for challenge and complexity, self-confidence, risk-taking, intrinsic motivation); b) emotional or affective processes (i.e. affective fantasy in play, passionate involvement in tasks, affective pleasure in challenge, tolerance of anxiety) and; c) cognitive abilities (i.e. divergent thinking, transformation abilities, sensitivity to problems, tendency to practice with alternative solutions, wide breadth of knowledge, insight ability and evaluative ability).

Teresa Amabile (1998) wrote extensively on the topic of creativity, specifying that intrinsic motivation of creative people is more important than extrinsic. For Amabile, intrinsic motivation is about passion and interest, an internal desire to do something. She sees motivation as one of the three components of creativity, the other two being expertise and creative thinking skills. Even if all three components of creativity can be improved, motivation, Amabile argues, is the one that can be most immediately influenced by the work environment, as expertise and creative-thinking skills are most difficult and time consuming to influence (Amabile, 1998). Amabile's research maintains that extrinsic motivation (i.e. external rewards) is not enough: a cash incentive is not a magic wand to motivate people. Intrinsic motivation is the major booster for engagement. Creative people are those who are engaged in a task or activity because they derive pleasure from the activity itself. As Csikszentmihalyi (1996) has it: they all love what they do. They experience a mental state of *flow*, being fully immersed in their activity, experiencing an automatic, effortless yet focused state.

Process

Lubart (2001) defines the creative process as “the sequence of thoughts and actions that leads to a novel, adaptive production”. In other words, the development of a creative product or idea is an integral part of the creative process, i.e. its outcome. Plucker et al. (2004) also argue that the creative process should have a perceptible product - an outcome that is observable and measurable.

NACCCE (1999) highlights four characteristics of creative processes:

- *Using imagination:* In an imaginative process, thinking is a generative / creative process, in which we attempt to expand the possibilities of a given situation, by looking at it from a new perspective, combining existing ideas and making unusual connections.
- *Pursuing purposes:* the imaginative activity is related to the specific goal of producing something in a deliberate way. Creative insights occur on the way to an overall objective, or to solving a central problem. The outcomes can be quite different than from those anticipated at the outset.

- *Being original:* Creativity involves originality. Three types of originality are being distinguished: individual (a work is original in relation to the person's previous works), relative (a work is original in relation to their peer group) and historic (the work is original in terms of previous outputs in a particular field).
- *Judging value:* Creativity involves an evaluative mode of thought. Indeed, the outcome of imaginative activity can only be called creative if it is of value in relation to the task at hand. Value here is a judgment of some property of the outcome related to the purpose. In this way creative thinking always involves some critical thinking.

There are various methods and techniques developed with the goal to enhance / stimulate the creative process. One of the well-known is the ICEDIP model proposed by Petty, (1971). This model has evolved through the years and continues being used in recent studies. According to this model, the creative process consists of six working phases: *inspiration, clarification, distillation, perspiration*, *evaluation, and incubation.* During the creation of a particular piece of creative work each phase could be experienced many times, in no definite order, sometimes for a very short time. More detailed description of the phases of ICEDIP can be found in Appendix 3.

Product

According to Cropley (2001), creativity is a property of products, which might be a tangible (documents, arts, etc.) or intangibles (ideas, strategies, systems) result of the creative process. As pointed out earlier, many authors, such as NACCCE (1999), Lubart (2001) and Plucker et al. (2004) share the same idea.

Novelty and value /usefulness

Comparison of various studies shows the commonly accepted view of creativity as involving the "*creation of something new and useful*" (Villalba, 2008 p.10). Thus for creativity to be manifested, the qualities of both novelty and usefulness must be expressed in relation to the examined context. Plucker et al. (2004) also states that the creative outcome is *"a perceptible product that is both novel and useful as defined within a social context"*. Cropley (2001) identifies three elements common to all the discussions on creativity: novelty (the creative product departs from the familiar), effectiveness (it achieves some end) and ethicality. Maruja Gutiérrez Díaz (2009) states that creativity is a human characteristic that enables people to purposefully produce new, original ideas, adequate to the situation they are being applied to. NACCCE (1999) also links the creative outcome as being original and of value, which is related to the purpose of the product.

To sum up, the meaning of the term 'creativity' as adopted by the majority of investigators in the field means *'the production of effective novelty'* (Cropley, 1999; Lubart, 2001; Maruja Gutiérrez Díaz, 2009).

Press

The fourth component of this model takes into account the environment and the surroundings in which creativity happens. The environment needs to nurture creativity and to boost intrinsic motivation. A creative environment is one where people feel comfortable in expressing their ideas and where constructive support is given in the development and analysis of those ideas.

As depicted by Horn and Salvendy (2006), to support the creative process the environment should provide sufficient resources and low organizational impediments. Also crucial is the role of the supervisor, if such exists, as he/she should provide encouragement, allow freedom of choice, openness to new and unusual ideas, respect for each other and for the ideas that emerge, etc.

1.2 Creativity in education

As stated in the Official Journal of the European Union[3], *"all levels of education and training can contribute to creativity and innovation in a lifelong learning perspective: the early stages of education concentrating on motivation, learning to learn skills and other key competences, and subsequent stages focusing on more specific skills and the creation, development and application of new knowledge and ideas"*.

According to many authors, the educational system in many countries does not promote creative teaching / learning processes (Robinson, 2006; Ferrari et al., 2009). Indeed, formal education does not facilitate creative behaviours and skills from students. Learners most often act as recipient of methods, pedagogies and knowledge (Ferrari, et al. 2009). Teachers tended to give importance to relevance, competence and the need to avoid mistakes (Ferrari, et al, 2009). Indeed, formal education has created a culture that often "*accepts only what is relevant*" (Beghetto, 2007b). According to Runco (1999), teachers prefer *"conforming"* and "*considerate*" students. Moreover, Ng and Smith (2004) state that teachers often dislike personality traits associated with creativity, as such persons are often dogmatic and will stand for their own ideas against everything and everyone, are self-confident, ambitious, passionate about their work and have a tough skin.

However, during the last part of the 20th century and early part of the 21st, creativity has been seen to be increasingly significant in education, within cultural policy discussions, starting with the landmark advice of the National Advisory Committee on Creative and Cultural Education (NACCCE, 1999). Many authors (e.g. Craft, 2005; Sawyer, 2006a) suggest that creativity should be an important educational objective: "*in today's knowledge societies, one of the key missions of the schools is to educate for creativity*" (Sawyer, 2006a). Current pedagogical discourses attempt to view learners as the centre of teaching and learning processes, with an active role in the production of knowledge and meaning, democratically bringing their expertise, experiences and ideas into the classroom (Williamson & Payton, 2009) and thus stimulating also creativity. Nevertheless, creativity still does not seem to play a central role in the curriculum or learning objectives that teachers are asked to follow in every country (Cachia et al., 2009).

1.2.1 From implicit to explicit view of creativity in education

According to a large EU level survey of teachers (Cachia et al., 2009) there is "*a remarkable agreement (over 95% of responses) in the understanding of creativity as an attribute that can be applied to every domain of knowledge and to every school subject, and therefore as a fundamental competence to be developed at school.*" Furthermore, teachers "*do not see creativity as being only relevant for intrinsically creative subjects such as the arts, music or drama. This is of paramount importance for the development of creative thinking as a transversal skill.*"

On the basis of Runco (1999), Sharp (2004) and Boghetto (2007), Ferrari et al. (2009) present a model opposing implicit and explicit theories of creativity.

"Implicit theories refer to the tacit and shared knowledge of ordinary people regarding creativity, while explicit theories refer to scientific research findings. This model reflects the change of scope regarding creativity that moves towards a personal approach in which there is a creative potential in all individuals and in different knowledge domains."

[3] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2008:141:0017:0020:EN:PDF

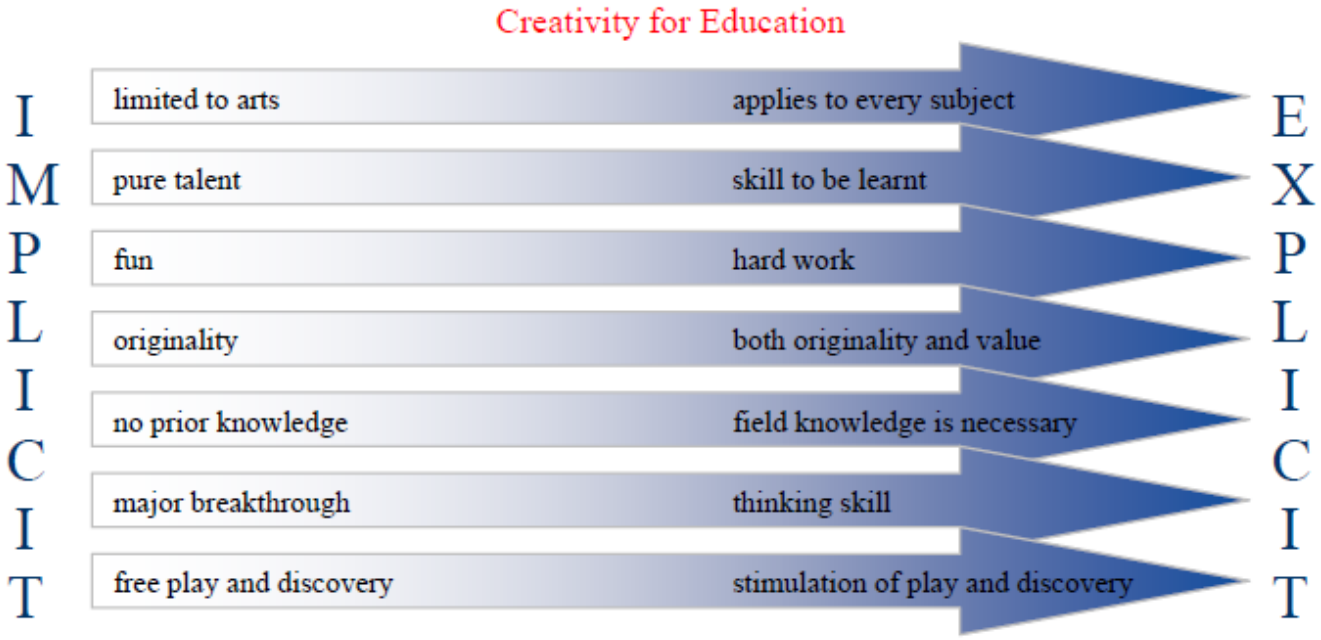

Figure 1: Implicit Versus Explicit Theories of Creativity

According to Ferrari et al. (2009), LCC seems particularly suitable for the educational sector, where a priority is to encourage all students and pupils, who have not yet reached their intellectual peak, to achieve their full potential. The authors see all people as capable of creativity from early childhood onward (Craft, 2005). According to this idea, creative potential can be found in every child (Runco, 2003); it can be encouraged or inhibited (Sharp, 2004); and its development depends on the kind of training people receive (Esquivel, 1995).

As regards LCC ("little c" creativity) and education, the kind of background knowledge needed by learners assumes a different nuance. Students require first of all a know-how of creativity, i.e. knowing how to think and how to perceive things in a different way, or how to make connections. Throughout the years which students spend in education, subjects or domain knowledge will become more important: the kind of knowledge needed is incremental from pre-school to university.

1.2.2 Teaching for creativity and teaching creatively

NACCCE (1999) made a distinction between *teaching creatively* and *teaching for creativity*. The former refers to teachers using imaginative approaches to make learning more interesting, exciting and effective. Indeed, teachers can be highly creative in developing materials and approaches that foster children's interests and motivate their learning. The latter (i.e. teaching for creativity) refers to forms of teaching that are intended to develop students' own creative thinking and behaviours. However, there is a close relationship between these two approaches, as *"teaching for creativity involves teaching creatively. Young people's creative abilities are most likely to be developed in an atmosphere in which the teacher's creative abilities are properly engaged"* (ibid, p. 103).

Teaching for creativity

NACCCE (1999) identifies three tasks in order to teach creativity:

- *Encouraging young people to believe in their creative potential*, as well as giving them the confidence to try, in order to stimulate creative performance. Moreover, it is important to push

pupils to take risks and be enterprising, to be persistent and to be resilient in the face of adversity and failure.

- *Identifying young peoples' creative strengths*, and help them to discover their creative abilities
- *Fostering the development of many common capacities and sensitivities* can help to foster creativity. Teaching for creativity can assist young people in understanding what is involved in being creative and help them become more sensitive to their own creative processes.

Moreover, Jeffrey and Craft (2004) add a fourth task, the inclusion of the learner in decisions about what knowledge is to be investigated, how to investigate it and how to evaluate the learning processes, in which the learner and the teacher are engaged in a collaborative approach to teaching and learning, according to a "learner inclusive" pedagogy.

In teaching for creativity, as stated by NACCCE (1999) teachers aim to:

- Allow for both broad and narrowly focused experimental activity, but always specifying and explaining the purpose of such activity. Those involved have to feel prepared and secure enough to be willing to take risks and make mistakes in a non threatening atmosphere that challenges but reassures. Such work has to be carefully attuned to the appropriate level of development;
- Encourage an appropriate attitude towards imaginative activity - a sense of excitement, respect, hope and wonder at the potential for transformative power that is involved, accompanied by a sense of delayed scepticism and distance;
- Assist in the understanding of the room that has to be given to generative thought, free from immediate criticism by the learner or others before ideas are subject to rigorous critical evaluation and further development;
- Encourage self expression that is oriented towards a given task;
- Convey an appreciation of the phases in creative activity and the importance of time - including the ways in which time away from a problem may facilitate its solution;
- Assist in developing an awareness of the differing contexts in which ideas may occur and of the roles of intuition, unconscious mental processes and non directed thought in creative thinking;
- Encourage and stimulate learners in periods of free play with ideas and conjecture about possibilities, but complement this with critical evaluation in testing out ideas;
- Emphasise the use of the imagination, originality, curiosity and questioning, the offer of choice, and the encouragement of the personal attributes that facilitate creativity

Moreover, teaching for creativity aims at encouraging:

- Autonomy: a feeling of ownership and control over the ideas that are being offered;
- Authenticity in initiatives and responses, deciding for oneself on the basis of one's own judgment;
- Openness to new and unusual ideas, and to a variety of methods and approaches;
- Respect for each other and for the ideas that emerge;
- Fulfilment: from each a feeling of anticipation, satisfaction, involvement and enjoyment of the creative relationship (ibid).

Above all there has to be a relationship of *trust*. Teaching for creativity aims to encourage self-confidence, independence of mind, and the capacity to think for oneself. Such teaching is compatible with a wide range of teaching methods and approaches in all areas of the school curriculum. The aim is to enable young people to be more effective in handling future problems and objectives; to deepen and broaden awareness of the self as well as the world; and to encourage openness and reflexivity as creative learners (ibid).

Teaching for creativity encourages a sense of responsibility for learning. It aims at a growing autonomy involving goal-setting and planning, and the capacity for self-monitoring, self-assessment and self-management. In principle, the earlier self-directed learning is internalised, the better, but again this aspect of teaching for creativity must be sensitive to the appropriate stage of the learner's development. It must be recognised that it will be in the secondary school where self-directed learning is more likely to move in tune with the development of young people's growing maturity, the flow of their need for independence, and their growing proficiency in forms of information technology. Creativity is itself a mode of learning. It is distinctive in the combination of three features:

- It involves a thoughtful playfulness and learning through experimental play. It is serious play conjuring up, exploring and developing possibilities and then critically evaluating and testing them.
- It involves a special flexibility in which there may be a conscious attempt to challenge the assumptions and preconceptions of the self - an unusual activity in which there is an active effort to unlearn in order to learn afresh.
- This process is driven by the need to find, introduce, construct or reconstruct something new. It seeks actively to expand the possibilities of any situation.

Teaching for creativity, or enhancing learners' creative skills, requires the practitioners to be creative themselves and to provide learners with an ethos and a culture that values creativity (Craft, 2005). This implies a change of the system of values, a valuation of creativity (Runco, 2007), where teachers manifest that creativity is worth pursuing. This should reflect a shift in pedagogy, moving towards an inclusive approach (Craft, 2005), where the environment is permissive and safe (Runco, 2007) and where learners are in control of their learning process (Woods, 2002). Amabile (1989) stresses the importance of a nurturing environment to kindle the creative spark, an environment where students feels rewarded, are active learners, have a sense of ownership, and can freely discuss their problems; where teachers are coaches and promote cooperative learning methods, thus making learning relevant to life experiences. Developing creative learning therefore demands innovative teaching.

Teaching creatively

Teaching creatively might be described as teachers using imaginative approaches to make learning more interesting, engaging, exciting and effective (Morris, 2006). As mentioned earlier, NACCCE (1999) defined teaching creatively in a similar way. Furthermore, Jeffrey & Craft (2004) point out that for many authors teaching creatively has the major aim to make learning experience relevant to learners as well as to make it interesting. For the learner, this means an ethos that is "dynamic and active", assuring the relevance of the curriculum to the learner which leads to increased understanding and learning because of the students' engagement and relation to their 'interest at hand'.

Sale (2005) provides a simple operational definition of creative teaching: "Creative teaching occurs when a teacher combines existing knowledge in some novel form to get useful results in terms of facilitating student learning. This may be either planned before the act of teaching, or invented as a response to the demands of the learning situation".

The creative and effective teacher relies on a series of sources that include ICT, but also realia (i.e. real objects), manipulatives (i.e. resources that can be manipulated), and innovative resources (Simplicio, 2000). They generally do not restrain their lessons to textbooks. Teachers should allow the co-construction of knowledge (Craft, 2005), being "reflective practitioners" (Esquivel, 1995), supporters and facilitators (Sharp, 2004) and not bureaucrats (Ng & Smith, 2004), nor technicians applying governmental policies without questioning them (Craft, 2005) or inhibitors by being overly didactic or prescriptive (Sharp, 2004).

An in-depth study on creative teachers (Horng, 2005) found that the factors that influence on the creative teaching are "(a) personality traits: persistence, willingness to develop, acceptance of new experiences, self-confidence, sense of humour, curiosity, depth of ideas, imagination, etc.; (b) family factors: open and tolerant ways of teaching children, creative performance of parents, etc.; (c) experiences of growth and education: self-created games and stories, brainstorming between classmates, etc.; (d) beliefs in teaching, hard work, motivation and (e) the administrative side of school organization". Furthermore, among these factors, "beliefs in teaching, hard work and motivation are the main aspects". The research found out that the effective teaching strategies used by their study subjects (i.e. creative teachers) were student-centred activities, a connection between teaching contents and real life, management of skills in class, open-ended questions, an encouragement of creative thinking and use of technology and multimedia.

Sale (2005) reveals that teaching professionals that have developed creative teaching competence most often are not explicitly aware of how they are being creative "rather they are focused on seeking to achieve certain important results in their teaching approach". Furthermore the study suggests that creative teaching involves creative planning of learning activities and also the situated construction of creative practices.

Some studies also try to relate creative teaching with the effectiveness of the teaching. A study by Aschenbrener (2008) shows that "students believe creative instructors are effective teachers".

Ferrari et al. (2009) also underline the strong need of innovative teaching for nurturing the creativity of students. Jeffrey & Craft (2004), basing their thesis on NACCCE report, also state that there is an integral link between teaching creatively and teaching for creativity, that is "teaching for creativity involves teaching creatively". More concretely, an atmosphere in which the teacher engages his/her creative abilities stimulates the development of the creative abilities to the young people.

1.3 ProActive approach towards creativity

ProActive aims at fostering teachers' / trainers' creativity. Thus, the project adopts an approach of personal creativity, in which the creative potential is in all individuals, and can be applied to all domains.

The creativity of a teacher is manifested in the way he / she teaches (i.e. in creative teaching practices). Thus, the project will focus on "teaching creatively".

As stated above, teaching creatively means to use imaginative approaches and to use existing knowledge in some novel form, in order to make learning experience engaging and effective for students, by increasing their understanding while matching curricular objectives. This involves creative planning of learning activities.

As described in next section, ProActive will engage teachers in a creative process of design of their own GBL scenarios. It is expected that this design process will foster teachers'/ trainers' creativity, by involving them in a creative process for preparing of creative learning scenarios."

2. GAME-BASED LEARNING

As stated earlier, ProActive aims at fostering teachers' creativity. The previous section showed that in order to teach creatively, teachers and trainers should use imaginative approaches that make learning experience interesting and engaging for the learner, as well as improve learning achievements (i.e. increasing students' understanding) and match the curricular objectives.

As it will be shown in this section, Game-Based Learning is a good candidate to fulfil these requirements. For this reason, ProActive offers to teachers and trainers the possibility to use a Game-Based Learning as an innovative approach in their teaching practices. Furthermore, as it will be shown later in the section, in order to overcome the obstacles of introducing Game-Based Learning in formal learning settings, ProActive will adopt a Game-Based Learning design approach. Furthermore, it is expected that Game-Based Learning design will foster teachers and trainers' creativity.

This section mainly relies on the results of a study conducted earlier in ProActive (internal report D3.1 – Success Factors for Game-Based Learning).

Although the term *Game-Based Learning* (GBL) has not been given a precise definition, it has been around for almost two decades. Several authors, such as Prensky, Aldrich, Jenkins or Gee, have been discussing Game-Based Learning definition is and potential in well-known articles and books (Aldrich, 2005; James Paul Gee, 2003; J.P. Gee, 2007; Jenkins et al., 2003; Prensky, 2001), thus laying the basis of Game-Based Learning concepts. Therefore, we can define Game-Based Learning as *the use of computer or other digital games of any kind as tools that support learning in a meaningful way*. Thus, Game-Based Learning is a trend which analyses the good characteristics of digital games together with their relation with learning, and proposes strategies and paradigms to take advantage of them for education.

Building on the ideas proposed by these authors and some others, the following section points out the more relevant issues that set the motivation towards Game-Based Learning and describes the potential of digital games as learning tools, as well as the way they can enhance learning experiences. Afterwards, we focus on the implementation of Game-Based Learning in formal learning settings.

2.1 What promotes learning in games?

Studies in the field of Game-Based Learning show a clear relation between playing digital games and learning (Charles et al., 2005; Rapeepisarn et al., 2008). Moreover, several reasons have been argued in favour of digital games as learning tools, with the more cited argument being that they can enhance students' motivation towards learning (Garris et al., 2002; Gee, 2003; T. Malone, 1981a). Indeed, digital games can provide challenging experiences that promote the intrinsic satisfaction of the players, keeping them engaged and motivated (Lepper et al., 1992; Malone and Lepper, 1987).

Moreover, players have fun while playing a game because they have to learn it (Prensky, 2001). Indeed, in games, the challenge usually increases as long as the game goes on. Therefore players need to improve their skills and learn new strategies until the game is completed.

Another feature of digital games that is remarkably aligned to learning is that games often provide short feedback cycles. This allows players to explore the game environment freely, trying out their hypothesis, learning by trial-and-error (Oblinger, 2004) and getting immediate information that they can use to redefine wrong assumptions in a risk-free environment (Aldrich, 2004; DeKanter, 2005). This characteristic is well aligned with educational requirements, given that most educational approaches require the

educator to provide students with feedback about their achievements. Nevertheless, in traditional educational approaches where the instructor must accomplish all the work manually there is a significant delay until students can receive the appropriate feedback. Digital games can help to reduce such delays almost to zero.

Therefore, as digital games set the player in a world that is free to explore without requiring the intervention of an instructor, video games are an ideal medium to promote authentic learning (Mims, 2003) and "learning by doing" (Aldrich, 2005; Lombardi, 2007) processes, turning the student into the leader of his / her own learning experience (Rieber, 1996). In this sense digital games can provide meaningful learning experiences by simulating highly interactive scenarios that professionals encounter in real-world settings, where they face open-ended, real-world problems (James Paul Gee, 2003; Mitchell et al., 2004).

In consequence, digital games represent a good medium to promote active learning and improve students' problem-solving skills instead of simple fact memorization. It has been demonstrated that for certain target groups (e.g. school students), they can increase personal fulfilment and lead to higher performance (Blunt, 2007; Mayo, 2007; Squire et al., 2004; Squire and Barab, 2004).

2.2 Game-Based Learning in formal learning settings

For the reasons mentioned above, an increasing number of teachers and trainers recognize the value of digital games in education. However, they are not sure how to bring Game-Based Learning approaches into the field. Indeed, some barriers to the implementation of Game-Based Learning in formal learning settings have been identified within a study conducted by BECTA on commercial off-the-shelf games (BECTA, 2010).

- The lack of integration of most games with the current curriculum and assessment framework.
- Time constraints.
- Technical and logistical issues (cost, licensing, limitations of school computers, technical support) - Game-Based Learning cannot become part of the fabric of the curriculum without the appropriate technology and technical support, which is challenging in some EU countries.
- Lack of teacher skills.
- Not all learners engage with games and many do not see a link between games and learning.
- Teacher and parent concerns over the content of some games (e-safety).

A more detailed description about the challenges and obstacles of introducing commercial games in schools is provided as Appendix 6. Finally, according to BECTA, there seems to be a potential for Game-Based Learning in informal learning settings.

In order to overcome the above mentioned challenges, ProActive proposes a framework in which teachers / trainers would design their own learning games. Indeed, available market games generally do not match curricular objectives. The big companies tend to ignore the educational market because of the difficulties posed by a wide and varied curriculum, a lack of interest on behalf of educational policy makers, the inability of schools to find the sort of money that commercial games tend to command and also the security issues associated with large institutions with small IT budgets. Thus teachers / trainers may benefit from ProActive, by developing games *for themselves* that have direct relevance to their teaching objectives.

The next section provides a brief literature review on game design in educational settings.

2.3 Game design in educational contexts

If it can certainly be said that there are some key features that should be common to all educational games to produce a successful learning experience through the game, it is also true that the effectiveness of games in facilitating learning relies in the way we use games for educational purposes. It is possible to say that digital games facilitate learning, but what do digital games have to offer that sets them apart from existing educational practice (Egenfeldt-Nielsen, 2006)? Different learning theories have their own approach to answering this question.
Egenfeldt-Nielsen (2006) outline that different approaches to learning find in educational games a different potential and also have contributed to create games that stress their own vision of what learning is. Each approach has something to offer to educational settings and although there is a need for integration between them, for now it is impossible to define GBL in a unequivocal way.
The game design process has been described as a powerful learning environment according to attributes identified by Smeets (2005) in recent studies on children, as it promotes effective learning and learner autonomy (Robertson, J. and Howells, C., 2008). In fact game design is considered a rich task that offers opportunities to exercise a wide spectrum of skills to embody creative ideas in a complex, cultural artifact that can be enjoyed in other contexts both from peers and from an audience (Robertson, J. and Howells, C., 2008).

The most noted contributions within this theme come from Kafai (1995) and Kafai & Ching (2001) from their studies on children as game designers. The core idea of her studies relies in the possibility of turning children into producers of knowledge, and letting them interact and play with their own game objects. Her researches proved that it is possible to acquire programming and maths knowledge through designing video games (Kafai & Resnick, 1996). In fact, "designing video games makes it possible for the learner to approach a subject in an active way, thereby constructing a personal representation of knowledge by using physical artifacts" (Egenfeldt-Nielsen, 2006; pp. 198). This full experience draws learning into different perspectives, while it allows to a variety of actions and to a more complete understanding of the topic to be learned.

Robertson and Howells (2008) in their research with children on game design outlined that the design activity is extremely complex, especially if we consider that its final outcome is an interactive artifact. In fact, "designing digital contents which responds to users' inputs through a series of rules requires the specification of conditions, consequences and sequences of behaviour which is not required in writing texts" (Robertson, J. and Howells, C., 2008, pp. 562-563).

Egenfeldt-Nielsen (2006), describes the experience of making games as a constructivist approach to the educational use of video games where the key role is played by external artifacts in order to facilitate the learning experience. In fact, in line with Papert (1980, 1998), he emphasized the role of an active approach to knowledge and the use of external artifacts for facilitating the learning experience. Egenfeldt-Nielsen (2006) also outlined that in a constructionist perspective, learning from video games doesn't mean that the knowledge will be transferred from the content of the video game to the learner; it means to make a game where the player can engage with the material, discuss it and use the video game as a means for constructing knowledge. The content is a prerequisite for such process, but it is far from enough.

This section showed that game design processes promote active learning and fosters creativity. However, the corresponding studies refer to the learners / kids as game designers. A literature gap can be observed, regarding the possibilities of game design by teachers. Indeed, although during the last years authoring tools have arose as an alternative to video game development, a study by ProActive consortium on the

existing game authoring tools reveals that it is difficult to find authoring tools specifically designed for the creation of educational games. Indeed, although some tools (like *Game Maker*) have been applied in educational experiences (Overmars, 2004; Robertson and Good, 2004), few of the alternatives found in the market have been specifically developed for instructors, as they do not support the inclusion of learning-oriented features in the games (e.g. evaluation the student's performance, adaptation of the behaviour of the game to the needs of each student).

ProActive will focus in Game-Based Learning design, i.e. teachers designing games for educational purposes. Indeed, we believe that a Game-Based Learning design approach will provide a context for creative processes.

ProActive will use two game editors (<e-Adventure> and EUTOPIA) that will be described in Section 5.

In order to help teachers / trainers in designing educational games adapted to their teaching objectives, next section provides success factors for Game-Based Learning.

2.4 Success factors for educational games

Within a previous study performed in ProActive (reported in internal deliverable 3.1 - "Success factors for Game-Based Learning"), some key features for the construction of a good educational game have been recognized. Three different dimensions have been identified, namely gaming aspects, learning aspects and technical aspects, which should be taken into account for designing successful Game-Based Learning scenarios.

The first dimension regards the gaming aspects and embeds the game characteristics a Game-Based Learning scenario should include. These are:

- *Goals:* The game should present clear goals and objectives that the player will have to accomplish in order to complete the game. The game should include final objectives, but might also have intermediate / short-term goals in order to facilitate the player in reaching the final ones.
- *Rules:* To achieve the goals proposed the player has to operate according to the rules of the game, which define what can and cannot be done in the game universe. The game's rules should be clear and consistent along the whole game.
- *Challenge:* The player should be continuously challenged. Players should strive for continuous improvement. This can be achieved by increasing level of difficulty. However, the level of challenge should not surpass the level of possibilities, in order to not discourage the player.
- *Rewarding system / short feedback cycle:* Players should be able to perceive the impact and consequences that their actions have in the game world, in order to be informed on how they are performing, check their progress continuously, and enable them to eventually adjust their actions. Positive feedbacks are often associated with rewards, which help the player in the achievement of the objectives and acts as a mechanism to increase engagement and immersion.
- *Engagement / immersion:* The game should engage the player, which can be achieved through different techniques: interesting plot / story, appealing environment / virtual world, contextualization, challenging goals, etc. Immersion is good way to stimulate the player's engagement into the game.
- *Adaptability / flexibility* (possibility of personalization from the player): The game experience should vary from one player to another and between different game runs. Adaptability is often achieved by varying the challenge depending on the player's skills and knowledge. As an example, the *game*

*might offer several l*evels of access based on user skills (e.g. beginner, advanced, professional). In simulations, it would be crucial not to predefine the paths for reaching the correct solution.

- *Replayability:* The player should be able to play the game more than once. Replayability is a result of a good design and an appropriate balance of characteristics such as adaptability (presenting different challenges each time) and engagement.
- *Competition / collaboration:* The game scenario should promote "good" competition and / or collaboration. Competition could happen between peers (in multiplayer games) but could also be self-competition, through game scoring or ranking systems. Collaboration could be between peers playing the same game, but could also happen outside the game with players discussing the game's strategies / solutions either online or face to face.
- *Entertainment:* The game should provide entertainment to the user, which can be achieved in very different manners. For example, it can be achieved directly by including humoristic aspects in the plot, but also by combining several of the aspects listed above.

The second dimension regards the learning aspects and embeds the educational characteristics a Game-Based Learning scenario should include. These are:

- *Educational objectives:* Clear educational objectives should be predefined. The educational affordances of the game should allow for the students to achieve these objectives.
- *Students' profile:* The students' age / skills / knowledge level / socio-cultural profile, should be taken into account when designing the learning scenario and the game.
- *Learning resources:* The game should provide internally or as links relevant learning resources which are necessary for achieving the educational objectives.
- *Evaluation methodologies:* The learning scenario should consider a specific evaluation methodology. In Game-Based Learning scenario, this evaluation method might drastically differ for traditional approaches, such as tests or exams. In Game-Based Learning, the rewarding system could be adapted to evaluate the players' performance within the game. This approach is much less invasive, in the sense that students might not be aware of the pedagogical evaluation process, but only aiming at reach the game objectives. This approach is especially suitable for reaching less performing students. Furthermore, Game-Based Learning allows for implementing immediate feedback systems, which might help learners to check their progress continuously.
- *Comprehensive learning scenario:* The Game-Based Learning scenario might be embedded in a predefined wider learning scenario which might include other learning activities (e.g. further discussion / reflection session in the classroom, group activities, reports, presentations, homeworks, etc.).
- *Contextualization:* Game-Based Learning allows for easy contextualization of both material and tasks that would be incorporated into the educational scenario. Although not a mandatory factor, contextualization might be suitable in many Game-Based Learning scenarios to increase students' learning outcomes, interest and motivation.
- *Progressive acquisition of knowledge:* at any point of the Game-Based Learning scenario, the level of challenge of the learning experience should be high enough to keep students engaged and motivated but without surpassing their abilities so they do not become frustrated.

- *Personalization:* The game might provide a personalized learning process according the students' profile. This might include the student's age, previous knowledge speed of knowledge acquisition, skills, etc. As an example, the game might offer several levels of access (beginner, advanced, professional).
- *Level of autonomy of the learner:* this factor should be predefined and depend on the educational context. Game-Based Learning environments usually promote the autonomy of learners, who are free to explore the game without the requirement of an intervention by an instructor.
- *Motivation:* Students motivation to employ themselves in the learning activity constitutes a crucial factor for achieving the educational objectives. The motivation would depend on a good combination of the above listed factors and on balancing between the educational and gaming aspects.

The third dimension regards technical aspects and embeds the experience of use that the game as technological artifact, should vehiculate. These are:

- *Usability:* The game should be user friendly and easy to use so that the player can concentrate on the objectives set within the game without frustration. The game functionalities should be easy to learn. There should be clarity in the interactions, and the navigation should not present any errors. Moreover, the game might include, if necessary, a user guide or any additional help in order to assist the player.
- *Well designed graphics:* The visual aspects of the game should be attractive in order to engage users. Moreover, certain scenarios might require a high level of realism. Such attractiveness could be reached whether by using high quality graphical elements, or by employing familiar objects.
- *Reusability:* As a consequence of their adaptation potential, games present a high level of reusability, defined as the potential to be used in different contexts without the need of complex and costly modifications to suit particular groups. This characteristic makes games attractive as learning tools as it helps to reduce costs by increasing the amortization of the initial investment.

These factors would be used to design guidelines and training materials for the teachers / trainers, which will have to take them into account when designing and developing their own Game-Based Learning scenarios[4].

[4] For more information on success factors for Game Based Learning see internal Deliverable 3.1 "Success factors for game-based learning". Within the project "ProActive: Fostering teachers' creativity through Game Based Learning".

3. THE FIVE METAPHORS FOR LEARNING

ProActive psycho-pedagogical framework would be closely related to different learning metaphors which would be linked to Game-Based Learning. Moreover, five metaphors (Imitation, Participation, Acquisition, Experimentation, and Discovery) have been identified by Simons (2004) and Simons and Ruijters (2003, 2004).

The five metaphors learning model (Simons, 2003; 2004; 2008) is a description of different ways of learning in different people, embedded with learning theories. It can be treated as a comprehensive model that comes out by combining some learning models with the theories of change by De Caluwé and Vermaak (1999). The result is a classification of the ways of learning into five groups (one per metaphor), each one representing a preference for learning that is not exclusive. In fact, every person is able to use all metaphors, but each one in a different situation. The core idea is that we don't learn in a sole way, but in different ways that depend on personal aptitudes, on the situation where the learning takes place and on the content to be learnt (Simons and Ruijters, 2004).

Simons (2003) recognizes that we need a language to talk about learning in less educational ways, incorporating implicit, social, collective and dynamic learning and describing different ways of learning besides the traditional perspective on training. The aim of the metaphors is to find an escape from automatic educational thinking when designing workplace learning trajectories.

In fact, although in formal contexts of learning teachers use a sole dominant paradigm, relevant studies (Resnick, 1995) show that it is quite different in the ways of learning in everyday contexts. If in formal learning contexts we learn essentially in individual situations from abstract concepts that are separated from the contexts where these concepts will be applied, in everyday life we learn from direct experience using the concept directly in the real situation where they have to be applied in interaction with others.

Simons' work on learning metaphors has been chosen as core psycho-pedagogical model for ProActive since it offers a comprehensive explanation of possible situated learning experiences. The strenghtness of this model in respect of others (Marzano, 2000; Costa & Kallick, 2009) is, in fact, the focus on contextualized educational theories rather then on cognitive instructional paradigms.

Despite this model is a core reference for the ProActive project, it has anyway to be contextualized and adapted to our methodology and purposes. In fact, the metaphor model is quite unrefined and uses the existing literature on learning in not ever clear and compatible ways. Simons' core contribution is that learning can be experienced in different ways, but the metaphors in Simons' work are analyzed basing on organization and professional learning literature, so we have adapted them, as follows, in order to cover also formal educational contexts (schools and universities) and psycho-pedagogical literature.

Our thinking is that everyone can learn in different ways, which depend on the context of learning, the actors involved in the learning process and the artifacts used for learning, etc. Starting from this socio-cultural approach on learning we also claim that artifacts are not neutral: they reflect the psycho-pedagogical model adopted by the artifact designer.

3.1 Acquisition

The acquisition metaphor corresponds to the idea traditionally diffused of how we learn. It is congruent with the organization of the contexts of institutional learning (as school for example). In the acquisition metaphor the leading idea is to transfer an information from one who possess them (the teacher) to another one who is a passive receiver (the learner). It doesn't matter which is the font and the learning

activity, who the learner is and how he prefers to learn. Learning is always a repetition and a replication of the acquired knowledge, product of an individual mental activity. The educational psychology that centered his work on the acquisition metaphor (Ausubel, 1963; 1968; 1978) clarified that it can be applied only on a kind of learning "receptive" and "expositive" which is generally realized in formal contexts of learning and has to be divided from other learning strategies founded on different cognitive processes as, for example, situations of problem solving in real life contexts. The process of evaluation is a check of the replicated contents, often learned from textbooks. Although pedagogical literature strongly outlines the link between the acquisition metaphor and formal learning contexts, it is also true that the acquisition metaphor can be also found in non formal/informal contexts, as in the case of a stand alone research on the textbook or on the enciclopedy.

The basic assumptions of the acquisition metaphor have been theorized by Bruner (1996), and are these:

- *Knowledge of the world is an objective truth that can be transmitted from one person to another;*
- *A medium is needed to transport the knowledge from one who knows to one who don't;*
- *Learning has, in the most time, to be institutionalized in a building (school).*
- *Focus on outcomes/products of learning*
- *Knowledge and knowing can be separated from situations where they take place*

Educational games in the acquisition metaphor perspective

Educational games are not the favourite learning objects for the acquisition metaphor, which privilege oral or written exposition for a type of knowledge that is theoretical and abstract. They can be used within the context of an acquisition process, as a reinforce for learning through the repetition: a sort of workbooks that can help in the assimilation and memorization process. the acquisition metaphor is related to presenting some information/data by the teacher/trainer to the student and the expectation that the student will 'know' it at the end. It is about remembering. How exactly the students will remember it is not important for this metaphor.

The process activated by these games is generally the memorisation and the automatic repetition. The games are a sort of infinite workbook where students, rather than learning about a certain area, are trained performing mechanical operations since they memorize the parrot-like activity without a deep understanding of the skill or content (Egenfeldt-Nielsen, 2006). Often there is a lack of teacher involvement in this activity (Gee et al., 2004; Healy, 1999; Jonassen, 2001; Schank, 1999) that is often perceived as a mechanical stand alone training activity that doesn't need further elaboration. It is however true that if teachers can be involved more extensively in this process an elaboration of what happens in the game would be possible and would well fit with the institutional learning system objectives because of its natural affinity with stand-alone-assimilation-and-repetition processes.

3.2 Participation

The participation metaphor definitively focuses on social aspects of learning activities, where learning means to become a member of a community of practice (Lave and Wenger, 1991). Communities of practice are groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly.

Learning is a process that allows the learner to access to more and more relevant contents within the group and to access to negotiation practices more and more central within the working group. Learning in

this perspective means to understand shared meanings of working practices: meanings that allow to a more central participation to the group's activities.

Another core concept of this metaphor is that innovative practices have to be constructed directly in the contexts where they take place and not separately from them. If we think of knowledge as "an act of participation with complex learning social systems" (Wenger, 2000:26), it assumes the sense of a bidirectional tension between competence and experience, where personal transformations are combined with the evolution of social structures (Wenger, 2000). In fact the content by teacher is just a stimulus for learning but then the teacher himself cannot predict where learners will go through the creation of new meanings and new learning paths.

The collaborative activities can be both practical and intellectual as long as they provide a dialogical interaction (Bachtin, 1988) between the actors involved in the learning process. When we speak about dialogical interaction we refer to an interaction where a key role is played by the "other" which is considered not only "other than self" in the dialectical reason, instead becomes the fulcrum for the development of the self within the dialogical reason (Wegerif, 2007). The dialogical interaction can be facilitated in the learning process thanks to the task if it is able to create interdependence among participants.

Another fundamental reference for the participation metaphor has been provided by Sfard (1998), who makes a distinction between the acquisition and the participation metaphor by presenting some alternative assumptions which identify the last one in contraposition with the first one:

- *There is not objective truth and knowledge is constructed in a social-interactions between people;*
- *Learning should be done by people themselves, we cannot do it for them;*
- *The learner is gradually becoming a member of a community of practice; this happens for an important part outside the institutions and tacit knowledge and skills play important roles in it.*
- *Focus on activities*
- *Cognition and knowing are situated and distributed over individuals and their environments.*

As it can be seen, learning is a process of participating in various cultural practices and shared learning activities, rather than a simple process of individual knowledge formation. From the participation perspective, learning occurs by gradually transferring from peripheral to full participation, engaging in corresponding enculturation that re-creates one's identity, and learning to interact according to its socially negotiated norms (Lave & Wenger, 1991; Packer & Goicoechea, 2000). This metaphor assumes that knowledge does not exist either in a world of its own or in individual minds but is an aspect of participation in cultural practices (Lave, 1988; Brown, Collins, & Duguid, 1989; Lave & Wenger1991; Anderson, Reder & Simon, 1997; Greeno, 1997).

Educational games in the participation metaphor perspective

The participation metaphor's perspective on educational games has a lot to share with recent studies (Talamo, Pozzi, Mellini, 2010; Mellini, Talamo, 2009) on MMORPGs[5]. These studies have found the work of Erving Goffman (1959) useful for thinking about how the representations that participants create about their context are produced within collective activities. They are not at all due to individual interpretations:

[5] Acronym for Massive Multiplayer Online Role Playing Games

"The definition of a situation projected by a particular participant is an integral part of a projection that is fostered and sustained by the intimate co-operation of more than one participant" (Goffman, 1959: 77–78). Recent literature considers video games to constitute a new form of experience, and this is especially so with multiplayer games. When players coproduce narratives during game sessions, they produce a new form of knowledge "that has the potential to integrate pleasure, learning, reflection and expanded living" (Gee, 2006, p. 61).

The motivation to learning with games developed within this framework is intrinsic and relies on the possibility to be co-author of a collective narration, where ideas, knowledge and activities are shared. This is because a sense of community belonging is fostered by the idea of writing a story jointly with numerous co-authors. Participating and playing means being able to orient events in the playworld, or being able to affect the stories of others with one's own actions (Talamo, Pozzi, Mellini, 2010; Mellini, Talamo, 2009).

In fact, in the participation metaphor's perspective, the game should just allow interaction, not necessarily interactivity. The possibility for learning relies in the interaction with others, not in the interaction with the game itself. Within this metaphor the game can be seen as a social tool rather than as a cognitive tool as in the metaphors that promote individual knowledge. A cognitive tool allows isolated persons to access to information and contents, whereas a social tool allows to communicate, share and negotiate practices, identities and meanings. Moreover, in Game-Based Learning (and through a game) participation could be stimulated not only outside the game, but also externally. In real life, game players' communities create forums, blogs, chats, etc. outside the game and cooperate to help each other on game advancements. So in real life game world communities of practice are very much stimulated by the game but implemented also with external tools.

It is an important issue to take into account when a game-based on participation is created.

Within these kind of games, the teacher acts as a facilitator by designing the sketch of the game story to be developed through the interaction by the learners. While the story goes on, not a single player, neither the teacher, can say how it will end and which will be the learning outcomes because they will be shaped by the leaning interaction within a dialogic process. In fact, although the game story can be pre-defined by the teacher, the story itself is defined only during the interaction between characters.

3.3 Discovery

The discovery metaphor assumes that by working creatively with knowledge, learners can deeply understand. By generalizing results of cognitive research on writing and expertise, Bereiter and Scardamalia (1987a, b) developed a new pedagogical approach, the knowledge-building theory that assumes that learners can work creatively with knowledge (Bereiter and Scardamalia, 2003). Learners are guided to pursue their own research questions, follow them in depth, generate intuitive theories for understanding, and explain various issues relevant for their school education. The Copernican revolution of education is in putting students' ideas into the centre rather than periphery of educational activity (Scardamalia 1999). "The knowledge-building process is focused on advancing entities that Bereiter (2002) calls conceptual artifacts. Just as ordinary tools are used for such practical purposes as hammering and drilling, conceptual artifacts can be used for epistemic purposes such as explanation and prediction" (Hakkarainen, 2009).

Starting from this point, Paavola, Lipponen and Hakkarainen (2002) introduced the third metaphor of learning which focuses on how something new is developed during learning (Paavola, Lipponen, & Hakkarainen, 2002; Paavola & Hakkarainen, 2003). They called it "*knowledge-creation metaphor of learning*" and it emphasizes processes of deliberate transformation of knowledge and corresponding practices. Learning is seen as analogous to innovative processes of inquiry where new ideas, tools, and

practices are created collaboratively, and the initial knowledge is either substantially enriched, or significantly transformed during the process. These kinds of processes have been emphasized in different models from whom the third metaphor arise, such as Yrjö Engeström's model of learning by expanding (Engeström, 1987, 1999), and, first of all, Bereiter's model of knowledge building (Bereiter, 2002). These models propose a description of how innovative knowledge communities function, and try to export this functioning model of the educational context. What is different from the other two metaphors? That the focus is not on individual mental processes (like in the acquisition metaphor), neither on social processes (like in the participation metaphor), but rather on those *mediating artifacts*, objects, and practices that are developed during the process of learning. Knowledge is a tool that can help in the developing of these mediating artifacts and practices.

These scholars identify six common characteristics shared by these theories that complement the acquisition and the participation metaphors:

- *Learning is understood broadly to involve knowledge advancement in general*
- *Focus on bringing mediating elements to the process of knowledge creation*
- *New ideas grow between individuals and not within individuals*
- *Yet individuals play important roles as instigators of innovation*
- *Tacit knowledge is an essential resource of creative learners*
- *Focus on conceptual and theoretical modelling*

Knowledge-creation comes out from transformative actions on learning materials and situations, it is an "incidental" learning experience that comes out from the developing of a strong epistemic agency (Scardamalia, 2000) by the learner, in the sense that he feels himself responsible for the advancement of his own learning and for the advancement of the group learning. In learning by discovery the crucial point is that it creates new contents and the structuring of learning activities is which lead to discovery.

Learning means that various mediating artifacts, tools, and processes are systematically developed during the process. Individual efforts and varieties should be embedded to collaborative efforts. Innovative processes are emphasized, which means that the interaction between various forms of knowledge is emphasized; conceptual knowledge, knowledge embedded in practices and action, and tacit knowledge and hunches are all important. Knowledge is not so important as such but especially as a way of instigating further processes of inquiry. It is a dynamic factor in the learning processes that can be presented from different angles and even in contradictory perspectives.

In work environments the focus is more on the innovation processes and on the meaning construction, so Simons had to find a better name for this metaphor: in "Differing colours of learning" (2003) he choose to call this the "meaning construction metaphor", and then, in "Varieties of work-related learning" (2008), basing on Hager (2004) work, who calls a similar metaphor the "construction metaphor", and considering the different connotations between "creation" and "construction", he chooses to call this the "discovery metaphor" instead. This is the label we can also trace in "Metaphors of learning at work and the role of ICT" and the one we choose for ProActive.

Educational games in the discovery metaphor perspective

The discovery metaphor's perspective perfectly fits with educational games and Game-Based Learning. In fact, learning can be seen as a sort of treasure hunt where a complex game world allows students to explore and discover from it. The focus of this kind of learning with games can be traced in the possibility both to develop meta-cognitive skills, both to construct knowledge within a flow experience during the interaction with the game world and its objects. By this way, a cognitive approach to learning with games can be linked with a constructivist one. The cognitive approach to Game-Based Learning can be traced in

the attempt to build intrinsic motivation by integrating learning and game experience: in fact, we can say that the play experience challenges the player's schematas and so stresses the use of knowledge about how to organize the material in terms of retrieval, encoding, chunking, modalities, and transfer problems (Egenfeldt-Nielsen, 2006). The focus is on the process and on the skills much more than on the content of learning. There are "elements of discovery and inquiry presenting meaningful learning experiences so that the player can construct his/her own representations in an active dialogue with the game. […] Educational games within this approach can be described as aiming to engage players in a discovery process through a strong game experience that integrates learning and play while providing a strong experience akin to the limitations and potentials of the human mind" (Egenfeldt-Nielsen, 2006; pp. 195). In this perspective players engage with the game and learn it because it is interesting in itself, so that intrinsic motivation to learning is provided, as described by Malone and Lepper (Malone, 1980; Malone and Lepper, 1987a, b). Intrinsic motivation is linked with the critical concept of "flow[6]" in relation with learning from games (Jones, 1998; 1999). In fact, the flow theory largely explains the intrinsic motivational aspects of video games and can benefit the design of games.

Videogames are generally constructed in a way that facilitate flow (Bowman, 1982; Bisson and Luckner, 1996) and educators and game designers have to aim at elements in video games that are particularly strong, as manipulation, symbolic representations, adaptive sequencing, feedback and meaningful, contextualized activities (Klawe, 1998; Egenfeldt-Nielsen, 2006). This way the game favours a meta-skills perspective, with problem-solving as the most important.

The link with a constructivist approach to learning can be traced if in the game certain topics are represented in different artifacts that the player can interact with. If it is possible to make a game where the player can engage with the material, construct it, manipulate it, reflect and discuss on it, this mean that the videogame is a tool for constructing knowledge. The richness of the game world created is double linked to the meaningfulness of the playing/learning experience. Moreover, the possibility to experience a feeling of mastery over the game through knowledge creation and continue re-organization is the key feature of the discovery learning metaphor linked with educational games.

Although games are a sort of lost paradise of the discovery metaphor, because they are handy microworlds to be explored and discovered, to design these games is sure not simple, especially if they have to be designed by teachers. In fact, due to the complexity of the material to be provided to the student, we can certainly say that game-based scenarios linked with the discovery metaphor are the most difficult to be designed. They need to be well defined and articulated, and complexity is time consuming. They also need to be full of objects that work in an allegoric way in order to stimulate critical thinking, and this is a challenge even for the most creative designer. Despite these criticisms, especially if they are contextualized in a critical reflection, they can allow a true meaningful learning experience, and this sure worth the effort.

[6] Flow has been described in terms of a mental state as "the holistic experience that people feel when they act with total involvement" (Csikszentmihalyi, 1975; pp. 36) and refined in terms of a comprehensive experience from Novak (1997: 1) as composed of:

- The core experience of flow;
- Close correlates of the flow experience, such as playfulness;
- Antecedents of flow, including skill, challenge, interactivity, focused attention, arousal, telepresence;
- Consequences of flow, including positive affect, exploratory behavior, and control.

3.4 Imitation

The imitation metaphor is based on the social learning theory by Bandura (1973, 1977, 1986) and it is focused on modelling behaviour, attitudes and emotions by observing others' reactions to events. The leading idea is that vicarious learning experiences can orient one's own actions. This metaphor is linked with observation, hearing and modelling and so, with the possibility of seeing someone other experiencing something.

Meggison (1996) describes a particular way of learning, not planned in advance, that is much pre-dominant in management learning, and she calls it "emergent" learning.

Van der Sluis (2000) and Van den Berg and Poeli (2002) describe learning styles of managers, so that we have these fundamental characteristics for the emergent learning:

- *Often it is not recognized as being learning;*
- *It occurs mainly through observation, modelling and imitation;*
- *It is an implicit way of learning that comes from other people through observation and imitation and in practice where one encounters problems and disappointment.*

In "Differing colours of professional learning" (2003) Simons calls this the "copying-the-art metaphor", then, relating it to the social learning theory of Bandura (1986), in "Varieties of work-related learning" (2008), he chooses to use the term "Apperception metaphor". In "Metaphors of learning at work and the role of ICT" (2004) he calls it the "imitation metaphor" and this is the name we choose for ProActive.

Educational games in the imitation metaphor perspective

Imitation is composed of two kinds of actions: the first one is passive and consists mainly in observation of other's experience, the second one is active and is connected to the possibility of trying to do in first person what has been previously observed. If the second part is easily implementable in games, the first one is much more complicated, because games are, per definition, an active form of learning. The key role is played by the model that has to be imitated, that can be the teacher or a character in the game. Games are not the favourite learning objects of the imitation metaphor, however, games have the potential of increasing the possibilities of the learning scenarios and, so, of the models that can be presented to the students. Games developed under the imitation metaphor's perspective can appear similar to those developed under the experimentation one, because in both them the first person experience has a dominant role. The main difference can be recognized in the explicit role played by the model and in the observation/replication of it in the imitation metaphor that cannot be recognized (explicitly) in the experimentation one.

3.5 Experimentation

The formal contexts of education are separated from real, where learning, rather than to be a mental experience is a kind of apprenticeship. The experimentation metaphor looks very close to "learning by doing". Considering the learning process largely as an apprenticeship process is the central aspect which emerges from the analysis of learning processes performed in everyday contexts (Lave, 1988; 1993; Childs and Greenfield, 1980). This means that the learning process is highly dependent on direct participation within a specific activity. This implies that very little learning is achieved in the traditional sense of the term. Describing the learning process using the metaphor of "scaffolding" may be useful as a guideline and provide assistance in understanding it (Wood, Bruner and Ross, 1976).

John Dewey (1899), more than one hundred years ago, criticized education based on writing, reading and listening in favour of a type of education based on "learning by doing". This is the classic theme of "active

education", also echoed by Bruner and Olson (1974). Numerous researches in the field of experimental psychology show that practicing a specific task allows making it in less time and with fewer mistakes (Howes and Charman, 2001).

The experimentation metaphor is very useful for learning specific activities, complex or dangerous tasks, because it provides an active and contextualised learning, mainly related to practical activities and skills (including refining movements). It is basically an individual practice, but may also include some social activities, as the coordination in teamwork.

Senge (1990) and Freire (1971) are the main authors that threat the fifth metaphors which relies more in the learning organization (Senge) and critical reflection (Freire) literature.

The basic assumptions of this metaphor are:

- *It is an explicit learning focused on the working environment;*
- *It is both individual and collective;*
- *It is focused not on knowledge, but on skills, attitudes and expertise;*
- *The learner has an active role and is consciously learning in collaboration with others and under the guidance of experts in safe environments.*

In "Differing colours of professional learning" (2003) Simons calls this the "experimentation metaphor", then, in "Varieties of work-related learning" (2008), he chooses to use also Erickson's deliberate practice theory (1993) as model and changes the name in "exercising metaphor". In "Metaphors of learning at work and the role of ICT" (2004) he calls it again the "experimentation metaphor" and this is the name we choose for ProActive.

Educational games in the experimentation metaphor perspective

Games can play a crucial role in this metaphor, because they permit to create realistic situations (i.e. simulating events, technical tools, etc.). In fact, as we already said, educational games actively engage learners with the learning environment as they explore and make decisions, which is a key assumption of most situated cognition research (Kirshner and Whitson, 1997; Rovengo, 1999; Rovengo and Kirk, 1995; Abernathy, Thomas and Thomas, 1993). As learners interact with the game environment, they appropriate information and adapt new knowledge to fit what they already know, which are also key elements of situated learning environments (Kirshner and Whitson, 1998; Prawat, 1999).

The development of games allows us to create more valuable and involving learning experience, similar to the everyday life situations where people naturally learn. There are two main features that make the game a learning experience:

- ❖ The learner can experience a simulate situation;
- ❖ He is responsible for the consequences of his actions on that specific context.

Within these games significant learning processes are activated by taking actions and competences within contexts that are similar to those in which they will be applied.

It is important that simulation accomplishes a realism criterion underlying the relationship between the variables which play a role in the real situation. This is the main difference between simulation training and videogames: in videogames the rules may be created with not-realistic criteria, instead in simulations for training the rules for action should reflect the ones in play in the real life environment.

We can recognize two different kinds of simulation: experiential simulation and symbolic simulation.

Experiential simulations are used to exercise abilities of interaction with objects or with the environment in a context where errors are permitted. In this kind of simulation the added value relies in the possibility of learning strategies that cannot be experimented in real life contexts. For example in an experiential simulation game the learner can make specific movements or manipulate objects without real consequences a lot of times. Digital technologies allow us to create simulation environments where the learner can act and have a feedback on the quality of his performance. This way it is possible to prove new abilities in contexts where errors are pointed out, but don't lead to dramatic consequences.

Realism is a key feature of these systems: in fact the possibility to transfer learning from one context to another is possible when the game system replicate exactly the actions to take and the tools to use in real life contexts.

Symbolic simulations are often used for learning problem solving strategies. They require that the game designer/developer has a deep understanding and knowledge of the tasks that the learner will have to carry on in his real life contexts, to well reproduce them in the game and let the learner practice them freely in the game. If narration goes on appropriately and the problem to solve is realistic, simulation will result attractive and people will deeply engage with the task (Hill and Semler, 2001). We call this kind of simulation "symbolic" because it is centered on the identification with the role proposed and not on the precision required for the carrying out of the task. However, also if in symbolic simulations the task is represented (and not realistically reproduced as in experiential simulations), the simulation has always to accomplish a realistic criterion for the relation between the variables.

This is the feature that differentiates a learning game from a videogame: in videogames rules can be established arbitrarily; in learning games the game action rules reflect the rules of the real life system that the game wants to simulate.

The experimentation metaphor if fitted with educational games can also lead to a behavioristic perspective on educational games that is linked with exercising. In fact, for behaviorism, learning is a matter of reinforcing the relevant stimuli and response. In particular, Thorndike's law of exercise and effect, that states that repetition is crucial to learning, especially for basic skills of reading and writing, is the link between behaviorism and educational games. In fact, in educational games it is possible to change feedback to the student basing on previous inputs. Moreover, if the game will ask a question and the player will answer enough times to link the question and the answer, reinforced by a reward, learning will occur (Egenfeldt-Nielsen, 2006). The focus is on the player learning the right response to a given stimulus, while receiving rewards after each correct one. The game can become a sort of drill-and –practice machine where responses are needed to go on with the game or to reach a higher score. Exercising differs from the previous two kinds of simulation because the error should be pointed out right away and repetition of the activity would be required until no more errors appear. Furthermore, while in simulation you generally will consider many parameters to achieve realism, in exercising the scope might be narrow, i.e. fewer parameters to be considered at a time, in order to increase the clarity of the feedback

4. USERS' NEEDS ANALYSIS OUTCOMES

At the beginning of the project, 15 focus groups have been organized by the ProActive consortium in four different countries (Italy, Romania, Spain and UK). The main objectives were the following: a) to explore teachers' and trainers' use and interest in ICT and Game-Based Learning in their teaching methodologies; b) to explore teachers' and trainers' attitude and opinion about the link between creativity and Game-Based Learning; c) to explore teachers' and trainers' point of view in relation to learning metaphors and their adaptation to their teaching approach. The focus groups enabled to obtain quality data on current practices, as well as on practitioners' interests and needs for developing creative Game-Based Learning scenarios. Furthermore, the focus groups enabled to identify a list of specific adaptations of the two game editors that would be necessary in order to facilitate educators' participation in ProActive activities i.e. training and implementation.

This section resumes the main results of the focus groups, which have been taken into account for defining the pedagogical framework of the project (described further in this document in section 5). The complete report on user needs analysis is provided in a separate document (internal report D3.2 – User Needs Analysis).

4.1 Current use, interest and foreseen obstacles in utilizing ICT and Game-Based Learning in teachers' / trainers' practices

Throughout all focus groups organized by ProActive, a similar trend has been observed. Educators employ in their current practices common ICT tools to support the learning process. Among these tools we find: PowerPoint Presentation, Google scholar, Moodle, Internet search, e-mails, forum and others. Practitioners often use such tools to improve students' involvement in the activities foreseen by the lessons.

Very few focus group participants were familiar with Game-Based Learning, even less have used it in their teaching practice and almost no one had ever developed their own game to support their educational activities.

4.1.1 Why do teachers wish to use digital games in their teaching contexts?

The main motivation of teacher participating in ProActive focus group is to increase the interest of their students in the studied subject / field. Moreover, it is considered as important to establish a link between a subject and its application in real life context. Educators also feel it is important to adapt their teaching methodology to students' actual computer skills and to society change, filling the generational gap. Teachers recognize a change in students that makes the traditional teaching system no more appropriate. Indeed, pupils live in a society full of images, sounds and action, so that the concept of book, that is a static tool, cannot claim to be central to their repertoire. As students are changing the old teaching methods fail to magnetize their attention, so the use of games in education may encourage their participation and represents a new valid teaching strategy. They feel that Game-Based Learning approach is appropriate for satisfying these issues.

Another important reason is that educational games provide a safe environment where students are encouraged in exploring and experimenting knowledge. Furthermore, they see educational games as a possible way to help students in their self studying development, thus assuring them a teaching guidance together with the chance to freely produce and build their knowledge.

All participants showed a high level of interest in relation to the game design approach proposed by ProActive. Indeed, they are interested in games, in simulations and in experimentation and they acknowledge that to innovate in education is difficult but also stimulating. Moreover, they believe the design process can bring innovative elements to their daily teaching practices, as well as enhance both individual and collaborative learning opportunities.

4.1.2 Perceived obstacles

Several difficulties for employing design of Game-Based Learning in the participants' practices have been identified during the focus groups.

Generally, educators participating in ProActive focus groups were concerned with their lack knowledge regarding gaming and specific skills for game design. Thus they expressed the need for both initial training and further guidance on Game-Based Learning design.

Furthermore, teachers and trainers seemed worried about the actual possibility to use these new technologies when dealing with a high number of pupils. Moreover, they expressed their fear of not being able to create games with which to accomplish lessons' objectives.

Time constraints appeared as a possible obstacle perceived by many of the participants. Indeed, the time needed for making a good game from scratch might be too long and teachers might not have such free time due to the workload implied by the curriculum. Furthermore, time constraints could be perceived from the point of view of classroom organization, i.e. it was stated that the created Game-Based Learning scenarios should easily fit the scheduling of lessons, which might be difficult to design.

Finally, teachers agreed that in Game-Based Learning everything must be sized on the target users, i.e. the educational game should consider students' specific skills, needs, age, interests and size of the group. In consequence, Game-Based Learning is a good approach for matching to a specific context, nevertheless it might be a difficult and challenging task.

4.2 Attitude and opinion of participants towards creativity and its link to Game-Based Learning

A strong link between Game-Based Learning and creativity has been highlighted during the focus groups activities. Indeed, teachers' opinion is that creativity could be enhanced through innovative practices, such as Game-Based Learning. Such approaches are considered to improve students' curiosity about the world and facilitate knowledge sharing. Group creativity can be achieved, where everyone joins the everybody's learning process.

The participants clearly recognized the difference between *teaching creatively* and *teaching for creativity*, where the first is seen as flexibility in teacher's own approach, and the second is seen as a way to improve students' openness, flexibility and adaptability.

4.3 Use of the learning metaphors

Regarding the five metaphors, teachers recognized them easily and were able to match them with their current practices. Thus, metaphors can be considered as a pretty universal way of defining teaching / learning procedures that overcome the boundaries of different cultures and societies.

According to participants, the use of metaphors varies according to specific features, such as the kind of subjects that is being taught, the pedagogical goals, the profile of students, etc. Teachers stated that they often switch between different metaphors during the same session, in accordance to the learning flow at

stake. Moreover, teachers believe that the metaphors are not separated, but each one pervades the others so that it is really difficult to identify their independent functioning. Finally, they agreed that complete teaching approaches should include features belonging to different metaphors.

4.4 Teachers' / trainers' needs for achieving creative Game-Based Learning scenarios within ProActive

The focus groups enabled to set a list of needs. These needs can be divided into three categories, as described below.

a) Training needs

As mentioned above, participants would need training in order to be able to design their learning games. First, they need technical training, in order to learn how to use the game editors. Moreover, they need to get acquainted on the concepts around Game-Based Learning, i.e. what is good Game-Based Learning & how to create a good game. Furthermore, participants expressed that they would need a continuous guidance during the Game-Based Learning process.

b) Adequate tools

In order to create games adapted to their teaching objectives, teachers / trainers need adequate tools. Indeed, the specific affordances / functionalities / characteristics of the game editors should cover their specific educational scenario (e.g. tracking and assessment features).

c) Graphical resources

Quality graphical resources would facilitate the easy creation of games. Indeed, it was identified that most of the time invested in creating simple game scratches was related to gathering / producing the art assets (e.g. background images). A possible solution would be to provide a thorough library of images and sounds along with the tool.

ProActive has already taken into consideration the needs described in categories b and c, through an adaptation of each of the two game editors in an earlier stage of the project. In order to satisfy the needs from the first category, ProActive will develop training materials, as well as conduct training sessions. This is described further in this document (Section 6). Within the training and implementation phases of ProActive, target users will use ProActive pedagogical framework, which will stimulate their creativity, focus it on the variety of teaching models (the 5 metaphors) and giving indicators of success factors for Game-Based Learning, allowing the creation of new/innovative teaching resources (their own games) that are relevant, interesting, engaging for the learners.

5. PROACTIVE PSYCHO-PEDAGOGICAL FRAMEWORK: THE FIVE METAPHORS OF LEARNING AND THEIR RELATION WITH GAME-BASED LEARNING AND CREATIVITY

5.1 The ProActive approach

The main objective of the project is to analyse the conditions to stimulate the creativity of teachers by engaging them in GBL design processes. As shown in the theoretical background, teaching creatively consists in using imaginative approaches and combining existing knowledge in some novel form to make learning more engaging, assure the relevance of the curriculum, and increase understanding.

GBL is a good candidate to fulfil these requirements, as it provides challenging experiences that promote the intrinsic satisfaction of the learners and offers opportunities for authentic learning processes. For this reason, the study will offer to teachers the possibility to use a GBL as an innovative approach in their teaching practices. Furthermore, in order to overcome the obstacles of introducing GBL in formal learning settings, a constructivist approach is adopted, in which teachers will create their own learning games, i.e. innovative learning artifacts that are engaging for their students.

During this process, the five learning metaphors will be central, as they will act as guidelines for the project participants in the creation of educational games. Indeed, the metaphors will raise educators' awareness on different learning models, as well as they foster their reflection on possible new ways of active teaching, thus guide the game design process. In fact, it is assumed that each metaphor allows for the creation of games with different rules, objectives, roles for the actors involved, mechanics, tasks, etc. This fosters the reflection on which model to use for teaching.

Furthermore, as a result of the design process, a creative product will be obtained – a learning artifact (i.e. an educational game), tailored to the learning needs, institutional and curricular constraints and which can be shared with students. Such creative product is pedagogically innovative, useful and adapted to a specific teaching / learning context. It is assumed that this GBL scenario will be structured according to the learning metaphor(s).

Within an in-site pilot implementation of the GBL scenarios created, teachers will test their creative GBL scenarios in their educational settings. During this stage, students experience the creative GBL scenario.

The following figure summarizes the approach of the project. It links the concepts of creativity, GBL, game design and the five learning metaphors in order to draw a four stages circle of creative GBL.

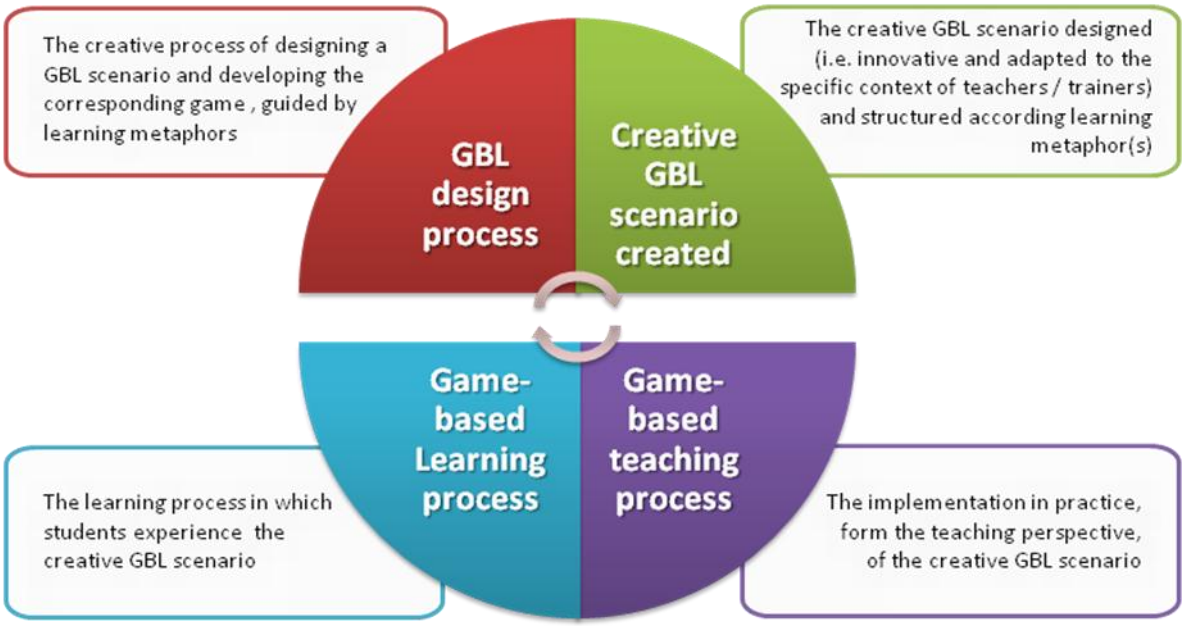

Figure 2: The circle of GBL within ProActive approach

5.2 Game design features in relation with the five metaphors of learning

The first step within the process described is to help teachers in defining which elements characterize an educational game and then to make them aware of how many different ways the process of learning from playing can work in respect of the psycho-pedagogical paradigm adopted in order to create the game. In fact, if the metaphors are incorporated in the design phase they are automatically transiting in the further phases shown in the figure, i.e. those metaphors that are planned during game design will be present in the created game and then in the teaching/learning process.

So, within this section we'll clarify how the metaphors fit with the design of educational games, trying to develop a framework where educational games are defined basing on the psycho-pedagogical theory that relies on them.

A grid (Table 4) will summarize the relation between each metaphor and educational games developed within that metaphor's perspective basing on some features that reflect both the work done by Simons in concretely defining the metaphors of learning and both Egenfeldt-Nielsen attempt on classifying educational games:

- *Learning objectives:* Learning objectives implicitly refer to what learning is and to what is expected learner and teacher to do to make the learning process successful. Learning objectives also refer to how the evaluation process would take place. They orient how a learning artifact has to be built to make the learner properly respond to the metaphor's expected educational outcomes.

- *Role of the teacher:* If we think about teachers as designer of the learning process and also of the learning game, we have to consider which role each learning model supposes they should have to make the learning process successful. In more traditional models they should be content providers, and in more innovative ones they should let the game environment created be explored by the learner.

- *Role of the learner:* The role of the learner refers to the representation of the learner that each model vehiculates. The major distinction concerning the role of the learner is between his viewing as a passive recipient or as an active producer of knowledge.

- *Game representation:* The game representation refers to how the game is considered within each learning model. As we stated, educational games can be perceived and used in different ways in consideration of the learning model adopted. This is because different kind of games posses different key features which stimulate more one process or another.

- *Learning strategy:* The learning strategy explains which paths the respective metaphor provide in order to promote an effective learning process within the context of a game. It also outlines which strategies are fostered through games constructed under different metaphors perspectives.

- *Dominant gaming aspects:* Referring to the classification of key features for a successful educational game previously analyzed in the Deliverable 3.1 and in the third chapter of this document, we suggest that each metaphor well fits with specific aspects and favours the construction of games with those dominant aspects. We do not claim that these dominant gaming aspects are exclusive of one metaphor instead of one another, neither that if one of this characteristic is present in a game it automatically refers to the correspondent metaphor, we're speaking about preferences, where some gaming aspects can be easily dominant within each learning perspective.

- *What promotes learning:* It refers to which mechanics in the game promote learning. Each metaphor represents a learning strategy, so obviously, it is reflected in the design of game-based scenarios developed within its perspective.

- *Nature of the task:* The nature of the task refers to the dominance of freedom or control of the player over the game. The task can be open or closed and have a direct relation with the possibilities offered to the player for going on with the game.

At the end of the section also the relation between the metaphors and ProActive game editors will be analyzed.

For a game constructed in the **acquisition metaphor** perspective the main objective is to acquire contents that the teacher exploits within the game. Through this acquisition the player/learner will go on in the game that is represented in the acquisition metaphor's perspective as a content provider. The main learning strategy is the memorization that can be rewarded within the game. The main aspects of this kind of games are a rewarding system, a short feedback cycle and the possibility of defining clear goals. What promotes learning, in fact, is, in main cases, exactly the desire to continue playing, the curiosity of what happens next in the game and the trying to reach a reward or a high score. The nature of the task proposed is, for definition, closed, because the game is structured for making the learner to acquire or to not acquire a certain kind of knowledge, no deviation is admitted.

For a game constructed in the **participation metaphor** perspective the main objective is to become part of a community of practice by interacting with peers for the development of a shared task. The task itself is given by the teacher to the students with the main scope of facilitating the interaction. The game is seen as an environment to construct and share with others and the strategy to reach learning is the interdependence and the sharing of meanings between participants, to be reached through competition, collaboration and flexibility (both of students and teacher). What promotes learning is the feeling of being part of a community of practice and, because this can happen in many different ways the task given has to be open. In fact, also if a common objective has to be prepared from the teacher to make students

interact, the results of these interactions are unpredictable and so the task has to be as open as the learners can feel that through negotiation and sharing they will build their own path to reach the task.

For a game constructed in the **discovery metaphor** perspective, the main objective is to create or to recognize relations between objects in a game environment full of undiscovered meaning. The game environment has to be built by the teacher mainly for let the students explore it. The main learning strategies implied in this kind of learning are, in fact, exploration, manipulation and deep understanding. They can be achieved by playing with the game rules and the engagement/immersion within the game. The openness of the task that let the learner freely discover the game promotes learning through the possibility of experience a feeling of mastery within the game environment.

For a game constructed in the **imitation metaphor** perspective the main objective is to gain expertise. The teacher has to act as a model or to create a model that the student will imitate by making a copy or an improvement of it. The game is the place for the observation of others' experience and for the repetition of it. By transforming it in a first person experience, learning is reached. The rewarding system, the short feedback cycle and the replayability are the main gaming aspects. And what promotes learning are the consideration and the internalisation of the model. The nature of the task is obviously closed because what the model does, the learner has to repeat.

For a game constructed in the **experimentation metaphor** perspective the learning objective is to gain expertise and fluency. The teacher has to give a task to the student and just let his/her experience it within the game. The student has to practice the task in the game that is a safe environment where errors consequences are not dramatic as in reality. The learning strategy is for trial and error and so, the dominant gaming aspects are the challenge and the replayability. What promotes learning is the experience of the consequences of the actions taken, and the task to experience is generally closed.

Table 4: The relation between each metaphor and educational games

	Acquisition	Participation	Discovery	Imitation	Experimentation
Learning objectives	To acquire notions and contents	To be part of community of practice	To recognize / create new relations between objects/concepts	To gain expertise	To gain expertise / fluency
Role of the teacher	To explain, question and evaluate through the game	To facilitate the interaction between peers in the game	To create a game environment full of undiscovered meaning	To show / create a model for the learner's actions	To give a task and let the learner experience it within the game

Role of the learner	To pass levels, advance in the game or reach the highest score by using the acquired knowledge or by answering the game questions	To contribute by interacting to the development of the task	To discover / construct meaning within the game environment	To make a perfect or improved copy of the model to go on in the game	To practice and experiment the task within the game
Game representation	book, learning material/content to be learned	Virtual environment to construct and share with others	World with its own rules / meanings to be discovered /created	Location for observation and repetition of other's experience	Safe environment where errors can be experienced
Learning strategy	View of the contents, possible multiple review of the data	Interdependence, sharing of meaning	Manipulation, exploration, deep understanding	Repetition of models and reward	Trial and error
Dominant gaming aspects	Rewarding system/short feedback cycle; clear goals, possibility for automatic and randomized Q&A	Competition / collaboration; adaptability / flexibility, goals common to the community	Rules, engagement / emersion, flexibility, manipulability, interactivity	Reward system, short feedback cycle, replayability	Challenge and replayability, feedback (automatic or manual with cycle length depending of the activity), positive / negative rewards
What promotes learning	The trying to reach a reward or an high score	The feeling of being part of a community of practice	The experience of a feeling of mastery over the game world, curiosity, intrinsic motivation to experiment	The credibility of the model, student's respect towards him/her as expert and consideration for the role-model	The experience of the consequences of the action taken
Nature of the task	closed	Open	open	Closed	closed

A consideration to take into account is that though the framework highlights the diverse roles to be assumed by the educator in line with the metaphor he has opted for, it does not analyse the cognitive and metacognitive processes involved and which, implicitly, support these role-swaps, since the project focuses on socio-cultural aspects of learning rater than on cognitive restructuring which may result from corroborating the five learning metaphors with a game based learning approach.

Moreover, in terms of products evaluation, these features can be also used to evaluate the game scenarios that will be produced by teachers and trainers during the project, so, this framework will work also as evaluation framework for the psycho-pedagogical section of the games developed.

5.3 ProActive game editors

Many different approaches to the development of video games have been proposed. The most traditional approach is to develop the games using general-purpose programming languages (e.g. C, C++). Nonetheless, modern video games are usually developed using programming languages, frameworks and engines that have been created specifically for games. Good examples of these technologies are the *Microsoft's XNA™* platform for the development of games for Windows or XBOX, or 3D game engines such as *Torque™*, *OGRE* or *Unreal™*. These platforms abstract most of the features that are needed to develop

video games (e.g. graphics, physics, sound management, etc.), allowing developers to focus more on the design of the games.

Nevertheless, during the last years authoring tools have also arose as an alternative to video game development. Game authoring tool provide further abstractions that allow people without a strong technical background to develop their own games. Moreover, authoring tools can reduce significantly the time required to develop a game and the development costs.

A study of the existing game authoring tools (ProActive internal report D3.1) reveals that is difficult to find authoring tools specifically designed for the creation of educational games. Projects such as *The FPS Creator*, *Game Maker* or *Mission Maker* provide utilities to create 3D games using a user-friendly interface, targeting in some cases a single genre of games (e.g. First-Person shooters) as a mechanism to balance expressivity and simplicity of use. Although some of those tools (like *Game Maker*) have been applied in educational experiences (Overmars, 2004; Robertson and Good, 2004), few of the alternatives found in the market have been specifically developed for instructors, as they do not support the inclusion of learning-oriented features in the games. When designing a videogame for educational purposes, the instructor should be in control of aspects that are pedagogically relevant. Between those relevant aspects, we highlight the following: how to track / evaluate the student's performance (i.e. assessment), and how to adapt the behaviour of the game in order to fit the needs of each student (i.e. adaptation).

5.3.1 ProActive game editors

Within the project, teachers will use at least two game editors in order to design Game-Based Learning scenarios: a free of charge 3D virtual environment allowing collaborative interaction of the learners (EUTOPIA); and an Open Source framework for implementing 2D user-centred adaptable scenarios (<e-Adventure>).

Further we describe the two tools and show their affordances for implementing the above described metaphors. Moreover, we have assured that both tools have interfaces that enable teacher even with limited IT skills to create simple games. In a previous project step, we have also performed detailed analysis to guarantee the tools adequacy according to the identified earlier success factors for game-editors (see Appendix 4).

5.3.1.1 EUTOPIA

EUTOPIA is a platform for creating, managing and delivering Online Role Playing Games (ORPG) with a set of tools that enable to play and analyze the social interactions that take place during the online sessions. EUTOPIA does not provide any contents or structure for the game. Indeed, the tutor defines the storyboards and the goals of the game, for each player involved in the simulation.

The following summarizes what EUTOPIA is not for:

- It is not designed for teaching a particular subject (e.g. Mathematics, History, Chemistry, etc.).
- It is not a game with a particular game design and rules built in or designed for a particular purpose.
- It is not a Second Life clone or a virtual world library. Indeed, EUTOPIA holds some special features:
    - an EDITOR: a tool for creating the plot and managing the participants' features (avatars, goals, communication etc.)

- a CLIENT: a tool for delivering the session, interacting with the participants as one of the characters or as a "deus ex machina" and recording the session
- a PLAYER: a tool for reviewing the recorded session and adding comments on special/meaningful frames. The player can be used by the tutor and the players both for reviewing the recorded and commented session.

The content provider is the tutor who can design a plot for his/her participants to play with. Like in a theatre he / she would be the director of a piece that himself/herself wrote down or had written down by somebody else. In fact, it implements the psychodrama methodology in a digital "scene". This approach permits to a small group of people to give a theatrical performance for educational or psychological purposes (counselling, diagnosis, therapy, coaching and training in soft skills). Each actor (or learner) controls an avatar and interacts with other avatars in a virtual 3D scene. Psychologists, Pedagogues, Teachers, Trainers, Educators can use different functions. They can write a storyboard as a playwright; they can assign the characters as a casting director; they can guide the action as a movie director; finally, they can give feedback to the group recording the scene action and adding personalized comments (debriefing phase). EUTOPIA is currently used in several European countries in vocational training programs and university courses. Experiences particularly significant were conducted to teach cultural mediation such as in Cyprus (Turkish-Cypriot and Greek-Cypriots), in North Ireland (Catholics and Protestants) and in Italy (EU citizenship and non-EU citizenship). EUTOPIA has been presented at Shanghai CHINA International Expo 2010 as one of the most innovative tools developed at ISTC CNR for people training.

EUTOPIA has been developed in joint venture by ISTC CNR (Rome, Italy) and NAC LAB, Dipartimento di Scienze Relazionali "G. Iacono" (Naples, Italy). EUTOPIA has been developed within the framework of projects funded by Lifelong Learning Programme (EACEA), for this reason its use is free of charge.

5.3.1.2 <e-Adventure>

<e-Adventure>[7] is an educational game authoring tool. It allows for creating 2D educational computer games and simulations. The tool was designed to reduce the development cost of educational games, facilitate their integration with e-Learning platforms (e.g. Learning Management Systems such as Moodle™[8]) and involve instructors in the development process. The <e-Adventure> platform aims to facilitate the integration of educational games and game-like simulations in educational processes in general, and in Virtual Learning Environments (VLE) in particular (e.g. Moodle). It is being developed by the <e-UCM> e-learning research group at UCM, with three main objectives:

- Reduction of the development costs for educational games
- Incorporation of education-specific features in game development tools
- Integration of the resulting games with existing courseware in Virtual Learning Environments

The core of the <e-Adventure> project is the authoring tool that allows educators with no technical background to produce their own educational games.

The structure of <e-Adventure> allows to produce point-and-click games that really well fit with the teaching of technical procedures and models.

[7] http://e-adventure.e-ucm.es

[8] http://moodle.org/

5.4 Relation between the learning metaphors and ProActive game editors

The metaphors are modalities for structuring the creation of a game scenario. But the utilisation of the metaphors is linked to the affordances offered by the tools used for the creation of the scenarios. ProActive game editors consent to implement games-based scenarios on all the metaphors. In the following paragraphs is discussed how each ProActive game editor fits with the learning metaphors, outlining strengths and weaknesses of the tools in relation with the five metaphors of learning.

Though the two game editors offer tools for developing games under all the five metaphors perspectives, they have different degrees of adequacy to the metaphors, so they will be used in the project in a complementary fashion.

For assuring that they are adapted in the design of educational games, success factors for game editors have been elicited in D3.1. Matching between these factors and ProActive game editors is provided in Appendix 4.

5.3.1 Relation between EUTOPIA and the learning metaphors

EUTOPIA has some features which can be further discussed regarding the learning metaphors.

- **Acquisition**: The acquisition metaphor can be easily implemented in EUTOPIA preparing an online session with a group of learners that "receive" information from a teacher who could also send textual contents in the form of written document. In this case the tutor will create, through the editor, special contents which will match the requirements for this type of metaphor.
- **Imitation:** This kind of learning could take place as a result of the social interaction happening during the game. The tutor could stimulate the observation and imitation of particular kind of social interactions/behaviours as part of a training activity in which, for example, the tutor could teach the building blocks (behaviours) of an effective communication context. Plus, the tutor could also record a master session, in which he/she exemplifies some specific behaviours he /she wants to show to the participants, who can watch, analyse and imitate afterwards.
- **Experimentation/Simulation:** EUTOPIA can be used (and actually have already been) to simulate many kind of social relations and dynamics. For example a tutor could prepare an online RPG in order to simulate a customer-supplier interaction, or an intercultural negotiation or a tutored introduction for disabled people in the university context (all those cited are example of projects realized). Within this context, players can experiment through different characters and with specific goals their behaviours and soft skills in action.
- **Participation:** Participation is probably the best implemented metaphor in EUTOPIA. This because EUTOPIA focuses on social aspect of learning. The Tutor gives just an input with the storyboard, but then everything emerges from players interactions and it's based on their interdependence (also on the base of the assigned roles/goals/constraints). In this case EUTOPIA provides just a substrate (i.e. direction, like in a theatre piece) for the interaction but the interactivity is not filtered and it's created "live" by the participants.
- **Discovery:** EUTOPIA is an open instrument in which most of what happen is an unpredictable emergent process. This makes it the ideal context for the discovery metaphor, by using external links to make EUTOPIA environment even wider.

5.3.2 Relation between <e-Adventure> and the learning metaphors

- **Acquisition**: There are several elements in <e-Adventure> that can be used to implement this metaphor. For instance, books, slidescenes and videoscenes can be used to provide the learner with a lot of information. Besides, characters and conversations can be used to implement in-game "tutors" and tests that can be used to ensure the transfer of knowledge.
- **Imitation:** The Imitation metaphor has not a direct translation to <e-Adventure>, but it could be achieved by combining characters, videos and animations with the player's goals and the behaviours that players could observe and apply in other contexts whether within the game itself or externally. For instance, in a game oriented to professional training players could find a person doing maintenance works in a building and observe and analyze his/her behaviour to be able to solve the next quest in the game (e.g. fix a window).
- **Experimentation/Simulation:** This metaphor can be easily implemented with <e-Adventure>, as it includes features to define thoroughly the rules of a process to be simulated. Moreover, <e-Adventure> games can achieve a high level of realism without requiring a huge investment through the use of photos of the real environment to make the game.
- **Participation:** Participation is probably the less supported metaphor in <e-Adventure>, as no multiplayer games are supported. Nevertheless, this issue could be addressed at least partially by implementing NPCs (non-player characters) or, better, embedding the games in Virtual Learning Environments (VLE) like Moodle™ where students can communicate using forums, chats or any tools provided by the system, or also playing as a team to resolve the game.
- **Discovery:** <e-Adventure> games can be produced according to the Discovery (individual) metaphor. Virtual worlds can be created that the students are free to explore, discovering how the environment reacts to their manipulation.

6. THE PROACTIVE APPROACH TO TRAINING

According to what has been said within the previous chapters, workshops will be delivered to teachers and trainers that participate to the ProActive project. Workshops will be designed to respond to individual circumstances across the partner institutions. What is offered below is a set of general headings for workshop organisation and content. These provide a check list of the most important issues that are likely to inform the design of workshops.

6.1 Guidelines for Game-Based Learning workshops

ProActive teachers / trainers will participate in two days workshop in their country: together with the research team, they will first learn about the pedagogical and technical approaches of ProActive, including the five metaphors for natural learning; then, through a co-design process, they will reflect on the ways to introduce creativity and flexibility into their teaching practices and develop their first creative learning games with the provided tools.

Data collection will also be conducted during the workshops via pre-defined templates. According to the ICEDIP model, ProActive will evaluate the creative process in which teachers / trainers design Game-Based Learning scenarios. The training workshops could be organized in the following way:

- *What is Game-Based Learning? Game-Based Learning in this country, in Europe, in the world*

This topic would offer definitions of Game-Based Learning with examples from across the world. ProActive study on Game-Based Learning (internal report D3.1) will be used as a basis, but other sources such as Futurelab's 'Serious Games' document will also provide some material for planning this section.

- *The advantages of Game-Based Learning*

The case for Game-Based Learning would be stated. The advantages that come from the different learning styles would be set out. Also here, ProActive study on Game-Based Learning (internal report D3.1) will be used as a basis.

- *The challenges of the introduction of Game-Based Learning*

The political and practical considerations would be discussed.

- The political considerations would include both local and national issues regarding the suitability of games as a medium of teaching and learning.
- Practical considerations would include machine requirements, timetabling, technical support and other delivery challenges.

- *Using the 5 learning metaphors*

Within this part of the training, teachers / trainers would be introduced to ProActive's pedagogical framework and will be hinted on how to use it within the game design process. The current practices of the participants for working with students in the classroom will be discussed.

This session will be of great importance for the whole workshop, as it provides the way ProActive aims to foster teachers' creativity through a constructivist approach to Game-Based Learning. In fact, the metaphors of learning will work as a sort of guidelines for the creation of educational games, assuming that each learning strategy (or each metaphor of learning) allows to use and create games for different purposes. As mentioned earlier, just the fact that teachers / trainers are stimulated to think about which

model of learning they want to use, means that they are escaping from the traditional learning model. In this way different learning models will be integrated in the educational context by constructing and reshaping their own game.

- *A directory of useful games*

The course would offer an overview of games that have proven and likely value for schools. It would include the following:

- Commercial games (recognised as offering educational value)
- Non-commercial games such as those arising from ProActive project

- *Game editors*

This section of the course would offer an overview of the various games editors available. Course leaders would try to include a good range from the most challenging and rewarding to the simplest of games editors. Special focus will be given on the two ProActive editors, providing to the participants the necessary technical training on tools functionalities, affordances and how-tos, i.e. how to create simple games. Depending on the participants' interest, they might be given further training on more advanced features.

- User-centred design (*UCD)*

The process of user-centred design would be set out with appropriate examples of design in action. It is likely that case study material from the ProActive project would be included.

During the workshops, participants will start designing their first Game-Based Learning scenarios with the close support and guidance from the ProActive team. To facilitate the creative process, the ICEDIP model might be followed (see also description in Appendix 3)

- *Ongoing support for teachers and trainers*

The course would outline the need for ongoing support for teachers and trainers in the task of developing their own game authoring capacity and suggest the type of structures that might deliver it. After the training workshop, teachers / trainers will continue to design their Game-Based Learning scenarios on their own. Each partner will closely follow and support the pilot sites by means of regular observations, frequent meetings with the teachers and technical support.

- *Success stories*

A final session might include case studies of ways in which teachers, schools and other institutions have made use of Game-Based Learning in the curriculum. Teachers / trainers will have the opportunity to present their scenarios to each other, discuss them and evaluate ProActive approach as a whole.

6.2 General considerations

Format of meeting

While the choice of format will be decided by the organisers, it is strongly recommended that some attention be paid to designing game-like presentational techniques.

It is also suggested that participants be introduced first to board and other games and be asked to design simple games. Thus the base elements of games can be re-disclosed to participants, elements that will re-emerge later in the workshop. This session will also be a lot of fun.

In some contexts it might be that multi-user video games are set up to be played. The EUTOPIA game editor can be used with workshop participants being offered the opportunity to design simple games using

it. A poster rich environment featuring material from commercial game promotion will offer visual clues to participants.

Input from participants

Where possible attention should be paid to drawing on the experience of participants. Therefore sessions should include activities that encourage teachers and trainers to talk about and, where appropriate, record examples of good practice. It may be that organisers gather case study materials in advance in order to use them in discussions.

Case study material

Content for workshops should also draw extensively on case-study material that describes practice from local, national and international sources. The workshop can also be a means of identifying potential case study material. Certainly one outcome of the workshop could be a report that details participants' experiences in Game-Based Learning in schools and other institutions.

Advanced participants

Course leaders could also expect some participants to be able to design or even create games over the session. It may be that programmers are at hand to help advanced participants implement or part-implement games over the sessions. If more time is needed participants could be sent results of designs as soon as possible after the workshop to maintain interest and momentum.

CONCLUSIONS

This document aimed at setting the psycho-pedagogical framework of ProActive project. To do so, the last trends regarding Game-Based Learning and creativity in educational settings have been described. Furthermore, the psycho-pedagogical approaches related to the five learning metaphors which are central in ProActive have been described. Moreover, the results of a user needs analysis performed within an earlier stage of the project have been highlighted.

On this basis, the pedagogical framework of the project has been defined, and can be resumed as following: in order to foster teachers' creativity, ProActive will offer to teachers / trainers the possibility to use Game-Based Learning as an innovative and imaginative approach in their teaching practices, so to enable them to create learning environments interesting and engaging for their students. A constructivist approach to Game-Based Learning is adopted, in which teachers will create their own learning games. It is expected that this Game-Based Learning design process will foster teachers'/ trainers' creativity, by involving them in a creative process for preparing of creative learning scenarios. During this process, the five learning metaphors will be central, as they will foster educators' reflection on possible new ways of teaching. In fact, it is assumed that each metaphor allows to create games with different rules, objectives, roles for the actors involved, mechanics, tasks, etc. and this fosters the reflection on which model to use for teaching. The game-based model used for the ProActive acts as a tool to experiment the implications of an innovative teaching practice where learning is situated, self-directed and fun.

The psycho-pedagogical framework will be used as a basis for the further steps of the project. According to the framework, the ProActive approach to training has been elicited. More specifically, it will help the consortium in designing the training content and developing the training workshops. Moreover, it will set the parameters to be taken into account in the implementation activities and in the design of ProActive evaluation framework and instruments.

APPENDIX 1: A CATEGORISATION OF APPROACHES TO CREATIVITY

Extraction from JRC Technical Notes - Innovation and Creativity in Education and Training in the EU Member States: Fostering Creative Learning and Supporting Innovative Teaching - Literature review on Innovation and Creativity in E&T in the EU Member States (ICEAC) – By Anusca Ferrari, Romina Cachia and Yves Punie, pp. 6-9 (http://ftp.jrc.es/EURdoc/JRC52374_TN.pdf)

Looking into existing research, it is evident that creativity is a complex issue, and difficult to describe. Several fields tackle creativity with their own methods and arrive, as noted before, at different conclusions. It is nevertheless possible to cluster many of these approaches, as more than one researcher has done before (Sternberg & Lubart, 1999; Taylor, 1988; Villalba, 2008). All the approaches entail a specific conceptualisation of creativity and a specific understanding of the concept. The categorisation we propose is based on the aforementioned articles. The aim is to outline a systematisation of the main research areas and to verify which aspects of creativity have been considered as most relevant. It includes:

› Psychometric approach;

› Psychoanalytic approach;

› Self-expression and mystical approach;

› End-product approach;

› Cognitive approach (embracing *phase-oriented studies*, *pragmatic methods* and *thinking theory*).

Psychometric approach

For researchers approaching creativity in a psychometric way, creativity is a quality that can be measured. Guilford suggested that this quality is possessed by everyone – it is therefore not just a characteristic of eminent individuals such as Einstein or Michelangelo (Guilford, 1950). This idea was taken further by Torrance, who developed the Torrance Test of Creative Thinking (Torrance, 1974) in the 60s and 70s. This written test evaluates divergent thinking and problem-solving according to statistical rarity of answers. This approach has been heavily criticised (Almeida, Prieto Prieto, Ferrando, Oliveira, & Ferrándiz, 2008) as it fails to capture and determine what creativity is and how it is expressed. Aside from the pitfalls of the measurements method, the added value of this approach resides in the belief that inventors and eminent creators are not the only people who possess creative abilities.

Psychoanalytic approach

The psychoanalytic approach sees creativity as the manifestation of the unconscious for artistic purposes. Its theoretical background lies in the work of Freud and in the tension between conscious and unconscious processes. Freud was convinced of the need of artists to express their unconscious wishes through a socially acceptable product (Freud, 1958). Under this approach, it is possible to find all the theories that connect pre-conscious or unconscious thinking with the "creative sparkle" (Eigen, 1983), including the research that relates the creative 'eureka' moment to day-dreaming, pre-dreaming, drugs and mental illnesses (Heilman, Nadeau, & Beversdorf, 2003). This approach has influenced the common and scientific vocabulary regarding creativity.

Self-expression and mystical approach

The self-expression and mystical approach sees creativity as the need to express oneself in a unique way. The emphasis is on aesthetic and expressive outcomes. It is based on common assumptions, implicit theories (Runco, 1999) and connotations, rather than on scientific research. This concept of creativity has often being mingled with associations to talent and inspiration. In ancient times, the creative person was seen as directly inspired by the divine (Sternberg & Lubart, 1999). This mystical approach has been mainly applied to the visual arts, music and writing and can be found in the invocation to the Muses or to God in many literary texts. It is related to the artistic domain and to the idea that creativity cannot be studied (Sternberg & Lubart, 1999). Such a view of creativity gives more emphasis to originality than value, sometimes intertwining creativity with drug use or with mental illnesses (Beghetto, 2005). This approach has an important spill-over effect in education. As Sharp (2004) remarks, most parents (or teachers), when talking about children's creativity, think about artistic or musical talent. This diminishes the role and relevance of creativity in other domains and areas of knowledge and also the concept of creativity as a skill that can be learnt.

End-product approach

The end-product approach sees creativity as a process that results in a product or work or output. Creative experience is thought of as opposite to reproductive experience (Taylor, 1988). While several researchers will not take this approach as their main understanding of creativity, the assumption that creativity is manifested in an output lies behind many theories and is a taken-for-granted factor. This understanding of creativity as a product is evident in design, visual arts, and music, in the "creative industries", where the manufactured goods are perceived as the result of a creative process. The idea permeates the literature, as is evident in many contributions to two reference books on creativity, namely *Theories of Creativity* and *Handbook of creativity*, where the authors tend to identify creativity with creations (Albert & Runco, 1990; Sternberg, 1999a). It has also been acknowledged that not all artistic products are creative (Taylor, 1988).

Cognitive approach

The cognitive approach sees creativity as a cognitive and thinking skill or process. It seeks to understand the thinking process of creative thought (Sternberg & Lubart, 1999). It is possibly the most prominent research area in the creativity debate, and it includes several schools of thought: *phase-oriented studies*, *pragmatic methods*, *thinking theories*. These perspectives have vast overlaps, as they all see creativity as a process and as a mental representation.

Phase-oriented studies explore the different steps of the creativity process. Creativity is not seen as irrational and sudden but as being built on several stages. The Geneplore model (Finke, Ward, & Smith, 1992) distinguishes between a generative phase and an exploratory phase, the first being the construction of the mental representation, the second the interpretation and validation of these constructions. The two phases are not linear, since a non-satisfactory output will bring the thinking process back to the generative phase through a re-focus or expansion of the original concept (see Figure 3).

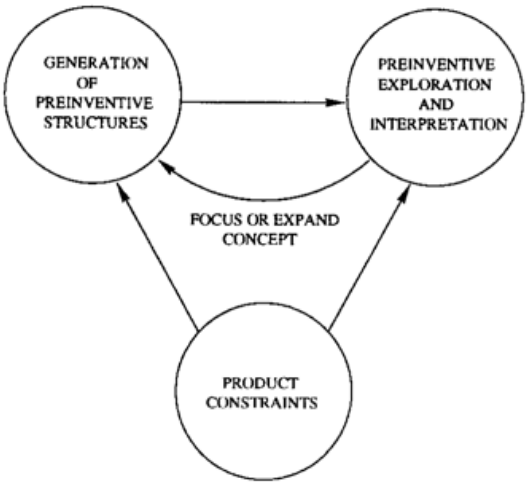

Figure 3: The Geneplore model (Finke, Ward and Smith, 1992)

For Wallas, the creative process consists of four phases: (1) preparation, (2) incubation, (3) illumination and (4) verification (Wallas, 1926). In the first phase the focus is on the problem dimension; in the second the problem is internalised; in the third there is an insight and the birth of a creative idea; and the last phase is about verification, elaboration and validation of the idea. Rossman, studying more than 700 inventors, expanded this model into seven phases: 1. observation of a need; 2. analysis of the need; 3. survey of all available information; 4. formulation of all objective solutions; 5. critical analysis of these solutions; 6. birth of the new idea; 7. experimentation to test, develop and refine the solution (Rossman, 1931). It is evident that Rossman proposed a model that foresees a balance between imagination and analytical skills. The advantage of these models is their descriptive structuring of the creative-thought procedure, which emphasises that creativity does not emerge in mystical or random ways. Moreover, the different stages of the creative process can lead back to the phases of the learning process.

A similar conception of creativity can also be found in *pragmatic methods*, which aim to develop creativity using a series of techniques. One of the first attempts to enhance creativity in such a way was the proposal of brainstorming developed by Alex Osborn. This technique focuses on a group generation of ideas or solutions to a problem and is based on the principle that a constructive atmosphere leads to the development of new ideas and solutions, while a critical and sceptical environment hinders creativity (Osborn, 1953). One of the most popular exponents of the pragmatic method is certainly Edward de Bono, who wrote extensively about creativity. His main concern was to find tools and methods that can take the thinker away from an analytical and critical perspective in order to develop lateral thinking skills and to broaden perception. Among his techniques, the "six hat method" is worth mentioning. It involves "parallel thinking" and is used mainly – but not solely – in meetings or group discussions. Each hat represents a specific line of thought (for example, the white hat is connected to the expression of neutral and objective information; the red hat with feelings and personal opinion; the green hat with new ideas) and participants are asked to "wear a hat" at the time, i.e. to pursue one line of thought or one side of the matter at a time (De Bono, 1985). Other lateral thinking techniques include the use of the linguistic device "po" (Provocative Operation) to attract attention to a possible restructuring of the ideas or issues at hand, to provoke lateral thinking and to attack common assumptions and the Random Input method which simulates 'inspiration' but which may be used to generate new ideas (De Bono, 1970). Other methods for the generations of ideas include the TRIZ tool set and the work of Guy Aznar. TRIZ is a Russian acronym that could be translated as "The theory of inventor's problem solving". It is based on logic methods and denies the role of intuition in the creative process (Altshuller, 1984). Guy Aznar is a French psychologist and economist who wrote about

problem-solving, idea-generation and other methods and techniques to foster individual and group creativity, and his special interest was the application of creativity to business (Aznar, 1973, 2005).

Under the umbrella of *thinking theory,* we cluster several scientific contributions ranging from the studies on personality to environmental variables of creativity.[7] Many focus on the study of genius, trying to establish what personal characteristics made these people become successful scientists, artists, inventors or creators (Albert & Runco, 1990). Others link creativity with the idea of intelligence (Albert & Runco, 1990) or with personal characteristics, such as persuasion (Simonton, 1990). Others focus on environmental factors that influence how creativity is shaped and perceived (Laske, 1993). Others analyse the motivational variables that may trigger or hinder the creative potential (Amabile, 1998).

Robinson (2001) and Albert & Runco (1990) give the example of the scientific revolution as a period of intense creativity, bringing about intellectual paradigm shifts. This comparison certainly suggests that the shaping of creativity is closely related to intellectual development and cultural change. It is assumed that to understand creativity it is also necessary to possess an understanding of both intellect and culture.

APPENDIX 2: FACTORS INFLUENCING LEARNERS' CREATIVITY

Creativity and play

The literature related to playfulness shows that it is assumed to have positive effects on learning at various school levels and on learning in working life as well (e.g. Sawyer, 2006).

Moreover, according to Craft (2005), *"We are constructing knowledge, and in this sense we could perhaps describe what we are doing as being creative. The more we are engaged in the meaning-making, the fuller and more fully owned by ourselves is the map that we are constructing. This is perhaps the most engaged space we can be in when we are in the process of imaginative playfulness."*

One strand of current approaches to play, creativity and learning comes from the more positivist perspective of cognitive science, but in the main they share the emphasis of the 'Creative Teaching' rhetoric (NACCCE, 1999, section 10) on the importance of divergent thinking. Sandra Russ, for instance, argues that '[p]lay has been found to facilitate insight ability and divergent thinking' (2003: 291), and that 'theoretically play fosters the development of cognitive and affective processes that are important in the creative act' (2003: 291). She argues that 'both the ability to think about affect-laden fantasy and the capacity to experience emotion are important in creativity. In play, children express affect in fantasy and experience emotion' (2003: 292-293). Following from this, she notes that the broad repertoire of associations built up via these fantasy play scenarios facilitates divergent thinking by broadening the search for associations, and that the ways in which children use toys, role plays and objects to represent different things in play are habitual ways of practising divergent thinking skills. Her own longitudinal study of children between first and sixth grade appears to confirm that 'affective and cognitive processes in play in young children were predictive of divergent thinking over time' (2003: 295).

As pointed out by Banaji and Burn (2006), there are claims that 'essentially the same cognitive resources are shared by adult creative thinking and problem solving on the one hand, and by childhood pretend play, on the other – namely, capacities to generate, and to reason with, supposition (or imagined possibilities)' (Carruthers, 2002: 225). There is widespread concern about the way in which childhood pretence and play are being squeezed out of the school curriculum, to be replaced by an approximation of 'adult'-type problem solving tasks. If, as Russ and Carruthers argue, it is even probable that there is a deep-rooted linkage between playful fantasy behaviour in childhood and successful problem-solving in adulthood, then simply forcing children to mimic adult thought processes as soon as they can, may be inhibiting, rather than enhancing, their chance of exploring life creatively as adults

Creativity and ICT

According to a recent EU survey, "*teachers believe to a very large extent that Information and Communication Technologies (ICT) can be used to enhance creativity*" (Cachia et al., 2009).

Indeed, ICT can bring new opportunities for teaching creativity. As stressed by NACCCE, "*information technologies provide for new forms of creative practice, through, for example, computer graphics, animation, and sound production*". Moreover, according to Loveless (2002) "*ICT can offer opportunities to be creative in authentic contexts in ways which have not been as accessible or immediate without new technologies.*" Moreover, the author states that "*creativity can be promoted and extended with the use of new technologies where there is understanding of, and opportunities for, the variety of creative processes in which learners can engage*". The author mentions six features of ICT: *"A characteristic of creativity with digital technologies would be the recognition of the potential of the features of ICT to be exploited and*

experimented with to support creative processes". However, the author mentions that it is not the access to digital resources which 'delivers' creativity, but the opportunities such access affords for interaction, participation and the active demonstration of imagination, production, purpose, originality and value. Loveless mentions ICT-based creative activities such as developing ideas, making connections, creating and making, collaboration, communication and evaluation.

According to the author, models of access to ICT resources should reflect characteristics of creative environments and teaching strategies which include:

- awareness of the ways in which creativity is related to knowledge across the curriculum
- opportunities for exploration and play with materials, information and ideas;
- opportunities to take risks and make mistakes in a non-threatening atmosphere
- opportunities for reflection, resourcefulness and resilience
- flexibility in time and space for the different stages of creative activity
- sensitivity to the values of education which underpin individual and local interest, commitment, potential and quality of life
- teaching strategies which acknowledge 'teaching for creativity' as well as 'teaching creatively'.

The designs of new communications technologies for creative interactions are presenting challenges to expectations of traditional classroom settings in terms of spaces, time, portability, connectivity and flexibility for individuals and communities.

Learners can engage in a range of activities, from using interactive whiteboards and wireless portable computers, to working together in virtual spaces to exchange and build ideas and artefacts.

Many learners and teachers have established a wide range of activities to support approaches to creativity and exploit the features of digital technologies in various processes such as:

- developing ideas: supporting imaginative conjecture, exploration and representation of ideas
- making connections: supporting, challenging, informing and developing ideas by making connections with information, people, projects and resources
- creating and making: engaging in making meanings though fashioning processes of capture, manipulation and transformation of media
- collaboration: working with others in immediate and dynamic ways to collaborate on outcomes and construct shared knowledge
- communication and evaluation: publishing and communicating outcomes for evaluation and critique from a range of audiences.

APPENDIX 3: ICEDIP MODEL

According to Petty's ICEDIP model, the creative process consists of six working phases: *inspiration, clarification, distillation, perspiration*, *evaluation, and incubation.* During the creation of a particular piece of creative work each phase could be experienced many times, in no definite order, sometimes for a very short time. Below is a description of each phase.

- **Inspiration**: during this research / idea-generation phase, the person generates a large number of ideas. The process is uninhibited and characterized by spontaneity, experimentation, intuition, and risk-taking. Many people wonder where creative people find their good ideas. The answer is, in amongst a huge pile of bad ones. If people are having difficulty with this inspiration phase, perhaps because they are too self-critical, or expect good ideas to come too quickly. This is not a phase in which to be negative or worried about form, practicality, rhyme or quality. Indeed, at least 90% of initial ideas should be rejected at later stages.

In order to generate a large number of different ideas you need to be deeply engrossed, fearless and free: spontaneous, risk-taking, joyful, 'slap-happy', intuitive and improvisational. It is very common instead to be self-conscious and fearful, and to try to use inappropriate logical thinking. There is also a common tendency to accept your first decent idea, instead of exploring more fully.

- **Clarification**: during this phase, the focus is on goals. The key-questions are: "what am I trying to achieve here?"; "what am I trying to say?"; "what exactly is the problem I am trying to solve?"; "what would I like the finished work to be like?". The aim here is to clarify the purpose or objective of the work. Indeed, it is important to not lose the sense of direction while dealing with detailed difficulties in creative work. When "stuck' in the middle of a project, rather than focusing on possible alternatives, it may be useful to clarify where exactly we want to go.

In order to clarify what you are trying to achieve you need to be: strategic and unhurried, analytic, logical and clear minded, and not afraid to ask difficult questions. Many people fail to clarify - they fail to achieve their goals because they don't know what they are.

- **Distillation:** this phase consists of looking through the generated ideas and trying to determine which ones to work on. Here ideas from the inspiration phase are sifted through and evaluated usually in the light of the findings of a clarification phase. The best ideas are chosen for further development, or are combined into even better ideas. This is a self-critical phase. It requires analysis and judgment rather than spontaneity. However, the phase should not be so critical as to inhibit productivity entirely.

In order to choose your best ideas from the inspiration phase you need to be positive, strategic, and intrepid. You need to be judgmental, but optimistic about where each idea might take you, clear about where you want the ideas to take you, and daring enough to take on original ideas. You need to be realistic but ready to take on challenges. Common mistakes are to choose ideas which are familiar and well worked out instead of those that will best achieve your intentions.

- **Perspiration:** this phase consists in working on the ideas chosen, through determined and persistent effort, towards the ultimate goal.

In order to bring your ideas to fruition you need to be: uncritical, enthusiastic and responsive. You need to be positive and persistent, deeply committed and engaged, and ready to respond positively to any shortcomings. It is common for even very creative people not to make the best of this phase. They are often

uncertain and self-critical and see weaknesses as lack of talent instead of as a need for more work or a different approach.

- **Evaluation:** This phase consists of looking back and reviewing the work in progress. Strengths and weaknesses are being identified, so to consider possible improvements. This phase may imply, afterwards, another perspiration phase in order to respond positively to the suggestions for improvement. Perspiration and evaluation phases often alternate to form a cycle. Indeed, hardly anyone gets things perfect from the first time. Creative people adapt to improve.

In order to improve earlier work you need to be critical, positive and willing to learn; self-critical (ruthlessly so sometimes), but positive about your vision of how the work could be, and your ability to do this. You must see weaknesses as opportunities to improve and to learn. Instead, creative people often see criticism as a threat and so fail to improve their work and to learn.

- **Incubation:** this phase consists in a pause, in which the work is put aside 'on the surface of the mind'. 'Incubation' is particularly useful after an 'inspiration' or a 'perspiration' phase, or if a problem has been encountered.

In order to leave work for your subconscious to work on you need to be unhurried, trusting and forgetful. You must expect difficulties, trust yourself to find a way round them and not be panicked into adopting a weak solution. Few people realise that some ideas take time to hatch, and difficulties and indecision are often seen as a sign of failure.

Those are the six phases of the creative process. In contrast to this complex, multi-phased process 'uncreative' people, though they may have the skills necessary for original work, will tend to latch on to the very first idea that comes to them, and complete the work quickly and uncritically, without revision, and without serious thought about what they were trying to achieve.

Each of these "ICEDIP" phases should be encountered many times, sometimes for very short periods, and not necessarily in any particular sequence.

APPENDIX 4: SUCCESS FACTORS FOR GAME EDITORS AND APPLICATION TO PROACTIVE TOOLS

Within the project, teachers will use at least two game editors in order to design Game-Based Learning scenarios: a free of charge 3D virtual environment allowing collaborative interaction of the learners (EUTOPIA); and an Open Source framework for implementing 2D user-centered adaptable scenarios (<e-Adventure>). These editors are offered within the ProActive project free and supported by training and additional helpful materials, which will be also available online on the project web (www.proactive-project.eu) site after the project end. Hereby we relate the two game editors with the five learning metaphors in order to develop an integrative approach of the project's concepts.

As the research conducted for the Deliverable 3.1 "Success Factors for Game-Based Learning" stated, there are some key features that characterized a good game editor and they are:

- *Ease of use:* The game editor should be user friendly, visual and intuitive to use, so to increase the independence and sense of control of the teacher / trainer. No programming skills should be required for beginners. Indeed, the tool should be designed focusing the efforts on developing the learning / gaming aspects rather than in programming issues. Possible solutions are user-friendly drag-and-drop interface, or rule-based programming to create easy-to-understand programs.
- *Flexibility:* the software should offer different options and functionalities, as well as a powerful set of tools, so to enable the creation of a broad number of games according to the learning objectives, subjects, and the students' profiles. As an example, it might offer the option to extend the complexity and power of the game through scripting. In this case, it would be important to provide diagnostic and constructive feedback on the developer's programming.
- *Guidance:* The tool should guide the teacher / trainer all along the creation of the game. As an example, it might include prefabricated wizards or templates, demonstrations, repository of downloadable examples, visual storyboard editors, suggested set of activities and suggested integration with the curriculum.
- *Library of digital objects:* The tool should provide a wide library of well designed digital objects, so to facilitate the creation of different games and to enhance different learning scenarios. Moreover, in many cases it is important that the game developer have the possibility to import his / her own graphical elements. Digital libraries will be implemented by CAST for the ProActive game editors in the adaptation phase.
- *Sharing / exchange:* Possibility to share / exchanges created Game-Based Learning scenarios would highly increase the reusability and decrease the cost of the game. This is a ProActive goal, and it will be carried out during the dissemination and exploitation phases of the project.
- *Explicit pedagogical aspects:* educational features should be made explicit, as for example templates for specific activities (puzzles, crosswords, mapping of concepts, predefined 3D virtual worlds, etc.), clear affordances for implementing evaluation, and export mechanisms to other standard educational platform (e.g. Moodle, SCORM, etc.). The psycho-pedagogical implications of the creation of a game-based scenario with the editors are analyzed in this deliverable. Each game editor is put in relation with the five learning metaphors to facilitate the adaptation of the tools in order to make them able to support all the metaphors.

- *Documentation:* the tool should be well documented and include both pedagogical and technical tutorials, manuals, FAQ, helps, in order to support the teacher / trainer in the creation of the Game-Based Learning scenario. Such documentation should be available in the targeted users' languages. This is a core goal within the ProActive project: workshops will be organized in order to support teachers in the creation of their scenarios and manuals will be released for further applications. During the workshop a socio-cultural approach to game-based teaching, explained within this deliverable, will be proposed.
- *Accessibility:* Good Game-Based Learning editors are usually accessible for variety of operating systems (e.g. Windows, Linux, Mac Os, etc.). Furthermore, an important is that the produced game is accessible through a variety of channels, including different operating systems, digital devices, online / offline, etc.

ProActive game editors

Within the project, teachers will use at least two game editors in order to design Game-Based Learning scenarios: a free of charge 3D virtual environment allowing collaborative interaction of the learners (EUTOPIA); and an Open Source framework for implementing 2D user-centred adaptable scenarios (<e-Adventure>). Further we describe the two tools and them to the identified earlier success factors for game-editors.

EUTOPIA

EUTOPIA is a platform for creating, managing and delivering Online Role Playing Games (ORPG) with a set of tools that enable to play and analyze the social interactions that take place during the online sessions. EUTOPIA does not provide any contents or structure for the game. Indeed, the tutor defines the storyboards and the goals of the game, for each player involved in the simulation.

The following summarizes what EUTOPIA is not for:

- It is not designed for teaching a particular subject (e.g. Mathematics, History, Chemistry, etc.).
- It is not a game with a particular game design and rules built in or designed for a particular purpose.
- It is not a Second Life clone or a virtual world library. Indeed, EUTOPIA holds some special features:
    - an EDITOR: a tool for creating the plot and managing the participants' features (avatars, goals, communication etc.)
    - a CLIENT: a tool for delivering the session, interacting with the participants as one of the characters or as a "deus ex machina" and recording the session
    - a PLAYER: a tool for reviewing the recorded session and adding comments on special/meaningful frames. The player can be used by the tutor and the players both for reviewing the recorded and commented session.

The content provider is the tutor who can design a plot for his/her participants to play with. Like in a theatre he / she would be the director of a piece that himself/herself wrote down or had written down by somebody else. In fact, it implements the psychodrama methodology in a digital "scene". This approach permits to a small group of people to give a theatrical performance for educational or psychological purposes (counselling, diagnosis, therapy, coaching and training in soft skills). Each actor (or learner) controls an avatar and interacts with other avatars in a virtual 3D scene. Psychologists, Pedagogues, Teachers, Trainers, Educators can use different functions. They can write a storyboard as a playwright; they

can assign the characters as a casting director; they can guide the action as a movie director; finally, they can give feedback to the group recording the scene action and adding personalized comments (debriefing phase). EUTOPIA is currently used in several European countries in vocational training programs and university courses. Experiences particularly significant were conducted to teach cultural mediation such as in Cyprus (Turkish-Cypriot and Greek-Cypriots), in North Ireland (Catholics and Protestants) and in Italy (EU citizenship and non-EU citizenship). EUTOPIA has been presented at Shanghai CHINA International Expo 2010 as one of the most innovative tools developed at ISTC CNR for people training.

EUTOPIA has been developed in joint venture by ISTC CNR (Rome, Italy) and NAC LAB, Dipartimento di Scienze Relazionali "G. Iacono" (Naples, Italy). EUTOPIA has been developed within the framework of projects funded by Lifelong Learning Programme (EACEA), for this reason its use is free of charge.

By analyzing EUTOPIA in function of each key feature that characterizes a good game editor, we can state what follows:

- *Ease of use:* The tutor version of the EUTOPIA software is user friendly, visual and intuitive to use, and it increases the independence and sense of control of the teacher / trainer. No programming skills are required for beginners. The tool has been designed focusing the efforts on developing the learning / gaming aspects rather than in programming issues, since the team of developers has a background in cognitive science and educational psychology.
- *Flexibility:* the software offers different options and functionalities (TUTOR software for: storyboard creation, session creation, session launching. CLIENT software for: gaming, chatting, feedback exchange. VIEWER software for: sessions review, comments adding). EUTOPIA set of tools enables the creation of a broad number of storyboards according to the learning objectives, subjects, and the students' profiles. Moreover the possibility to switch from a 3D to a 2D view can provide a different idea of immersiveness to the participants.
- *Guidance:* The EUTOPIA platform provides the teacher / trainer with a complete manual to help them in creating their game session step by step. Prefabricated storyboards are available for use and download, a short demonstration video is available for explanation of the major features.
- *Library of digital objects:* The EUTOPIA platform provides trainers and teachers with three different scenarios which can help in creating numerous storyboards and different settings for their simulations Moreover it will be possible to add external links to the storyboards, so that the students will be engaged in a sort of "web quest" useful to expand the learning settings.
- *Sharing / exchange:* EUTOPIA allows the possibility to share / exchange created Game-Based Learning scenarios highly increasing the reusability and decrease the cost of the game. In fact, EUTOPIA has a set of storyboards, which have been created by different tutors, these storyboards as the ones created by the new tutors, are collected in a database and are available for other tutor to be used.
- *Explicit pedagogical aspects:* EUTOPIA is not SCORM compliant, since the use of EUTOPIA is not typical of the traditional e-learning systems. Within the ProActive project a theoretical framework will be developed, where EUTOPIA will be put in relation with the "five metaphors model" applied to game-based learning.
- *Documentation:* EUTOPIA platform is well documented, both pedagogical and technical issues have been made explicit in a manual and a tutorial, in order to support the teachers / trainers in the

creation of their storyboard. All the documentation is available on EUTOPIA website[9] and also on ProActive website[10].

Accessibility: System Requirements: Operating system: Windows 95, Windows 98, Windows Me, Windows NT 4.0, Windows 2000, Windows XP or Windows Vista. - CPU: 1,5 GHz. -Ram: 512 MB. -3D video card: >=128 MB For more information read the EUTOPIA Manual. Nevertheless, it is not possible to use EUTOPIA offline, unless a local version is running on the computer.

<e-Adventure>

<e-Adventure>[11] is an educational game authoring tool. It allows for creating 2D educational computer games and simulations. The tool was designed to reduce the development cost of educational games, facilitate their integration with e-Learning platforms (e.g. Learning Management Systems such as Moodle™[12]) and involve instructors in the development process. The <e-Adventure> platform aims to facilitate the integration of educational games and game-like simulations in educational processes in general, and in Virtual Learning Environments (VLE) in particular (e.g. Moodle). It is being developed by the <e-UCM> e-learning research group at UCM, with three main objectives:

- Reduction of the development costs for educational games
- Incorporation of education-specific features in game development tools
- Integration of the resulting games with existing courseware in Virtual Learning Environments

The core of the <e-Adventure> project is the authoring tool that allows educators with no technical background to produce their own educational games.

By analyzing <e-Adventure> in function of each key feature that characterizes a good game editor, we can state what follows:

- *Ease of use:* <e-Adventure> is a visual game authoring tool that has been developed using a user-centered approach. Since <e-Adventure> was born 5 years ago we have conducted 11 different activities with school teachers, university professors and professional trainers where we have tested the usability of the game editor and listened to our potential users' requirements, suggestions and demands. As a consequence <e-Adventure> has been redesigned and refactored a number of times to guarantee that the system is stable and usable. The user interface is built upon simple interactions such as drag and drop or point and click. Moreover, no programming is needed to create a game.
- *Flexibility:* Current version of <e-Adventure> (v1.2) provides users with a lot of tools and features to develop their games. The number of characteristics that game authors can include in their games has increased notably, allowing for the production of games that were not contemplated in the original <e-Adventure> design. <e-Adventure> was first devised to the development of point-and-click adventure games (similar to the Monkey Island™ saga), but right now a whole set of different 2D games can be created, including simulation games or simple drag-and-drop games[13]. *Guidance:*

[9] www.nac.unina/eutopia

[10] www.proactive-project.eu

[11] http://e-adventure.e-ucm.es

[12] http://moodle.org/

[13] Some examples of games can be found at http://e-adventure.e-ucm.es

<e-Adventure> includes a built-in contextual help system to guide the game author and help her/him to complete specific tasks. All contextual help files can be accessed through specific "info" buttons that are located in relevant places throughout the user interface of the game editor.

- *Library of digital objects:* A library of resources is being developed especially for ProActive. By 31/10/2010, when the adapted version of <e-Adventure> is required, <e-Adventure> will also include a whole set of characters, scenes and objects ready to be used in the games.
- *Sharing / exchange:* <e-Adventure> is designed to foster interoperability, sharing and exchange of materials. The game editor allows for exporting the games as Learning Objects, following several popular specifications like IMS Content Packaging and ADL SCORM. In this manner games produced with <e-Adventure> can be automatically deployed in most of modern Learning Management Systems (e.g. Moodle™[14], Sakai™[15] or Blackboard™[16]) and open content repositories (e.g. the Agrega™[17] Spanish content repository) where educators can upload/download contents.
- *Explicit pedagogical aspects:* <e-Adventure> was enhanced since the very beginning with educational features. For example, game authors can define adaptation profiles based on rules to adapt the games to individual needs or specific contexts. These rules can be defined taking into account issues like the actual performance of the student, the student's profile (e.g. prior knowledge), etc. In addition, <e-Adventure> allows the definition of assessment rules to facilitate the evaluation of the learning outcomes. Using the assessment system game authors can track the students' interaction, filter actions that are pedagogically significant (e.g. a goal has been achieved, a question is not answered correctly) and produce human-readable reports that they can review after the session or machine-readable logs that can be sent to a back-end server for automatic processing. Finally, <e-Adventure>'s flexibility allows to implementing ProActive's five learning metaphors. For more information about <e-Adventure> see Annex 1 "<e-Adventure> & affordances.
- *Documentation:* <e-Adventure> is a well documented tool. Documentation available includes different paper-based tutorials (for beginners but also for more advanced users), a video tutorial divided in 13 chapters (available at Youtube), an introductory video (conceptual), a user manual (85 pages), game examples and support tools like forums. Most of the documentation of the platform is available both in English and Spanish.
- *Accessibility:* <e-Adventure> is a Java-based, multiplatform application. That means that the <e-Adventure> editor can be launched in Windows, MAC and Linux systems. In addition <e-Adventure> games can be launched as desktop Java applications (which can run also in any Operative System) or through the Web (as Java Applets or Learning Objects).

[14] http://moodle.org/

[15] http://sakaiproject.org/

[16] http://www.blackboard.com/International/EMEA.aspx?lang=en-us

[17] http://www.proyectoagrega.es/default/Inicio

APPENDIX 5: <E-ADVENTURE>: EXPRESSIVE ELEMENTS, GAME TYPES AND RELATION WITH THE 5 METAPHORS

INTRODUCTION

The purpose of this appendix is to briefly relate what users can do with the <e-Adventure> tool with the 5 learning metaphors in ProActive. However, as <e-Adventure> is quite powerful, with a lot of expressive resources at the disposal of the game author, some basic characteristics must be analyzed first to achieve the goal of the document. Therefore, in this document we provide a description of the basic expressive elements that make an <e-Adventure> game, and a short description of the interaction in <e-Adventure>.

Additionally, we describe some different types of games that have been implemented with the <e-Adventure> tool so far. However, this does not mean that no other kind of games could be implemented with <e-Adventure>: it is just we have not discovered them yet (every year our users discover new applications that we did not expected before).

Finally, please note that not all the features included in <e-Adventure> are described in this document. To know more about the platform and further features that have not been covered here (e.g. exportation of the games as Learning Objects, integration with Virtual Learning Environments, or assessment and adaptation profiles) please consult the contextual help of the game editor, our web-site (http://e-adventure.e-ucm.es) or our youtube channel (http://www.youtube.com/user/eAdventureUCM).

BASIC elements in <e-Adventure>

Chapters

An <e-Adventure> game is organized in chapters. In this manner the adventure is fragmented in small pieces easy to design, edit, and keep in memory when executing. Each chapter is a self-contained mini-game. All the elements defined in a chapter cannot be accessed in others.

Scenes

Each chapter is organized in scenes: the interactive scenarios where the action takes place. In <e-Adventure> scenes are basically compounded by a 2D background image and a sound track (optional). Scenes are linked together through *exits*, making in this manner a complex 2D navigational virtual world.

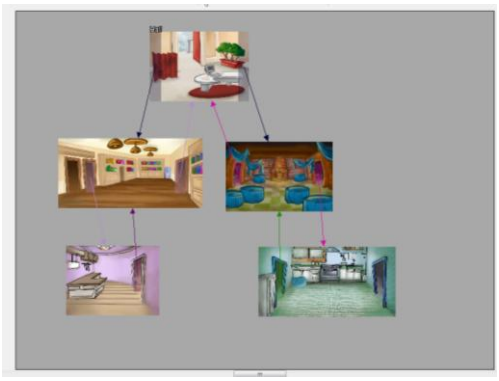

Figure 4: 2D virtual World of an <e-Adventure> game made up of 5 different scenes that are linked through exits (rectangles that are connected through Arrows).

Cut-scenes

Cut-scenes are vehicles to enhance the educational value of the games. Fundamentally, two types of cut-scenes are supported: *slide-scenes* and *video-scenes*. The first one is made of a succession of slides (similar to PowerPoint presentations), which are full-screen images displayed one after the other. A video-scene is, as its name indicates, a video which is played on the screen.

Books

<e-Adventure> is devised to produce educational videogames, which will require sometimes the delivery of huge amounts of data or extra reading materials to the student. For that purpose you can include in-game books in <e-Adventure> games. Those books will be available when you specify, and can be produced in two different ways.

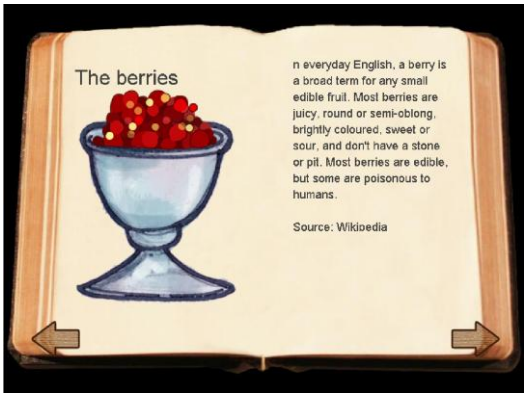

Figure 5: Screenshot of an in-game book.

Firstly, you can produce **simple books** without the support of any other authoring tool, just using the adventure editor. This kind of books may contain a succession of text, bullet and image paragraphs. The engine will deal with those paragraphs, placing them one after the other in the book, and using different pages if they do not fit in one page. The books produced of this type will be simple, but easy to create as you do not need to deal with pagination, margins, etc.

The second type of books is known as **formatted text books**. Those books will have a richer appearance, but to produce them you will need an external authoring tool. You can use Microsoft Word, Open Office, FrontPage or any other tool that supports the creation of RTF (Rich text format) or HTML documents. Those documents will be used as pages, so then the pagination is not managed by the engine.

Exits

Exits are interactive polygons used to allow the player transition between scenes. For instance, if there is a door drawn in a scene, you can define a rectangular exit over the door that is linked to another scene. In this manner, when the player interacts with the exit (left-button click) he/she will enter a different scene.

Figure 6: Screenshot of a scene where an exit (red rectangle) has been defined to link the door with another scene.

Active areas & Items

In <e-Adventure> games you can define interactive inanimate & static objects. These objects are called "items". The game author can define several kind of interactions (a.k.a. actions, see section 3.2) that the player will be able to execute (e.g. to grab the item and put it into the player's inventory for later use). Items are just defined by a 2D image of the object they represent.

The active areas are polygonal portions of the background of the scene the player can interact with. They are very useful if we have rich background images with several objects embedded on it, or if the game is developed using photos of real scenarios. Regarding the interaction with active areas, those are just as items which are embedded into a single scene. Their area can be delimited as for exits, and contains the same descriptions and actions that items.

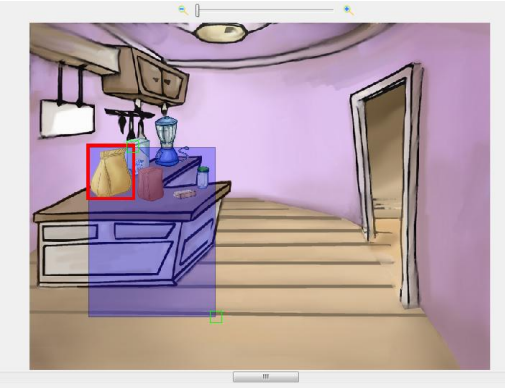

Figure 7: Screenshot of a game scene where 6 items have been defined (one item is selected).

Figure 8: Game scene where three active areas (green rectangles) have been defined to make three portions of the scene Interactive.

Barriers

Barriers are just like exits and active areas, polygonal regions that are defined in a scene. The barriers have a very specific functionality: prevent the movement of the player's avatar (other characters aren't affected by barriers). When a barrier is active it will block all pathways that go through it.

Characters

A character is an element which the player can talk to. Characters (usually known as Non-Player Characters – NPC) are like items, but with some differences. On the one hand, a character can be given a set of *animations* so during the game it looks like a living being. On the other, interactions you can define for a character are different, as characters cannot be grabbed, used or given but you can establish complex interactive conversations with them (see section 3.2). Besides, as opposite to items characters can move throughout the scene.

Figure 9: A game scene where two characters have been defined.

Timers

Timers allow game authors to "make some things happen" when a certain time gap has gone. Its usage is very simple:

1) When the *initial conditions* (e.g. the player talks to a character) are satisfied the time starts counting.

2) While the *end conditions* are not met (e.g. a puzzle is completed) a set of changes will be made in the game each *Time* seconds. The parameter *Time* is obviously configurable.

3) Once the *end conditions* are satisfied the count ends and another set of changes (effects) are triggered.

Random behaviours

<e-Adventure> games also support the definition of random behaviours. That is, as a response to player interactions game authors can define that a set of changes will be made in the game only in a certain percentage of the cases (see 3.2).

INTERACTION Resources in <e-Adventure>

Two Types of User Interaction

<e-Adventure> games are controlled using the computer mouse. However, two different kinds of interaction are currently supported in <e-Adventure>: point&click and drag&drop[18].

Point-and-click interaction

Typical interaction in <e-Adventure> games is *point-and-click*. In this manner, players have to move the mouse over the game scene in order to "discover" interactive elements. When the mouse is placed over an interactive element the mouse cursor will change, acquiring a different icon and displaying a short text to indicate the player that there is something to interact with.

Then, some interactions are triggered by clicking the left button of the mouse or the right button. In most of the cases the right button of the mouse can be used to display a contextual menu with different interactions that are available for that element.

Figure 10: Screenshot of an <e-Adventure> game. When the mouse cursor is placed over the gloves (an Interactive element) it changes its appearance.

Drag & Drop interaction

More recently a new kind of interaction has been added to <e-Adventure>: classical drag&drop. In this manner interactive elements can be dragged to other elements in the scene. This behaviour is very common in simple educational games (e.g. Flash games).

Available Interactions

Actions

In <e-Adventure> the interactions that can be defined for items and characters are called "Actions". An action is usually defined by a name (e.g. grab), a button for the contextual menu (see 3.1) and a set of changes that will be executed in the game (a.k.a. effects, see section 3.2.2). Actions can be unary (they are executed only over one element: e.g. grab notebook) or binary (the action combines two elements: e.g.

[18] Drag & drop interaction will be available in <e-Adventure> v1.1 which will be released in two or three weeks.

give the notebook to Ana). The numbers of actions that can be defined for an item are unlimited. Hence more than one action per type can be defined. Some actions have predefined meanings in <e-Adventure> and do not require the definition of those parameters:

Examine & Look Actions (unary)

Please, do not confuse "examine" with "look". All items in <e-Adventure> can be looked. When you look an item in the game the brief description you type on the documentation tab is displayed, which will be explained later. On the contrary, when an item is examined the detailed description is shown. You cannot change the behaviour of the look action, but the "examine" action is reconfigurable. You can use these two behaviours to give firstly a general scope of what the item is, and later a further description.

Grab (unary)

When a "grab" action has been added to an item the player will be able to take the item, which will be removed from the scene and put it in his inventory, the structure where the player stores the grabbed items. Then he will be allowed to use it wherever he is.

Use (unary)

Then the item will be usable on its own. That means you could use it and through that use produce somehow effects over the game.

Use with (binary)

It is equivalent to "use", but in this case the item will not be usable on its own, as you will need to use it with another item to produce those effects associated with the action.

Give to (binary)

You can specify the item could be given to a character. The item must be grabbed first, so it is already in the inventory. Then the given item will be consumed and removed from your inventory.

Talk to (binary)

As you can interact with items, you can do with characters as well. But this interaction is significantly different. For characters you can specify interactive "conversations", which are successions of dialogue lines that are spoken by either the main player or a character. Those are very useful for two purposes: to guide the player in the game, and to provide sometimes a source of information or evaluate the student through a multiple choice test.

More than one character and the player can take part in a conversation. As in conventional *Lucas Arts*^{TM} games the player can be prompted sometimes to select what line must be said next from a list of options. Depending on the option selected the conversation will take one path or another.

Conversations are attached to characters, so they are triggered when the player comes next to that character and selects to talk to him/her.

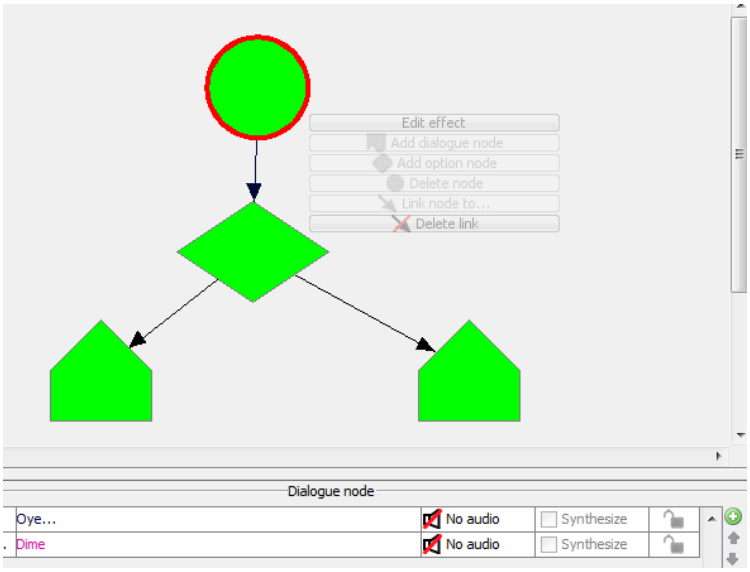

Figure 11: Screenshot of a conversation that can take two different paths according to the player's choices.

Effects

Effects are the basic changes that can be performed in an <e-Adventure> game as a response to player interactions (e.g. transit an exit, grab an item, talk to a character, etc.). Effects can be triggered isolated or in combination with other effects. Next table describes some of the effects that are at the disposal of game authors:

Effect	Description	Uses
Consume object	Removes an item from the scene.	A typical use for this effect is to make objects disappear when they are grabbed.
Generate object	Puts an item in the inventory	Typically used when objects are grabbed
Cancel action	Cancels the default action	Use it when you do not want an item to be grabbed for grab actions, or to avoid an item to be consumed when it is given to a character.
Speak player	Makes the player to say a single line	You can use this kind of effects when an action is forbidden
Speak character	Makes a character to say a single line	You can use this kind of effects when an action is forbidden
Trigger book	Displays one of the books defined in the game	This effect can be used to provide some information for a limited period of time
Play sound	Plays the selected sound	Can be used to produce sound effects for actions as those sounds are played once
Play animation	Plays a new animation	Can be used to trigger sets of slides.
Move player (Third person mode only)	Makes the player to go to the selected position (x, y)	A typical behaviour in adventure games: characters and players move while

		speaking
Move character	Makes the selected character to go to the selected position (x, y)	Same as above
Trigger conversation	Triggers the selected conversation	You can use this effect to provide interactive guidance at some points in the game
Trigger cut-scene	Triggers the selected conversation	A video or set of slides can be played to provide information or explanation at some points in the game
Trigger scene	Changes the current scene	Useful since it allows to change the scene without using an exit
Effect with probability	Depending on a given probability the game engine decides the effect to launch from a list of two effects	Allows pseudo-random behaviours in the adventures.
Trigger last scene	Changes the current scene, coming back to the last visited scene.	Useful to implement navigational environments when you cannot know which is the next scene to visit a priori
Launch macro	Launches a macro (set of effects)	Facilitates the reutilisation of the effect blocks.

BASIC Game Types supported by <e-Adventure>

First-person simulation games

Description: Games that try to provide students with safe test environments where they can reproduce real procedures or complex sequences of actions. The plot that drives the game experience is defined by the own rules of the procedure. They are usually experienced in first person to enhance realism and immersion. These games are composed with photos of real scenarios as realism is an extremely desirable feature for these games.

LLP Subprogram(s): Due to the characteristics of these games they seem to be more adequate for Erasmus and Leonardo applications.

Example(s) / Case studies: Several of these games have been produced to simulate medical and clinical procedures (Moreno-Ger et al., 2008). As an example we can show the *HTC game* (Moreno-Ger et al., 2010; J. Torrente, Moreno-Ger, P., Fernández-Manjón, B. & del Blanco, A., 2009), where students have to perform the procedure to measure the Hematocrit level in a blood sample. The goal is to reproduce the procedure as accurately as possible, just as they would do in the real laboratory.

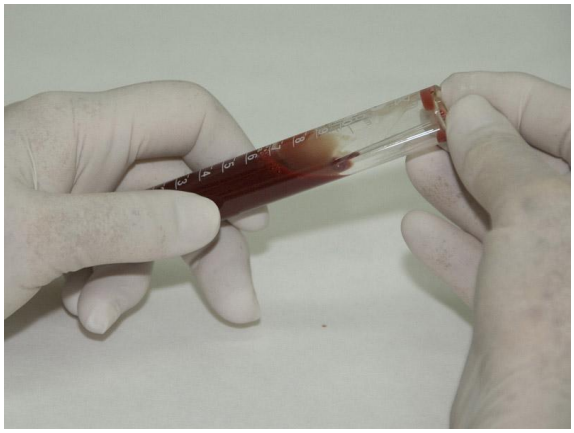

Figure 12: Screenshot of the HTC game

Level-based games

Description: These games are composed by a set of different puzzles/levels the player must complete. Each puzzle or level can be seen as a different mini-game or scene. Therefore, these games can be provided with a narrative plot that embeds all the mini-games into a common story or not. For instance, <e-Adventure> could be used to develop puzzle-based games such as *Professor Layton and Pandora's Box*, where the players must complete different self-contained tests that are embedded into a single story in order to go on in the game, or games such as *Brain Training* where puzzles are just levels that are no connected at all.

LLP Subprogram(s): All kind of applications.

Example(s) / Case studies: Parity game. This game is oriented to teach the concept of parity (odd/even) in an active way to 7-8 years-old children. The game has an immersive and fantastic plot where two turtles are the main characters: *Odd* an *Even*. Nonetheless, in order to complete the game the player must solve different drag&drop puzzles that are isolated and self-contained.

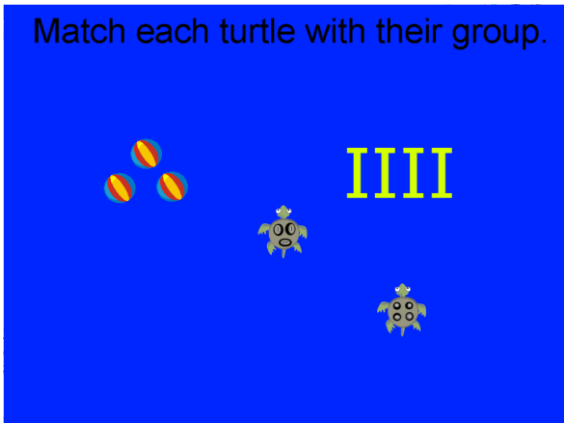

Figure 13: Screenshot of the Parity game.

Third-person story-based games

Description: In these games a strong narrative plot is the more important element. All the puzzles and quests that the player must solve in the game are directly related to the feats that compound the plot. Fantasy and an immersive game world are usually present in these games, which are experienced in third person (the player controls an avatar) most of the times. Characters are usually defined with strong personal traits.

LLP Subprogram(s): Due to the emphasis that immersive narration and fantasy have in these games they seem to be more appropriate for Comenius applications.

Example(s) / Case studies: The 1492 game is a good example (J. Torrente et al., 2009). The goal of the game is to recreate the historical feats that occurred in Spain during the year 1492, when America was discovered by Cristobal Columbus. The real feats are immersed into a fantastic plot where a small child, Cristobalín, is the main character of the story.

Figure 14: Screenshot of the 1492 game.

Relation between <e-Adventure> and the 5 Learning Metaphors

Acquisition: There are several elements in <e-Adventure> that can be used to implement this metaphor. For instance, books, slidescenes and videoscenes can be used to provide the learner with a lot of information. Besides, characters and conversations can be used to implement in-game "tutors" and tests that can be used to ensure the transfer of knowledge.

Imitation: The Imitation metaphor has not a direct translation to <e-Adventure>, but it could be achieved by combining characters, videos and animations with behaviours that players could observe and apply in other contexts. For instance, in a game oriented to professional training players could find a person doing maintenance works in a building and observe and analyze his/her behaviour to be able to solve the next quest in the game (e.g. fix a window).

Experimentation/Simulation: This metaphor can be easily implemented with <e-Adventure>, as it includes features to define thoroughly the rules of a process to be simulated. Moreover, <e-Adventure> games can achieve a high level of realism without requiring a huge investment through the use of photos of the real environment to make the game.

Participation: Participation is probably the less supported metaphor in <e-Adventure>, as no multiplayer games are supported. Nevertheless, this issue could be addressed at least partially by implementing NPCs (non-player characters) or embedding the games in Virtual Learning Environments (VLE) like Moodle™ where students can communicate using forums, chats or any tools provided by the system.

Discovery: <e-Adventure> games can be produced according to the Discovery (individual) metaphor. Virtual worlds can be created that the students are free to explore, discovering how their acts affect the environment.

APPENDIX 6: GAME-BASED LEARNING AS A TEACHING PRACTICE

Teaching teachers: Concerns for trainers

The generational divide

Attempts to develop Game-Based Learning in schools have to overcome a number of obstacles. The Futurelab report (Futurelab 2010) suggests that there is a generational divide between teachers and their pupils. It notes that while nearly three quarters of teachers don't play games, over four fifths of their pupils do.

This is not to say that teachers are unaware of some potential in using games for learning. Indeed the report notes that teachers tend to believe that games engage and motivate pupils. This may have led to a situation when it comes to game-based learning where pupils are the experts and teachers the ill-informed. Relinquishing the traditional teacher as expert role might be a challenge too far for many and is one that trainers have to recognise when devising and delivering Teacher Training courses.

Teacher training courses

Teacher training courses in the UK feature a component designed to provide would-be teachers with the skills to utilise information technology (IT) in their teaching. Typically this will include some consideration of the role of computer-based games in teaching and learning. However there is not sufficient time allocated to this element of teacher training to attempt an in-depth consideration of game-based learning. This inevitably means that teachers who use games in education are largely self starters and are not part of a recognised group or network.

This aspect of the training situation in the UK is mirrored in the USA as described by Mahiri: "not many teachers get formal training about Game-Based Learning or the integration of technology in their initial schooling." [Mahiri 2010].

Trainers are in a unique position to inform and influence teachers in the making. While trainers will always have to make sure that practical considerations are not ignored, they can also champion ideas that lead to changes in policy. That is to some extent the measure of the task in many countries in relation to Game-Based Learning.

Leadership in the field

Innovation, and that is what we are concerned with here, requires leadership. There are few if any national or regional bodies that actively promote game-based learning in schools. In the UK, Futurelab has led research into the field and has published a number of relevant papers, one of which is discussed at length below. However it is a relatively small body with many different projects.

BECTA, a quasi-autonomous non-governmental body funded by the UK government, has in past years assumed a leadership role in aspects of game-based learning. It did at one time compile a list of reviews of games titles of interest and relevance to schools. This was well-used by teachers. BECTA is, however, a victim of recent UK government spending cuts and will soon cease operating.

Both organisations have made significant contributions to the debate in the UK around Game-Based Learning in schools. BECTA made the following comments on the education and training situation in the UK in its 2008 paper: 'Analysis of emerging trends affecting the use of technology in education.' (BECTA 2008) It stressed the importance of the role of the teacher:

"The greater adoption of technological tools in education and training poses challenges in keeping educators' skills up to date so they can use the technology with confidence. While it is commonly said that

young learners from the 'net generation' often outstrip the technical competence of their teachers, when it comes to vital digital literacy skills, the need for good teaching remains as strong as ever."
In saying this the report's authors highlight the need for teachers to ensure that young learners are made aware of the range of skills and understanding that make up 'digital literacy' and are supported through programmes of work that concentrate on applying those skills to advance an agreed curriculum.
In addition BECTA draws on lessons from past inadequacies in initial teacher training and continuous professional development as well as the weakness of some monitoring of change in practice in the field to back up their assertion that:
"There is a need to ensure that teachers have the space and support to become confident pedagogical innovators with new technology... there is a tendency for many teachers, often unwittingly or due to other pressures, to merely recreate old pedagogies with new tools, which can be a missed opportunity." (BECTA 2008)
The report demonstrates an informed understanding of pedagogical issues in Game-Based Learning. It goes on to state that new modes of learning "significantly alter such factors as classroom management, the pace of learning, teacher control and the learner–teacher relationship."
And that: "… wrestling with such matters is a lengthy process which needs to be supported and enabled through the entire system of teacher training and personal development at all levels of education and training."
The report sees the introduction of Game-Based Learning in schools as patchy:
"Cutting-edge whole-school innovations are undertaken by only a minority of innovators." (BECTA 2008)
The reasons for this approach it says lies with the reluctance of managers to push through changes that are seen to bring uncertain outcomes:
"Many…school leaders have reservations about the integration of personalised technologies. These reservations arise in part from resistance to change and from people feeling out of the educational technology loop, but also reflect concerns about e-safety, logistics and sustainability." (BECTA 2008)
It is clear from the comments of BECTA, championing as it did the UK Government's IT in Education strategy that not only is the training of teachers in this field not consistently promoted or well advanced, as planned it does not respond positively to the challenges of game-based learning in educational institutions.

Teaching with games

This section aims at describing the main issues confronted by those who wish to more fully introduce Game-Based Learning into schools. Most of these issues are discussed within the Futurelab report "teaching with games". The report aims to identify the factors that affect the use of game-based learning in schools, to identify the processes by which teachers plan and introduce Game-Based Learning into the curriculum and to provide recommendations for future Game-Based Learning approaches in schools. An important first consideration for teachers is the plethora of games on the market.

The myriad choices
An important point made by a number of commentators is that teachers can be overwhelmed by the myriad of choices of games. Added to that is the search for particular curriculum-related merit in them. There have been a number of solutions proposed and (as stated above) in the 1990s BECTA posted on its website reviews of educational software titles outlining potential applications in the curriculum in the UK. However, in the UK there is no single reference point for teachers seeking to find games that will help them teach.

There is clearly an opportunity for an organisation to review games titles and to offer a broad overview of their potential application in the broader school curriculum. Currently the various magazines, newsletters and websites that serve the specialist interests offer this service and a co-ordinated school-wide approach would have to gather, filter and customerise information.
The current challenge then for individual teachers is to identify those aspects of games that will add value to their teaching. This demands much from teachers. Choosing a game, playing it and devising ways in which it can be introduced into the subject curriculum demand much in terms of time and in terms of subject expertise. Primary school teachers who teach the entire curriculum to their classes have to grapple with curriculum issues in every subject area. This makes their task even more daunting.

The constraints of the curriculum
Teachers who choose to deliver parts of the curriculum through games then face the challenge of planning and delivery of games within the school.
Access to computers varies from school to school. The quality of the computers is also a factor to be considered and both these are discussed later.
Teachers need to decide how they can introduce the games to their students. They need first of all to minimise the time students will take to familiarise themselves with the technical aspects of games including navigation and other practicalities. Teachers should not assume as many do that students are all expert game players. However they must keep the introductions short so as to lessen the risk of putting the more adept players off the experience. This may turn out to be an inexact science as games vary and students will have an individual set of experiences.
Lessons may typically be planned with an introduction setting out lesson objectives, giving information regarding any practical issues associated with the game to be played and a clear setting out of individual tasks to be completed. Students will then get on with tasks. There will then be a time allowance at the end for reflection on and consideration as a class of progress made.
Teachers need to decide also how support can be delivered. They may wish to prepare FAQs and make them available, perhaps online. They may wish to appoint students as advisers or they may wish to take on the task themselves. They need to plan in advance any technical support from technicians, teaching assistants or other teachers.
They also have to plan the time needed to cover the learning objectives they have decided on. They will need to decide how many lessons can be used. Experience will give teachers the knowledge and understanding they need to estimate the time allocation but given the variables involved estimations will always have an element of hit and miss. Thus contingency time has to be planned for and properly resourced.
Consideration of what students can do at home will also be a factor. Where licenses and other practical issues such as remote distribution and unevenness of computer ownership can be overcome, it may be desirable for students to make progress in time allocated for 'homework'. This will lead to issues around collaboration, time management and parental permission which will need to be dealt with.

If work is to be carried on at home, technical issues on home computers will also arise and the implications of these will need to be part of the teacher's considerations.

Tools for learning
Teachers will need to approach game-based learning activities with a clear view of the lesson or course objectives and how the use of games fits into that. They should be confident enough to use only part of the game experience to achieve course objectives. Students can continue to play games out of lesson if permissions allow.

Teachers need to ensure that the use of the games enables as much progress as other teaching tools.
Sharing the learning objectives with students may require a lot of preparation and strong communication skills. There will be a desire among students to play the game as they do outside of the school environment: with absolute freedom to act. This autonomy is one of the aspects of games that appeal to game players. This will need to be acknowledged and where this affects progress to learning outcomes, it will have to be managed by the teacher.

How to choose the games to be used:
The games will have to be chosen for a range of factors. Following are some of the questions that teachers may have to answer for themselves:

Is the game readable by students?
Teachers will need to work through games to ensure that the language used in introductions, manuals, menus and help are checked for readability. Their evaluations will need to include not just straightforward readability issues but also cross-cultural language differences that arise from the regions in which the games were created.
To get the most out of games, teachers might want to consider producing help booklets or web pages to go alongside games that 'translate' the language used, providing a glossary for terms used in the game that are likely to be new to some or all users.
This preparation would be designed to ensure users spend as little time as possible on language issues that might get in the way of working through the game.

Is the content sufficiently accessible to all?
Accessibility issues may also include an ignorance of gaming conventions, for example navigational methods. With some learners there might be accessibility issues due to visual or other sensory impairment. Users may need adapted keyboards or other input devices. Teachers will have to prepare for these and in certain cases resource them.

Are the graphics appropriate for the target group?
Commercial and non-commercial game developers spend a lot of time and effort on the look and feel of games. Commercial standards in particular are very high with motion-capture and other techniques providing games that rate very highly in terms of realism and excitement as the convergence of film and game progresses.
Teachers will be able to make informed choices from working through games whether the look and feel will appeal to students or put them off. They may wish, to back up their own intuition, to use a small selection of students to evaluate candidate games. Likely questions to be answered are:

- How attractive are the graphics to the user group?
- Do the graphics engage the users and retain their interest?
- Do they add to or detract from the game's appeal?

Is there sufficient challenge for all students?
The challenge will be both subject related and game related. Students (and users generally) will want there to be a strong game-related level of challenge. Teachers and their managers will want the subject-related challenge to be similarly strong.
Teachers will hold to one principle: progress in subjects cannot be inhibited by the game.

Depending on the ability range found in the group, teachers may wish to offer different challenges to more or less able students. The introduction of differentiation will have to be carefully prepared and managed to ensure sufficient challenge for each individual. The careful identification of barriers to individual progress will need attention.

Is there a suitable balance of knowledge, skills and understanding?
Similarly teachers will have to work on the balance of knowledge, skills and understanding offered by a game and relate it to subject-specific demands. Where the balance is unequal the teacher will need to make sure that some compensatory adjustment is made in the wider learning programme. While there is some opposition to the use of games in schools, teachers will always have to prepare a case for the defence.

Are goals/rewards attractive/appropriate?
Goals and rewards are obviously essential elements of games and are used to motivate and engage users. As teachers work through games, they will need to be aware of these internal elements as well as possibly constructing a system of external rewards to complement them.
Teachers will need to assess what part rewards will play in possibly truncated versions of games and ways in which this will impact on users' enjoyment. One way through this might be to make students more aware of the rationale for reward systems. This in itself may be a very important educational process.

Is there sufficient interaction to give students appropriate autonomy?
Users cite autonomy as an important part of the enjoyment they experience in playing games. Teachers' adaptations of games to curriculum use may compromise this autonomy and this will need to be justified and explained to users.

Making users aware of the psychological impact of elements on them such as autonomy (and reward systems) can be of positive benefit, making them more objective about game-play by raising their awareness of game play behaviours and game design considerations.

Are the game paths available open to all students?
Users will follow paths within games based on their internalised understanding of common narrative structures. Teachers will need to be sensitive to these structures if learning is to go the way they want it to. For example, where games come from different cultures the narrative structures may differ. Characters within the structures may bring with them cultural references that do not translate well just as the step mother does in pantomime or the Harlequin character in commedia dell'arte.

Is the game exciting, will it hold the attention of all?
Teachers will have to ensure that the games they choose have the elements of what are seen to be 'good' games such as pace, action, diversion tactics, graphical attractiveness and perhaps most importantly, a suitable balance of text and action.

Is support and feedback accessible at the times likely to be needed?
Commercial games are often rich in feedback and certainly where this is not immediately available, users create their own support networks. Social networking sites such as Facebook are used extensively for this.
There are various ways support can be offered in schools. Social networking is not available in many schools due to the perception that this is often misused. Other support will include peer group mentors,

skilled technicians and teachers as well as web delivered support from FAQs and links to reliable, safe web forums.

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