Marjaana Kangas

The School of The FuTure:

Theoretical and Pedagogical Approaches for Creative and Playful Learning Environments

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For Samu and Joona
in the hope that creativity and playfulness
will guide you, your friends
and those that come after you

ABSTRACT

Marjaana Kangas
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This qualitative study investigates how learning and a learning environment can be defined and how the school learning environment should be designed to accommodate the potential of an innovative playful learning environment. Conceptually, the playful learning environment (PLE) refers to an indoor-outdoor technology-enriched play and learning environment that has been developed for pre-primary and primary education. The five empirical studies comprising the thesis represent a continuum describing the development of the PLE, its pedagogical foundation, and its evolution. The study draws on two methodologies: grounded theory (GT) and design-based research (DBR). Both provide a researcher with the opportunity to generate theory and develop novel educational practices.

The particular focus of the research is on pre-primary and primary-aged children, their ideas, views, experiences and activity processes in various playful learning environments. The first study provides insights into the central features of the environment and the related learning activities. Among other findings, the research indicates that feelings are an essential part of children's play and learning activities. The second study analyzes children's creative collaboration in playful co-design activities and provides tools for defining learning. Here, the research yields insights into narrativity, creativity, and imagination in

children's collaborative activity. The third study illustrates children's ideas and expectations regarding their ideal school and learning environment. It shows how primary school children's expectations resonate in many ways with the arguments advanced in the current educational debate on what kinds of learning environments might best support children's learning and well-being.

The fourth and fifth studies examine experiences of the PLE in authentic curriculum-based play and learning settings. These studies mark the beginning of a series of innovative design experiments. The results of the research indicate that various forms of creative and playful learning in the playground context can serve children's learning in a multifaceted way. The two studies provide a strong underpinning for further research and design experiments relating to the PLE.

As defined in the thesis, learning is creative and playful learning that comprises mind-on, hands-on and body-on activities. It encompasses two slightly different learning processes: creative learning and playful learning. The former takes place mostly in classrooms, using various technology and media affordances, whereas the latter, as a physical form of learning, typically takes place outdoors, on a technology-enriched playground. The theoretical approaches to creative and playful learning elaborated in the thesis culminate in a pedagogical model for creative and playful learning. The model provides educators with a pedagogical foundation and tools for applying creative and playful learning in innovative environments and for approaching learning in ways that might contribute to the school of the future. The study captures the ideal creative and playful learning environment through a vision of a learning environment that encourages the use of various formal and informal learning places and spaces, novel technologies and technology-enriched learning environments, creativity, playfulness, physicality and children's overall well-being.

Keywords: playful learning environment (PLE), creative and playful learning, pedagogical model, creativity, playfulness, technology

TIIVISTELMÄ

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Tulevaisuuden koulu: teoreettisia ja pedagogisia lähestymistapoja luoviin ja leikillisiin oppimisympäristöihin
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Tämän väitöskirjan keskeinen tutkimuskonteksti on monitieteisessä yhteistyössä syntynyt leikkikenttäympäristö ja sen kehittyminen innovatiiviseksi teknologiaa hyödyntäväksi oppimisympäristöksi, leikilliseksi oppimisympäristöksi. Tässä tutkimuksessa leikillistä oppimisympäristöä tarkastellaan ja määritetään luovan ja leikillisen oppimisen näkökulmasta. Luova ja leikillinen oppiminen on tutkimuksessa kehitetty teoreettinen ja pedagoginen lähestymistapa, joka määrittelee oppimisen ja oppimisympäristön keskeisiä piirteitä sosiokulttuurisen viitekehyksen ja leikillisiin oppimisympäristöihin liittyvien empiiristen tutkimusten valossa. Tutkimuksessa esitellään myös luovaan ja leikilliseen oppimiseen pohjautuva pedagoginen malli, jota voidaan soveltaa esi- ja perusopetuksessa. Leikillinen oppimisympäristö nähdään yhtenä tulevaisuuden oppimisympäristönä, joka osaltaan voi vastata ajankohtaisiin haasteisiin, kuten luovuuden, yhteisöllisen tiedon rakentamisen ja mediataitojen edistämiseen oppimisessa. Tutkimuksessa on tukeuduttu kahteen eri metodologiseen lähestymistapaan: grounded-teoriaan ja design-tutkimukseen, jotka ovat tarjonneet tutkijalle mahdollisuuden sekä teoreettisten ja pedagogisten konstruktioiden rakentamiseen että oppimisympäristöjen ja opetuskäytänteiden kehittämiseen. Tutkimuksessa valotetaan myös leikillisiin oppimisympäristöihin liittyvää mo-

nitieteistä ja -tahoista yhteistyötä, sen merkitystä ja haasteellisuutta uusia ympäristöjä kehitettäessä.

Avainasemassa tutkimuksessa ovat 6–12-vuotiaat lapset; heidän ajatuksensa ja näkemyksensä sekä toiminnan prosessit erilaisissa leikillisissä oppimisympäristöissä. Osatutkimukset muodostavat jatkumon leikillisten oppimisympäristöjen kehittymisestä ja niihin liittyvistä empiirisistä tutkimuksista. Ensimmäinen tutkimus, jossa tarkasteltiin lasten toiveita leikin ympäristöille, tarjoaa perustan leikillisten oppimisympäristöjen suunnittelulle ja leikin kautta oppimisen määrittelylle. Tutkimus muun muassa osoittaa emotionaalisten tekijöiden keskeisyyden lasten leikeissä ja toiminnassa. Toisessa tutkimuksessa analysoitiin luovaa yhteisöllisyyttä ja narratiivisuuden ilmentymistä lasten pienryhmätilanteissa, joissa yhteistyössä omistauduttiin leikin ympäristöjen suunnittelulle. Tutkimus tarjoaa teoreettisen viitekehyksen oppimisen määrittelemiseksi erityisesti narratiivisuuden ja luovuuden näkökulmista. Kolmannessa tutkimuksessa tarkasteltiin lasten näkemyksiä koulusta, joka vastaisi heidän toiveisiinsa ja mieltymyksiinsä. Tutkimus osoittaa, että lasten toiveiden oppimisympäristö tukee monipuolisesti lasten hyvinvointia ja tuottaa oppimisen ja tekemisen iloa.

Neljäs ja viides tutkimus esittelevät ensimmäiset opetuskokeilut, jotka toteutettiin leikillisissä oppimisympäristöissä pilottileikkikenttien valmistuttua Rovaniemelle. Opetuskokeiluissa tutkittiin sitä, miten lapset kokevat leikin ja pelaamisen kautta oppimisen ja miten leikillinen oppimisympäristö voi tukea ja rikastuttaa opetusta. Tutkimustulokset muodostavat keskeisen perustan luovan ja leikillisen oppimisen määrittelylle sekä siihen liittyvän pedagogisen mallin kehittämiselle. Tutkimukset osoittavat, että vaikka tutkimusajankohtana pilottileikkikenttä ei vielä tarjonnut mahdollisuuksia esimerkiksi teknologian monipuoliseen hyödyntämiseen, leikillisen oppimisympäristön voidaan nähdä, etenkin tulevaisuudessa, palvelevan monia oppimisen tavoitteita. Opetuskokeiluilla on ollut tärkeä merkitys myöhemmille opetuskokeiluille, jotka ovat jatkaneet design-tutkimuksia ja pedagogisten mallien testaamista leikillisten oppimisympäristöjen kehittämiseksi.

Luova ja leikillinen oppiminen määritellään sekä ajatteluun, aktiiviseen tekemiseen että koko kehon hyödyntämiseen perustuvaksi oppimiseksi, jonka

keskeisiä piirteitä ovat luovuus, leikillisyys, narratiivisuus, yhteisöllisyys, emotionaalisuus ja fyysinen aktiivisuus sekä teknologian ja median monipuolinen hyödyntäminen. Luova ja leikillinen oppimisympäristö puolestaan nähdään tulevaisuuden koulun visiona, jonka keskiössä ovat erilaiset formaalit ja informaalit oppimisen paikat ja tilat, uudet teknologiat ja teknologiapohjaiset oppimisympäristöt, luovuus, leikillisyys, liikunnallisuus ja lasten kokonaisvaltainen hyvinvointi.

AVAINSANAT: leikillinen oppimisympäristö, luova ja leikillinen oppiminen, pedagoginen malli, luovuus, leikillisyys, teknologia

LIST *of* ARTICLES

Study I

Hyvönen, P. & Kangas, M. (2007). From bogey mountains to funny houses: Children's desires for play environment. Australian Journal of Early Childhood (AJEC), 32 (3), 39–47.

Study II

Kangas, M. Kultima, A. & Ruokamo, H. (in press). Children's creative collaboration – view of narrativity. In D. Faulkner & L. Coates (Eds.) The Expressive Nature of Children's Creativity. Taylor & Francis Books.

Juujärvi, M., Kultima, A. & Ruokamo, H. (2005). A Narrative View on Children's Creative and Collaborative Activity. In H. Ruokamo, P. Hyvönen, M. Lehtonen & S. Tella (Eds.). Proceedings of the 2nd International NBE Conference: Teaching-Studying-Learning (TSL) Processes and Mobile Technologies – Multi-, Inter-, and Transdisciplinary (MIT) Research Approaches (pp. 203–213). Rovaniemi: University of Lapland Press.

Study III

Kangas, M. (in press). Finnish children's views on the ideal school and learning environment. Learning Environments Research (LER).

Study IV

Kangas, M., Hyvönen, P. & Latva, S. (2007). The Space Treasure outdoor game in the playful learning environment: experiences and assessment. In H. Ruokamo, M. Kangas, M. Lehtonen & K. Kumpulainen (Eds.) Proceedings

of the 2nd International NBE Conference: The Power of Media in Education (pp.181–196). Rovaniemi: University of Lapland Press.

Study V

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In 2003, I was chosen to be a researcher on the Let's Play project, whose aim was to study and develop intelligent playgrounds – novel technology-enriched play and learning environments. The job launched me on an incredible and challenging research journey exploring the development of innovative playful learning environments and the related pedagogies and theories. The theme required that I take a very broad approach to doing research and engage in intensive, open-minded collaboration with experts and scholars from many professional and scientific areas. Accordingly, there are very many people indeed who have contributed to my work and the evolution of this thesis, and to whom I would like to express my gratitude.

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I have often guided Samu and Joona to enjoy learning in their school work and in freestyle skiing, and encouraged them to keep in mind that achievement and the joy of learning can be realized only through hard work that includes creativity and playfulness. This insight has paved the way for my attempts to understand creative and playful learning through this thesis. With this in mind, I would like to finish up by citing Anselm Strauss and Juliet Corbin (1998, p.14): "Doing research is hard work. It also is fun and exciting. In fact, nothing can compare to the joy that comes from discovery." I believe this is true in work as well as in life in general.

Levi, June 2010

Marjaana Kangas

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1 INTRODUCTION

1.1 Research Context and Pedagogical Premises of the Playful Learning Environment (PLE)

Future learning environments are currently the focus of a great deal of attention in education (e.g. Natriello, 2007; Sawyer, 2006c; 2008; Tuomi, 2007). A significant goal is to see learning as a lifelong and lifewide process that takes place in a variety of learning environments including schools and classrooms but encompassing many innovative and informal places and spaces as well. Play, games, and various playful, creative and participative learning activities enriched with new technology are seen as important forms of learning in innovative learning environments, for they provide emerging perspectives on the discussion of the school of the future (e.g. Doppelt & Schunn, 2008; Hyvönen, 2008; Kafai, 2006; Resnick, 2006; Sawyer, 2008; Tuomi, 2007).

This thesis considers innovative learning environments in pre-primary and primary education[1]. The study contributes to the current educational discourse on technology-enriched learning environments, creativity and innovation, and identifies new locations for learning beyond the classroom and indoor spaces. The work also draws heightened attention to utilizing outdoor places and spaces for learning (e.g. Hyvönen, 2008; Rudd, 2008) (see Figure 1).

1. Preschool children in Finland are six to seven years of age. They are offered an optional one-year preschool curriculum in either a kindergarten or a primary school. The basic education is a nine-year general education that starts in the year when a child turns seven.

Figure 1. Towards future creative and playful learning environments.

The context of the study is what I shall call the playful learning environment (PLE), an innovative indoor-outdoor technology-enriched play and learning environment where learning can take the form of content creation as well as physical games and play (see Kangas & Ruokamo, 2010). The history of this doctoral thesis is closely intertwined with the development of a pedagogical and theoretical conception of the PLE and the studies associated with that process. I have been involved in the development of and pedagogical groundwork for the PLE through multidisciplinary research projects[2] whose aims were to study and develop a technology-enriched play and learning environment for pre-primary and primary-aged children.

The PLE is examined here as a futuristic and innovative contribution to schooling that has the potential to rise to the challenges of the future school. Those challenges include preparing children to be active participants and knowledge creators in increasingly technologically oriented societies, fostering their creativity and imagination (Craft, 2005; Egan, 2005; Egan & Madoc-Jones, 2005; Sawyer, 2008), providing them with sufficient technology and media skills (e.g. Kafai, 2006; Sefton-Green, 2006) and helping them remain physically active (e.g. Clements, 2004; Hannon & Brown, 2008). With the rapid societal changes in re-

2. These are the Let's Play project (SmartUs project: www.smartus.fi) (2003–2006), the PlayIT project (2006) and the InnoPlay project (www.ulapland.fi/innoplay) (2007–2010).

cent decades, many governments have realized that the current structure of their education systems may not be able to respond to twenty-first-century challenges (Awartani, Whitman & Gordon, 2008). This means that traditional methods and thought models need to be reassessed (e.g. Claxton, 2002; Kirshner, 2004). Warrington et al. (2006) suggest a holistic approach that would use a variety of teaching methods and develop action-oriented learning and teaching models.

To understand the future of learning and the ways in which play and games are perhaps changing the way children learn, my interest in this thesis centers on how new technology-enriched playgrounds can be harnessed for curriculum-based learning in light of the empirical studies in which I have been involved. While work in the early stage of developing the PLE focused on how play is defined as a central learning activity (e.g. Hyvönen & Juujärvi, 2005a; Hyvönen & Ruokamo, 2005a; Hyvönen & Kangas, 2006b), in this study I focus on how learning and the learning environment can be defined and how the school learning environment should be designed to accommodate the potential of the PLE. The term "learning environment" here encompasses the entire pedagogical process of teaching-studying-learning[3].

New technology and its affordances are essential in the PLE: technology is not harnessed only for play and games but is increasingly seen as a tool to tap the creative potential of learners, who actively construct knowledge (Craft, 2005; Linn, 1997; Säljö, 2005) and develop artifacts – external representations of the created knowledge (Krajcik & Blumen-

3. In keeping with a socio-cultural approach, the quality of education cannot be explained in terms of "learning" or "teaching" as distinct processes, but is better viewed as the outcome of an interactive process of 'teaching-and-learning'. The English language does not offer an elegant way of referring to this teaching-learning process; Vygotsky used the Russian word 'obuchenie', which embraces both (Mercer, 2002). The teaching-learning process can be expanded to a teaching-studying-learning process where the active role of the learner is emphasized (e.g. Uljens, 1997; Kansanen, 1999).

feld, 2006). By designing artifacts such as play, game content or drawings, children can create and re-create their understanding and find a meaningful way to take part in their learning activities. Many studies of the future school deal with technological ideas and innovations that support learning (e.g. Natriello, 2007; Tuomi, 2007). However, technology and media tools develop continually and it becomes challenging for educational institutions to adapt to innovations. Accordingly, the term "the future school" is appropriate to describe the situation where current technologies have not yet been implemented in pedagogical practices. Pedagogical ideas for a specific technology are often future-oriented and elaborated to an extent that makes it impossible to implement them readily in educational practices.

Following many educational scholars, I rely on the notion that the core of the knowledge society is creativity and innovation and that one of the key missions of the schools should be to educate for creativity (e.g. Beghetto, 2007; Craft, 2005; Cropley, 2004; Jeffrey, 2006; Sawyer, 2006c; 2008). Hence, creativity and innovation are highly valued in endeavoring to define learning in the technology-enriched PLE context. As Resnick (2007) and Sawyer (2006) argue, most schools do not focus on helping students develop as creative thinkers and do not teach how knowledge is created. Instead, in formal schooling children are typically taught that knowledge is static and complete, and they become experts at consuming rather than producing knowledge (or media). Hence, what becomes relevant in education is not only new technology, but also the modes of acting, participating and creating knowledge. Innovations that spring from groups and teams who hold diverse perspectives, share goals and knowledge, and therefore engender creative collaboration, are seen to align with the societal nature of innovation (Claxton, Craft & Gardner, 2008; Sawyer, 2006c; 2008).

The present study established two fundamental purposes on the basis of the empirical studies (Studies I–V) carried out in pre-primary and primary schools and in two pilot PLE settings: one was to explore edu-

cational stakeholders' – especially children's – thoughts, views and experiences regarding ideal play and learning environments and playful learning environments; the other was to use these ideas as a basis for developing the PLE and a theoretical and pedagogical framework for it. Another principal aim of this study was to illustrate the development of the PLE in order to highlight salient features of the process, such as the innovative nature of the research, its close relationship with product development, the co-operation with experts from different scientific fields, and the focus on involving educational stakeholders in the research process. Children were active agents, designers, players and learners in the studies.

The first empirical study provides insights into the features of the PLE and the related learning activities. The second analyzes children's creative collaboration in playful co-design activities and provides tools for defining learning in the PLE settings. The third illustrates children's expectations of their ideal school and learning environment. The fourth and fifth studies examine experiences of the pilot PLEs in authentic curriculum-based play and learning settings. In the latter, both children and teachers were interviewed so their voices could be heard. In the following section, I will outline the evolution of the PLE and some pedagogical premises of the thesis.

1.2 Evolution of the PLE

Although 'playful learning environment' has been used in some scholarly studies – particularly in the contexts of technology-related learning environments and toys (e.g. Hinske et al., 2009) – the term is comparatively rare in the literature. The initial pedagogical conception of the PLE in the present case was that of a technology-enriched playground where curriculum-based learning activities take the form of play and

playful activities. The PLE is also referred to as SmartUs[4] – a commercial technology-enriched playground complex that integrates not only modern technology and playground equipment, but also outdoor playgrounds and computers in the classroom.

Many theoretical contributions have influenced the conceptual foundation of the PLE, examples being the theories of play (Bodrova & Leong, 2003; Corsaro, 2005) and playfulness (Lieberman, 1977), classifications of games (e.g. Caillois, 2001; Sutton-Smith, 2001), and the socio-cultural approach to learning (e.g. Säljö, 2005; 2004a; Wells & Claxton, 2002). The learning sciences (see Sawyer, 2006b) have provided a comprehensive theoretical approach to the studies through definitions of learning.

In the early phase of the evolution of the PLE, the quality of play was acknowledged as an important defining characteristic of activities in the environment and the concept of *playfulness* was chosen to describe learning that is facilitated by play and games (e.g. Hyvönen & Juujärvi, 2005a; Hyvönen & Kangas, 2006; Hyvönen & Ruokamo, 2005a; 2005b). Playfulness was seen as critical to combining curricular goals with learning activities in the PLE. The features of playfulness, that is, the quality of play, were defined according to the levels of action, embodiment, collaboration, creativity, narration, insight and emotion (Hyvönen & Juujärvi, 2004b; 2005a, 2005b; Hyvönen & Kangas, 2006b; Juujärvi & Hyvönen, 2005; Hyvönen & Ruokamo, 2005a; 2005b). It was concluded that play activities should enable:

- *physical activities*, because the PLE, as an outdoor playground, is meant to engage children in action (e.g. Price & Rogers, 2004);
- *embodiment,* because play activities involve the whole body;
- *collaboration*, because learning through play is regarded as a primarily social activity (e.g. Vygotsky, 1978);

4. SmartUs: www.smartus.fi

- *creativity,* because it is through play that children develop and refine their imagination and creativity (e.g. Egan, 2005);
- *narration,* because stories with plots are created and acted out in play and games;
- *insight,* because problem-solving tasks and situations are included in the plot; and
- *emotions,* because emotions accompany all human activity (e.g. Vygotsky, 1978).

Later, Hyvönen (2008), in her doctoral thesis, complemented the above list with the features of authenticity and concretization. She was interested in what the affordances of the PLE are for play in curriculum-based education and studied teachers' expectations of the PLE. She found that teachers are willing to increase play as a pedagogical practice if they find that it clearly promotes the attainment of curricular goals, if examples of playful learning processes are provided for them and if suitable outdoor environments for play and learning are available.

The theoretical pedagogical model of tutoring, playing and learning was created to orient teachers to the use of play in education (Hyvönen, 2008; Hyvönen & Juujärvi, 2005b; Hyvönen & Kangas, 2006a; Hyvönen & Ruokamo 2005a; 2005b). Another theoretical pedagogical model – co-creative learning processes – was developed to support creativity in learning processes, especially when learners create content for the PLE and other technological applications (Kangas, Kultima & Ruokamo, 2006). The starting point was that pedagogical models are required to help educators use novel technologies and harness innovations (Tuomi, 2007). A third model required was a practical pedagogical model for the playful learning process, which was designed in the present case to integrate play activities on the playground with curriculum-based education (Hyvönen, 2008; Hyvönen, et al., 2006; 2007; Kangas, et al., 2006; 2007). In this thesis, I continue the pedagogical consideration of the PLE and focus on various aspects of learning in the PLE. I

will re-define learning activities, drawing on the features of play activities presented above, the empirical studies of this thesis, and the development of the facilities in the PLE. I will also present the pedagogical model for creative and playful learning, which is based on the initial pedagogical models mentioned above.

I have listened carefully to what educational stakeholders – especially children – can offer to this theoretical and pedagogical study through their thoughts, expectations and ways of acting and playing in various creative and playful learning environments. As the nature of learning is complex in PLE settings, it becomes necessary to account for several different learning processes that can all take place when children engage in learning. Consequently, like many studies built on the learning sciences, this study seeks to produce new ideas and new ways of thinking about learning (Sawyer, 2006b). The purpose is to test the value of the innovation and, presumably, stimulate the development of theory (Barab, 2006, 157). Harnessing innovations for educational practices requires systematic theory-building, because the salient features of technology-enriched learning environments such as the PLE lie in the educational theories behind them (Bottino, 2004). The theoretical and pedagogical foundations of learning in the PLE are presented in chapter 2. The timeline in Figure 2 illustrates the research history of the PLE and the sources of data for this thesis.

The first phase of the evolution of the PLE started with the Let's Play project[5] (2003–2006), a collaborative effort of researchers from different fields, such as education, physical exercise technology and industrial design[6]. The project produced two pilot playful learning environments

5. Let's Play project (2003–2006) team: researchers Pirkko Hyvönen and Marjaana Kangas; planning officers Suvi Latva and Annakaisa Kultima.

6. The SmartUs project included Let's Play (education), WePlay (industrial design), UbiPlay (software), Moto+ (physical exercise) and PlayTech (technologies). The products and software were produced by Lappset R & D of Lappset Group Ltd., a playground manufacturer. www.smartus.fi

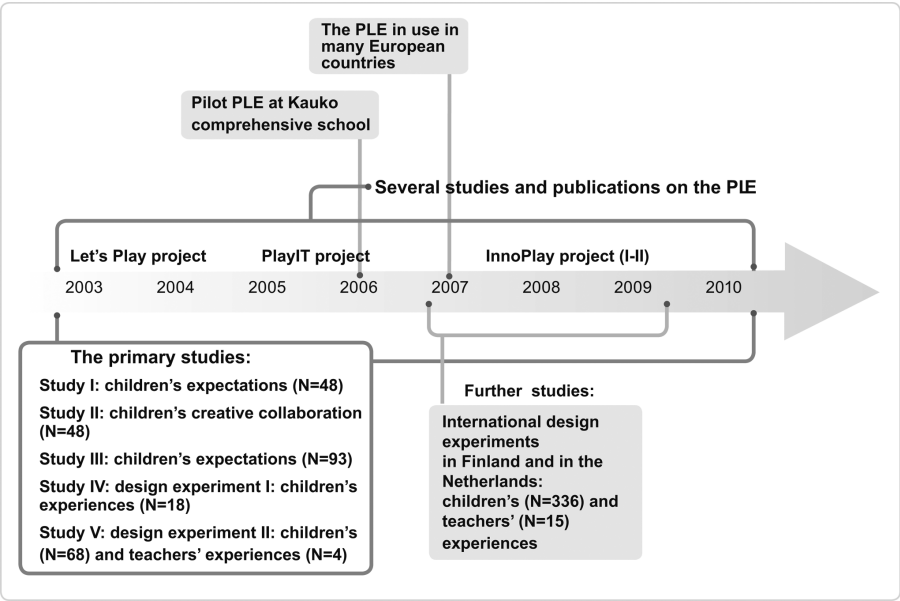

Figure 2. The history of research on the PLE in this thesis.

in the city of Rovaniemi, Finland, in 2006, one located at Kauko Comprehensive School, the other at Nivavaara Kindergarten. At the same time, sparked by this development work, SmartUs was launched on the national and international markets. In the second phase, the PLE was developed in the PlayIT and InnoPlay[7] projects (2006–2010), which provided novel perspectives on the future school and the debate on the PLE.

The research for the thesis began in 2003 and the empirical data presented were gathered during the period 2003–2006. In the Let's Play project, our team's starting point was to provide pedagogically ground-

7. The InnoPlay project is a part of the multidisciplinary InnoSchool Research Consortium [innoschool.tkk.fi], where the concept of the future school is being co-designed

ed knowledge for designing a novel play and learning environment for curriculum-based education (see also Hyvönen, 2008). One objective was to integrate new technology with play and learning. We first listened to children's voices and let them contribute to our research and design work: We asked pre-primary-aged children to co-design play environments where they would like to play (Study I). Primary-aged children's thoughts regarding their ideal school and learning environment were also explored (Study III). The pilot PLEs were built in 2006, making it possible to carry out the pilot design experiments in authentic curriculum-based contexts. In contrast to what the technology offered during the design experiments presented in this thesis (Studies IV and V), the SmartUs environment represented significantly improved facilities in the PLE. Since 2007, the PLE has provided a media environment that enables children to actively take part in learning by both designing and playing games. Indeed, one key aspect of the PLE for purposes of this thesis is the opportunity that it affords pupils to create their own content for outdoor play.

On the above grounds, the playful learning environment is defined as follows (see Figure 3):

> *The playful learning environment is a physical, pedagogical, intellectual, socio-emotional, cultural and media-rich learning environment. It encompasses an outdoor playground and the related equipment, technology and software used for educational purposes. The PLE consists of indoor and/or outdoor learning activities, including game creation, games on the playground, and/or play without technology.*

The PLE as a physical environment extends the classroom and school to include an outdoor playground. As a physical environment, the PLE contributes to sporty, playful and enjoyable learning experiences. As a pedagogical environment, a PLE is a theoretically and pedagogically defined and empirically tested learning site. The pedagogical model for

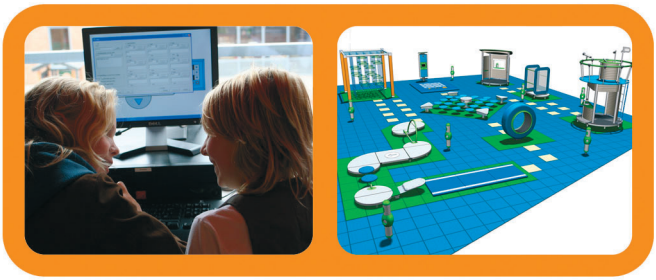

Figure 3. The PLE as a physical, pedagogical, intellectual, socio-emotional, cultural and media-rich environment.

creative and playful learning defined in this thesis endeavors to integrate and broaden earlier models. The PLE's function as an intellectual learning environment refers to its support for cognitive, mind-on activities. As a social learning environment, the PLE accommodates all participants – children, teachers and others – who are involved in learning processes. Where emotional learning is concerned, the PLE aims to produce joy of learning. That the PLE is a cultural and media-rich environment refers to the continual development it must undergo in terms of technology and media resources, such as affordances for users' own content and game creation.

Providing an opportunity to design game content for the playground was the early starting point for including forms of creativity in the PLE in addition to playfulness in learning. Another source of inspiration was the research on playful design processes that examined children's creative collaboration (Study II). The design experiments (Studies IV and V) in this thesis were carried out in the pilot PLE at Kauko Comprehensive School. Those studies have contributed to my conception of learning in the PLE. Although not included in this thesis, other research has played a part in building the theory of learning used here (see e.g. Kangas et al. 2009; 2010). Next, I will describe the research context, the PLE, as a physical and technological playground construction.

1.3 The PLE as a Physical and Technological Playground Construction

At Kauko Comprehensive School, the site of a pilot PLE, the outdoor learning environment consists of nine different pieces of non-technological playground equipment: the *exploration unit*, *stage*, *jungle gym*, *wave platform*, *stepping stones, drawing walls and spinning mill*, as well as SmartUs technology (see Figure 4) comprising an *iStation, iGrid, iPosts* and related software.

The technological elements (Figures 4 and 5) can be located in the schoolyard, integrated in non-technological playground equipment or located in the natural environment near the school, such as woods. The central console in the schoolyard is the iStation, which guides games with images and audio. The functions on the iStation screen are controlled using four buttons and by displaying the iCard playing card.

Technology in the playground is also located in the gaming posts, the iPosts, which provide the gaming points for the play and learning environment. The iGrid jump mat works with the iStation console as one gaming point at which pupils can create their own content. The iPosts, which are located throughout the PLE, recognize identifier tags on the iCards, which players swipe past the inbuilt sensors of the posts or stations as they play (see Figure 5).

RFID (radio frequency identification device) technology is used for access. RFID is also used in the functionality of the iGrid, which consists of twelve tiles, nine for playing a game and three to control the functions on the grid. The user's physical actions are picked up by sensors under the tiles and transformed into information at the information station. Players then obtain feedback on their actions on the jumping grid through the information station screen and loudspeakers. The jumping grid is useful in various games based on curriculum content, such as English vocabulary, natural sciences and mathematical tasks. At

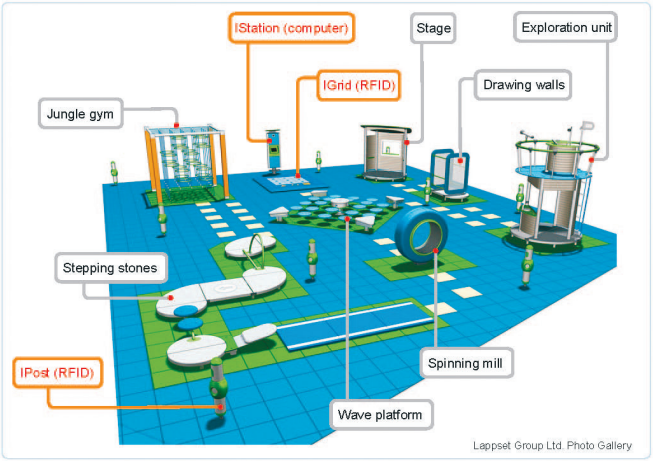

Figure 4. Elements of the PLE in the schoolyard. Images by SmartUs.

Figure 5. Views of the SmartUs playground. Images by SmartUs.

the de Bongerd School[8] in the Netherlands, the PLE consists of the full range of playground equipment and game fields, two outdoor iGrids and nine iPosts. The SmartUs system provides some ready-tailored games whose goal is to increase collaborative physical activity connected with educational tasks.

Some differences between SmartUs and the PLE should be noted: The PLE is a pedagogically defined learning environment, whereas SmartUs is a commercial product. The PLE can consist of a variety of playground equipment other than and additional to the SmartUs playground elements. The PLE is mainly designed for educational purposes, whereas SmartUs provides a play environment for leisure games as well. Both SmartUs and the PLE afford novel and active ways to work, play and learn. However, the PLE as a pedagogical concept requires rethinking and re-definition from the viewpoint of learning.

1.4 Outline and Aims of the Thesis

The thesis sets out to define the qualities of learning in the PLE and guiding principles for designing a learning environment that can tap the potential of the PLE. The study also explores how new technology-enriched playgrounds can be harnessed for curriculum-based learning. A third goal is to outline some visions of future learning environments built on the empirical studies. The thesis elaborates theoretical and pedagogical approaches that explicate creative and playful learning and construct a pedagogical model for creative and playful learning (CPL).

The thesis is structured into six chapters, which are followed by the six original research publications. I will start by presenting the theoretical approach of the study, i.e., a definition of CPL and the pedagogical

8. The de Bongerd School was one of the pilot schools in the InnoPlay research project.

model associated with it. Through the examples of the empirical studies I will outline the main qualities and principles of learning that I have explored within the perspective of the learning sciences (see Sawyer, 2006a), and especially the educational framework from a socio-cultural perspective (Säljö, 2004a, 2005; Wells & Claxton, 2002).

The multiple research tasks prompted me to embrace two methodological approaches: grounded theory (Glaser & Strauss, 1967; Strauss & Corbin, 1990; 1998) and design-based research (Brown, 1992; Barab, 2006; Barab & Squire, 2004). Both provide tools to identify unfamiliar or innovative phenomena, and allow the researcher to produce a theoretical account of those phenomena or advance a new theory. The research methodologies, research questions and methods are described in detail in chapter 3. This is followed by an overview and evaluation of the five empirical studies (chapter 4). In chapter 5, I discuss CPL from the viewpoint of future learning environments, inasmuch as it illuminates in many ways discussions in the field of education of the future school and children's expectations of their ideal learning environment (Study III). The concluding chapter (chapter 6) discusses the general results of the research.

2 A THEORETICAL *and* PEDAGOGICAL APPROACH *for* CREATIVE *and* PLAYFUL LEARNING (CPL)

Säljö (2005) asserts that learning is a tool-dependent and metaphorical concept that should be specified in each theoretical framework. The theoretical framework of the present study draws on the learning sciences[9] and especially a socio-cultural perspective (Säljö, 2004a, 2005; Wells & Claxton, 2002). The main theoretical premise underlying creative and playful learning is that learning is a phenomenon that cannot be isolated from the activity, culture, context and environment in which it takes place (Vygotsky, 1978; 1986; Säljö, 2004a; 2005; Wells & Claxton, 2002). I will discuss creative and playful learning in the light of empirical studies that encompass:

- children's views of the ideal play environment (Study I);
- children's creative and collaborative activity and narrativity in creative collaboration (Study II);
- children's views of the ideal school and learning environment (Study III); and
- children's and teachers' experiences of the PLE in curriculum-based formal education (Studies IV and V).

9. The learning sciences study teaching and learning from different scientific perspectives (Benavides, Dumont & Istance, 2008). The term "learning sciences" refers to an interdisciplinary field that brings together researchers in psychology, education, computer science, and anthropology, among others (Sawyer, 2006b).

Learning scientists argue that deep learning is more likely to occur in complex social and technological environments (Sawyer, 2006b). Recently, in studying learning in rich social and technological environments, researchers have referred to several types of learning, such as *game-based learning* (Prensky; 2008); *project-based learning* (Bintz, Moore, Hayhurst, Jones & Tuttle, 2006; Krajcik & Blumenfeld, 2006; Holm Sorensen, Danielsen & Nielsen, 2007), *playful learning* (Resnick, 2007), and *learning by design* (Hennessy & Murphy, 1999; Kafai, Franke, Ching & Shih, 1998; Roth, 1998) or *design-based learning* (Doppelt & Schunn, 2008). The playful learning environment is a complex physical, pedagogical, social and cultural environment that enables children to actively participate in curriculum-based learning by both designing and playing. Accordingly, the concept of learning here is defined in terms of creative and playful learning, which entails designing and playing.

2.1 The Components of Creative and Playful Learning

Learning in the PLE setting is multifaceted in nature. The theoretical and pedagogical underpinnings of creative and playful learning lie in four sources: the theoretical framework of playfulness (Hyvönen & Juujärvi, 2004b; 2005a; 2005b; Hyvönen & Kangas, 2006b; Juujärvi & Hyvönen 2005; Hyvönen & Ruokamo, 2005a; 2005b), co-creative learning processes (Kangas, Kultima & Ruokamo, 2006), the initial pedagogical models for the PLE, and the empirical studies undertaken as part of this thesis. Because playfulness refers mostly to play in the PLE (see e.g. Hyvönen, 2008), the concept is not sufficient to describe the entire learning process or learning potential in the PLE. Therefore, I prefer a conception of learning in which play, gameplay and various other creative and playful learning activities are possible (Studies IV and V). As defined here, creative and playful learning is based on thinking,

doing and physical activities, in other words, mind-on, hands-on and body-on activities. It encompasses states of minds as well as ways of acting and participating in the PLE.

Creative and playful learning consists of two key components: creative learning and playful learning. With their different theoretical backgrounds, the concepts complement each other and inform the conception of learning in the PLE. They represent different sites of learning in innovative, technology-enriched learning environments. The following sections define the concepts briefly.

Creative Learning

As applied in this thesis, Creative Learning (CL) primarily relates to any learning where knowledge is built, applied and used creatively. It is a way of thinking and doing consisting of a variety of mind-on and hands-on activities. In the PLE context, the aim of creative learning is to create knowledge, content and artifacts such as media products or games for playing and learning on a playground. The roots of the term "creative learning" are in recent research where creativity and imagination are recognized as important aspects in education (e.g. Craft, 2005; Eckhoff & Urbach, 2008; Egan, 2005; Egan & Madoc-Jones, 2005). To a considerable extent, there is an assumption that *the concepts of learning and creativity are approaching one other* and that creativity enters into creative learning in an essential way (e.g. Craft, 2005).

Although creativity can be interpreted in many ways – some emphasizing the locus (person, collective, process), others the product (idea or physical outcome) and still others impact (global, local) – several contemporary scholars view it as involving *the generating of novel ideas* (Craft, 2005). Creativity offers new perspectives and raises new questions in learning (e.g. Sternberg & Lubart, 1999; Craft, 2005). The focus is not only to assume knowledge, but rather to consider knowledge from new perspectives and make it visible (cf. Burleson, 2005; Craft, 2005; Joubert, 2001; Karmiloff-Smith, 1992).

Creativity is also seen as a social phenomenon (Csikszentmihalyi, 1996; 1999; Sawyer, 2003; Watson, 2007). Csikszentmihalyi (1996, 23) has pointed out that creativity is a systemic rather than an individual process: "It does not happen inside people's heads, but in the interaction between a person's thoughts and a sociocultural context." In this respect, creativity is not just a trait of particular children but a constructive process in which children use various cultural tools to engage to different degrees in knowledge creation (cf. John-Steiner et al., 2005).

Empirical studies of creative partnership have shown that young people who had been involved in creative learning activities reported that their motivation, self-confidence, achievement and ability to work well with peers and teachers improved (see Craft, 2005). However, as Craft (2005) observes, creative learning must, by definition, have more to do with the generation and initiation of new possibilities than with motivation and engagement, which can be seen as necessary, but not sufficient conditions for creativity.

Although creativity is often associated with the arts, it has been more prominently recognized in recent years that opportunities for developing learner creativity exist across the curriculum (Craft, 2005). Creativity and imagination in educational practices have been associated with science (Johnston, 2006), mathematics (Briggs, 2006), physical education (Chedzoy, 2006) and music (Hennessy, 2006; Sawyer, 2008). Hence, creative learning need not be tied to the subject-matter in the PLE either.

Craft et al. (2007) acknowledge that the research literature in the area of creative learning is patchy and emergent given the relative novelty of the term and the lack of shared understanding of what it means. In the present study, creative learning encompasses knowledge co-creation and design-based learning in the context of creativity, imagination and innovation. When primary-school children (Study V) studied curriculum-based topics in the PLE, the focus was the process in which the students designed and planned their play and game content for playful learning

Figure 6. Views of creative learning processes in the classroom (Study V).

on the outdoor playground. They engaged in various collaborative and creative activities (see Figure 6) – planning in small groups, drawing, making art and craft works, inventing narratives for the games, choosing the best ones and presenting the plans to the entire class – before playground playing. In the implementation, children were able to apply their knowledge creatively to come up with content for a game. The learning was very much based on engaging the children's imaginations and producing an innovation that encouraged artifact creation, with creative learning then manifested as processes of discovery.

On the above grounds, it is assumed in this thesis that creative learning allows, stimulates and promotes innovation, creativity and imagination (Craft, 2005). It is based on the use of various cultural tools and technological resources (Craft, 2001; Jeffrey, 2003; Loveless, 2006). Hence, available technology and media are extensively used in the PLE. Next, I will describe how the multifaceted phenomenon of playful learning is understood in this study.

Playful learning

Playful learning (PL) refers to various learning activities that are based on play, playfulness and physical game playing. It primarily supports learning through the whole body because it encourages physical activities and embodiment. The term can also refer to a playful attitude

towards learning, which typically appears in creative learning. Resnick (2003, 2006) uses the term "playful learning" in contrast to "edutainment", which usually refers to the sugar-coating of unpleasant learning tasks. He found that many people's best learning experiences come when they are engaged as active participants in activities that they enjoy.

Playful learning in the PLE can be either a technology-enriched game or play process, or a game or play without technological affordances (see e.g. Hyvönen, 2008; Kieff & Casberque, 2000). Play is a central way of learning in Finnish pre-primary school, and primary-school teachers maintain that play and playful activities should be used more in primary school (Hyvönen, 2008). Children have been satisfied with the PLE (Study V; Kangas et al., 2009), supporting the notion that they view play and games in the schoolyard as desirable ways to engage in curriculum-based learning.

In playful learning settings, the integration of school subjects is both relevant and reasonable. For instance, playful learning can be closely integrated with physical education and science. In the PLE context, the entire physical environment or a single playground device (Figure 7) can be used. Playground devices such the iGrid and the Wave Platform represent a context for playful game-based learning using a single device (Figure 7) (Study IV; Kangas et al., 2009; 2010).

Figure 7 depicts playful learning as consisting of technology-enriched game playing on the play devices and as physical play without technologies.

The *Space Treasure* game concept, designed[10] for the PLE, encompasses the central elements of playful learning (Study IV). The game is based on children's embodiment, with physical activities enhancing mathematical calculations on the outdoor playground device. Playful learning in this case requires physical body movements, mathematical

10. Designed by Suvi Latva (presented in Hyvönen, Kangas, Kultima & Latva, 2006; 2007)

Figure 7. Playful learning on the iGrid and the Wave Platform.

and logical thinking, and a plot for a treasure hunt in space. As Study IV shows, a good physical curriculum-based game can offer opportunities for playful learning in which the players reflect on and articulate their nascent understanding throughout the process of gameplay and learning (see Sawyer, 2006). Sutton-Smith (2001) classifies play according to the ways in which persons develop in play. The highest level of development is represented by playful forms of play, which typically appear in the variety and complexity of playful transformations occurring during the game.

Space Treasure is an example of a learning environment where learning is based on playful learning and on game-based learning (e.g. Prensky, 2008). Game-based learning typically refers to various desktop-computer and game-console learning environments, but here it includes physical game-based learning on a playground. Environments such as the PLE encourage children to play outside the formal school setting, providing them with an opportunity to engage in physical activities, play and games in their free time as well (Kangas et al., 2009).

The characteristics of creative learning and playful learning will be considered in detail in the next section. As creative learning and playful learning are intertwined in many ways, the discussion refers to both concepts. Indeed, creativity and playfulness are difficult to separate from learning activities in practice.

2.2 The Qualities of Creative and Playful Learning

As presented in the introduction, the qualities of learning have been re-examined and re-thought in terms of the initial definitions of play activities in the PLE. The features of learning can thus be regarded as descriptions of a variety of *learning processes*, including play processes. The qualities of creative and playful learning activities[11] are summarized below, and then elaborated on and analyzed in the light of the PLE.

1. *Creativity* refers to creative knowledge-building and learning creatively by using new technology and designing artifacts, games or media products (cf. Craft, 2005; Paavola et al., 2004). Creativity also refers to the opportunity to make discoveries and solve problems and to use one's imagination and possibility thinking (Egan, 2005; Craft, 2001; Cremin et al., 2006).
2. *Playfulness* refers to an attitude towards learning and learning through play and games. The features of playfulness, presented earlier, relate to play activities (e.g. Hyvönen, 2008).
3. *Narration* refers to a narrative mode of thinking and understanding as a key aspect of meaning-making (Bruner, 1996, 2002, 2003; Egan, 2005; Lyle, 2000). It follows from this that one way to make sense of experience and the world while learning is narratives.
4. *Collaboration* emphasizes knowledge co-creation and collaborative design and play processes. Collaboration with peers encourages motivation and cognitive engagement (e.g. Blumenfeld, Kempler & Krajcik, 2006).

11. The qualities of play activities are included in the features of creative and playful learning

5. *Emotions* involve all human activity having a key role in thinking and learning (e.g. Mahn & John-Steiner, 2002; Vygotsky, 1978).
6. *Media richness* entails the use of technology and media as a natural part of learning processes and curricula.
7. *Embodiment and physical activity* refer to physical learning activities and the use of the whole body in learning processes where 'embodied knowledge' (see Hyvönen, 2008) can be achieved. The whole body – hands-on and body-on activities – are used in addition to mind-on activities.

Learning is a creative process

In this study, knowing and learning are viewed as creative processes (e.g. Craft, 2005; Säljö, 2004a) that involve not only the individual but also the social community as a whole (Scardamalia & Bereiter, 2006; Wells & Claxton, 2002; Wenger, 1998). Learning is seen as a process of discovery in which the term "transformation" has a special meaning. It implies that learning is no longer repeating what is known, but creating something new (e.g. Säljö, 2006; Tuomi, 2007). In this light, learning and creativity are closely intertwined and learning is seen as taking place through creative processes. Anna Craft (2005, 52) illustrates this interaction:

> 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.

Sfard (1998) has proposed two broad, irreconcilable metaphors of learning: the acquisition metaphor, in which learning consists of individuals

acquiring knowledge that is then stored in their minds; and the participation metaphor, in which learning consists of increasing participation in "communities of practice" (Wenger, 1998) or "learning communities" (e.g. Scardamalia & Bereiter, 2006). In the participation approach, it is submitted that cognition and knowing are distributed over individuals as well as their environments. In this sense, learning is "situated" in the relations and networks of distributed activities of participation (Paavola, Lipponen & Hakkarainen, 2004). The concept of knowledge co-creation is thus a focal part of creative and playful learning. Paavola et al. (2004) have added a third metaphor – *the knowledge-creation metaphor* – to refer to new knowledge objects or social practices which are created in the world through collaboration. The authors (2004, 569–570) state:

> Learning is not conceptualized through processes occurring in individuals' minds, or through processes of participation in social practices. Learning is understood as a collaborative effort directed toward developing some mediated artifacts, broadly defined as including knowledge, ideas, practices, and material or conceptual artifacts.

As the knowledge-creation approach emphasizes, it is not only knowledge that is created but other artifacts as well (see Bereiter & Scardamalia, 2003; Paavola et al., 2004). In the PLE context, such artifacts can be novel and appropriate ideas, products of games, or play content that children and teachers design through creative learning activities in their learning community.

Traditionally, design is found in crafts, dramatic productions, and creative writing in school, but as Bereiter and Scardamalia (2003) point out, those artifacts are often not *conceptual* artifacts. The authors argue that the essence of design is idea improvement, which usually is somewhat lacking in schools. Instead, learning in schools is mostly based on our being concerned with what we and other people believe or should

believe and our responding to ideas by agreeing or disagreeing. In design-based learning, the focus is on the usefulness, adequacy, improvability, and developmental potential of ideas, as knowledge work in the real world emphasizes (Bereiter & Scardamalia, 2003). It then becomes meaningful to ask in the PLE setting: What is this game idea good for? How could it be improved to enhance its playability or correspond better to the goals of the curriculum?

Drawing on this foundation, learning in this study is defined through the concept of *knowledge co-creation*, where the prefix 'co' emphasizes collaboration in knowledge and artifact creation. Such co-creation requires learners' commitment to the same task during the learning process. Many similar concepts are used in research for comparable understandings of the decentralization of knowledge in which learning involves activities that are shared, constructed and created in cooperation with others. Among the terms to be found are *collaborative knowledge building* (Wells, 2002) *knowledge co-construction* (John-Steiner, 2000; Wegerif, 2006), and *creative co-construction* (Craft, 2005). In creative and playful learning, co-creation encompasses learning processes in which knowledge and innovativeness in learning (see Paavola et al., 2004) are not only shared but also jointly generated and socially validated.

Creative and playful learning encompasses innovation, creativity and imagination. In the context of business, creativity and innovativeness are essentially synonyms (Feldman, 2008), but I follow Craft (2005) and describe the relationship between the concepts simply as follows: creativity might encompass imagination, whereas innovation encompasses creativity *and* imagination. Runco and Sakamoto (1999) point out that creativity can be regarded as one of the most complex of human behaviors and seems to be influenced by a wide range of developmental, social and educational experiences. This is also evident with the conception of imagination.

Egan (2005, p. 220) defines imagination as "[t]he ability to think of things as possible – the source of flexibility and originality in human thinking." For their part, Policastro and Gardner (1999, p. 217) define imagination as "a form of playful analogical thinking that draws on previous experiences, but combines them in unusual ways, generating new patterns of meaning." As the definitions show, imagination and creativity are closely related concepts; they are not synonymous, however, for imagination can be seen as the source of and vehicle for creativity. Vygotsky (1998) considered imagination as a process directly connected with meaning-making, a higher psychological function that has connections with emotions and intellectual functions. Imagination is important because it mirrors in complex ways the *emotional life* of the human being, such as subconscious thoughts and memories (Egan, 2005). Egan (2005, xii–xiii) writes:

> To bring knowledge to life in students' minds we must introduce it to students in the context of the human hopes, fears, and passions in which it finds its fullest meaning. The best tool for doing this is the imagination.

Imagination should be seen as a prerequisite to making any activity educational (Egan & Nadaner, 1988; Egan, 2005). Egan (2005) asserts that the key to successful learning is to engage students' imaginations in learning processes and to this end educators should use tools such as stories, metaphors, mental imagery, jokes and humor, and play. In the case of the PLE, these tools are also expected to engage children in learning through creativity and playfulness (Studies IV and V).

In Studies I and II, children took the role of playground co-designer and collaboratively created their ideal play environments and shared their thinking and experiences; they created, drew, discussed, played, imagined and experienced various feelings during the co-design processes. According to Joubert (2001), this kind of activity manifests children's

natural power to use their imagination, which encompasses mental images, pictures, sounds or even feelings created in the mind. Indeed, when preschoolers' imaginations were allowed to run free in the playful co-design sessions, heightened emotional engagement could be seen in both their collaborative activities and their play environments.

Jeffrey and Craft (2005; 2006), who consider creative learning in their studies, have pointed out that the *construction of possible worlds* is essential for creativity and creative learning (see also Craft, 2000; 2001). This view is based on the notion of there being associations between creativity and imagination. It also is a response to the increasing shift in educational discourse towards philosophical discussions on the nature of creativity (Craft, 2006; Study II). For this thesis, children's learning and design activities were studied from the viewpoint of the creation of possible worlds in two cases: one study focused on preschool-aged children's creative activities and narrativity (Study II), the other on learning processes in the PLE setting (Study V). Craft (2000; 2001) argues that possibility thinking is implicit in learners' engagement with problems. She suggests that it is exemplified through the posing, in multiple ways, of the question "What if?" and that it evolves in a shift from "What is this and what does it do?" to "What can I do with this?" This conceptualization has been explored and validated through empirical work in many primary classrooms (Jeffrey & Craft, 2006).

Joubert (2001) has put forward the criticism that children often lose their natural power of imagination when they are faced with the formal structures of schooling. Gajdamaschko (2005) argues that the imaginary plane of the human being is moving such that the "make-believe" play of preschool children becomes the imaginary life of students in schools. By this she refers to the idea that children gradually become masters of their own imagination during their school years. As a conclusion, the author suggests that the process of mastering one's imagination leads to mastering emotions and changing cognitive tools (Gajdamaschko, 2005). One strategy for stimulating and developing the imagination is

play and playfulness (Studies I, II, IV and V), and thus playfulness is deemed to be a feature of creative and playful learning.

Learning is a process of playfulness

Dewey (1960) argued that playfulness is a more important consideration than play. He suggested that the former is an attitude of mind and the latter a passing outward manifestation of this attitude. Hence, playfulness refers to playful engagement in learning (Cremin, Burnard & Craft, 2006), which is broader than imaginative play in the PLE. For instance, as a result of playful engagement, children's actions in playful co-design sessions (Study II) spanned the levels of play, verbal action and emotions and these became more complex and more emotional during the collaboration. In this light, playfulness is evidently an attitude towards learning that is closely related to creativity (Lieberman, 1977) and imagination (Egan, 2005). According to Cremin et al. (2006), playful engagement requires an environment where students have an opportunity to collaboratively engage in explorative and playful tasks, group work, arts integration projects, technology-based projects, and the like. In this respect, in addition to various co-design processes, playful engagement can cover activities such as role-play and gameplay on an outdoor playground. It can also encompass learning activities in the classroom where content for playground activities is planned and designed using new technology. In this kind of learning environment, students' creative and innovative contributions are valued and celebrated, and they are empowered to be more playful and confident in their creative and playful learning activities.

Nina Lieberman (1977) was among the first to propose a relationship between playfulness and creativity, identifying five aspects of playfulness: *cognitive, social and physical spontaneity, the manifestation of joy, and sense of humor*. Cognitive spontaneity refers to the use of imagination, social spontaneity to the qualities of the interaction, and physical spontaneity to the level of coordination and motor activity. Manifestations

of joy include enthusiasm, exuberance, enjoyment and lack of restraint. Sense of humor captures joking and clowning around. Although Libermann's focus was on the aspects of playfulness as they occur in individuals, the five features were clearly embedded in the children's creative collaboration in the playful sessions geared to designing play environments (Study II). These sessions attest to the power of playful knowledge co-creation: the richest and most promising ideas emerged in playful situations characterized by spontaneity, a manifestation of joy, and a sense of humor. Humor was manifested mainly in word play. When playfulness appears as word play or humor between participants, it is seen as creating a common ground: playing with words and ideas assumes an orientation of mutual trust and support in which each participant knows that what he or she says, creates, draws, acts out and so forth will be accepted (Wegerif, 2005). In fact, as Wegerif (2005) argues, it is very hard to get children to perform any kind of task in educational settings without their being playful with language.

It has been argued that childhood playfulness does not translate into playfulness in adulthood, an assertion that playfulness is not a stable trait (Casas, 2003). Thus, the learning environment has an important role in affording and creating a playful or creative attitude towards learning. The literature related to playfulness shows that it has increasingly been seen to have positive effects on learning at various school levels and on learning in work life (e.g. Sawyer, 2006a). Considerable evidence demonstrates that a playful approach to the task at hand also increases the likelihood of producing creative results (Amabile, 1983; Bruner, Jolly & Sylva, 1976). Csikszentmihalyi (1993) identifies the following qualities of playfulness: a clear, goal-oriented focus, loss of self-consciousness, intrinsic motivation and the belief that an experience is worthwhile for its own sake. These features create the experience of joy about one's own learning.

In addition to being seen as an attitude towards activities and engagement in learning, playfulness in this study refers to *learning through*

play and games. When children were asked to depict their ideal play and learning environments (Studies I and III), the findings revealed that they genuinely expected environments where they would be active participants who could act, play and learn in many ways, including playful activities. The playful activities they envisioned involved technology, games and various new forms of learning in formal schooling, as the following excerpt reveals: "We don't have to study everything from books, but are allowed to explore the Internet and to use the computer in our studies…We (also) have an opportunity to study through games. Studying will be easy and playful. And we will listen to music, and the music will be pop music that will teach us biology, for instance." (Study III). This vision accords with the notion presented by Tuomi (2007), who puts forward a scenario for the future school that emphasizes a shift from traditional classrooms to educational networks and from textbooks to educational play and games.

Playfulness is a central concept in all the empirical studies in this thesis, and it has figured frequently in the articles investigating the quality of activities in the PLE setting (see also Hyvönen, 2008). Playfulness has also been the main feature of the research method by which the data were gathered in the co-design sessions in Studies I and II. Given this emphasis on playfulness in the knowledge co-creation approach, creative and playful learning are strongly based on collaboration, which I discuss next.

Learning is a process of collaboration

Learning scientists have argued that collaboration with peers encourages motivation and cognitive engagement (Blumenfeld, Kempler & Krajcik, 2006) and promotes learning (e.g. Sawyer, 2004; 2006b). Schrage (1990) defines collaboration as two or more individuals with complementary skills interacting to create a shared understanding that none had previously possessed or could have had on his or her own. In this kind of activity, those collaborating think and act together. Creative and playful

learning embodies collaboration that requires the participants' commitment to the same task during a learning and play process (Studies II, IV and V). Collaboration involves working with others both inside and outside of the classroom to obtain information, to share and discuss ideas, to exchange data and interpretations, and to receive feedback on one's work (Blumenfeld et al., 2006). Opportunities for collaboration in the PLE context are provided in the form of working in small groups with peers during learning processes when using technology and creating artifacts or playing on the playground. Places and spaces for collaboration can emerge almost anywhere in the PLE setting (see Figure 8).

In collaboration, participants co-create knowledge and develop artifacts, that is, original contributions to the PLE. In the empirical study of the pilot design experiment (Study V), the children worked in mixed groups of three to six girls and boys. The game worlds for the playground – the artifacts – were first planned at the small-group level, after which the ideas were shared and validated at the whole-class level. The most feasible ideas were chosen and a common narrative for the play world was created. The findings of the study revealed that participation in collaboration was not always easy. Children felt that they occasionally had problems in interaction. As one student described it: *"Sometimes we argued about stuff, but then, like, you know, in the end even though we had argued, then everyone agreed about it"* (Study V). It is often erroneous to assume that children automatically learn better when collaborating and that they automatically have the skills to collaborate without receiving guidance on specific ground rules. In Study V, the teachers felt that they might have offered more tutoring and guiding for the children's group work. They realized that they could have directed the children's groups differently and they should have allocated more time and effort to the group-work phase of the learning.

Despite the emphasis on collaboration, it must be acknowledged that the participants in an activity do not necessarily have identical goals, nor do they necessarily share the same beliefs and values. Hence,

Figure 8. Spaces for collaboration in the PLE setting (Studies IV and V)

the kinds of groups in which children participate when engaging in knowledge co-creation are a relevant consideration. For collaboration to occur – during learning or play activities (see Studies IV and V) – there must be a degree of overlap in goals and skills, as well as a willingness to attempt to understand the perspectives of others (cf. Wells & Claxton, 2002). This usually requires that the working styles of those collaborating are compatible and that the participants have interaction intense enough to achieve high-quality collaboration and joint activity (cf. John-Steiner et al., 2005). In addition to appropriate forms of groups, successful collaboration requires explicit guidance; peers are often the ideal guides through the zone of proximal development (ZPD) (Vygotksy, 1978; Crook, 1998).

Collaboration is important for creative and playful learning. Playing on the playground device known as the *Wave Platform* tapped the power of social interaction (see Extract 1) and supported the view that externalizing and articulating developing knowledge can promote learning (e.g. Bransford, Brown & Cocking, 2000). Although one child could win the game, children monitored, reflected on and assisted in doing each other's mathematical calculations during the game. Extract 1 illustrates externalization and collaboration in physical game-based learning (Study IV):

Extract 1.

Noora, Kalle, Matti and Niko are involved in physical game-based learning

(It is Matti's turn to make a move.)

Noora:	Do it this way: two times three and jump there!
Kalle:	Wait a minute…
Niko:	Two times two is fourteen!
Noora:	Let me say,…jump to "two", and then, from here to "three"
Matti:	Wait! Two times three is…
The others:	Six!
Matti:	Six (jumps to the step)
Niko:	Right, Matti. Two times three is six
Niko:	Matti, step two times two; it makes four (ponders the route…)
Matti:	Two times two is four (steps on the play equipment)
Niko:	You should have stepped there (points at step four)
Noora:	You can't change the route anymore.
Kalle:	What number do you have there?
Noora:	Two.
Niko:	Two times two is four (proceeds on the steps)
Kalle:	You need step on two there!
Noora:	We have to block all the steps to number four!
Kalle:	That's right, we do! Then he can't go there.

Children use language as a tool for thinking and support each other when solving problems. Following the socio-cultural perspective, whereby language is the main cultural tool for creating knowledge (Mercer, 2000; 2002; Säljö, 2005; Vygotsky, 1978), an ability to communicate and to reason with others is regarded as important for collaboration and success in education (e.g. Wegerif, Littleton, Dawes, Mercer & Rowe, 2004). In the play situation, enabling social control gave each player the possibility to speak about the equations he or she constructed. The power of articulation is explicated by Sawyer (2006b, 12) as follows:

"The learning sciences have emphasized that articulating and learning go hand in hand, in a mutually reinforcing feedback loop. In many cases, learners do not actually learn something until they start to articulate it; in other words, while thinking out loud, they learn more rapidly and deeply than studying quietly." The game illustrated above provides novices – preschoolers in particular – with a meaningful way to practice simple mathematical calculations provided they have the requisite mathematical skills. The idea of the PLE is, however, that the tasks can be adapted to the learners' age and skills.

Mercer (2000) doubts whether life outside the school provides all children with adequate experiences or guidance for collaboration, for example, in the use of language as a tool for collective thinking. One argument for learning collaboratively and using argumentation and verbalization is that shared activity gives rise to intermental understanding, which in turn leads to individual (intramental) knowledge and skill (Vygotsky, 1978; Mercer, 2002). In creative collaboration, learners can become more reflective, serving as "revealing mirrors" to each other (John-Steiner, 2000). Furthermore, sharing one another's mathematical reasoning through verbalized thinking appears to develop children's *metacognitive skills* (Flavell, 1976), that is, the skills to control, monitor, and assess one's own activities. Collaborative problem-solving provides a possibility to acknowledge one's own and other people's decision-making and thinking. These kinds of learning experiences provide potential for socially mediated metacognition (Goos, Galbraith & Renshaw, 2002).

Three types of children's "talk" have been found empirically in collaborative learning in classrooms (e.g. Wegerif & Mercer, 1997):

- Cumulative talk, in which speakers build positively but uncritically on what others have said;

- Disputational talk, which is characterized by disagreement and individualized decision making and in which an argument is seen as a competition which each participant seeks to win;
- Explorative talk, in which children engage critically but constructively with each other's ideas.

Many studies have shown that children who have been inducted into ways of talking and thinking together in collaboration used more explorative talk than those in control groups (e.g. Mercer, 2002) and that explorative talk promoted children's capacity for collaboration and for group and individual problem-solving and reasoning (e.g. Rojas-Drummond, Mason, Fernandez & Wegerif, 2006). Moreover, many recent studies on creativity in learning have concluded that classroom discussions and participatory activities can provide an ideal forum for students to develop their creative thinking skills as well (e.g. Beghetto, 2007; Rojas-Drummond et al., 2006; Vass, 2007; Wegerif et al., 2004; Wegerif, 2005). Yet, creative collaboration can be manifested in many other places and spaces than the classroom and PLE settings.

Learning is a process of narration

It has been argued that one way to make sense of experience and the world while learning is narratives (Bruner, 2003; 2002; 1996; Egan, 2005). The words *narrative*, *narration* and *narrate* have a Latin root that suggests a close connection with knowledge and skilful practice (Whyte, 1981). In the contemporary research literature, a narrative is defined as *a mode of thinking;* a continuous account of a series of events or facts that shapes them into an emotionally satisfactory whole; it involves a sequence of events (Bruner, 1996; Egan, 2005). It follows from this that thinking gives learning a shape whereby it becomes explicit and thus easier to process (Bruner, 1996). Bruner (1996) points out that a narrative is not only a mental structure for organizing information, thoughts and emotions into coherent entities, but also *a vehicle in the process of*

education (Bruner, 1996, 119). Accordingly, I use the term "narrative" in this thesis to refer to both a narrative way of thinking and a means of structuring playful and creative learning processes into a coherent whole. In their depictions of the ideal school, children described learning as a meaningful process and narrative continuum, as the following extract illustrates:

> Risto's [ideal] school is at the edge of a forest. Each week, his class and the other classes of the school take a trip to the forest. In the woods they take photos for the arts class. They examine bugs for the biology class and collect herbs for the herb science class. In the herb class they make tea and herbal drinks out of the leaves and they learn to recognize plants from which to make herbal mixtures. (Study III).

In his discussion of narration, Bruner (1996, 148) refers to metacognition, a form of mental activity in which the object of thought is thought itself. In narration, metacognition converts ontological arguments about the nature of reality into epistemological ones about *how* we know. Here, procedural knowledge becomes important, that is, knowledge about how knowledge is created and how one learns and studies. In this respect, metacognition provides a reasoned foundation for collaboration and for the interpersonal negotiation of meanings – a way to achieve mutual understanding even when collaboration fails to bring consensus (Bruner, 1996, 148).

One way to develop narrative thinking is to fix children's imagination on the material that is being learned in school and to stimulate their imaginations through fiction (Bruner 1996; Egan, 2005). Bruner (1991) has stated that children are very skilful at creating narratives, especially about unusual events and things. This became evident in the empirical studies comprising this thesis: narration and imagination are closely intertwined in children's playful co-design activities (Study I and

II) and can be readily integrated in curriculum-based learning activities (Studies IV and V). Narratives were embedded in the PLE design experiment in that students created a plot-based "what if" play world with a range of specific features and realized it in the technology-enriched playground (Study V). Hence, co-created "views of reality" were acted out in imaginary free play and physical game-play. The technology provided by the PLE constitutes a forum in which narrative can be used for a variety of learning purposes.

One reason why narration is an integral component of creative and playful learning is that the research on children's co-design sessions (Study II) proceeded from our[12] assumption of the pivotal role of narrative thinking in creative and collaborative activities. Following Bruner (2003; 2002; 1996), we were interested in how narrative as an instrument of mind operates in the construction of reality. In Study II, we found that narratives can take the form of drawings, descriptions, discussions and play in children's co-design activities. We distinguished four features in children's narrative thinking: *entity*, *fascination with surprise*, *integration of fact and fiction*, and *emotions*. In addition, we discerned five properties of children's *shared narrative thinking* – a concept constructed in the study (see Table 1).

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Table 1. The main features of narrative thinking and shared narrative thinking in children's co-design processes (Study II).

Narrative thinking		**Shared narrative thinking**	
Category	*Implication*	*Category*	*Implication*
Entity	*Tendency to form meaningful entities*	**Imitative**	*Creating narratives through imitations for construction of common ground*
Surprise	*Meaning in the stimulation of thinking*	**Associative**	*Creating narratives through associations*
Integration of fact and fiction	*Tendency to generate imaginative situations around formal knowledge*	**Productive**	*Creating narratives productively through collaboration*
Emotionality	*Essential role of emotions in the play worlds*	**Transformative**	*Refining and elaborating ideas through collaboration*
		Emotional	*Emotional commitment to a shared idea*

Through narratives, children structured and organized their experiences and products of imagination into *entities* through which the artifacts created – play environments in this case – acquired meaning. Furthermore, an element of *surprise*, that is, surprising alternatives presented by peers or an adult, inspired the children's imagination and narrative thinking. In playful co-design, children also seemed to generate imaginative situations on the basis of formal knowledge without difficulty. Here one sees the *integration of fact and fiction* in narrative thinking. *Emotionality* was also evident in narrative thinking.

Shared narrative thinking refers to joint verbal and non-verbal activity that is characterized as imitative, associative, productive, transformative and emotional in creative and collaborative activity. Imitative activity appears to be meaningful in collective imagination and constructing a common view and ground; associative activity refers to

narration construction through reciprocal associations; productive activity indicates a wealth of ideas, transformative activity the refining and elaborating of ideas and co-creating, and emotional activity a strong emotional commitment to the shared plot, understanding or "theory" of the world. The concept of shared narrative thinking is closely related to Vera John-Steiner's (2000) constructs of the emotional zone of development and mutual appropriation. John-Steiner (2000) suggests that this kind of intentional stance provides a rich resource for stretching the self in collaboration. Achieving shared narrative thinking in creative collaboration requires participation in which the borders of individual imagination and engagement are crossed and learners become capable of achievements exceeding the individual level (cf. Vass, 2007). In their investigations of the dynamics of creative collaboration, John-Steiner et al. (2005) found that collaborators who established the most integrative relationships relied on the largest number of jointly constructed utterances. The authors noted that it was as if collaborators were inside each other's heads and completing their partners' unfinished thoughts. Representations of shared narrative thinking are not only verbal, but include movements, actions, and drawings (Study II).

Based on Study II, we developed *a three-dimensional theoretical model of narrativity* (Figure 9). This model incorporates the dimensions of meaning, activities and collaboration. The model introduces a flexible idea of narrativity: it starts from separate entities and moving towards whole worlds, with narrativity lying in between these two poles.

At the bottom of the model are the simplest meanings, such as those associated with characters and objects. Moving up, we see the act of combining simple elements with different kinds of relations, such as time and causality, producing a narrative. At the top, the narrative expands into an entire possible world. As we approach the narrative level, which should not be thought of as a definite level with real borders but as a continuum, the significance of the axes of collaboration and creativity grows. Narratives that emerge in collaboration are hard to fit into

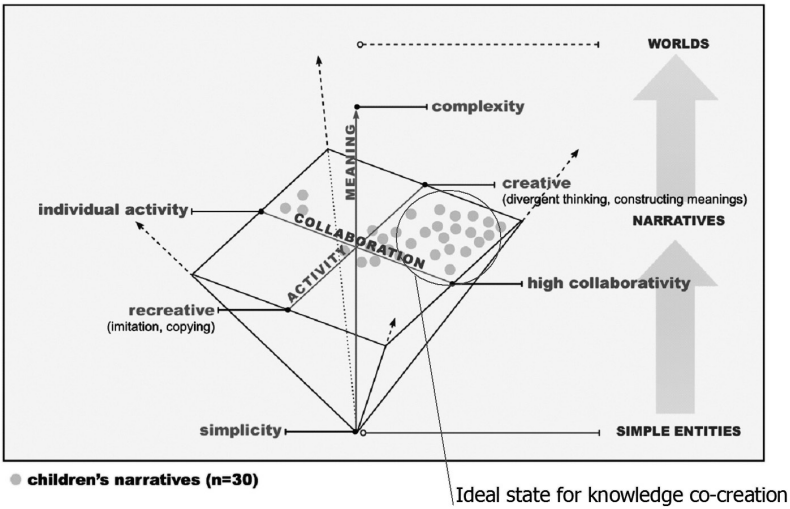

Figure 9. A model of narrative thinking in creative collaboration (Study II).

the figure because of the very complex nature of all three dimensions. Our aim in Study II was to provide a theoretical model that would help better describe narrative in the playful co-design process. The model shows how narratives created in high-level collaboration concentrate in the quadrant representing shared narrative thinking; this is the ideal situation for knowledge co-creation.

Learning is a process of emotions

Emotions involve all human activity and play a key role in thinking, action and learning. Affective and motivational resources are important because they may mediate effort, attention, and a desire to engage in learning (see Bransford et al., 2006). According to Siegel (1999), an emotion is a complex series of processes that reflects the essential way in which the mind emerges from the interface between neuro-physiological processes and interpersonal relationships. Some psychologists view emotions as existing within the individual, whereas others view them as

being created between people (Siegel, 1999). I emphasize the latter view, because in the framework of creative learning knowledge is predominantly created in collaboration and emotions are central to that activity (see e.g. Vass, 2004). Indeed, as Studies I and II show, creative learning involves emotions that are often socially constructed.

Siegel (1999) states that emotions are primarily non-conscious mental processes. He uses 'affect' to refer to the way in which an internal emotional state is externally revealed through non-verbal signals such as facial expressions and bodily motions. The term 'feeling' is usually used to describe the conscious awareness of either an emotion or an affect. Emotions associated with play and learning activities emerged in all the empirical studies conducted for this thesis in both co-design sessions and authentic curriculum-based learning. For instance, in their reflections on their experiences of creative and playful learning in the PLE setting (Study V), children's feelings were both positive and negative. Positive feelings were associated with the active way of learning and involvement, designing imaginative things, working in groups, collaboration and the opportunity to share the fictive game world with others on the playground. Thus, designing a common game world and an opportunity to turn fact into fiction in formal schooling were regarded as an enjoyable, fun, and 'tops' experience, with living out one's own play world on the playground being especially exciting and 'cool'. Younger children seemed to enjoy the playing more than the older children, who in a few cases regarded it as frustrating and childish. The design experiment in the PLE context showed that children considered various writing tasks using a pencil to be the most boring and tedious[13].

A sense of joy is important for learning and the experience of flow, a completely immersed state of consciousness (Csikszentmihalyi, 1990; 2006). Hence, the concept of *joy of learning* becomes important for

13. Traditional paper-and-pencil tools were used because digital game development tools were not yet in use in the pilot version of the PLE.

Figure 10. Joy of learning in the PLE [Pictures from a design experiment (V) and the image gallery of Lappset Group Ltd.]

meaningful learning and was expected by not only the researchers and educators but also the children, who required that their ideal school offer the joy of learning (Study V). According to Awartani et al. (2008), the joy of learning is the motivation and capacity to learn and positive feelings such as the belief that learning activities are fun. However, it is important to be aware of the dangers of learning being perceived as no more than having fun or making pretty things rather than as being challenging and often painful or frustrating, or "hard fun" (cf. Loveless, 2006; Csikszentmihalyi, 1990).

Rantala (2005) studied the joy of learning in her classroom and argues that students do not experience it by listening to teachers but by having an active role in learning. She points out that the joy of learning does not consist of positive feelings only; rather, it encompasses feelings from the whole spectrum of emotional life, depending on the learning activities at hand. The PLE-related studies have shown that implementing creative and playful learning in that context can enhance the joy of learning (e.g. Kangas et al., 2009), which in that setting may involve a variety of feelings, hard effort in using imagination and creating knowledge, the enjoyment of insights gained, or physical learning activities (see Figure 10).

A model of an emotion-rich play environment was built on the basis of the first empirical study, and boys' and girls' shared and separate themes were identified. The model integrates a set of propositions comprising three views on playful learning environments: 1) Children's emotional worlds are rich and diverse; 2) The most commonly desired play environments engender feelings of scariness, happiness, excitement, amusement, aggression and care; and 3) The genders have divergent as well as shared emotional play worlds (Study I). The study showed that emotional worlds related to children's desired play environments are multifaceted and ambivalent; the question of positive and negative emotions became blurred in the study, because what are typically considered negative emotions were also experienced as positive ones, and different emotions were intertwined (Study I). The empirical findings support the view that emotional states in learning are complex and that it is important to become aware of one's own feelings during the learning processes. In order to achieve joy of learning, with its full spectrum of emotions, creative and playful learning has to bring motivation and engagement, which must arise in the learners themselves (cf. Csikszentmihalyi, 1990).

Learning is a media-rich process

There are numerous types of technology in addition to PLE facilities and the Internet: rich media with images, animation and video; games and mobile devices; communication devices; and media recorders such as digital video cameras, voice recorders, media players. These can be applied in a variety of ways in creative and playful learning to support knowledge creation. Learning scientists argue that students learn better when they express their developing knowledge by designing and creating papers, reports, games or other artifacts that can be socially shared and validated (Bereiter & Scardamalia, 2003; Paavola et al., 2004). This assertion is based on the assumption that new technology can support reflection (e.g. Collins, 2006; Scardamalia & Bereiter, 2006; Kolodner,

2006; Sawyer, 2006b). Technology provides numerous possibilities to create artifacts and to redesign them easily.

According to Barron (2004), children are used to sharing knowledge on how to create and learn with new technologies. Using technology in creative learning permits students to recapture creativity and to develop, apply and extend it. Following Sawyer (2006b), the meaningful use of the PLE and its technological resources and affordances is seen as supporting deep learning in many respects. The technology associated with various media tools makes it possible for children to create their own game content, play the games on the playground with peers, and assess the activities afterwards (Study V). Designing curriculum-based content in the form of play or a game and the experience of a jointly created game in the PLE settings allow:

- abstract knowledge to be represented in concrete form;
- learners to articulate their developing knowledge in a visual and concrete way;
- learners to manipulate and revise their developing knowledge;
- learners to experience topics through the whole body;
- learners to experience topics in various places and spaces;
- learners and players worldwide to connect via the Internet and combine their developing understandings and benefit from the powerful collaborative learning.

Many practitioners have noted that novel learning environments are often received with great enthusiasm by students and teachers, but that this reaction rapidly decreases with time, with traditional methods then reappearing (Niemi & Kumpulainen, 2008). Learning scientists explain

why the promise of computers in schools has not yet been realized. One reason is that much educational software is based on *instructionism*[14] (Papert, 1993), with the software acting as an expert authority delivering information to the learner (Sawyer, 2006b). Hence, especially software and networks that offer an opportunity for game creation and design processes can support deep learning, because they encompass multiple opportunities to work with and through new technology and media (see Sawyer, 2006b).

The ongoing debate as to what role new technology should play in the classroom expands in this study to concern learning places and spaces that consist of many formal and informal learning environments, such as virtual environments, where students share their knowledge via the Internet or a playground in the schoolyard.

Learning is embodiment and physical activity

There are a large number of digital games available, but few are designed for outdoor use or provide physical activity. Exceptions are the outdoor game Camelot (Verhaegh, et al., 2006) and a learning environment that integrates outdoor game and learning activities such as physical motion, problem solving, inquiry and collaboration (Spikol & Milrad, 2008). Hence, the PLE and its devices, games and technology applications are innovative in global perspective. Embodiment and physical activity here apply in the case of learning where the whole body is used in hands-on and body-on activities. Study IV demonstrates that physical playground games can offer a meaningful way to integrate academic learning with physical game-based activities. The children enjoyed playing the game on the *Wave Platform* and reported that they learned mathematical reasoning, logical thinking and motor skills. Hence, their experiences of

14. *Intructionism* refers to a vision whereby schooling was to prepare students for the industrialized economy of the early twentieth century instead of the present, innovation-based economy (see Sawyer, 2006b).

the game resonated with the socio-cultural view that learning is related not only to academic achievement but also to all actions involving "the whole person – body, mind, and spirit" (Wells & Claxton, 2002, 5). This same potential was realized in the second design experiment, where creative and playful learning was implemented using the whole playground and its equipment (Study V) for physically active play and learning.

Later, in follow-up studies, children had an opportunity to study various topics through playful learning in international research contexts by playing self-created games on the iGrid. Two such studies have shown that games that are based on grammar, geography, natural science, traffic, mathematics, and English can be played in a way that promotes physical activities and embodiment in learning (e.g. Kangas et al., 2009; Kangas et al., 2010).

Studies I and III establish that the children clearly expect physical places and spaces for play and games as well as an opportunity to engage in and express themselves through physical activity. For instance, 66 percent of the primary school children in the studies (N=93) envisaged a wide range of sports and game facilities with high physical content in their learning environment (Study III). Forty percent of the children wanted to be involved more in physical education (PE) during the school day. Examples of the sport and playground facilities that the children envisioned in their ideal school settings were swimming pools, football fields, gyms, tracks, tennis courts, climbing walls, golf courses, climbing places, labyrinths, bouncy castles, playgrounds, trampolines and roller coasters. Children wanted to climb, slide, run, swing, slide, ride and jump, for instance, although they also respected knowledge acquisition. Although the children did not expect that curriculum-based topics would actually be integrated with physical activities, the findings support the notion that physical playful learning, augmented by new technological applications, can offer one alternative to respond to children's expectations with regard to their schooling.

Roger Caillois' (2001) four types of play – *agon*, *alea*, *mimicry* and *ilnix* – offer an interesting viewpoint on physical game-based and playful learning in the playground context (Study IV). According to Caillois (2001), agon denotes games in which the central aspect is competition, and alea chance- and luck-based games. Mimicry describes games based on imitation and simulation, and ilnix games that are based on vertigo and physical achievement. Playful learning that practices balancing and motor skills is considered ilnix, which the Wave Platform and the iGrid at their best can afford. Caillois also differentiates games with respect to their rules: there are games of free play (*paidia*) and rule-based games (*ludus*). The former can be applied in playful learning by means of non-technology-based activities. The latter can embrace games both with and without technological enhancements.

In sum, an analysis of creative and playful learning shows that it can be seen as a complex phenomenon involving many intertwined perspectives on learning. Each of these perspectives needs further investigation if we are to better understand learning in the PLE setting; together they constitute the foundation for understanding and defining learning in the PLE context. The research to date on these perspectives has shown that there are numerous possibilities for children and teachers to apply creative learning in the PLE setting, in particular in creating games and other content for implementation indoors or outdoors.

Next, I will focus on how creative and playful learning can be implemented in the PLE context. I will outline the pedagogical model associated with creative and playful learning (CPL).

2.3 A Pedagogical Model for Creative and Playful Learning

The experiences documented in the empirical studies show that adopting appropriate pedagogical tools and theoretical frameworks is important. For example, the international studies on the PLE indicate that teachers need training and support if they are to benefit from the environment in their daily educational practices (e.g. Kangas et al., 2009; Kangas et al., 2010). If he or she is to optimize the learning environment, design-based research (DBR) requires the researcher to systematically engineer the contexts of empirical studies in ways that allow for the advancement of new theories and pedagogical practices (see e.g. Barab & Squire, 2004; Barab, 2006). The pilot implementations of the PLE marked the beginning of an iterative cycle to systematically refine and improve not only the learning environments, but also the design experiments.

The pedagogical model for CPL is based on the empirical studies comprising the core of this thesis as well as on a set of pedagogical models designed for the PLE (e.g. Hyvönen & Juujärvi, 2004b; 2005a; 2005b; Hyvönen & Kangas, 2006a; Hyvönen et al., 2006; 2007; Hyvönen & Ruokamo, 2005a; 2005b; Kangas et al., 2006). CPL has developed in conjunction with the empirical studies of this thesis and the follow-up design experiments conducted in 2007 (e.g. Kangas et al., 2009; 2010). In particular, the follow-up studies have provided a richer understanding of the role of technology and media in creative and playful learning, as technological applications have developed considerably since 2006, when the pilot design experiments were carried out. The pedagogical model for creative and playful learning is presented in Figure 11.

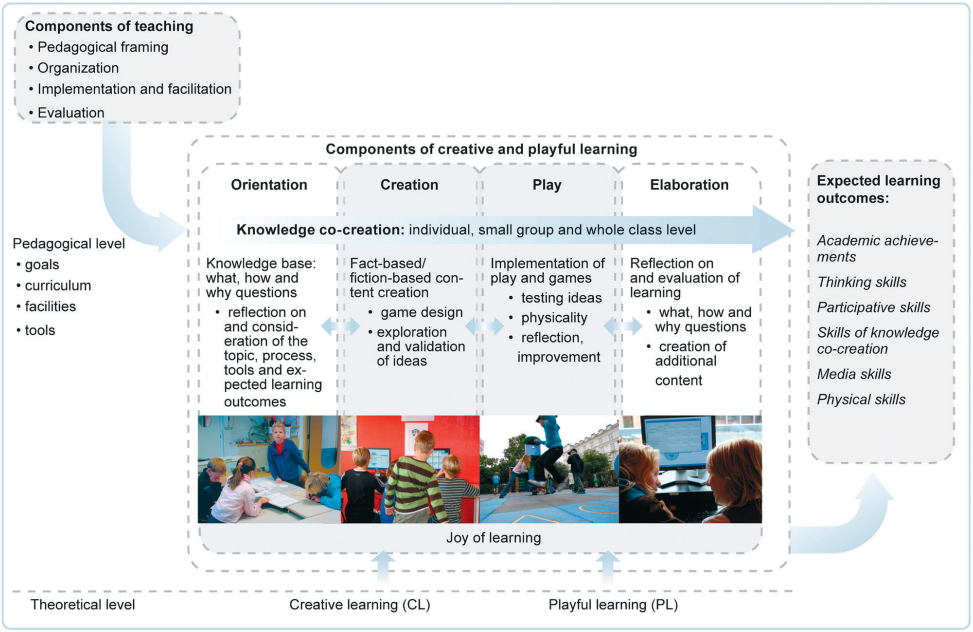

Figure 11. The pedagogical model for creative and playful learning.

Theoretical level: As explained above, playful and creative learning are distinguished at the theoretical level, as they represent partly different learning paradigms in the PLE. Creative learning primarily appears in and defines the phase of creation, playful learning the phase of play implemented in the pedagogical level (see Figure 11).

Pedagogical level: The pedagogical level refers to teaching and learning activities in practice. I first present the components of the process of creative and playful learning. Of those components, creation and play can be integrated or applied separately in teaching. However, the components can also be *phases* if the purpose is to go through the whole learning process.

Orientation

Csikszentmihalyi (1996) emphasizes that a learner cannot be creative in a domain to which he or she is not exposed. From this point of view, orientation to the domain is important for children if they are to become creative knowledge co-creators in the PLE. The purpose of orientation is to create an initial knowledge base, a script and a schedule for upcoming learning activities. The point is to create a common ground – "a mental narrative" – for a chosen subject using the cultural tools at hand. The forthcoming learning process is 'framed' and small groups are formed. A variety of methods, tools and environments may be used to this end. Orientation to the subject may take the form of drawing, writing, or gathering data from various media resources. In addition, children can interview each other or experts on a certain issue via virtual learning environments or face to face. For example, a teacher or outside expert can give a short lesson about the focal topic and themes.

Orientation comprises reflection on, and familiarization with, the 1) subject matter, 2) methods and procedure, 3) technology and media tools at hand, 4) ground rules for group work and collaboration, and 5) expected learning outcomes. The following questions can be dealt with:

- What are the goals for learning?
- What are the theme and central topics?
- What skills are expected to develop?
- What kinds of methods and strategies are used?
- What technological tools and media applications are available?
- What are the ground rules for group work?

It is important that students learn to ask the questions what, how and why. Answers to those questions can be reflected on together first in small groups and then at the whole-class level to support learners' thinking skills and metacognition. What-questions help students and teachers create an understanding of *conditional knowledge* (What are we

learning?) and when-questions serve participants' joint understanding of the *procedural knowledge* related to learning (How are we learning?). Joint understanding of *declarative knowledge* refers to awareness of why a topic is being studied in a particular way (Yore & Craig, 1995). As Study V shows with reference to creative and playful learning that highlights knowledge co-creation, *ground rules* for group work and collaboration have to be introduced beforehand. In some cases, children might create a project based on the learning goals and the ground rules.

Creation

The creation and game design component in learning consists of creative learning activities geared to producing content as well as artifacts or media elements for implementing that content. The central goal is to make things visible and feasible (Craft, 2005). In the PLE context, students' creations can be tested on the playground. Creation can include fact-based or fiction-based content and game design. It is based on children's creativity, imagination, capacity for narration, and skills in using cultural resources. The creation and design phase can proceed virtually by using computer software, such as game development tools, or by planning a game first on paper, as was done in Study V. One method is to give students an opportunity to create games for younger students and to focus solely on the game design process instead of the game-playing phase.

Implementations of CPL in follow-up cross-cultural design experiments showed that teachers found creativity-based game design to be the most salient activity for academic learning in that it forces children to solve problems by inventing questions relevant to the games and to consider the issues from different points of view (Kangas et al., 2010). Creating relevant questions and narratives pertaining to the games is important for meaning-making. In Study V, the goal of learning was to create a game for the whole playground and to play it. By contrast, in the follow-up studies children created games for the iGrid. Hence,

the content, goals and tools of design are determined by the contexts in which they are needed. In the PLE, the various artifacts created can be seen as building blocks for the games; these elements include narratives, images, figures, sound, voice and music. The following learning activities come into play in organizing and facilitating game-creation processes:

- giving shapes to the topic;
- make the topic visible and playable;
- defining the goals for the game;
- developing tentative narrative scripts for the games;
- defining and creating building blocks for the game by
    - inventing relevant questions,
    - taking digital pictures and making/defining voice elements for the games,
    - making collages using digital images, and
    - using ready-made game building blocks;
- sharing game building-blocks with other schools locally as well as globally; and
- testing games virtually before playing them physically.

Game design through a variety of creative learning activities challenges young children as well as teenagers to work and play with technologies and develop their logical and creative thinking.

Play

The play phase in the PLE setting involves physical and active game playing or other playful learning activities where the whole body is used. Students might play self-constructed or peer-constructed games. Playing offers children the opportunity to reflect and practice. The play can encompass either all of the playground equipment or some of it: children can play in the game world designed for the whole playground

or they can play on just a single device, such as the iGrid. Playing a self-created game on the playground encourages reflection because students can look back on how successful they have been in game design. While teachers emphasized the game creation phase as being the most important for academic learning in the PLE-related studies, the physical playful learning phase was important for motivation and the joy of learning (Study V; Kangas et al., 2010). Children are often eager to see how a game they have created themselves works in practice. The play phase is usually carried out in formal timeframes, but practice has shown that children are also eager to play their games after school in non-formal clubs or in their free time. This is possible because the playgrounds are located in the schoolyard and children in Finland are usually allowed to use their school playgrounds after school hours. Hence, the use of the PLE is not bound to time.

Elaboration

Elaboration refers to reflection on and the evaluation of activities designed to reformulate and transform knowledge and the games played (Study V). Elaboration refers to activities where children use elements of what is to be learned and expand and transform information and experiences by relating other information to it. Thus, the elaboration phase of learning connects the information and skills to be learned with the information and skills that children have already mastered. It affords students the opportunity to reflect on knowledge and experiences. Reflection encourages learners to look back on their performance and to compare it to other performances (Collins, 2006). Reflection encompasses making outputs and novel artifacts visible through knowledge creation and technological resources, as well as sharing and validating them at the small-group and whole-class levels.

Elaboration is an important phase for validating understanding and enabling the assembly and review of the knowledge that has emerged in the earlier phases of learning. This involves dealing with the conceptual

(cf. declarative) and procedural knowledge that enables students to understand what and how (cf. Craft, 2005) they have learned and why. For instance, the chosen theme can be elaborated by writing narratives and creating mind-maps or collages. In this phase, each learner can review his or her understanding while developing other games and activities on the playground. Learners can produce new ideas and transform existing games.

Expected learning outcomes

Adapting Säljö (2005), it is not necessary to ask *whether* children are learning in creative design-based and playful game-based learning activities; instead, we should ask *what* they learn in the various learning situations in which they are engaged. Learning outcomes in creative and playful learning environments are expected to be multifaceted: they contribute to academic achievement, thinking skills, physical skills, participative skills, media skills, and knowledge co-creation skills (Study V). Indeed, such a learning environment is designed to stimulate learning and well-being and to fulfill academic as well as non-academic goals (see Hofer, 2007). Any combinations of intellectual, physical and socio-emotional engagement are valued as learning outcomes. In this respect, creative and playful learning environments address the challenges of enhancing students' physical, educational, cultural and socio-emotional well-being and encouraging the joy of learning (see Study III).

It can be expected that children using the PLE will, among other things, learn to develop their own ideas, test boundaries, experiment with alternatives, get input from and give input to others and generate new ideas based on their experiences (cf. Resnick, 2007). Learning by design and play in conjunction with creative and playful learning has many other benefits for learning as well. According to Collins et al. (2004, p. 24), "[s]tudents came to value the expertise of other students; not just content expertise, but sometimes expertise in using computers or in keeping the group working effectively toward their goal." This

observation prompted the authors to put forward the notion of diverse expertise, which emphasizes respect for and listening to others. In this manner, children can acquire expertise, emerging as skilful players and game designers from whom other children can learn. Expertise can also encompass skills in using a video camera, making video clips or recognizing plants in the woods near the school.

The components of learning – orientation, creation, play and elaboration – can be seen as distinct possibilities to implement creative and playful learning for various curricular and learning purposes. Implementing the whole process takes considerable time. However, it can also save time in the curriculum, as one teacher noticed in the follow-up studies (Kangas et al., 2009): "I was surprised when I realized that I gained so much time by this learning concept. I am three chapters ahead compared to my colleagues. Besides, I don't think I have neglected other subjects."

Components of teaching

According to Hyvönen (2008), teachers have three central roles in the PLE: leader, afforder and allower. They are also coordinators, supporters, tutors, motivators and facilitators. *Pedagogical framing* can start with co-design between teachers and students involving working methods or technological tools (cf. Wood & Attfield, 2005). The teacher's role during the process can vary depending on how much he or she emphasizes the children's own involvement and agency.

Organization consists of decisions on considerations such as when and how outdoor and indoor environments are used, how small the groups to be formed will be, how ideas are shared and validated, and how feedback is given during the process. The teacher decides how to integrate subjects, methods and environments and to facilitate creative and playful learning processes. Tutoring encompasses the whole learning process.

Implementation and facilitation are based on a learner-centered approach. It has been argued that where teachers focus on learning rather than teaching, their continual reflection-in-activity leads to assistance strategies that become potential resources for students' learning processes (Stone & Gutierrez, 2007). Depending on the curriculum and the goals of learning, implementation of CPL can vary considerably. Sometimes the play phase is the focus, whereas at other times creation and co-design constitute the central learning activities. Tutoring is also expected from students, and/or additional staff.

The teacher is responsible for the *evaluation* of the component learning phases. However, evaluation methods must be re-assessed when the emphasis is on creative and playful learning methods and the PLE. As Tynjälä (2008) has observed, although diverse group activities at school are becoming increasingly common, students are still usually judged on the basis of individual tasks and tests. Furthermore, teachers' pedagogical thinking and systems of organization have to correspond with the underlying logic of the learning environment and its theoretical basis if teachers and students are to successfully design, organize and evaluate learning based on creative and playful learning methods and environments (see also Hyvönen, 2008).

CPL underscores the importance of the following activities in tutoring creative and playful learning during the orientation, creation, play and elaboration phases (adapted from Egan, 2005; Craft, 2005; Wegerif, 2005; study II):

- Working on stories based on fact and fiction
- Creating and reflecting critically on ideas, actions and outcomes
- Envisaging what might be (thought experimentation)
- Using mental imagery, possible thinking and playing
- Looking for opposites, giving shapes and contents
- Making connections and seeing relationships
- Exploring and validating ideas

- Constructing and transforming shared understandings
- Encouraging shared narrative thinking and reciprocal creativity
- Allowing humor and playful talk as an important element of the learning process.

The above activities are more common in creative learning than in playful learning if the learning components are considered in theoretical perspective.

Facilitating knowledge creation in small groups

If it is widely assumed that knowledge is created in communities of practice, why would we not create and build learning environments that promote children's participative skills and skills of knowledge co-creation? The creative and playful learning approach encourages knowledge creation and working and playing in groups. Earlier findings in the field point out that children learn to reason better as individuals by personally appropriating strategies used first in dialogue with others (e.g. Wegerif et al., 1999; Wegerif, 2005). Furthermore, because it is assumed that knowledge creation occurs in small groups and that participatory learning activities can provide an ideal forum for students to develop their creative thinking skills (e.g. Beghetto, 2007; Rojas-Drummond, 2006; Vass, 2007) and deepen their understanding of the topic, children should have an opportunity to develop as good collaborators and knowledge co-creators. Yet, successful collaboration requires explicit orchestration (e.g. Crook, 1998).

Empirical studies of the ground rules for exploratory talk or for dialogical reasoning have shown that children inducted into ways of talking and thinking together in groups used more exploratory talk: children engaged critically but constructively with each other's ideas (e.g. Wegerif, 2006; Wegerif & Mercer, 1997; Wegerif et al., 2004). The following ground rules for exploratory talk have been put forward (Wegerif et al., 2004):

- Everyone in the group is encouraged to speak by other group members.
- All relevant information is shared.
- Reasons are expected.
- Contributions are considered with respect.
- Challenges are accepted.
- The group takes responsibility for decisions.
- Alternatives are discussed before a decision is taken.
- The group seeks to reach agreement.

One application of the creative and playful learning approach is to alternate small-group and whole-class co-creation processes (cf. crosstalk; Brown & Campione, 1996). An example of this would be where small groups present and explain their thoughts and ideas to others, and the whole classroom then becomes responsible for choosing, validating and elaborating ideas (Study V). Here, knowledge co-creation occurs at both the small-group and whole-group levels, the point being that each group presents and explains its thoughts and ideas to the others. The idea is closely related to Well's (2002) 'community of inquiry'. Other groups and the teacher could pose questions to co-create a common understanding, for example, for the game being co-created. Alternation of knowledge co-creation and meaning-making in small groups and at the classroom level promotes both individual and collective understanding (cf. Wells, 2002).

Wells (2002, 202) notes: "these meetings also provide an occasion for taking a meta stance with respect to the processes in which students are engaging…for recognizing and valuing the diversity of ideas that are contributed to the forging of a common understanding." Thus, presentation to others is an efficient way to create and validate information. In addition, presenting to the entire group enhances children's presentation and reflection skills and, in particular, serves as an aid in forming a shared narrative understanding, a common view and ownership of the

issue. Stories, drawings or mind maps can be used to help children visualize their thoughts.

I will conclude this theoretical and pedagogical discussion of creative and playful learning by summing up some general principles based on learning scientists' consensus on the fundamental facts about learning (cf. Bransford, Brown & Cocking, 2000; Sawyer, 2006b; Bransford et al., 2006). These facts pave the way for designing future learning environments for creative and playful learning:

1. *The importance of deeper conceptual understanding*. Expert knowledge includes facts and procedures. Therefore, when children gain a deeper conceptual understanding, they learn facts and procedures in a much more useful and profound way that transfers to real-world settings. Deeper conceptual understanding can be achieved in the PLE context through fact-and-fiction-based content design (Study V).

2. *Focusing on learning in addition to teaching*. Children cannot achieve deeper conceptual understanding solely from teachers instructing them but only by actively participating in their own learning (Studies IV and V). Accordingly, the learning sciences focus on both learning processes and instructional techniques, that is, on pedagogical approaches.

3. *Creating learning environments*. CPL entails a pedagogical approach that provides the tools for creating innovative and meaningful learning environments. The focus is on creating key features of learning environments that help children learn meaningfully. Crucial to this process is viewing the person as

a whole: *body, mind, and spirit* (see Wells & Claxton, 2002). Children become involved in creating such learning environments and become central elements of those environments (Studies III, IV and V).

4. *The importance of building on a learner's prior knowledge*. Children come to school with knowledge that is based on preconceptions and developing skills, but they may also be very expert on specific topics and skills (cf. "island of expertise"[15], Crowley & Jacobs, 2002). Those skills and expertise should be taken into account in learning and creating learning environments. For example, expertise can emerge in skilful use of technology, such as processing digital pictures or producing video when creating game content in the PLE setting.

5. *The importance of reflection.* Students learn better when they express their developing knowledge through collaboration, when they design and create papers, reports, games or other artifacts, and when they are provided in this process with opportunities to reflectively analyze their state of knowledge (see also Bereiter & Scardamalia, 2003; Paavola, Lipponen & Hakkarainen, 2004). Creative game design and playful learning on the playground are examples of situations that provide rich conditions for reflection (Studies IV and V).

6. *Moving beyond the individual.* "Families, friendship, peer groups and larger social networks are all units *of* learning as

15. "Island of expertise" refers to the fact that children often develop considerable knowledge about topics of interest before going to school (Crowley & Jacobs, 2002). The expertise can also take the form of technology management, such as expertise in making digital videos on topics of interest.

well as significant contexts *for* learning" (Bransford et al., 2006). The PLE, as an innovative learning environment with an Internet connection, provides a forum for sharing and creating knowledge on virtual networks. In addition, it provides a forum for joint game experiences with peers and parents in students' free time.

7. *The role of affect in learning.* The joy of learning is a feeling worth identifying and striving for, because all human activity encompasses feelings. Children's ideal environments were full of emotions (Study I) and expectations of enjoying learning (Study III).

8. *Expanding the conception of what is learned.* Studies of learning have usually focused on academic content. However, there are forms of expertise other than content knowledge. These include physical skills, thinking skills, collaborative knowledge creation skills, participative skills and media skills (Study V). CPL draws heavily on this expanded notion of content (see also Kangas et al., 2010).

9. *Innovative and media-rich learning environments are used.* CPL tends to contribute to innovation (e.g., Craft, 2005; 2008), technology and media production (Kafai, 2006; Sefton-Green, 2006) and, ultimately, to a collaborative knowledge-creating culture (Scardamalia & Bereiter, 2006) that virtual spaces and software can support.

3 RESEARCH METHODOLOGIES

The qualitative research described in this chapter was conducted at the pre-primary and primary education levels during the period 2003–2009. The empirical studies form a parallel continuum of the development of the PLE and its pedagogical foundation. The studies have been reported in several research articles, of which six are included in this thesis. Three have been published in refereed international scientific journals, two in refereed international conference proceedings, and one in an international scientific edited volume. In this chapter, I present the central methodological issues of the study (see Table 2), introducing the research questions, the data, the methodological approaches, and the methods and analysis used. Overviews, evaluations and discussions of the studies are taken up later, in chapters 4 and 6.

3.1 Research Themes and Questions

The main research question is:

How learning and the learning environment can be defined and how the school learning environment should be designed to accommodate the potential of the playful learning environment (PLE)?

The studies are strongly based on *children's (N=228) viewpoints*, that is, their ideas about play and learning environments (Studies I and III) and experiences of the PLE in formal education (Studies IV and V). In addition, *teachers' (N=4)* experiences of the pedagogical use of the PLE were

Table 2.
Research design.

Aims and Contributions	Research Questions
Study I **Exploring preschool children's ideas regarding the play environment: *children as co-designers of play environments*** - Richer understanding of the features of the PLE and its learning activities	1) In what kinds of environments do children want to play? 2) What are the tentative features required of a PLE and its learning activities?
Study II **Exploring children's creative collaboration and the role of narrativity in co-design processes: *children as active co-designers and knowledge creators in their play environments*** - Richer understanding of narrativity and creativity in children's activity	1) How does children's narrative thinking appear in creative and collaborative activity? 2) What is the role of narrative thinking and creative collaboration in learning and the PLE?
Study III **Exploring children's ideas regarding the school and learning environment: *children as designers of ideal learning environments and creators of the future school*** - Richer understanding of the features of future learning environments from children's point of view	1) What do school children expect from an inspiring school and learning environment? 2) What are the main features of an ideal school and learning environment?
Study IV **Exploring children's experiences of the playful learning environment in curriculum-based formal education: *Children as players and learners in the PLE*** - Richer understanding of play, creativity and learning	1) How do children experience the PLE, gameplay and learning in the PLE setting? 2) How does the pedagogical Space Treasure game for the PLE meet the challenges of gameplay, creativity and learning?
Study V **Exploring children's and teachers' experiences of the playful learning environment in curriculum-based formal education: *children as knowledge co-creators and players, teachers as tutors in the PLE*** - Richer understanding of creative and playful learning	1) How do children and teachers regard the PLE and creative and playful learning that is based on game design, knowledge co-creation and integration of fact and fiction? 2) What type of new knowledge does the teaching experiment yield for developing a pedagogical model for creative and playful learning?

Methodological Approaches,Methods, Data Sources and Analysis		Publications
Grounded Theory Approach **Playful co-design method** **15 playful co-design sessions** with **preschool children, aged 6 to 7 (N=49)** 2-5 children per group of co-designers	**Outputs and processes**: Discussions Drawings of the play worlds Transcribed audiotaped recordings (7 hours) Video recordings (7 hours) N*Vivo qualitative coding and analyzing Narrative analysis	**Refereed international scientific journal:** Hyvönen, P. & Kangas, M. (2007). From bogey mountains to funny houses: Children's desires for play environment. *The Australian Journal of Early Childhood (AJEC)*, 32 (3), 39-47. **Refereed international edited volume:** Kangas, M. Kultima, A. & Ruokamo, H. (in press). Children's creative collaboration – view of narrativity. In D. Faulkner & L. Coates (Eds.) *The expressive nature of children's creativity.* **Refereed international conference proceedings:** Juujärvi, M, Kultima, E & Ruokamo, H. (2005). A Narrative View on Children's Creative and Collaborative Activity. In H. Ruokamo, P. Hyvönen, M. Lehtonen & S. Tella (Eds.) *Proceedings of the 12th International Network-Based Education (NBE) Conference 2005: Teaching – Studying– Learning (TSL) Processes and Mobile Technologies – Multi-, Inter-, and Transdisciplinary (MIT) Research Approaches.* (pp.203–213), September 14-17, Rovaniemi: University of Lapland Press.
Grounded Theory Approach **Writing sessions with schoolchildren (N=93)** aged 10 to 12	**Narrative writings** N*Vivo qualitative coding and analysis	**A refereed international scientific journal:** Kangas, M. (in press). Finnish children's views on the ideal school and learning environment. *Learning Environments Research.*
Design-Based Research **Design experiment** **Gameplay sessions** in the PLE **Schoolchildren aged 10 to 12 (N=18)** 4 children per group of game players	**Game processes** Video recordings (2 hours) Group interviews (N=18) Field notes Content analysis	**Refereed international conference proceedings:** Kangas, M., Hyvönen, P. & Latva, S. (2007). Space treasure outdoor game in the playful learning environment: experiences and assessment. In H. Ruokamo, M. Kangas, M. Lehtonen & K. Kumpulainen (Eds.) *Proceedings of the 2nd International NBE 2007 Conference: The Power of Media in Education* (pp.181–194). Rovaniemi: University of Lapland Press.
Design-Based Research **Design experiment** Creative and playful learning in the PLE settings **Four participative classes:** **Schoolchildren (N=68)** aged 7 to 12 **School teachers (N=4)**	**Learning processes** Group interviews - children (N=38) - teachers (N=4) Video recordings (6 hours) Field notes Content analysis	**Refereed international scientific journal:** Kangas, M. (2010). Creative and playful learning: learning through game co-creation and games in a playful learning environment. *Thinking Skills and Creativity,* 5(1), 1–15.

explored (Study V) in order to understand better the role of the PLE and various creative and playful learning methods in the future school. The study of children's creative collaboration in playful co-design complements the primary goal of the thesis, that is, constructing a theoretical and pedagogical framework for technology-enriched playful learning environments.

The aim in Study I was to explore children's ideas regarding outdoor play environments and to tentatively define features of the PLE and the related learning activities (see also Hyvönen, 2008). Children's interests were examined by gender, although gender is not a focus of the thesis. The following research questions were addressed:

1. In what kinds of environments do children want to play?
2. What are the desirable features of the PLE and its learning activities?

Study II continued the data analysis carried out in Study I by training the focus on exploring and analyzing children's creative collaboration, specifically the role of narrative thinking in their playful co-design situations. This information was useful in endeavoring to understand learning and knowledge co-creation when developing a theoretical and pedagogical approach for creative and playful learning. Study II discusses the following research questions:

3. How does children's narrative thinking appear in creative and collaborative activity?
4. What is the role of narrative thinking and creative collaboration in learning and the PLE?

In addition to information gained from preschool children (aged 6 to 7) concerning play environments, I considered it important to involve older children in the research process, and to examine how primary-

school students (aged 10 to 12) conceived of their ideal school and learning environment. The study conducted to this end (Study III) provided novel insights for development of the future school, future learning environments and the PLE as well. The focal research questions in that study were:

5. What do schoolchildren expect from an inspiring school and learning environment?
6. What are the main features of an ideal school and learning environment?

Study IV was conducted very soon after the pilot PLE was constructed in the yard of the Kauko School in 2006. The study explored the potential of the PLE in formal education and focused in particular on game-based playful learning in the outdoor playground context. The aim of the research was to test with the children a version of the *Space Treasure* game concept[16] designed for the PLE, and to examine how it might serve curriculum-based formal learning. The following research questions were identified:

7. How do children experience gameplay and learning in authentic PLE settings?
8. How does the Space Treasure game for the PLE meet the challenges of gameplay, creativity and learning?

Study V continued the design experiments in the pilot PLE settings at Kauko School. The aim was to explore creative and playful learning in authentic curriculum-based learning using a tentative pedagogical

16. Designed by Suvi Latva (presented in Hyvönen, Kangas, Kultima & Latva, 2006; 2007)

model – *co-creative learning processes*[17] – and the *Different World* game concept designed for the PLE (e.g. Kultima, 2006; Kangas, Kultima & Ruokamo, 2006). The following research questions were addressed in the study:

9. How do children and teachers regard the PLE and creative and playful learning that is based on game design, knowledge co-creation and the integration of fact and fiction?
10. What type of new knowledge does the study yield for developing a pedagogical model for creative and playful learning?

3.2 Methodological Approaches

In addressing the research questions presented above for the five studies, I have drawn principally on two methodologies: grounded theory (GT) (Glaser & Strauss, 1967; Strauss and Corbin, 1990; 1998) and design-based research (Brown, 1992; Barab, 2006; Barab & Squire, 2004; the Design-Based Research Collective, 2003). The reasons for using these two methodologies derive from the multiple research tasks involved in developing the PLE: the need to develop facilities, technologies and pedagogy for the future school that can contribute an innovative approach to curriculum-based learning and further children's development and well-being (see Kangas, 2010).

The empirical studies presented here marked the beginning of the unique process of research and development for the PLE, which had not been studied or developed earlier or elsewhere. In this respect, the grounded theory approach was justified because its strength is *identify-*

17. A pedagogical model for co-creative learning processes was presented at the *Workshop on Human Centered Technology HCT06* Conference and EARLI's JURE Conference in 2006.

ing unfamiliar phenomena, in this case educational stakeholders' views and expectations of their ideal play and learning environment. The grounded theory approach also helps to consider alternative meanings of phenomena (Strauss & Corbin, 1998). In addition, as one central goal was to develop a pedagogy for the PLE, it was also necessary in the first phase to test and harness the theory in practice, that is, to incorporate the theory underpinning the PLE into the pilot school's educational practices. The advantages of design-based research lie in its purpose, which is to improve teaching and learning with a view to making theories work in educational practices (cf. Sawyer, 2006b). The need to create theories as well as to provide novel tools for educational practices in the pilot school was evident. The design experiments carried out in the PLE settings aimed to advance theory, practice and development of the product, that is, the physical learning environment and its technologies. Both of the methodological approaches adopted were seen as serving the above aim in that they produce a theoretical account of the phenomenon or advance a new theory (e.g. Creswell, 2007; Barab, 2006). Next, I will discuss the characteristics of grounded theory and design-based research, and present the methods, data and data analysis used in the studies.

3.2.1. Grounded Theory (GT) Approach

It is essential in developing innovative educational practices to give educational stakeholders in the field an opportunity to be heard and to contribute to the design process. The grounded theory approach provided a meaningful tool to start the pedagogical investigations and to move towards identifying the salient features of the PLE. Grounded theory is useful when trying to understand how people interpret their relations to the environment, play and learning activities and peers (see also Hyvönen, 2008). In applying grounded theory, my approach relied most closely on that described in the work of the sociologists Strauss

and Corbin (1990; 1998), in particular as regards the analytic procedures and techniques.

Grounded theory was proposed by Barney Glaser and Anselm Strauss (1967); they were the first scholars to articulate qualitative grounded theory strategies and advocate developing theories from research grounded in data rather than deducing testable hypotheses from existing theories. In this type of inquiry, the researcher generates an abstract analytical schema of a phenomenon, a theory that explains some action, interaction, or process (Creswell, 2007). By 'grounded theory' Strauss and Corbin (1990; 1998) mean a theory derived from data that are systematically gathered and analyzed through the research process. The authors (1998, p. 12) describe it as follows:

> In this method, data collection, analysis, and eventual theory stand in close relationship to one another. A researcher does not begin a project with a preconceived theory in mind (unless his or her purpose is to elaborate and extend existing theory). Rather, the researcher begins with an area of study and allows the theory to emerge from the data. Theory derived from data is more likely to resemble the "reality" than is theory derived by putting together a series of concepts based on experience or solely through speculation (how one thinks things ought to work). Grounded theories, because they are drawn from data, are likely to offer insight, enhance understanding, and provide a meaningful guide to action.

With reference to the quotation above, my aim in Studies I and II was to derive a theory from data that would likely to account for children's reality, that is, children's views and ways of doing things. The GT approach is considered well suited for pedagogical and educational research, because it has been created primarily for examining social activities and interactions (Studies I and II) and for describing individual experiences and meanings (Study III) (Martikainen & Haverinen, 2004).

According to Strauss and Corbin (1990; 1998), grounded theory analysis is composed of three major types of coding: a) *open coding*, b) *axial coding*, and c) *selective coding*. These phases have been included in Studies I, II and III. However, the authors emphasize that the boundaries between each type of coding are "artificial" and the different types do not necessarily take place in stages (1990, p. 58). Grounded theory coding can be considered flexible: if a researcher wishes, he or she can return to the data and make a fresh coding (Charmaz, 2006). This was a principal consideration in Study II.

In the open coding process, categories of information were formed and several properties, or subcategories, were identified. After that, the data were put back together and assembled in new ways by making connections between categories. In selective coding, the researcher often develops the theoretical model that best explains the subject under study. The following table (Table 3) describes the objects of the studies and the conclusions, that is, the theoretical contributions of the studies in terms of the GT approach:

Table 3. The studies and the contributions based on the GT approach.

Grounded theory studies	***Object of study***	***Focus of analysis***	***Theoretical contributions***
Study I Exploring children's ideas regarding their ideal play environment	**Preschool children (N=49):** Individual and co-created views, experiences and meanings	**Outputs**: discussions and drawings	Richer understanding of the features of the PLE and learning activities - A model of emotion-rich play environments
Study II Exploring children's creative collaboration, narrativity and narrative thinking in design processes		**The design processes**: discussions and drawings	Richer understanding of narrativity and creativity in children's activity - A model of narrative thinking in creative collaboration

Study III Exploring children's ideas regarding the ideal school and learning environment	**Schoolchildren (N=93):** Individual views, experiences and meanings	**Narrative writings**	Richer understanding of the requirements of future learning environments - The BELE model: Broadening and Engaging Learning Environment

One characteristic feature of the GT approach is that formal theory is defined in the study applying it (e.g. Martikainen & Haverinen, 2004). As Table 3 shows, the studies have produced a richer understanding and richer models of:

1. emotion-rich play environments,
2. narrative thinking in creative collaboration, and
3. the Broadening and Engaging Learning Environment (BELE).

As noted above, in the GT approach the researcher analyzes and codes data in stages to reach the phase where he or she chooses a central category, such as the BELE, and posits theoretical accounts of the data. However, rather than seeing theoretical accounts as static constructions, researchers using GT work more with models that will achieve the status of theories after they have been tested in subsequent and related studies (Glaser & Strauss, 1967).

According to Charmaz (2006), the researcher creates the codes by defining what he or she sees in the data. She points out that coding is an emergent process in which unexpected ideas emerge and language plays a crucial role in how and what to code. Having children as informants has provided me as a researcher with a fascinating opportunity to deal with the rich and imaginative language of children and to use in the studies the vivid expressions they suggest. Additionally, creativity on the part of the researcher in data coding and analyses is a vital component of GT (Glaser, 1978; Strauss & Corbin, 1998). Coding can be seen

partly as work, but, according to Charmaz (2006), it is also play with data. The researcher plays with the ideas he or she gains from the data. He or she becomes involved with the data and learns from it. Coding offers a focused way of viewing data. Through coding the researcher makes discoveries and gains a deeper understanding of the empirical reality. In this respect, playfulness once again becomes a central factor: Charmaz points out how *theoretical playfulness* allows the researcher to try out ideas and to see where they might lead (see Charmaz, 2006). In this study, the "playfulness" required by the theory seemed to fit this account: the categories are based on children's responses, primarily their creativity, imagination and word-play (Studies I and III).

For analyzing the data, I used *N*Vivo, qualitative coding and analyzing software designed in keeping with grounded theory, which proved to be an appropriate tool for managing the data in the first phases. After transcribing the research material – discussions (study I and II) and handwritten texts (study III) – I imported the data into the software and segmented it in order to identify concepts and categories, as well as their properties and dimensions (see Strauss & Corbin, 1990). This first step produced the basic categories, such as schoolyard, nature, learning activities, fantasy and adventure. Among the questions I asked during this initial coding were the following: (cf. Glaser, 1978; Charmaz, 2006):

- What do the data reveal and suggest with regard to the PLE and learning activities?
- What theoretical category do these specific data indicate?

The openness of initial coding stimulated my thinking and allowed new ideas to emerge (cf. Charmaz, 2006; Strauss & Corbin, 1998). In the first studies[18] (I and II), coding was carried out in our research team and

18. Study I: data analysis in collaboration with Pirkko Hyvönen (using *N*Vivo software separately)

the data were coded separately, then compared and combined. In addition to increasing validity, such researcher triangulation facilitates the emergence and elaboration of different theoretical terms and concepts before final categories and a theoretical model are defined that best explain the focal phenomenon.

3.2.2 The Design-Based Research (DBR) Approach

Two of the empirical studies (Studies IV and V) were conducted in keeping with the principles of design-based research (DBR) (Brown, 1992; Barab, 2006; Barab & Squire, 2004; The Design-Based Research Collective, 2003). DBR is less a method than *a series of approaches* that involves a commitment to researching an activity in authentic settings with the goal of advancing theory and at the same time directly impacting educational practice. Wang and Hannafin (2005, pp. 6–7) describe the DBR process as follows:

> a systematic but flexible methodology aimed to improved educational practices through iterative analysis, design, development, and implementation, based on collaboration among researchers and practitioners in real-world settings, and leading to contextually sensitive design principles and theories.

Studies IV and V started the design cycle of research on innovative PLEs, which comprises the processes of designing, implementing and advancing theory in collaboration with researchers and educational practitioners. The participants, children and teachers were regarded as co-designers, a perspective which adheres to Barab's and Squire's (2004) notion that informants in DBR are not 'subjects' assigned to treatments,

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Study II: data analysis in collaboration with Annakaisa Kultima (based on the analysis of Study I)

but instead co-participants in the design and even the analysis. Being pilot studies, the design experiments played a significant role in planning and implementing following iterations geared to continually revising designs in order to test the value of the innovation and to optimize the learning environment (see Barab, 2006; Collins, Joseph & Bielaczyc, 2004).

Conducting DBR requires posing significant questions that can be investigated empirically (Barab, 2006). In the present case, the main questions were: "How do children experience curriculum-based outdoor gameplay in authentic PLE settings" and "How do children and teachers experience the idea of creative and playful learning in authentic PLE settings?" One task of the children and teachers in the studies was to suggest ideas for developing the PLE. Table 4 describes the DBR-based studies in the thesis, as well as the objects of the studies and their theoretical contributions.

Table 4. The studies and the contributions based on the DBR approach.

Design-based studies	***The target of study***	***Analysis focus***	***Theoretical contributions***
Study IV Exploring a playful learning environment in curriculum-based formal education I	**Schoolchildren (N=18)** Individual and co-created experiences, meanings and suggestions	Gameplay processes: interviews and video data	Richer understanding of play, creativity and learning Theoretical framework of game-based playful learning
Study V Exploring the playful learning environment in curriculum-based formal education II	**Schoolchildren (N=68) and teachers (N=4)** Individual and co-created experiences, meanings and suggestions	Creative and playful learning processes *(orientation, game co-creation, game play and elaboration):* Interviews and video data	Richer understanding of creative and playful learning

As Table 4 shows, the studies yielded the following theoretical contributions:

1. a theoretical framework for game-based playful learning, and
2. a theoretical and pedagogical framework for creative and playful learning.

Barab and Squire (2004) point out that to systematically understand and predict how learning in a special context occurs, learning scientists have to develop technological tools as well as appropriate curricula and theories. In addition to contributing to the development of the innovative environment, the present DBR-based studies have specifically contributed to the theory of and pedagogical approach promoting creative and playful learning (CPL). The challenge was to develop a "flexibly adaptive" (Barab & Squire, 2004) theory of creative and playful learning, one that would remain useful when applied to new, changing contexts. Fishman et al. (2004) suggest expanding the conception of design-based research to include research innovations in the context of systemic reform. In the present case, this extension of DBR provided a significant impetus for elaborating theory and practice as well as for developing the technology-enriched innovative playground and its facilities in collaboration with educators, designers and producers. The iterative phases of design experiments require multiple voices to critique the theory, the designs (see Barab, 2006) and the PLE.

Ann Brown (1992) states that researchers usually systematically adjust various aspects of the designed context such that each adjustment serves as a type of experimentation that allows the researcher to test and generate theory in naturalistic contexts. The design experiments (IV and V) were based on the experiments carried out in the indoor test environment (see Hyvönen, Juujärvi & Latva, 2005), the initial theoretical principles and a variety of pedagogical models developed for the PLE (e.g. Hyvönen & Juujärvi, 2005b; Hyvönen & Kangas, 2006a; Hyvönen

& Ruokamo, 2005a, 2005b; Hyvönen et al., 2006; 2007; Kangas et al., 2006) and the findings of Studies I and II. The design experiments were followed by re-designs[19] and enhancements of the PLE consisting of specific improvements in the technological applications[20] and the theoretical and pedagogical approaches underpinning CPL. The re-designed and implemented experiments are presented in several research publications (e.g. Anttila, 2009; Kangas et al., 2009; 2010; Korva, 2008) that will pave the way for DBR-based studies of the PLE in the future.

3.3 Research Data, Methods and Analysis

During the years 2003–2006, empirical studies were carried out in pre-primary and primary school settings with a total of 228 children from the northern Finnish city of Rovaniemi. The playful co-design sessions (Studies I and II) were carried out in the following preschools in Rovaniemi: Nivavaara, Koulurinne, Syväsenvaara, Kivalonpuisto and Rantavitikka. These are locations where the kindergartens arrange pre-primary education. Primary-aged children came from the schools in Ounasrinne and Ylikylä, as well as the Kauko School. Only children who had written consent from their parents took part in the studies. All data are first-hand data, which means that I conducted each of the co-design sessions (I, II, III) and design experiments (IV and V) with my colleagues. Figure 12 illustrates the sets of data and the titles of the relevant thesis articles.

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19. Further studies drawing on the CPL approach have been conducted in 15 classrooms in international settings (e.g. Kangas et al., 2009; Randolph et al., 2008; Kangas et al., 2010). These studies were carried out after the SmartUs playground – a technology-enriched PLE – became more popular in 2007.
20. The technological applications available in the PLE include the content creation tools and web-based applications that the SmartUs playground can provide.

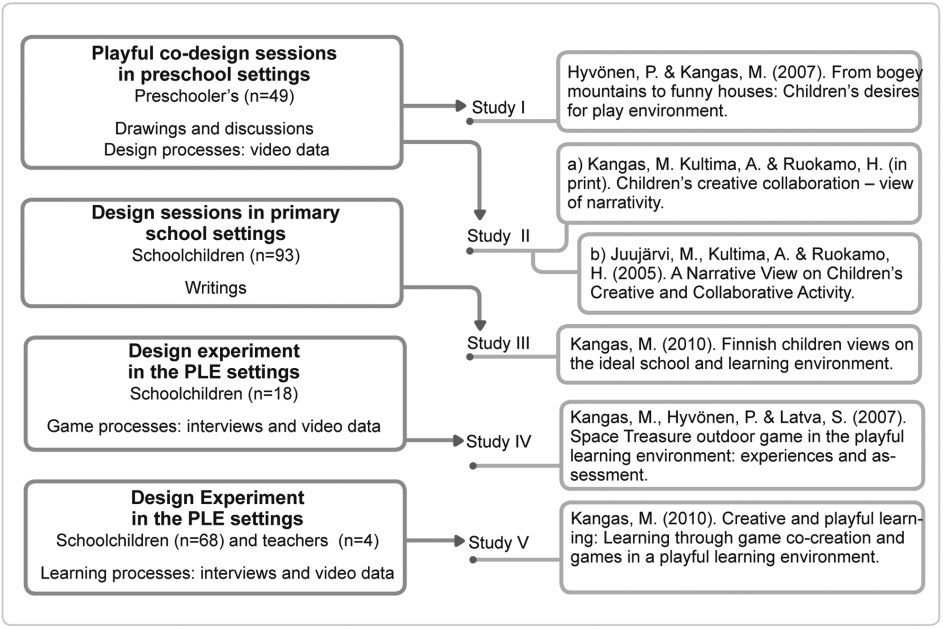

Figure 12. Data sets and articles comprising the thesis.

Owing to the differing goals and tasks of research in grounded theory and design-based research on the PLE, multiple types of theoretically relevant data were used (see Barab, 2006, p. 167): transcribed interviews, video recordings, field notes and written texts. The methods and techniques by which qualitative data (see Gray, 2004) were gathered include group interviews, video recordings, participant observations and narrative writings. In addition, the playful co-design method – a special playfulness-based research method – was applied. The method was created and elaborated in Studies I and II as well as in a follow-up study exploring children's involvement in the research process (see Hyvönen & Kangas, accepted). Next, I will briefly present the method of playfulness-based research; this will be followed by an account of other methods and analyses used.

A playfulness-based research method: playful co-design

Playful co-design sessions with children provided data for answering research questions 1–4, set in studies I and II. Those design sessions were initially called 'image-crafting' (Hyvönen & Kangas, 2007), an ideating process where children in small groups form images of play environments. However, in this case, I prefer the term "playfulness-based research"[21], as it better reflects the nature of the present research with preschoolers, which took the form of co-design sessions where playfulness and creativity were crucial. The method is useful in research settings where the aim is to involve children in the research process and to get them to express themselves and create and ideate for the real purpose of developing novel play and learning environments. It refers to research *with* children rather than *on* children (see e.g. Corsaro, 2005). The method is also a meaningful way to gather data from children by engaging them to work and design in creative collaboration (Study II). Hence, it can serve research where sharing understandings among children and researchers is valued.

The method responds to the need to develop and practice new, child-centered methods that encourage children to present their views, images and representations of their lives as well as to generate new suggestions and ideas collaboratively (cf. Corsaro, 2005; Williams & Bendelow, 1998). Indeed, it has been suggested that research in this field should aim to deliver tools that help create better play and learning environments, especially by stimulating a reciprocal relationship between educational designers, researchers, teachers and children (cf. Könings et al., 2005). Involving children in the research and development process relating to innovative playful learning environments was the impetus for implementing playfulness-based research in the present case.

21. The playfulness-based research method is presented in more detail elsewhere (Hyvönen & Kangas, accepted)

Various playful and collaborative design sessions using art, craft and other cultural tools proved to be a meaningful way to conduct playfulness-based research and to gather data, because imagining, drawing, coloring and playing are natural ways for children to express their views and emotions. A wide range of creative and playful activities can be used, including technology. The cultural tools on hand in the co-design sessions included a large sheet of paper and coloring pencils. Figure 13 illustrates a playful co-design session. In the session, children became inspired to use their creativity and even their whole body to express themselves and their thoughts: they talked, played, drew, made suggestions, imitated and created narratives relating to their play environments (Studies I and II).

As mentioned earlier, the co-design sessions were qualitatively analyzed by applying grounded theory. To this end, the sessions were recorded and videotaped, and the discussions were transcribed. In addition, the play environments drawn by the children were photographed. Charmaz (2006) emphasizes that grounded theory can well be complemented by other approaches of qualitative data analysis. Hence, because Study II used the same data as Study I, the analysis in Study II also focused on *narrative analysis* (Polkinghorne, 1995). In the narrative analysis, the transcribed data were re-structured in the form of plot-based narratives depicting the interaction in the playful co-design sessions. On the basis of the analysis, 30 narratives relating to the play environments were created, with the processes conveyed in these narratives then forming the object of the analysis.

Given that innovativeness and imagination seem to run free and that children's "whole body" talks in this kind of creative and playful activity, it can be assumed that the playful co-design method served the goals of research with children well; its success hinges on the idea that the mind works as a whole that includes the body, emotions and imagination (Egan, 2005). The qualities of playfulness, have been partly derived from these playful co-design sessions (see also Hyvönen & Kangas,

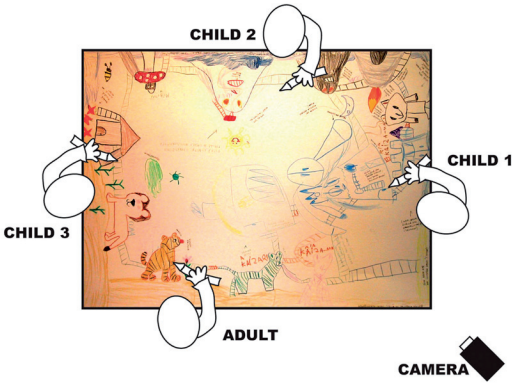

Figure 13. A view of playful co-design sessions such as those used in studies I and II.

2006b; Hyvönen & Ruokamo, 2005a; 2005b). In fact, the features of embodiment, creativity, narrativity, collaboration, insight and emotion that are presented in many PLE studies (Hyvönen, 2008; Hyvönen & Juujärvi, 2005a, 2005b; Hyvönen & Kangas, 2006a, 2006b; Hyvönen & Ruokamo, 2005a, 2005b) are also appropriate for characterizing successful playfulness-based research. Hence, it is essential to describe here briefly what these qualities entail in the research cases (see also Hyvönen & Kangas, accepted).

Embodiment denotes the opportunity for children to use their whole bodies, that is, to be involved in mind-on, hands-on and body-on activities in the research situation. *Creativity* pertains to shaping new knowledge and playing with ideas by using the cultural tools on hand and designing artifacts. It requires a tolerant and safe environment in which to express elements of the process such as humor and divergent thinking. *Narrativity* refers to the sequential and plot-based nature of activities and content which makes them coherent, and to a narrative mode of thinking. *Collaboration* is important for the co-creation of ideas and for reaching a common understanding. *Insight* refers to the opportunity

to make discoveries and solve problems together. *Emotions* are always involved in activities, and humor creates a common ground for collaborative activity; the researcher's sensitivity in recognizing and naming emotional states and encouraging their expression is essential.

On balance, the researcher's role in child-centered research is important as an interpreter, talker and actor (Corsaro, 2005). The researcher's role appeared to be important in playful co-design sessions as well: he or she oriented the children to the task, listened to them carefully, encouraged and inspired them to use their imaginations and express their thoughts and ideas, and participated in the story-lines that were constructed. It is also common that the roles of researcher and informant become intertwined in the process: when talking and designing in playful co-design situations, the researcher's contributions influence the design processes and outcomes (Study II).

Group interviews

Data were also collected through semi-structured group interviews of children (Studies IV and V) and teachers (Study V). In Study IV, the students were interviewed on the playground immediately following gameplay sessions. They were asked for their experiences and thoughts regarding the challenges of the game, the plot of the game, and learning. The data collected through these interviews were analyzed in accordance with these themes.

During and after the one-week design experiment (Study V), I interviewed students from grades 3–4 and grades 5–6 in pairs or in three-student groups, eliciting their views on the following themes: 1) experiences of game design, 2) experiences of group working, 3) experiences of the various learning and co-creation phases, 4) emotional feelings about the process and 5) experiences of learning. The interviews were audiotaped and transcribed for analysis. First and second graders were interviewed in more informal ways in their classrooms and on the playground as part of participant observation. Participating teachers were

interviewed after the one-week experiment by two researchers[22], with one interviewer acting as chairperson and controlling the direction of the interview, while the other took notes. The teacher interviews were audiotaped and videotaped.

The interviews were analyzed using *qualitative content analysis* (e.g. Gray, 2004) in terms of the themes chosen. Content analysis involves the making of inferences about data by systematically and objectively identifying special characteristics and categories within them (Gray, 2004). Flick (1998) points out that these categories are often derived from theoretical models. For instance, the analysis of the teachers' interviews was based on the models that were built in Studies I and II and that form the pedagogical foundation of the PLE (e.g. Hyvönen & Juujärvi, 2005a, 2005b; Hyvönen & Ruokamo, 2005a, 2005b; Hyvönen, Juujärvi & Latva, 2005).

However, as Cohen, Manion and Morrison (2000) point out, an interview is a social encounter and in being transcribing it may lose some critical potential in that it becomes solely a record of data rather than a record of the social encounter. To offset this potential shortcoming, video recordings and participant observations of the learning and play processes were used to complement the other data in the studies.

Narrative writings

Study III is based on primary school children's narrative writings dealing with their views on their ideal school and learning environment. To accommodate the need to listen to children's expectations in this regard, I carried out one-hour design sessions in five classrooms. The children depicted their views and expectations by writing them out on paper. The narrative writings were first transcribed into digital format and then analyzed in accordance with grounded theory using *NV*ivo Software. According to Gray (2004), using narratives is an ideal way of capturing

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the lived experiences of participants, which in the present case meant evocative thoughts about school and its learning environments.

Video recordings

Video recordings were an essential source of information when conducting playful co-design sessions (Studies I and II) and exploring the PLE in primary school settings (Studies IV and V). The video material was expected to reveal participants' engagement and emotional feelings and ways of acting together. The video data complemented the interview data in the design-based studies, where interviews were the focal data source. The analysis of video recordings was carried out such that I first identified and searched for data such as relevant episodes from the playful co-design sessions and learning phases. These data consisted of episodes related to re-structured narratives that were co-constructed in creative collaboration (Study II) and children's collaborative gameplay (Study IV). Here, I adhered to Erickson's (2006) view that the relevant data have to be identified on all recorded videotapes if they are to provide a resource for data construction.

Video data from a week-long design experiment (Study V) were divided in accordance with the phases of activities found in creative and playful learning: orientation, game co-creation, gameplay and elaboration. Accordingly, the data for content analysis ultimately comprised a variety of relevant learning phases in the classroom and on the playground.

Participant observations

Learning scientists who conduct design-based studies usually collect multiple types of theoretically relevant data (Barab, 2006). Accordingly, along with interviews and video data, participant observations were collected, offering important additional information about the design experiments (Studies IV and V) carried out at Kauko School. Collecting these observations meant informal meetings with colleagues and participating teachers and taking field notes during the research. Par-

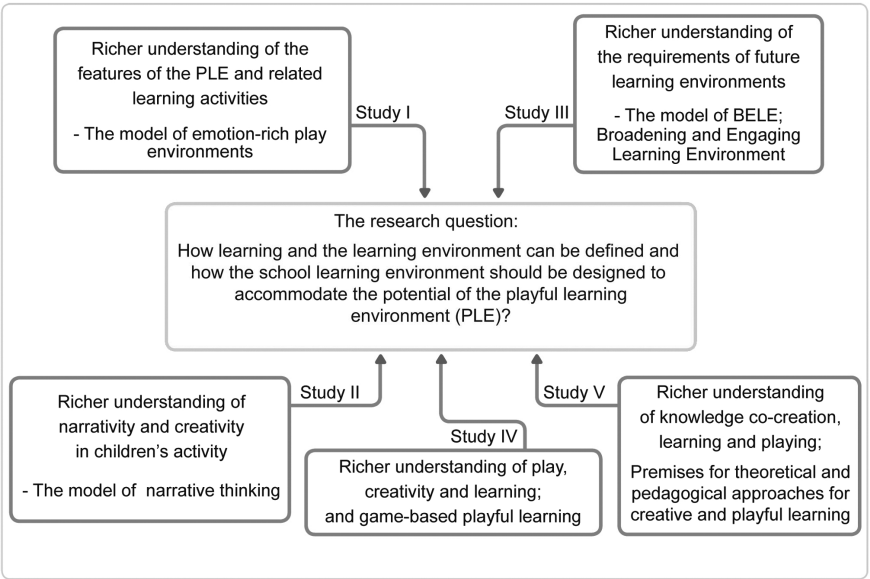

Figure 14. The five empirical studies and their contributions to the research question.

ticipant observation is largely qualitative and emphasizes the meanings that participants give to their actions (see Gray, 2004). In the case of Study V, field notes revealed details of how creative and playful learning was applied in the classrooms, how teachers formed small groups, how they gave instructions, and how students were engaged in the process. In both case studies, the field notes were analyzed in collaboration with co-researchers. The information gained from participant observation provided insights into each of the research questions related to defining future playful learning environments and to a pedagogical approach that would promote creative and playful learning. Barab (2006) refers to data as "field observations" when learning scientists are involved in design-based research for developing and researching technology-enriched learning environments in naturalistic learning settings.

Figure 14 sums up the main research question of the study and the central conclusions emerging from the empirical studies.

4 OVERVIEW *and* EVALUATION *of* THE EMPIRICAL STUDIES

This chapter presents a summary and an evaluation of each of the empirical studies and its contributions to the research questions. The evaluations are not meant to assess the studies thoroughly, but rather to consider certain methodological issues and the most relevant benefits for the development of the PLE and related pedagogy.

4.1 **Study I:** Exploring preschool children's ideas regarding the play environment: Children as co-designers of play environments

Hyvönen, P. & Kangas, M. (2007). From bogey mountains to funny houses: Children's desires for the play environment. *Australian Journal of Early Childhood (AJEC)*, 32 (3), 39–47.

4.1.1. Overview

The study represents the first step in investigating the prerequisites for purposeful play and learning environments in co-operation with Smart-Us researchers, designers and producers[23]. We first listened to the views

23. www.smartus.fi

of pre-primary-aged[24] children and started the development of innovative play and learning environments. Children's ideas were valued because children can be considered experts in play as well as intelligent and articulate observers of their learning environments (e.g. Kershner & Pointon, 2000; Smees & Thomas, 1998; Smith & Parr, 2007; Wardle, 2003). Children's views were also regarded as important because it is they who will be the main users of the future PLE. Furthermore, pre-primary children represent a group who usually use outdoor playgrounds and who naturally express themselves through play. This was our starting point in arranging and designing the research settings, which had to be as playful and authentic as possible. The study was conducted in 2003 in five kindergartens that provide pre-primary education in the city of Rovaniemi. The empirical data consist of 15 playful co-design sessions, drawings by pre-primary children aged *six to seven* years, and discussions with the children. The children (N=49; 31 boys and 18 girls) designed their ideal play environments in small groups in which the researchers[25] also participated. The children were told that the results of their creative ideation would be used for real purposes, that is, designing new types of playgrounds in their hometown, Rovaniemi.

In short, the study provided insights into the desirable features of the PLE and its learning activities. It also produced a model of emotion-rich play environments. Results revealed that children designed play environments or, rather, 'play worlds', that facilitate physical activities with friends, are close to nature and are emotionally rich and vivid (see Figure 15).

24. In Finland pre-primary education is also called preschool and consists of one year of education for children before they enter primary school.

25. The research data were collected by researchers Suvi Latva, Pirkko Hyvönen and Marjaana Juujärvi in the Let's Play project in autumn 2003.

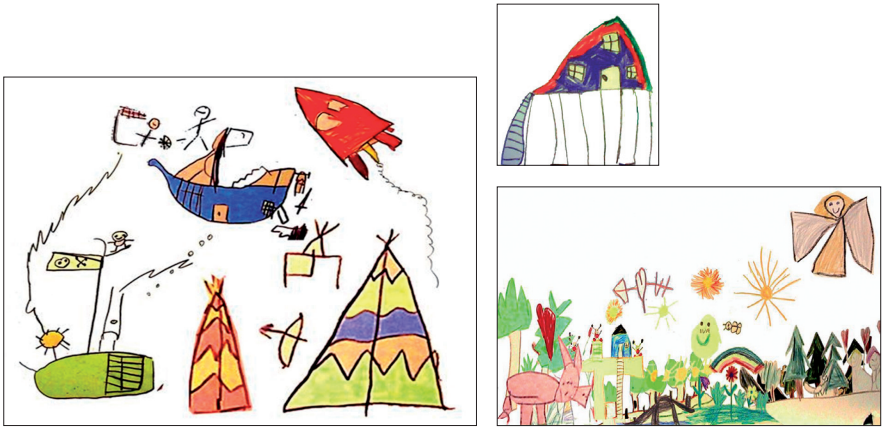

Figure 15. Images of ideal play environments drawn by the children.

The girls designed play worlds that were characterized by both *scariness,* with various scary features and episodes, and *happiness*, with summer and beauty. Boys had worlds of *care* with domestic play and, on the other hand, *aggression* and *competition*. Common themes found in the play worlds designed by boys and girls were *excitement* and *amusement*, both accompanied by a feeling of security. Activities, adventures, role-playing and nature – all in imaginary situations – can be found in the worlds. "Spiral lava", "a lava slide", and "a dough mountain" are some examples of the exciting features in the children's plans. They wanted to have a place where they could create emotionally strong adventures that are terrifying, yet safe and fun. In terms of amusement and humor, unusual and imaginary phenomena made the children laugh. Nature, animals included, provided fascinating environmental features for the children.

Even though the results emphasize emotional play worlds, there appeared a variety of other requirements that children placed on the play environment. Combining the cognitive, emotional and social aspects of the play environment was thus a demanding task in designing and defining the PLE and its activities. Further, the study showed that the cen-

tral features of playful learning environments lie in *collaborative activities*. First, this means that collaborative activities in general have to be valued in defining learning in the PLE and designing places, spaces, and activities for children. Second, common themes are naturally a good basis for girls' and boys' collaborative activities (see Hyvönen, 2008).

In addition to being included in this thesis, the study has been presented in a number of scientific conference papers and popular publications (e.g. Hyvönen & Juujärvi, 2004a; Hyvönen & Juujärvi 2004b; Hyvönen & Juujärvi, 2005a; 2005b; Juujärvi & Hyvönen, 2005). The research also forms part of Hyvönen's (2008) doctoral thesis.

4.1.2 Evaluation

The data from the playful co-design sessions – video recordings, transcribed discussions and drawings – functioned well as qualitative data for analysis using grounded theory (Glaser, 1978; Strauss & Corbin, 1998). The data were collected in the school environment in pre-primary education, where children are used to designing play or playing together. Gathering data in natural and authentic creative and playful design situations was a meaningful and fertile way to interact with young children. The method was also suitable where the goal was to identify previously undetected or unfamiliar phenomena. Before arranging the design sessions, we obtained written parental consent for each child to participate in the study and for the use of photographs or video recordings of the children for research purposes.

We started coding the data in accordance with the theoretical sampling techniques chosen (Strauss & Corbin, 1998), and continued data collection for fifteen sessions, the point at which data saturation occurred (see also Hyvönen, 2008). We compared the results and interpretations, which corresponded to a sufficient extent. As mentioned in the chapter on methodology (see 3.2.1), the data were coded and analyzed collaboratively, thereby reinforcing the validity of the study. However,

discussions and assessment were needed to achieve mutuality in interpreting the results and labeling the theoretical concepts.

One purpose in grounded theory is to construct a formal theory and judge it against *fit* (Strauss & Corbin, 1998; Lomborg & Kirkevold, 2003). Fit pertains to the validity of the study and means that the theory must fit the substantive area to which it will be applied. Fit also means that the data categories should not be chosen from pre-established theoretical points of view. In the present case, the categories describing the children's emotional play worlds have not been selected from preconceived understandings, but have been developed inductively from the empirical data (see also Hyvönen, 2008).

One strength of the study where evaluation is concerned is that the children's ideas were used for real purposes in developing technology-enriched innovative future play and learning environments. Hence, children's wishes and ideas were concretized in many ways. First, the results were taken into account by the playground designers in the Smart-Us project when designing equipment. Second, the results of the study were used in developing play content for the indoor PLE test environment (Hyvönen et al., 2005). When the data were being gathered, I actively participated not only in the work of our research team, but also in a variety of meetings, workshops and discussions with the industrial and scientific collaborators designing the PLE. In those meetings we discussed children's wishes and ideal play worlds, as well as their experiences of the test environment. Our aim was to create a common vision for the playful learning environment being designed.

The weaknesses of the study lie in the area of relevance, that is, in the difficulty of applying the theory constructed in the research in the substantive area. Lomborg and Kirkevold (2003) emphasized that theories should be relevant to action in the area they purport to explain. Although the theoretical construction of emotional play worlds in the present research can be considered relevant, the worlds should be further tested in practice.

Indeed, it was challenging to incorporate children's wishes in scientific co-operation, for instance, in endeavoring to concretize high-emotion play worlds in product design. Another challenge was to take into account the educational and physical requirements, as well as safety and economic considerations. Since the tentative findings were first presented, the research, as well as the innovative playground being created, received a great deal of media publicity (e.g. Pajula, 2004; Partanen, 2004; Sensio, 2005; Sillito, 2005). This was partly due to the context of innovation, that is, its background and goals in multidisciplinary research and development work.

The strength of the study lies in its findings regarding how children's emotions are intertwined with their activity in play environments. The research indicates that feelings have to be seen as an essential part of play and learning activities. Emotions were involved in children's activities during the sessions and in the play worlds they created. Humor seemed to be very important for joint activity and functioned as a strategy to test boundaries (see Vass, 2007). In fact, the role of humor in preschoolers' ideal play environments was one of the more fascinating observations in the study. It was striking that children welcomed ideas – from another child or the researcher – that entailed some humorous elements or that engaged them emotionally in another way. There were several emotions embedded in the play worlds and activities, and all of them made that environment fascinating and motivating. This finding supports the notion that the joy of learning in one's activity can consist of feelings from the whole spectrum of emotional life (see Rantala, 2005; study III). Emotions and various forms of activities that produce joy of learning should be better taken into account in designing innovative future learning environments.

Additional strengths of the study relate to methodological issues and the playfulness-based research method used (see also Hyvönen & Kangas, accepted). Indeed, the study offered many insights into carrying out research among children. It revealed how children played and

used their whole bodies while drawing and discussing matters around the large sheet on the floor. Furthermore, we were successful in creating an informal and creative atmosphere in the design sessions. The video camera did not seem to detract from enthusiastic participation.

The findings show that in many cases children were collaboratively engaged in mutual design and story creation during the design sessions. They also created play worlds built upon common play activities. This establishes the power of collaborative knowledge creation and the importance of narration for meaning making. The manner in which the children participated in the design sessions and became involved in their ideal play environments paved the way for the following studies exploring and analyzing children's creative collaboration in these processes (Study II). In addition, the findings of this study prompted an interest on my part in primary-school-aged children's views of their ideal learning environments (Study III). I assumed that the studies would complement each other and deepen my conception of inspiring future play and learning environments for children. In any event, Study I proved significant for further studies. It was a starting point for the series of studies and development work on the PLE and related pedagogy. The study offered numerous insights based on children's voices. One of the follow-up studies has focused on children's expertise in the playful design processes and considered the processes from the viewpoint of current expertise studies (see Hyvönen & Kangas, 2010).

4.2 Study II: Exploring children's creative collaboration and the role of narrativity in co-design processes: Children as co-designers and knowledge creators in their play environments

(a) Kangas, M., Kultima, A. & Ruokamo, H. (in press). Children's creative collaboration – views of narrativity. In D. Faulkner & L. Coates (Eds.) *The expressive nature of children's creativity*.

(b) Juujärvi, M., Kultima, A. & Ruokamo, H. (2005). A Narrative View on Children's Creative and Collaborative Activity. In H. Ruokamo, P. Hyvönen, M. Lehtonen & S. Tella (Eds.) *Proceedings of the 12th International Network-Based Education (NBE) Conference* (Former PEG) 2005: *Teaching–Studying–Learning (TSL) Processes and Mobile Technologies – Multi-, Inter-, and Transdisciplinary* (MIT) Research Approaches. (pp. 203–213), Rovaniemi: University of Lapland Press.

4.2.1. Overview

Our goal in this study was to examine the data from the playful co-design sessions (Study I) in terms of creativity and narrative thinking. When pre-primary children created their emotion-related play environments, they created a large number of stories around those play worlds. In other words, the co-design sessions inspired children to insert plot-based narratives into the play environments they had drawn. Thus, we focused our attention on this narrativity and took as a starting point that narrativity and a tendency to create plot-based stories are essential elements of creative and collaborative action. The study investigated how the narratives were constructed through creative processes and what effect narrative thinking had on such processes.

In narrative analysis, the data from discussions were re-structured in the form of narratives such that the talk relating to a particular play

idea formed one narrative episode. We analyzed what kinds of narratives children created for their ideal play environments and how these narratives were built up. The narrative analysis revealed 30 narratives that were built during 15 playful co-design sessions, representing an average of two narratives per session. The children's narratives were analyzed such that one narrative unit consisted of one story with a clear plot or formed a connected whole. Thus, one narrative could be a short description of the environment and an activity or the whole environment ideated on the paper.

After the narrative episodes were identified, the children's collaboration in those episodes was analyzed. Nineteen of the narratives were built up in collaboration, and eleven of the narratives were based on weak collaboration or were individual outputs (see Appendix 1). The criteria for collaboration were: 1) jointly generated ideas and plots for the play environment, 2) shared emotions, and 3) reciprocal activity in the co-design situation. In this study, we intertwine educational and philosophical aspects of narrativity and get closer to both a versatile theoretical examination of this phenomenon and multidisciplinary research.

Our data analysis prompted us to conclude that in playful co-design situations children often shared their narrative thinking and constructed narratives with a high level of collaboration. We also noted that narratives usually emerged as play, verbal action and joint emotions, and that these became more complex and stronger during the session. The richest and most complex narratives emerged in playful situations characterized by spontaneity, a manifestation of joy and a sense of humor, all of which interrelate strongly with divergent thinking (see Lieberman, 1977).

We noticed that the researchers' role in the playful co-design sessions was important in orienting the children to the task; the researchers listened to them very carefully and encouraged and inspired them to imagine, ideate and draw. The study also shows that the researchers' questions, which sometimes could be quite provocative, had a special meaning for the process. For example, in one session each child first

Figure 16. A playful design session with a group of three pre-primary-aged girls.

drew a tiger, and when the researcher asked if the animals could speak, the children seemed not to react to the question. However, later in the session, children transformed the same animals into climbing frames with tongues providing an opportunity to slide. Hence, asking if tigers could speak stimulated the children's imagination, although only when they found the proposed ideas adequately appealing. It was also noticed that surprise is closely connected to the integration of fact and fiction in children's narrative thinking.

In addition, the study showed how important narrative thinking may be in children's activity and in collaborative knowledge building. We submit that by paying careful attention to the verbal and non-verbal narratives that children construct during creative episodes researchers and educators can arrive at a better understanding of the underlying social and cultural influences that appear to shape and support children's imaginative processes. The study also yielded evidence that emotions are closely linked to imagination (e.g. Egan, 2005), to narrative thinking

(e.g. Bruner, 1996), and to all human activities, and are thereby worthy of attention in learning processes, as mentioned earlier.

The possibility thinking of six- to seven-year-old children emerged as an imaginative way of testing and integrating fact and fiction as they planned and designed their ideal playing environment. We noticed that combining fact and fiction seemed to inspire children and tended to exclude conventional elements from the narratives.

We distinguished four distinct features in children's narrative thinking: entity, fascination with surprise, integration of fact and fiction, and emotions. In addition, we posited the concept of *shared narrative thinking*, which can be described by the following adjectives: imitative, associative, productive, transformative and emotional. These features were explained in chapter 2.2. We also refer in this study to a model of reciprocal creativity. It expresses well the essence of collaborative idea generation: ideas are refined such that none of the children can create them alone. Hence, we drew a distinction between the concepts of shared narrative thinking and creative collaboration. Narrative thinking emphasizes a state of joint thinking and mutual action accompanied by emotional factors, whereas creative collaboration refers to reciprocal creativity and is a more goal-oriented action (Study II).

Following grounded theory (Glaser & Strauss, 1967; Strauss and Corbin, 1990; 1998), we developed a model of narrative thinking. We defined the role of narrativity in creative collaboration and located the narratives created by the children in the model. We situated all the narrative-creation processes in the three-dimensional model in order to illustrate their emergence and presence. On the basis of this combination, we sought to understand this complicated process and in particular its meaning in the narrative construction of reality (e.g. Bruner, 2003).

The study revealed that playfulness has a significant role when listening to children's voices for research purposes. We concluded, consistent with the assumption of Egan (2005), that playfulness during activity may help children think about and reflect on the world in a way that

is free from constraints. Hence, the playfulness-based research method seemed to serve this research well, in which children's imaginative ideas and views were the focus.

The study was published for first time in the proceedings of the NBE 2005 conference. Later, we were asked to contribute this study to an international edited volume on children's creativity, and thus Study II is referred to as comprising two publications. The latter article better elaborates the phases of analysis and the findings of the study, whereas the conference article perhaps better illuminates the process of developing the PLE.

4.2.2 Evaluation

The clear strength of the study for this thesis is that it provides insights into narrativity, creativity, and imagination in children's activity. It also illuminates creative collaboration and knowledge co-creation – the features on which creative and playful learning is built. The study has contributed substantially to the development of the theoretical and pedagogical approaches underpinning creative and playful learning (CPL) by generating further interest in how narrativity, creativity and imagination should be included in learning in the PLE setting.

Furthermore, the study provided evidence that group composition might affect the level of collaboration and quality of knowledge co-creation; that is, the most coherent narratives seemed to emerge between same-gender children and in the groups where children were used to playing with each other. One reason for the finding might be the close relationship between the children, who were also more successful in creating rich play environments collaboratively. Vygotsky (1986) claimed that verbal patterns vary according to the degree of emotional and intellectual closeness.

Another advantage of the study lies in the richer understanding it yielded of peers' and adults' role in children's creative collaboration. The

researchers' participation and engagement in the design sessions was important. They acted as interviewers, designers and researchers, but first and foremost as inspirers and motivators. The researchers had to be very sensitive in the creative situation, on the one hand staying in the background and, on the other, actively participating in discussions and activities.

The study has had significant implications for further research (Study V) and the development of the PLE, including the development of *the Different World* game concept (Kultima, 2006; Hyvönen et al., 2006; 2007). Different World offers an innovative idea of how technology-enriched innovative learning environments can be used meaningfully in curriculum-based learning. The second design experiment (Study V) in the PLE was systematically based on the findings and theoretical conclusions of this study. Hence, the study has also contributed to the development of the theoretical and pedagogical approach underpinning creative and playful learning (CPL). In this respect, the study strongly whetted my enthusiasm to understand and conceptualize the central patterns of creative and playful learning. The research is also a contribution to the discussion on the school of the future. On the basis of the results, we concluded that the learning environment of the future should be adaptive, flexible and customizable if it is to support children's own narrative activity and creative collaboration.

However, in light of the present research, the evidence of the children's narrative thinking and shared narrative thinking is still weak and further research is needed to better explain children's creative collaboration and shared narrative thinking. The relevance of group composition for successful collaboration also merits further study, as do issues of gender differences. A weakness of the study is that it does not explain how girls' and boys' joint activities differ in creative collaboration.

The research had still another significant outcome in that it furthered our goal of doing multidisciplinary research by examining the focal phenomena through psychological, educational and philosophi-

cal lenses. Based as it was on theoretical and methodological triangulation, the study is in line with the notion that a multi-method approach can provide new knowledge about the complex dynamics found in joint thinking and co-constructive endeavors (John-Steiner et al., 2005, p. 193). It can be assumed that analyzing the data using two different methods (grounded theory and narrative analysis) for two research purposes (Studies I and II) increased the reliability of the study.

4.3 **Study III:** Exploring children's ideas regarding the school and learning environment: children as designers of ideal learning environments and as creators of the future school

Kangas, M. (in press). Finnish children's views on the ideal school and learning environment. *Learning Environments Research*.

4.3.1. Overview

This study, which draws on grounded theory, reports on an investigation of children's views of their ideal school and learning environment. The study contributes to the discussion of the future school by listening to "school experts" and discussing how their thoughts could be realized in the development of school to better respond to the challenges of the future. The empirical data were collected at three primary schools in Rovaniemi. Ninety-three pupils (43 girls and 50 boys) aged 10 to 12 participated in the study by writing about the school of their dreams. The children were prompted to imagine the kind of school and environment in which they would like to study. The guiding questions were: "Imagine the kind of school you would be eager to study in. What does the school look like? What kind of activities does the school offer?" The

children were allowed to use their imagination in their descriptions (see Figure 17).

Based on the data analysis, I decided to use the term 'well-being' as a central descriptor of learning environments in which schoolchildren are happy to study. The findings that the ideal learning environment facilitates well-being reveal that students desire a learning environment that contributes to the following, partly overlapping factors:

1. Physical well-being,
2. Educational and cultural well-being,
3. Socio-emotional well-being and joy of learning, and
4. Fantasy and innovations.

The children's ideal school and learning environment enables physical well-being and environmental comfort. Following Awartani et al. (2008), physical well-being refers to "feeling comfortable with one's body and physical ability, and being in a healthy physical state and a healthy physical environment". For the most part, the children wanted various physical sports and playground and game facilities. Almost equal proportions of girls and boys regarded sport as an important factor. In the children's stories, expectations of various pleasant learning methods and tools for learning were equaled by expectations of learning in informal settings. These expectations fall into the categories of educational and cultural well-being. Educational well-being is reflected in the use of methods and practices which respond to the children's desire to be active, playful, creative and participative in learning. Cultural well-being refers primarily to the use of the various and purposeful cultural tools available when learning in school.

Alongside their ideas with regard to the physical environment and instruction methods in their ideal school, the children highlighted important social and emotional aspects of the ideal learning environment. Their requirements pertained to socio-emotional well-being and the joy

Figure 17. A child thinking about the kind of school she would like to study in.

of learning. Socio-emotional well-being is defined in the study as feeling good about relationships (peers, teachers, other adults) and feeling safe, competent and happy in the learning community and in the physical learning environment. The children's ideal school and learning environment was also innovative, affording and fantasy-oriented. The category of fantasy and innovations was divided into two subcategories: fantasy-oriented ideas and unconventional school practices. These comprise ideas and practices that promote schoolchildren's curiosity and creative citizenship.

As summarized, the children's learning environment broadened from formal learning places to informal settings, and offered an affordance network (Barab & Roth, 2006) that empowered them. I use the term 'Broadening and Empowering Learning Environment' (BELE) to illustrate the totality of the learning environment that children's expectations revealed. This is an environment that provides potential for vari-

ous informal and formal learning experiences and promotes children's well-being, joy of learning and school satisfaction. This means that children find it to be an encouraging environment.

The study has offered insights in my work to define learning in future learning environments. The research also confirmed previous findings that children have relevant and appropriate thoughts and ideas regarding their learning environments, that they are well aware of the potential of schools, and that they fully understand that the learning environment has to support different aspects of their development (e.g. Kershner & Pointon, 2000; Smees & Thomas, 1998; Smith & Parr, 2007).

4.3.2 Evaluation

Introducing children's perspective informs the recent debate on the future school in many ways. First, children's expectations are quite realistic, which reflects their ability to assess their own learning environment. Second, the views include widely varying aspects of the learning environment: physical, social, emotional, educational and cultural. In addition, the present perspective, which highlights innovation in learning environments, has much to offer the discussion. There was not so much evidence in the data illuminating the issue of children's "*intellectual well-being*". One reason for this may be that the children view intellectual aspects of learning as important per se, and take them for granted in the school context.

Grounded theory (Strauss & Corbin, 1990; 1998) served the purpose of the study well, that is, identifying quite unfamiliar phenomena and yielding a theoretical account. The data gathering was successful, and the children engaged in the design task enthusiastically. I use the term "design session" in this study, because children were allowed to both write and draw in the research situation. Yet, only the written narratives were analyzed for research purposes. One weakness of the study is that,

unlike the preschoolers, the older children were not offered a possibility to ideate their ideal learning environments in creative collaboration. However, the writing task best served the aim of getting an opportunity to listen to as many children's voices as possible.

The study inspired me to consider how well the findings echo what we know about the pedagogical foundation of the PLE. The preliminary results of the study were presented in the book "Tutkimuksia leikillisistä oppimisympäristöistä" (Hyvönen et al., 2006; 2007). My subsequent research work in the InnoSchool Research Consortium[26] has provided new perspectives with which to interpret and understand the findings of this study. Hence, the in-depth analysis sparked by the findings presented in this study has provided many insights into how learning environments should further a variety of aspects of children's well-being. The study contributes to the very recent debate on the future school and its educational features. I will take a closer look at this issue in chapter 5.

4.4 **Study IV:** Exploring children's experiences of the playful learning environment in curriculum-based formal education: Children as players and learners in playful learning environments

Kangas, M., Hyvönen, P. & Latva, S. (2007). The Space Treasure outdoor game in the playful learning environment: experiences and assessment. In H. Ruokamo, M. Kangas, M. Lehtonen & K. Kumpulainen (Eds.) *Proceedings of the 2nd International NBE 2007 Conference: The Power of Media in Education* (pp.181–194). Rovaniemi: University of Lapland Press.

26. The InnoPlay project is part of the multidisciplinary InnoSchool Research Consortium, where the concept of the future school is being co-designed

4.4.1. Overview

In order to answer the research question how curriculum-based playful learning can be applied in an outdoor playground context, we carried out a design experiment in a pilot PLE setting in 2006. We examined children's experiences of *the Space Treasure* game, designed by Suvi Latva (see Hyvönen et al., 2006; 2007) for a playground device, the *Wave Platform* (Figure 18). The study centers on an experiment in which we created visions of a technology-enriched playground device that challenges children to play and learn. The idea of technology-enriched playground equipment as a setting for plot-based game content was inspired by our initial studies in the test environment (Hyvönen et al., 2005). The design experiment was based on physical and playful game-based learning on the playground.

Children (N=18) from the fifth and sixth grades (aged 10 to 12) played the game in groups of three or four. Ten boys and eight girls participated in the study, with most of them playing the game several times. The basic idea of the game was for the children to move on the platform by making multiplication and division calculations in the imaginary frame of a space theme. The goal was to search for the hidden space treasure on the steps of the play equipment. However, because the technological apparatus required was not available in practice, we designed the experiment so that the researchers simulated the technology. The edges of the wave platform simulated the "home planet" of each player and were the starting points of the game. The children were able to see the numbers 2 to 12, which we attached to the 25 steps. They moved in all directions by using the available numbers for multiplying and dividing. During the game, they were asked to verbalize the mathematical operations they were performing. The aim was to avoid bandits, find the treasure and bring it to the home planet.

The data were collected by observing and videotaping all of the implementations of the game and by interviewing the children after playing the game. We evaluated the gaming and playing through current

Figure 18. Playful game-based learning on the Wave Platform.

learning theories and the concepts of playability, enjoyability, usability, and learnability. These perspectives we derived from Caillois's (2001) definitions of what a game is, Csikszentmihalyi's (1990; 2006) conception of the flow experience, and a practical perspective on usability in the playground context.

Despite some limitations, such as the unavailability of the technology belonging to the original game concept, the findings showed that children enjoyed active play in the mathematical and plot-based framework. The fact that the technology had to be simulated did not seem to disturb the players. We also noticed that a game which challenges students' mathematical skills, yet is based on chance as well, attracted the children. As a result, we concluded that a plot-based game designed for a playground device can offer a meaningful context for curriculum-based learning. The game also fulfilled other criteria that increase playability: it involved all the game forms distinguished by Caillois (2001) – *agon, alea, mimicry* and *ilnix* – which describe the playability of the

game in this case. As presented earlier, Caillois uses *agon* to refer to games in which the central aspect is competition and *alea* to signify chance- and luck-based games. *Mimicry* denotes games based on imitation and simulation, and *ilnix* games which involve vertigo and physical achievement.

Where creativity and the presence of the flow experience are concerned, it seemed apparent that the children felt some sort of enjoyment while playing. Even if it was not flow, the learning of new skills, the goal orientation, continuity, feedback, rules, and a possibility to create strategies (Csikszentmihalyi, 2005; 2006) provided satisfaction and made the playing challenging enough. Hence, in spite of the easy numbering on the steps, the children found it challenging to create game strategies and to move around by making calculations. The game provided the enjoyment that is also typically related to creativity and playfulness.

4.4.2 Evaluation

In reflecting on the findings, I have concluded that the research had much to offer for the development of the PLE. First, the theoretical concept of playful learning and how it is defined in this thesis is strongly based on the findings of this particular study. Hence, the insights gained into playful game-based learning as a form of learning has influenced the theoretical and pedagogical approach for creative and playful learning. Second, the subsequent design experiments in the authentic PLE context were based on this pilot experiment (study V; e.g. Kangas et al., 2009; 2010). This study helped me better understand how gameplay, creativity and learning can be intertwined in this kind of learning environment. It also helped me to see how children at different achievement levels can benefit from playing games: they play and learn with the assistance of peers. Indeed, because the game included an element of chance, it provided an opportunity for low-achieving students to succeed as players and learners while practicing their basic mathematical

reasoning. This can be assumed to influence children's overall competence as learners.

In this respect, that is, in exploring how physical game-based learning and the PLE could meet the challenges of curriculum-based learning, the study was meaningful. It provided an example of how a playground can serve as a learning environment for curriculum-based learning with or without technology. The study shows how playful learning can be implemented outdoors, in an informal learning environment. Even if the pilot experiment was less than ideal in terms of the facilities available at the time, it has been of great importance in designing future PLEs and the related pedagogy.

There are multiple ways to conduct design-based research (Barab, 2006). The qualitative study described here started the design cycle of design-based research (DBR) in quite simple circumstances in the innovative playground. It does not fully meet the requirements of DBR, but did provide valuable information on the PLE. One weakness of the study was that the design experiment was carried out mostly by the researchers, with the teachers playing a minor role. The teachers stayed in the background; when one group of children took their turn playing the game on the playground, the others were with their teachers in their classrooms. Hence, unlike in design-based research in general, teachers were unable to influence the course of the experiment. In addition, the researchers' role in the experiment was different compared to that in many other studies related to technology or innovations: they had to simulate the technology of the playground equipment by giving feedback during the game. For this reason, it was important to prepare an exact script for each session, because the game was based partly on chance – *alea* in Caillois' (2001) terms.

Another weakness was the size of the study. Only eighteen children played the game and gave feedback how it worked. To better understand how children experience the PLE and the game-based learning on the playground, the game should have been tested in varying settings

with children of different ages. A short experiment does not necessarily bring out all the aspects of playful learning on the playground. In addition, more systematically design experiment would probably have given better insight of children's experiences of the device as a play and learning environment. Despite some weaknesses of the study and the game environment, the experiment provided an excellent opportunity for children to be involved in the development of this innovation, although it has never been realized as a technology-enriched product due to the challenges of integrating the technology with the wobbling steps in the Wave Platform. This notwithstanding, this study has been followed over several years by new types of designs in which the teachers have been deeply involved in developing methods and innovative learning environments. At the time the design experiment was conducted, only the pilot school in Rovaniemi had a *Wave Platform*. Nowadays the equipment is enjoying popularity in many schools and can be found in several playgrounds around the world, although it is not enriched with technology. The future will tell if this particular piece of playground equipment can be successfully combined with technology.

4.5 **Study V:** Exploring children's and teachers' experiences of the playful learning environment in curriculum-based formal education: children as knowledge co-creators and players, teachers as tutors in the PLE

Kangas, M. (2010). Creative and playful learning: learning through game co-creation and games in a playful learning environment. *Thinking Skills and Creativity*, 5(1), 1–15.

4.5.1. Overview

This study followed the design experiment presented above and was conducted around the same time in 2006, right after the pilot PLE was constructed at the Kauko School. In this experiment, children aged 7 to 12 years studied curriculum-based topics by creating their own game contents for the games and playing them. As in the previous study, technology was not fully exploited. Children planned their game worlds on paper and the researchers took the ideas out onto the playground. The learning methods in the one-week experiment alternated between classroom activities and playground activities, applying a tentative version of the pedagogical approach for creative and playful learning (CPL). However, the implementation of the design experiment was strongly affected by the *Different World* game concept (Kultima, 2006) designed for the PLE. Study II contributed to the conception of learning in the design experiment: learning was characterized by narrativity, possibility thinking, creative collaboration, imagination and knowledge co-creation. In addition, in guiding the participants to consider the differences between factual and fictional worlds in science learning, the design experiment challenged researchers, teachers and children to test something novel in education. Therefore, instead of focusing on learning itself, the study concentrated on children's and teachers' *experiences* of the experiment.

Sixty-eight children and four full-time teachers from the Kauko School participated in the study. The children comprised four groups: first graders (N=14), second graders (N=16), a combined class of third and fourth graders (N=20), and a combined class of fifth and sixth graders (N=18). Each of the classes focused all of its efforts over one week on the project. The main data were collected through semi-structured group interviews of children (N=38, 15 girls, 23 boys) and teachers (N=4). Group interviews were conducted systematically in only two of the classes: in grades 3–4 and 5–6. The reason for this choice was that in these classes the design experiment better adhered to the idea of creative and playful learning where working in small groups was concerned

than was the case in the younger children's classrooms. Research data were also gathered by participant observation in the classes and on the playground and by video recordings of the various learning phases (see Figure 19).

The learning activities were divided into the following phases: 1) studying the topics in diverse ways in the classrooms (orientation phase), 2) planning a "what if" play world by turning fact into fiction (planning phase), 3) playing a common class game on the playground (play phase), and 4) reflecting on and evaluating both factual and fictional issues in the classroom (elaboration phase).

To answer the question how children experienced creative and playful learning processes, I developed a coding scheme to categorize the factors that children reported as the significant challenges they faced during the learning phases. Five categories emerged from the data. The first, *intellectual potential and challenges,* relates predominantly to issues that arose in turning fact into fiction and in composing stories. Most pupils thought that they had been given a chance to think imaginatively and creatively while creating the common game and while learning.

The second category, *participative potential and challenges*, related to small-group work and collaborative decision making in small groups and at the classroom level. Since the objective was to create a common play world, it was first necessary to decide on a common goal at the group level and then at the classroom level by making compromises, negotiating and deciding what ideas were to be included in the common plan. Third, *potential and challenges with knowledge co-creation* were categorized separately from the participative approach, and were divided into two parallel processes: a) fact-based co-creation and b) fiction-based co-creation, the latter being emphasized in the planning and play phases. These processes seemed to complement one other, and teachers' and researchers' participation – questions in particular – were able to create spaces for considering factual and fictional issues at the same time.

Figure 19. Views of the creative and playful learning phases in the PLE.

Fourth, the learning processes produced *emotional potential in and challenges for* the children. They could reflect on and test a variety of feelings regarding their play worlds at the level of imagination or action while playing on the playground. The co-created play world, with its threats and narratives, served up the whole repertoire of human emotions in many cases. However, playfulness, humor and the joy of doing were emphasized. Positive feelings were associated with the active way of learning and involvement, designing imaginative things, group work, collaboration and the opportunity to share the fictive game world with others on the playground. Finally, numerous *opportunities for physicality and sport* were evident, one example being running on the playground while playing the games.

The teacher interviews revealed that learning through the integration of fact and fiction and based largely on small-group work demanded a different type of instruction and tutoring than that found in traditional mainstream teaching. The teachers felt challenged in drawing the line between sufficient tutoring and over-tutoring when engaging and nurturing the children's imaginations. They also considered it important

that the children learned to negotiate and make decisions and to face the challenges related to participation in this study.

In order to outline a theoretical and practical model for the PLE, the study formulated a pedagogical model for creative and playful learning. In one of its principal findings, the study showed how many ways creative and playful learning can be applied in the PLE context, and how many different technological tools, spaces and places can be included in the process. The research has much to offer to the future school through the many non-traditional and inspirational aspects of the learning processes it has explored.

4.5.2 Evaluation

One strength of the study was that the pedagogical design and teaching arrangements were carefully planned and implemented in collaboration with the teachers. In this respect, the experiment adhered to the principles of DBR (e.g. Barab, 2006). Some need for improvements was noted during the research process. For example, the teachers should modify the curriculum, the orientation and game design phases to better suit children of different ages. As Brown and Campione (1996) have emphasized, design is an integrated system, and the evaluation of design is an ongoing process that changes as designs change. Collins et al. (2004, p.17) illuminate the same idea as follows:

> Designs in education can be more or less specific but can never be completely specified. Therefore, evaluation of designs can only be made in terms of particular implementations, and these can vary widely depending on the participants' needs, interests, abilities, interpretations, interactions and goals.

Although the design and the theoretical groundwork had been carefully done and co-operation with the teachers was smooth, the experiment in

the pilot environment was challenging to implement. Most challenges related to the lack of technology, which was still under development and therefore only partly in use on the playground. The game concept would have required more sophisticated technology for optimal educational use. Accordingly, as researchers we had to collaborate closely with the experts from the playground manufacturer, especially technology experts, during the experiment. It is also worth mentioning that additional challenges included the cold winter weather at the time: the outside temperature was minus 20 degrees Celsius, which had some impact on the use of technology, mainly the use of laptops on the playground. This experience, however, reminded us of how technology can be a sensitive element, especially in outdoor contexts.

According to Barab and Squire (2004), in contrast to other methods focused on producing theory – such as grounded theory – the most radical shift proposed by design researchers may be the requirement that inquiry involves producing demonstrable changes at the local level. As in the development of other educational innovations, in this case we worked closely with teachers and children from the school to design, develop, implement and evaluate the innovation together in authentic learning situations (cf. Brown, 1992). Another challenge to be addressed was the novelty of the environment, for the physical playground and the method were new to the teachers as well as the children. However, most of them participated in the design experiment with enthusiasm. In particular, the head teacher was very motivated and inspired other teachers to engage in the experiment and use the PLE later in their pedagogical practices. This kind of commitment has a positive influence on *systemic variables* (Collins et al., 2004), which contribute to the further adoption of innovations at the school level.

Design studies usually end up collecting large amounts of data such as video recordings, in order to understand what is happening in detail (Collins et al., 2004). In this study, the research data included interview and video material, as well as field notes from participant observation.

Had our focus been learning processes, the video recordings would have been carried out more systematically. Yet, as mentioned earlier, the focus was on experiences and development ideas instead of exploring the effectiveness of the design for learning. However, a more systematic and much longer design experiment would have given a better understanding of how a playful learning environment can serve curriculum-based learning. It takes time for children and teachers to become familiar with a novel learning environment and therefore the study might reveal incomplete and skewed information on their experiences. However, the duration of the design experiment was determined by the time resources in our research project, which ended immediately after the design experiments were conducted at Kauko School.

One clear strength of the study was that it used data from multiple sources and was strongly based on researchers' collaboration in designing and implementing the inquiry. Such an approach makes it possible to increase the validity and reliability of the research (Wang & Hannafin, 2005; Design-based Research Collective, 2003). On the other hand, as is often the case in design research, replication is difficult to achieve, and the present study is no exception. First, the technology was developed in the learning environment. Second, the study involved too many theoretical perspectives to control. It is also important to be aware of other limitations: the effectiveness of a design in one setting is no guarantee of its effectiveness in others (Barab & Squire, 2004; Collins et al., 2004). Therefore, the key challenge in DBR is to "draw connections to theoretical assertions and claims that transcend the local context" (Barab & Squire, 2004).

The emphasis in the present study was on linking children's imaginations to the subject-matter and on providing new tools for promoting their thinking skills and creativity while learning. These objectives were pursued along with improved academic achievement and the promotion of physical activities and physical play. The study showed that learning consists of several dimensions at the same time. It produced a model of

creative and playful learning and motivated me to develop the model further in this thesis. The model was designed to integrate curricular subjects, environments, processes and methods. Hence, the experiences gained from this design-based research led to a new iterative cycle of studies for producing a better-justified set of theoretical constructs and tools for implementing a PLE in education with various combinations of creative and playful learning. These studies were carried out in 2007 as follow-up studies after the construction of the SmartUs playground and improvements to its game development tools.

5 TOWARDS FUTURE CREATIVE *and* PLAYFUL LEARNING ENVIRONMENTS

Sawyer (2006c) states that the key issue in education is to outline a vision for the schools of the future. Many current studies of the future school (e.g. Bottino, 2004; Fisher & Konomi, 2007; Natriello, 2007; Holm Sorensen, Danielsen & Nielsen, 2007; Smeets, 2005) focus on its relationship with technology and innovations that are expected to support learning (e.g. Sawyer, 2006; 2008; Songer, 2006; Tuomi, 2007). Some studies suggest that future learning environments will be more informal, interactive, global, and technology-based environments that may be located outside traditional classrooms (e.g. Natriello, 2007; Smeets, 2005; Tuomi, 2007). Hence, many interfaces can be seen between these visions and the PLE and the findings of the empirical studies.

The significance of informal learning environments, where learning takes place in multiple contexts and environments, is widely acknowledged (Anderson et al., 2003; Ash & Wells, 2006; Bekerman et al., 2006; Hull & Greeno, 2006). The PLE represents an informal learning environment as well as a forum to integrate formal, non-formal and informal learning. Interestingly, many features of informal learning environments are the same as those advocated for the traditional school on the basis of recent learning theories (e.g. Resnick, 1987; Tynjälä, 2008). First, school activities are customarily based on individual activities, whereas much informal learning is socially shared. This is an important viewpoint in light of the current discussion on how knowledge is created in collaboration. Learning in groups is justified in part because most knowledge work takes place in complexly organized teams (Sawyer, 2006c).

Second, paper and pencil are emphasized in schoolwork, while outside of school people are now accustomed to using various intellectual, technological and media tools. Studies of professionals as knowledge workers show that they almost always apply their expertise in complex social settings, using various cultural tools, including a wide array of technologically advanced tools, as well as pencil, paper and blackboards (see e.g. Sawyer, 2006c). A third salient viewpoint pertains to knowledge producing and content creation (e.g. Hayes, 2008). Many young people are used to producing content on the Internet or for virtual games: they create knowledge, seek information from various sources, and form social networks in virtual learning environments (cf. Sefton-Green, 2009).

The general scientific goals of the present study were to ascertain how *learning* can be defined, what kind of pedagogical approach is needed for using the PLE in pre-primary and primary education, and what kinds of pedagogical underpinnings future learning environments should rest on. Crucially, these aims were pursued while taking into account educational stakeholders' views, current visions of the future school, and learning in a knowledge and creativity society. The study shows that the PLE is not only an affordance for integrating physical activity, play and learning (see Hyvönen, 2008), but also a meaningful context for integrating creativity and innovation with curriculum-based learning. In this respect, the study lends support to the theoretical premise that it is not sufficient to define learning solely in terms of play activities and features of playfulness as qualities of play. There are many other elements in the PLE that support learning, as the theoretical and pedagogical approaches for creative and playful learning show.

Designing learning environments that are based on the theoretical underpinnings of this study requires not only appropriate technologies and facilities, but also interest and motivation on the part of educators, designers and decision makers. The sections to follow describe how I see the future learning environments that allow and promote creativity and playfulness.

Creative and Playful Learning Environments

Generally, the learning environment is referred to in this study as a physical, intellectual, socio-emotional, pedagogical and cultural entity in which learning occurs and which enhances children's achievement and development (cf. Fraser, 1998; National Board of Education, 2004). The *Creative and Playful Learning Environment* (CPLE) is a pedagogically justified learning environment where learning takes the form of creative and playful learning activities, involves the production of knowledge, content, artifact or media, and uses indoor and outdoor, formal and informal, and physical and virtual environments.

As a concept CPLE is broader than the PLE because a technology-enriched playground is not necessary for creating a creative and playful learning environment. The CPLE represents a future (playful) learning environment. The creative and playful learning environment is continually transformed depending on the resources and affordances (cf. Hyvönen, 2008) available today and in the future. The following table (Table 5) presents some differences between the features of a creative and playful learning environment and the classroom as a traditional learning environment (cf. Hyvönen, 2008; Sawyer, 2006a).

Table 5. Comparison of future creative and playful learning environments and traditional learning environments

Future creative and playful learning environments	Traditional learning environments
Encourage the use of indoor and outdoor places and spaces along with classrooms	Focus on classroom activities
Encourage collaborative knowledge creation and content design: Learners are knowledge creators and media producers	Focus on individual knowledge acquisition and building: learners are mainly knowledge consumers (see Resnick, 1987; Resnick, 2007)

Encourage an active and participative role in learning through mind-on, hands-on and body-on learning activities	Focus on listening to teachers talking (e.g. Rantala, 2005)
Integrate methods and curriculum subjects	Focus on one curriculum subject at a time
Acknowledge the status of knowledge gained from informal learning environments	Inadequately acknowledge children's expertise gained from informal learning environments
Use new technology and various media tools in a versatile way	Use new technology and media tools quite a bit, yet focus more on paper and pencil (e.g. Säljö, 2004a)
Adapt to apply various innovations	Conform and adhere to familiar ways of teaching

This comparison of the future creative and playful learning environments and the traditional classroom environment is not to suggest that classrooms are unsatisfactory as learning environments (see also Hyvönen, 2008); rather, it presents complementary and additional arguments for creating learning environments that might better mirror the surrounding society. Many traditional ways of learning are reasonable and justified. Creative and playful learning approaches used in conjunction with the PLE provide an alternative way to implement curriculum-based teaching and learning.

One goal in a creative and playful learning environment is to contribute to children's physical well-being (Study III). This means that sport and physical education are highly valued. They can be integrated with other curricular subjects, play and playground games. This follows the current recognition of the interdependence of physical and mental well-being, which regards the education of the body and the mind as equally important (see OECD, 2007). A physical learning environment extends from the classroom and school building to outdoor playgrounds, nature and other informal learning places and spaces, such as museums and school kiosks (Study III). In the design experiments conducted in the PLE settings (Studies IV and V; Kangas et al., 2009;

2010), children studied the subject at hand in classrooms, in computer classes, on the school playground, at home and in various technology and media environments. Ordinary classrooms have very little space for children's activities, group work or using new technologies; they are predominantly spaces in which students can listen (see also Dewey, 1957). Creative and playful learning activities require a great deal of space for collaborating, doing and learning (Study III).

A creative and playful learning environment encourages collaborative knowledge creation and content design; in it learners are viewed as knowledge co-creators and media producers. It also encourages learners to take an active and participative role in their learning by involving them in a variety of hands-on and body-on learning activities. Hands-on activities entail the use of meaningful tools for learning and collaborating. Some scholars have argued that games and new technological applications will replace traditional textbooks to some extent (e.g. Sawyer, 2008; Tuomi, 2007). Tuomi (2007) points out that in the future games will not only be useful in simulating the real world and providing platforms for skill and knowledge creation, but will also provide social micro worlds that become platforms for creative and immersive experimentation. Today, children generally study from a textual reality (Säljö, 2005); that is, they study most subjects from schoolbooks and through individual learning activities. In the PLE, children may collaboratively design content and artifacts for the playground games: they may draw, take digital pictures or make video clips, with the outcome of this work then used as elements of the game or play. Body-on activities encompass learning through physical activities and gameplay with or without technology. According to Claxton (2007), learning activities should be selected and designed to stretch each aspect of the student's learning capacity. Neither 'stretching' nor the joy of learning will occur merely by listening to a teacher (Rantala, 2005).

The creative and playful learning environment of the future will "use technology and a variety of media tools in a versatile way". Hence, it

will enhance children's media skills and proficiency, which are considered essential for future citizens in the global community in an age of information and innovation (cf. Claxton, 2002; Palincsar & Ladewski, 2006; Sawyer, 2006a). *Media proficiency* here refers to Leu et al.'s (2004) definition of new literacies; it includes the skills, strategies, and dispositions necessary to successfully use and adapt to the rapidly changing technologies and contexts that influence all areas of our lives. Media and technology are seen as a natural part of the content for any subject where various media skills can be learnt, such as mathematics, foreign languages or physical education. A media-rich learning environment caters to the needs and skills of today's children in spanning a range of media and new technologies such as digital cameras, social media, the Internet, videos, mobile phones, iPods, computer games, virtual learning environments and video design software.

The PLE and the SmartUs playground facilities can be seen as a rich media environment that integrates an outdoor playground with computers inside the classroom and thereby links students to SmartUs environments in various countries. Its game development tools – LinkIT and PlayCreator – facilitate the creation of games using voice, pictures or text, and provide numerous opportunities to use technological tools for creating game content. The playground also offers a unique opportunity to develop virtual gameplay and knowledge co-creation communities in global learning environments. This vision is in line with arguments that learning is increasingly both *local* and *global* (e.g. Natriello, 2007; Tuomi, 2007). This trend is not restricted to formal curriculum-based learning, however, for the SmartUs playground provides opportunities for local and global learning across the range of formal, nonformal and informal learning purposes.

Schugurensky (2006) defines *formal* education as an institutionalized system that generally entails compulsory basic education, whereas *nonformal* education refers to all organized programs that take place outside the formal school system and are usually short-term and voluntary in

nature. Both formal and nonformal education involve some degree of institutional design and organized teaching efforts, which, according to Schugurensky, makes them 'education'. Informal learning, by contrast, embraces many things that students learn in school and throughout life, intentionally and unintentionally, that are not part of the curriculum (Livingstone, 2006; Schugurensky, 2006). Informal learning has always been an important source of skills and knowledge, but new technologies make it much more effective and visible (Tuomi, 2007). On the one hand, it enables children to gain expertise outside of the school and, on the other, makes it possible for them to use adult experts via virtual environments at school; that is, children have online access to a wide range of part-time mentors who mainly live and work in the world outside the school (Lemke, 2002). The network created by SmartUs users and players is one example of such an expertise network of the future.

Furthermore, creative and playful learning environments encourage creativity and innovations. This is in line with the current national and international trends for innovative learning environments (Finnish Ministry of Education, 2005; OECD, 2008). For instance, the Finnish Ministry of Education (2005) has proposed that schools should stimulate and enhance learning strategies based on creativity and innovation. The ministry has also stated that creativity-based learning methods should be implemented in order to promote media education. Teachers have an essential role in creating a learning environment for creative work, collaboration and innovation.

Lemke (2002) has put forward the criticism that the school teaches the content but not the medium. By this he refers to educational practices that do not teach students *to talk* science, *to write* science or *to draw* science. He proposes the introduction of learning activities in the curriculum in which students would, for instance, explore how complex meanings are expressed by combining words and graphic images. In that vein, we can ask, "Do educational practices require learning activities which teach how *to play science*, or how *to create* science *games*?"

Applying Lemke's (2002) list, the creative and playful learning environment can encompass innovative and collaborative projects, multimedia and playground study modules, specialized learning activities such as content design and game co-creation, physical outdoor activities, games and play. Students can also create global game designs or knowledge co-creation groups, as well as games for each other. These creative and innovative learning communities can consist of children and experts of different ages. (Lemke, 2002).

To sum up, future creative and playful learning environments

1. combine formal, informal and nonformal learning environments, such as classrooms, outdoor playgrounds, nature, virtual spaces (studies, III, IV and V);
2. provide multiple learning activities and emotional *experience*s (studies I and II);
3. respond to the challenge of children's well-being, for example, intellectual, socio-emotional, physical, educational and cultural well-being (study III); and
4. afford innovations and contribute to the joy of learning (study III).

In light of this study and its main findings, creative and playful learning environments are not valuable if they do not produce joy of learning. As the empirical studies (especially studies III, IV) indicate, the experience of joy is one of the features of activities that children value and expect most. The joy of learning is a feeling of competence and a belief that learning is relevant (Awartani et al. 2008). Implementing CPL in an appropriate way with children of different ages in pre-primary and primary education in the PLE setting is assumed to enhance the joy of learning. CPL also aims to further overall satisfaction and well-being.

Finnish schoolchildren have been consistently judged to be academically successful in international comparisons; for example, they achieved

the highest scores in the PISA surveys (OECD Program for International Student Assessment). Nevertheless, as Välijärvi and Sahlberg (2008) point out, educational excellence is more than statistical averages of student achievement; it also requires that students enjoy learning at school. Educators in Finland and elsewhere are worried about children who do not enjoy school or do not find it meaningful (Hyvönen, 2008; Malin, 2006: Säljö, 2004b). For example, about 20 percent of boys in northern Finland have a negative attitude towards schooling (Lauriala & Laukkanen, 2010). Learning activities that encourage creative and playful hands-on and body-on activities, as well as the use of new technology, would presumably encourage a positive attitude towards school for both genders.

It has been argued that there are strong links between satisfaction with schooling, overall life satisfaction (Suldo et al., 2006) and physical and psychological well-being (Natvig et al., 2003). The link between satisfaction with schooling and overall satisfaction is so strong that satisfaction with schooling has come to be accepted as one of the five critical components in children's overall life satisfaction (Huebner, 1991). Follow-up design experiments investigated 331 students' (aged 7 to 12) overall satisfaction with school, with teacher gender and class size proving to be significant predictors of satisfaction (Randolph et al., 2008).

Girls, younger students, students who liked their teachers, students who had a male teacher, and students in classes with about 20 other pupils tended to be more satisfied with school than others. These are interesting signals for successful implementation of CPL in schools. Tutoring small-group work in various learning phases, for instance, is too challenging for one teacher. As yet, there is not enough evidence to answer questions such as whether children in fact enjoy schooling more when a technology-enriched innovative playground environment is used or learning proceeds in multiple creative and playful learning processes.

Sawyer has observed, "The learning sciences are centrally concerned with exactly what is going on in a learning environment" (Sawyer, 2006a, 10). The pedagogical approach for creative and playful learning

is a tool for educators to define, plan and implement creative and playful learning in educational practices. A learning environment is an entity which evolves in educational practices within affordance networks, facts, concepts, cultural tools, methods, people, commitments and goals (Barab & Roth, 2006). This means that it is the authentic learning context that ultimately determines how creative, playful or innovative a given learning environment is.

On balance, the challenge is to succeed in narrowing the gap between the rapid changes in society and formal education, given that the demands of society in the twenty-first century are likely to become even more complex. The future school should not only guarantee achievement in a variety of subjects, but also foster students' proficiency as future citizens. Claxton (2002, 23) describes the nature of education in the future thus:

> If [that] future is imagined accurately, and the curriculum is appropriate, the ensuing education will be empowering. If the methods are ineffective, or if they develop skills that are unequal or inappropriate to the demands of the real world-to-be, then education fails…If the main thing we know about the future is that we do not know much about it, then the key responsibility of the educator is not to give young people tools that may be out of date before they have even been fully mastered, but to help them become confident and competent designers and makers of their own tools as they go along.

6 DISCUSSION

> "It is precisely human creative activity that makes the human being a creature oriented toward the future, creating the future and thus altering his [or her] own present."
>
> (Vygotsky, 1998, 9–10)

In this study, I have asked how learning and the learning environment can be defined and how the school learning environment should be designed to accommodate the potential of the PLE. In addressing this question, I have built up theoretical and pedagogical approaches for creative and playful learning environments. The approaches do not contribute merely to learning in the PLE setting; they provide a theoretical foundation and a set of workable principles that can guide teachers' pedagogy and pedagogical thinking in a variety of contexts that emphasize creativity, playfulness, technological tools and physicality (see also Kangas, 2010). The approaches for creative and playful learning have been elaborated in conjunction with the empirical studies for this thesis and the related development of the PLE and its technological applications.

The studies have mainly been conducted during two innovative and multidisciplinary PLE-related research projects: Let's Play and InnoPlay. In the projects, we created something novel for *children* – today's as well as tomorrow's. The educational context has been pre-primary and primary education. The studies and project work have required a comprehensive approach to research and intensive collaboration with experts in many professions. Theory and practice have proceeded hand in hand in the empirical studies. Children, the main informants, have served as designers, players, learners, knowledge creators and content producers embarking on novel avenues of learning.

The PLE evolved in our research team in the Let's Play project, where *play* had a key status. Play is better elaborated in Pirkko Hyvönen's (2008) studies. In this thesis, I have focused more on defining *learning* and presented how the cycle of design experiments was started in the PLE. This has been a significant step forward in elaborating the relevant theory and practice. The design experiments have continued in the InnoPlay project (2007–2010). For this thesis I selected the six articles that best describe not merely the evolution of the PLE and the approaches to creative and playful learning (CPL), but also the multiple challenges of integrating and developing theory, design and educational practices. On this fascinating journey, it became essential to elaborate concepts such as play, games, learning, narration, imagination, creativity, and collaboration. However, further studies are needed to deepen the understanding of the relationships among these concepts in creative and playful learning.

In this study, I have presented the kinds of expectations children have towards play and learning environments and outlined a vision of future learning environments where these views have been taken into account. Children's views and experiences have broadened my conception of a meaningful play and learning environment to one that supports emotional experiences and empowering physical, creative and playful activities (Studies I, II and III). I have also provided examples of how new technology-enriched playgrounds can be harnessed for creative and playful learning, specifically, how design-based learning, game-based learning, creativity, technology, physicality and a knowledge-creating culture (Scardamalia & Bereiter, 2006) together can complement traditional classroom-based education.

Teachers have an important role in applying creative and playful learning in their teaching and in using the PLE. Follow-up studies show that the more satisfied students are with their teacher, the more satisfied they seem to be with the PLE (Kangas et al, 2009). The teacher's engagement with the environment and creative and playful learning

methods seems to indicate student satisfaction. The teacher's interest in technology and his or her pedagogical use of the environment are important classroom-level factors which seem to influence students' satisfaction with the PLE.

Research has shown that the critical factors in teachers' innovative use of technology are: 1) a student-oriented pedagogical approach, 2) a positive attitude towards technology, 3) computer experience and 4) personal "entrepreneurship" (Drent & Meelissen, 2008). "Entrepreneurship" here refers to the extent to which a teacher sees opportunities for professional development in the use of technology. Entrepreneurship is considered essential for the implementation of an innovation in education (Drent & Meelissen, 2008; Spillane, 1999). It is also an important signal for the pedagogical use of the PLE. Spillane (1999) assumes that teachers who are strongly committed to their professional development are more motivated to undertake activities that lead to better understanding of the goals of an innovation.

The curriculum should provide a flexible timeframe for integrating subjects and implementing creative and playful learning in the PLE. In preschool, the timeframe is not as strict as in primary school, where the school day typically consists of forty-five minute lessons followed by fifteen-minute breaks that children usually spend in the schoolyard. Ideally, the timetable would consist of formal and informal activities with curriculum-based and co-curricular club activities alternating in varying proportions (Study III).

Methodological considerations

The study applied two methodologies: grounded theory (GT) (Glaser & Strauss, 1967; Strauss and Corbin, 1990; 1998) and design-based research (DBR) (Brown, 1992; Barab, 2006; Barab & Squire, 2004; the Design-Based Research Collective, 2003). The impetus for using these two methodologies sprang from the multiple research tasks involved in developing the PLE, that is, developing facilities, technologies and

pedagogy for the future school that can contribute an innovative approach to curriculum-based learning and further children's development and well-being.

The value of both research methodologies – GT and DBR – has been borne out in the studies relating to learning environments. DBR is geared to studies of innovation[27] (Fishman et al., 2004) and was therefore a suitable approach for studying the pilot PLEs in authentic primary-school settings. Those engaged in design-based studies are designers and researchers who usually spend a great deal of time in schools and are committed to improving teaching and learning and making theories work in practice (Sawyer, 2006b). They usually work closely with teachers and students to design, develop and evaluate an innovation in authentic educational practices (Brown, 1992; Fishman et al., 2004).

Teachers from the pilot PLE schools had a special role in designing, developing, implementing and evaluating design experiments (Studies IV and V). They were designers in that they participated in developing and evaluating the PLE. Although the empirical studies were conducted in a primary school, the teachers from the other pilot school – a pre-primary school arranged in a kindergarten – also participated in developing the PLE (see e.g. Hyvönen et al., 2006; 2007).

By nature, design-based studies require multiple iterations, or progressive refinement: each cycle should provide a further refinement of the design in order to test the value of the innovation and stimulate the evolution of theory (e.g. Barab, 2006; Confrey, 2006; Collins et al., 2004). Each new application is also an extension of the theory (Barab & Squire, 2004, 9). Hence, as Cobb et al. (2003) observe, evaluation of the design – in the present case, the implications of CPL – is a continuing process and experiments are conducted to develop theories, not merely to empirically test what works. Ideally, teachers in design-based research

27. SmartUs has received an award from NOT 2007 (National Exhibition on Innovation) in the Netherlands.

should be voluntary participants; where this is the case, they clearly engage in innovation and their use of innovations will likely extend beyond the time that researchers are directly involved in the school. This can be seen as *sustainability* (Fishman et al., 2004). Likewise, in the ideal case, the pedagogical ideas that are engendered in working on the innovation will spread into teachers' general repertoires. This is the essence of *scalability* (Fishman et al., 2004). However, as Sawyer (2006c) notes, "systemic change can only occur if a design experiment results in curricula and software that can be transferred to many other schools with a relatively minor additional investment."

As Collins et al. (2004) point out, the success or failure of an innovation cannot simply be evaluated in terms of how much children learn. Therefore, different kinds of evaluation are needed. It is necessary to ask, for instance, how sustainable the design is after the researchers leave, how much the design emphasizes aspects of learning other than rote learning, and how the design affects the students' attitudes. The design experiments presented in this thesis have played a significant role in defining new cycles of creative and playful learning. Both qualitative and quantitative evaluations are seen as essential parts of design-research methodology (Collins et al., 2004). This criterion has been taken into account in the follow-up studies (Kangas et al., 2009; 2010).

The strength of the grounded theory studies (Studies I, II, V) has been obvious, as the purpose was to identify unfamiliar phenomena (Strauss & Corbin, 1998). I have tried to understand how children view their ideal play and learning environments and how the environments conform to the desirable affordances of creative and playful learning environments. The purpose of using GT is to build a theory that highlights certain issues yet does not have the explanatory power of a larger, more general theory (Strauss & Corbin, 1998). In other words, as the authors emphasize, it is more important to speak the language of explanatory power than of generalization. As a researcher, I functioned as a tool for interpreting the data. No method can ensure that the in-

terplay between the data and researcher will be creative enough. This depends on analytic ability, theoretical sensitivity and a writing ability sufficient to convey the findings (Strauss & Corbin, 1998, 272). That interplay was supported by researcher and method triangulation in Studies I and II.

Study III drew on children's written responses to the question of the ideal learning environment; it was assumed that an open writing assignment would elicit responses in which children could deal with their views in greater depth than would have been possible in an interview (see Tynjälä, 1997) or even in collaborative design. A personal writing task can reveal hidden thoughts, feelings and views and serve as a method when participants have experience in the focal topic and view the task as significant (Charmaz, 2006). Children regarded the task as meaningful because their ideas and thoughts were valued and used for research purposes. I relied on children as informants but was aware that adults' thoughts and views are also important, and that there is no objective truth.

The research used many types of triangulation: researcher, data, theory and methodological triangulation (Denzin, 1978), all of which improve the validity of the study. However, I have not relied on a single definitive account of the world. Rather, much as learners create knowledge in their learning processes, a researcher constructs a theory of the phenomenon that evolves in interaction with the data, methods, theories, cultural and technological tools, and social network. In this case, the social network extended to numerous people: colleagues and researchers in the conferences where the empirical studies were presented, designers, engineers, teachers, decision makers and similar actors.

Today, the same children who participated in the studies in two schools – Kauko School and Nivavaara Kindergarten – can use the PLE in their daily play and learning activities. Encouragingly, it has become increasingly popular to involve children in designing and contributing to their learning environments, for children's authentic perspective

is still somewhat lacking in education (see Flutter, 2006; Mitra, 2008; Smith & Parr, 2007; Thomas et al., 2000). Moreover, it is apparent that children and educators have different views on what constitutes a good learning environment, whereby the views complement each other (e.g. Piispanen, 2008).

Evaluation and future visions

This thesis, which utilizes theory and practice as well as research and design, has a number of implications for education. The study has contributed to:

- follow-up design experiments in which CPL is applied in PLE settings;
- follow-up studies related to creativity, learning and technology in other educational contexts and innovative learning environments;
- methodological issues, for example, by providing tools for using various playfulness-based research methods for gathering data from children in educational inquiry (Hyvönen & Kangas, accepted);
- theoretical issues, by providing novel theoretical frameworks, such as the use of narrative thinking in creative collaboration;
- pedagogical issues, for example, by providing novel perspectives on learning, and starting points for further PLE studies;
- follow-up research projects whose aim is to harness the pedagogy for educational practice in national and international PLE settings; and
- teacher training by providing views of creative and playful learning and the pedagogical use of the PLE.

Among its other applications, the study has implications for teacher training and curricula at the University of Lapland. Three PLE-related

courses have been offered: "Play, games and simulations in teaching, studying and learning processes" (2006), "Being a researcher in a playful learning environment" (2007), and "Playful learning environments". This thesis can also contribute to the curriculum in teacher training and university teaching in general. The research themes taken up in this work have prompted a variety of follow-up studies: children's design sessions are being analyzed and discussed further from the viewpoint of expertise studies (Hyvönen & Kangas, 2010) and methodological issues (Hyvönen & Kangas, accepted). In the methodological article, we discuss how new technologies and media applications can be used when involving children in design processes.

The follow-up international studies in Finland and the Netherlands in 2007 represent the second phase of the iteration cycle. The data analysis is partly still in progress. The other follow-up research themes of the PLE relate to children's school satisfaction (Randolph et al., 2008; 2009), satisfaction with the PLE (Kangas et al., 2009) and academic achievement in the PLE (Kangas et al., 2010). The plans regarding the follow-up studies call for developing the PLE, its physical implementations and software, and CPL.

Furthermore, the thesis has prompted an interest on my part in how teachers and children actually view learning, that is, what their conceptions of – or, rather, "scripts" for – learning are and how these correspond to the features of creative and playful learning. Research has shown that both students' and teachers' conceptions of learning and teaching influence the quality of learning (e.g. Entwistle & Peterson, 2005; Könings et al., 2005; Trigwell et al., 1999). It would also be important to study how educational stakeholders' conceptions of learning change during the time they use the PLE or apply CPL. Children's conceptions of learning have been studied in the follow-up design experiments in the PLE and in an international study on Finnish and American students' thoughts about learning (e.g. Kangas et al., in progress; Ruokamo et al., 2010), but additional studies are needed.

Many of the studies focusing on the school of the future discuss technological innovations that somehow support schooling. Although technology and media do not necessarily form part of the creative and playful learning, their value in children's life is evident. Children's worlds are increasingly populated by intelligent technologies (e.g. Bernstein & Crowley, 2008) and a variety of media environments. To understand the future of learning and the ways in which computers, media and games are changing the way children learn, this thesis has taken a look beyond learning environments to where not only the ways of learning, but also the sites on which learning occurs differ fundamentally from those associated with traditional schooling.

The PLE as a playground-based learning environment has provided a fascinating context in which to create theories and pedagogies for creative and playful learning. The study yielded insights into how challenging and, at the same time, how fascinating it is to integrate subjects and game content, as well as technology and ways of learning, with activities in an outdoor playground. The PLE – whatever form it might take in the future – is already an innovation (see also Hyvönen, 2008). Although theory and practice are still far from each other in PLE development, the experiences are encouraging. The PLE can help meet challenges such as children's obesity (e.g. Breslin et al., 2008), decreased outdoor play (e.g. Clements, 2004) or the decrease in play activities among children (e.g. Oksanen, 2005). What is more, there is one essential difference between the ordinary use of technology or media and the applications designed for the PLE: children's physical activity outdoors.

Although some technological applications based on bodily movement have been designed (e.g. Verhaegh et al., 2006; Spikol & Milrad, 2008) for children, few have been designed for curriculum-based education or outdoor use (see also Rudd, 2008). Yet, new technology and media and virtual networks can be harnessed for learning in a physical outdoor playground complex as well. Incorporating new technologies into outdoor learning and play spaces should not, according to Rudd

(2008), be undertaken merely as an end in itself, or to give the appearance of modernization; rather, that technology will be best and most appropriately applied when it significantly contributes to and enhances the wider learning aims and activities envisioned for young people. Outdoor settings are often a missed opportunity for learning and can be a valuable resource (Rudd, 2008), with or without technology. However, a built-up environment can never replace the relationship that a child has with nature (Studies I and III). Indeed, consideration of how to better integrate nature and PLE activities in learning would be a worthwhile line of research.

SmartUs and various combinations of technology-enriched playgrounds are gradually becoming more popular in primary schools in Finland and abroad, and this development is spawning new research environments. In the future, one mission will be to develop an international collaboration network between university researchers and practitioners working in PLE-equipped schools. A research network between the University of Lapland and international universities is currently under development. Another idea that might serve teachers is to create various learning objects, that is, components and tools for the PLE. Learning objects are pedagogically justified and meaningful entities that simultaneously integrate subjects, methods, environments and tools. They are based on a number of independent components which teachers can use like Lego blocks, choosing different objects for various purposes, curricular goals and learning environments.

Learning objects can be used, refined and re-used to promote learning among children of different ages and skills and thus the objects are constantly in flux, as are novel learning environments and related facilities. For instance, grammar, foreign languages and physical education could be integrated in the same object. In the ideal situation there would be a web-based environment for creating and sharing learning objects. In such a case, teachers who use the PLE in their teaching around the world would be free to use, offer or refine the objects according to their

own purposes. Similarly, children need a forum for creating content and games for the PLE and for learning. In order to take this critical next step, it will be necessary to continue research on creative and playful learning in a variety of PLE settings.

One key objective in the further development of the PLE and the SmartUs playground system is improvement of the software. The idea of taking learning outside of the school and providing technology- and game-based learning in the playground is very innovative. However, the studies on which this thesis is based show that while the experiences are positive and correspond strongly with the expectations of children, continuous development of software and networks is needed. As learning scientists emphasize, educational software should be designed around learners' goals, needs, activities, and educational contexts in what is known as learner-centered design (Quintana et al., 2006; Soloway, Guzdial & Hay, 1994). Hence, the next steps might be to involve children, not only teachers or other educationalists, in improving the design of the existing SmartUs playground software. This could be a significant advance in continuing the learner-centered design process.

New technology and media environments will change continually. However, it appears to me that in order to engage children in learning in future learning environments, creative and playful activities should be included in learning in some way. Recent studies have shown that applying creative and playful learning in the PLE context can help students learn their curriculum content regardless of their gender, age, satisfaction with schooling, or the country they live in (Kangas et al., 2010). These results encourage me to continue with the research theme in my post-doctoral studies; in particular, I will seek to deepen my understanding of the complex phenomenon of learning in future learning environments, where learning will have many other values alongside academic achievement.

The study has shown how challenging and enriching it is to be involved in innovative and multidisciplinary research and development

work at the same time. Without multidisciplinary co-operation this research would not have been possible, nor would the work on the PLE have succeeded. Primarily, my position has been that of design researcher and grounded theorist. However, I have also been learner, player, knowledge creator and content designer, like the children involved in the studies. I have learned through creative and playful learning as well. I have learned about children, learning environments and the factors that influence them, multidisciplinary collaboration, research methodologies and, above all, have come to realize that creativity and playfulness are also a way to learn and develop as a researcher. There is no end point in creative and playful learning.

REFERENCES

Amabile, T. (1983). *The Social Psychology of Creativity*. New York: Springer-Verlag.

Amabile, T. M. (1996). *Creativity in Context*. Boulder (CO): Westview Press.

Anderson, D., Lucas, K. & Ginns, I. (2003). Theoretical perspectives on learning in an informal setting. *Journal of Research in Science Teaching*, 40(2), 177–199.

Anttila, K. (2008). *Viidesluokkalaisten kokemuksia leikillisestä oppimisprosessista ympäristö- ja luonnontiedon opinnoissa*. Masters Thesis. University of Lapland, Faculty of education, Finland. Rovaniemi: University of Lapland Printing Centre.

Ash, D. & Wells, G. (2006). Dialogic inquiry in classroom and museum: Actions, Tools, and Talk. In Z. Bekerman, N. Burbules, D. Silberman-Keller (Eds.). *Learning in places. The informal education reader* (pp. 35–54). New York: Peter Lang Publishing.

Awartani, M., Whitman, C. & Gordon, J. (2008). Developing instruments to capture young people's perceptions of how school as a learning environment affects their well-being. *European Journal of Education*, 43(1), 51–70.

Barab, S. (2006). Design-Based Research. A methodological toolkit for the learning scientist. In R. K. Sawyer (Ed.) *The Cambridge Handbook of the Learning Sciences*. (pp. 153–169). New York: Cambridge University Press.

Barab, S. & Squire, K. (2004). Design-based research: putting a stake in the ground. *The Journal of the Learning Sciences*, 13(1), 1–14.

Barab, S. A. & Roth, W-M. (2006). Curriculum-based ecosystems: Supporting knowing from an ecological perspective. *Educational Researcher*, 35(5), 3–13.

Barron, B. (2004). Learning ecologies for technological fluency: Gender and experience differences. *Journal of Educational Computing Research*, 31(1), 1–36.

Beghetto, R. (2007). Does creativity have a place in classroom discussions? Prospective teachers' response preferences. *Thinking Skills and Creativity*, 2, 1–9.

Bekerman, Z., Burbules, N., Silberman-Keller, D. (2006). Introduction. In Z. Bekerman, N. Burbules, D. Silberman-Keller (Eds.). *Learning in places. The informal education reader* (pp. 1–8). New York: Peter Lang Publishing.

Benavides, F., Dumont, H. & Istance, D. (2008). The search for innovative learning environments. In OECD. Innovating to Learn, Learning to Innovate. Paris: OECD.

Bereiter, C. & Scardamalia, M. (2003). Learning to work creatively with knowledge. In E. D. Corte, L. Verschaffel, N. Entwistle, & J. V. Merriënboer (Eds.). *Powerful learning environments: Unravelling basic components and dimensions* (pp. 73–78). Oxford: Elsevier Science.

Bernstein, D. & Crowley, K. (2008). Searching for signs of intelligent life: An investigation of young children's beliefs about robot intelligence. *The Journal of the Learning Sciences*, 17, 225–247.

Bintz, W. P., Moore, S. D., Hayhurst, E., Jones, R. & Tuttle, S. (2006). Integrating literacy, math and science to make learning come alive. *Middle School Journal*, 37(3), 30–37.

Blumenfeld, P. C., Kempler, T. M. & Krajcik, J. S. (2006). Motivation and cognitive engagement in learning environments. In R. K. Sawyer (Ed.) *The Cambridge Handbook of the Learning Sciences*. (pp. 475–488). New York: Cambridge University Press.

Bodrova, E. & Leong, D. J. (2003). The importance of being playful. *Educational Leadership*, 60(7), 50–54.

Bottino, M. R. (2004). The evolution of ICT-based learning environments: which perspectives for the future? *British Journal of educational Technology*, 35(5), 553–567.

Bransford, J. D., Barron, B., Pea, R. D., Meltzoff, A., Kuhl, P., Bell, P., Stevens, R., Schwartz, D. L., Vye, N., Reeves, B., Roschelle, J. & Sabelli, N. H. (2006). Foundations and opportunities for an interdisciplinary science of learning. In R. K. Sawyer (Ed.) *The Cambridge Handbook of Learning Sciences*. (pp. 19–34). New York: Cambridge University Press.

Bransford, J., Brown, A. & Cocking, R. (2000). *How people learn: Brain, mind and experience & school*. Washington, DC: National Academy Press.

Breslin, C. M., Morton, J. R. & Rudisill, M. E. (2008). Implementing a physical activity curriculum into the school day: Helping early childhood teachers meet the challenge. *Early Childhood Education Journal*, 35, 429–437.

Briggs, M. (2006). Creative mathematics. In A. Wilson (Ed.). *Creativity in Primary Education* (pp. 102–111). Glasgow: Learning Matters.

Broadhead, P. (2006). Developing an understanding of young children's learning through play: The place of observation, interaction and refection. *British Educational Research Journal*, 32(2), 191–208.

Brown, A. (1992). Design experiments: theoretical and methodological challenges in creating complex interventions. *Journal of the Learning Sciences*, 2, 141–178.

Brown, A. & Campione, J. (1996). Psychological theory and the design of innovative learning environments: On procedures, principles, and systems. In L. Schauable & R. Glaser (Eds.), *Innovations in learning: New environments for education.* (pp. 289–325). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Bruner, J. (1986). *Actual minds, possible worlds*. Cambridge: Harvard University Press.

Bruner, J. (1990). *Acts of meaning*. Cambridge: Harvard University Press.

Bruner, J. (1996). *The Culture of Education*. Cambridge: Harvard University Press

Bruner, J. (2002). *Making stories: Law, Literature, Life*. New York: Farrar, Strauss & Giroux.

Bruner, J. (2003). The narrative construction of reality. In M. Mateas & P. Sengers (Eds.). *Narrative Intelligence* (pp. 41–62). Amsterdam: John Benjamins Publishing Company.

Bruner, J., Jolly, A. & Sylva, K. (1976). *Play*. London: Penguin.

Burleson, W. (2005). Developing creativity, motivation and self-actualization with learning systems. *Human-Computer Studies*, 63, 436–451.

Caillois, R. (2001). *Man, Play and Games*. Urbana (III): University of Illinois Press.

Casas, A. (2003). *Childhood playfulness as a predictor of adult playfulness and creativity*: A longitudinal study. Retrieved from: scholar.lib.vt.edu/thesis/available/etd-051522003-231917/

Charmaz, K. (2006). *Constructing grounded theory. A practical guide through qualitative analysis*. London: Sage.

Chedzoy, S. (2006). Children, creativity and physical education. In A. Wilson (Ed.). *Creativity in Primary Education* (pp. 112–122). Glasgow: Learning Matters.

Claxton, G. (2002). Education for the learning age: a sociocultural approach to learning to learn. In G. Wells & G. Claxton (Eds.) *Learning for Life in 21st Century. Sociocultural Perspectives on the Future of Education* (pp. 21–33). Cambridge, MA: Blackwell.

Claxton, G. (2007). Expanding young people's capacity to learn. *British Journal of Educational Studies*, 55(2), 115–134.

Claxton, G., Craft, A. & Gardner, H. (2008). Concluding thoughts: Good thinking – education for wise creativity. In A. Craft, H. Gardner & G. Claxton (Eds.). *Creativity, Wisdom and Trusteeship. Exploring the Roles of Education*. (pp. 168–176). Thousands Oaks: California.

Clements, R. (2004). An investigation of the status of outdoor play. *Contemporary Issues in Early Childhood*, 5(1), 68–80.

Cobb, P., diSessa, A., Lehrer, R. & Schauble, L. (2003). Design experiments in educational research. *Educational Researcher*, 32(1), 9–13.

Cohen, L., Manion, L. & Morrison, K. (2000). *Research Methods in Education*. London: RoutledgeFalmer.

Collins, A. (2006). Cognitive apprenticeship. In R. K. Sawyer (Ed.) *The Cambridge Handbook of the Learning Sciences*. (pp. 47–60). New York: Cambridge University Press.

Collins, A., Joseph, D. & Bielaczyc, K. (2004). Design research: Theoretical and methodological issues. *The Journal of the Learning Sciences*, 13(1), 15–42.

Confrey, J. (2006). The evolution of design studies as methodology. In R. K. Sawyer (Ed.) *The Cambridge Handbook of the Learning Sciences.* (pp. 135–151). New York: Cambridge University Press.

Corsaro, W. A. (2005). *The Sociology of Childhood*. Thousand oaks, California: Pine Forge Press.

Craft, A. (2000). Creativity across the primary curriculum: Framing and developing practice. London: RoutledgeFalmer.

Craft, A. (2001). Little c creativity. In A. Craft, B. Jeffrey, & M. Liebling (Eds.), *Creativity in Education* (pp. 45–61). London: Continuum.

Craft, A. (2005). *Creativity in Schools: Tensions and Dilemmas*. Abingdon: Routledge New York.

Craft, A. (2006). Changes in the landscape for creativity in education. In A. Wilson (Ed.). *Creativity in Primary Education* (pp. 7–18). Glasgow: Learning Matters.

Craft, A. (2008). Tensions in creativity and education. Enter wisdom and trusteeship? In A. Craft, H. Gardner & G. Claxton (Eds.). *Creativity, Wisdom and Trusteeship. Exploring the Roles of Education*. (pp. 16–34). Thousands Oaks: California.

Craft, A., Cremin, T., Burnard, P. & Chappell, K. (2007). Teacher stance in creative learning: A study of progression. *Thinking skills and creativity*, 2, 136–147.

Craft, A., Gardner, H. & Claxton, G. (2008). Nurturing creativity, wisdom and trusteeship in education: A collective debate. In A. Craft, H. Gardner & G. Claxton (Eds.). *Creativity, Wisdom and Trusteeship. Exploring the Roles of Education*. (pp. 1–13). Thousands Oaks: California.

Crawford, C. (2003). Assumptions underlying the Erasmatron storytelling system. In M. Mateas & P. Sengers (Eds.). *Narrative Intelligence* (pp. 189–197). Amsterdam: John Benjamins Publishing Company.

Cremin, T., Burnard, P., & Craft, A. (2006). Pedagogy and possibility thinking in the early years. *Thinking Skills and Creativity*, 1, 108–119.

Creswell, J. V. (2007). *Qualitative inquiry and research design*. Thousand Oaks, CA: Sage.

Crook, C. (1998). Children as computer users: the case of collaborative learning. *Computers & Education*, 30 (3/4), 237–247.

Cropley, A. J. (2004). *Creativity in education & learning.* London: Routledge.

Crowley, K. & Jacobs, M. (2002). Islands of expertise and the development of family scientific literacy. In G. Leinhardt, K. Crowley & K. Knutson (Eds.) *Learning Conversations in Museums*. Mahwah, NJ: Erlbaum.

Csikszentmihalyi, M. (1990). *Flow, psychology of optimal experience.* New York: Harper and Row.

Csikszentmihalyi, M. (1993). *The evolving self: a psychology for the third millennium*. New York: Harper Perennial.

Csikszentmihalyi, M. (1996). *Creativity: Flow and the psychology of discovery and invention.* New York: HarperCollins.

Csikszentmihalyi, M. (1999). Implications of a systems perspective for the study of creativity. In R. J. Sternberg (Ed.). *Handbook of Creativity* (pp. 313–335). Cambridge: Cambridge University Press.

Csikszentmihalyi, M. (2006). *Flow: Den optimala upplevelsens psykologi*. Stockholm: Natur & Kultur.

Denzin, N. K. (1978). *The research act: A theoretical introduction to sociological methods*. New York: McGraw-Hill.

Design-Based Research Collective (2003). Design-based research: An emerging paradigm for educational inquiry. *Educational Researcher*, 32 (1), 5–8.

Dewey, J. (1957). *Koulu ja yhteiskunta*. Helsinki: Otava.

Dewey, J. (1960/1933). *How we think*. Boston: Heath.

Doppelt, Y. & Schunn, C. D. (2008). Identifying students' perceptions of the important classroom features affecting learning aspects of a design-based learning environment. *Learning Environment Research*, 11, 195–209.

Drent, M. & Meelissen, M. (2008). Which factors obstruct or stimulate teacher educators to use ICT innovatively? *Computers and Education*, 51, 187–199.

Eckhoff, A. & Urbach, J. (2008). Understanding imaginative thinking during childhood: Sociocultural conceptions of creativity and imaginative thought. *Early childhood Education Journal*, 36, 179–185.

Egan, K. (2005). *An imaginative approach to teaching*. San Francisco: Jossey-Bass.

Egan, K. & Madoc-Jones, G. (2005). Education and imagination. *Teaching Education*, 16(1), 1–2.

Egan, K. & Nadaner, D. (1988). *Imagination and education*. Milton Keynes: Open University Press.

Entwistle, N. & Peterson, E. R. (2005). Conceptions of learning and knowledge in higher education: Relationships with study behaviour and influences of learning environments. *International Journal of Educational Research*, 41, 407–428.

Erickson, F. (2006). Definition and analysis of data from videotape: some research procedures and their rationales. In J. L. Green (Ed.). *Handbook of Complementary Methods in Education Research.* (pp.177–191). Mahwah, NJ: Lawrence Erlbaum Associates, Publishers.

Feldman, D. H. (2008). Creativity and wisdom: Are they incompatible? In A. Craft, H. Gardner & G. Claxton (Eds.). *Creativity, Wisdom and Trusteeship. Exploring the Roles of Education*. (pp. 77–83). Thousands Oaks: California.

Finke, R. A., Ward, T. B. & Smith, S. M. (1992). *Creative Cognition. Theory, Research and Applications*. London: The MIT Press.

Finnish Ministry of Education (2005). *Kolme puheenvuoroa luovuuden edistämisestä*. Luovuusstrategian osatyöryhmien raportit 35. Retrieved from www.minedu.fi. (30.5.2006)

Fisher, G. & Konomi, S. (2007). Innovative socio-technical environments in support of distributed intelligence and lifelong learning. *Journal of Computer Assisted Learning*, 23, 338–350.

Fishman, B., Marx, R. W., Blumenfeld, P., Krajcik, J. & Soloway, E. (2004). Creating a framework for research on systemic technology innovation. *The Journal of the Learning Sciences*, 13(1), 43–76.

Flavell, J. H. (1976). Metacognitive aspects of problem solving. In l. R. Resnick (Ed.). *The Nature of Intelligence* (pp. 231–235). Erlbaum: Hillsdale.

Flick (1998). *An Introduction to Qualitative Research*. London: Sage.

Flutter, J. (2006). 'This place could help you learn': student participation in creating better school environments. *Educational Review*, 58(2), 183–193.

Fraser, B. J. (1998). The birth of a new journal: Editor's introduction. *Learning Environments Research*, 1, 1–5.

Gajdamaschko, N. (2005). Vygotsky on imagination: Why an understanding of the imagination is an important issue for school teachers. *Teaching Education*, 16(1), 13–22.

Glaser, B. G. (1978). *Theoretical sensitivity: Advances in the methodology of grounded theory*. California: Sociology Press.

Glaser, B. G. & Strauss, A. (1967). *The discovery of grounded theory*. Chicago: Aldine.

Goos, M., Galbraith, P. & Renshaw, P. (2002). Socially mediated metacognition: Creating collaborative zones of proximal development n small group problem solving. *Educational Studies in Mathematics*, 49(2), 193–223.

Gray, D. E. (2004). *Doing research in the real world*. London: Sage Publications.

Hannon, J. C. & Brown, B. B. (2008). Increasing preschoolers' physical activity intensities: An activity-friendly preschool playground intervention. *Preventive Medicine,* 46, 532–536.

Hayes, E. (2008). Game content creation and it proficiency: An explorative study. *Computers and Education*, 51, 97–108.

Hennessy, S. (2006). Creativity in the music curriculum. In A. Wilson (Ed.). *Creativity in Primary Education* (pp. 140–154). Glasgow: Learning Matters.

Hennessy, S. & Murphy, P. (1999). The potential for collaborative problem solving in design and technology. *International Journal of Technology and Design Education*, 9, 1–36.

Hinske, S., Lampe, M., Price, S., Yuill, N. & Langheinrich, M. (2009). Kingdom of the Knights: Evaluation of a seamlessly augmented toy environment for playful learning. *Proceedings of the 8th International ACM SIGCHI Conference on Interaction Design and Children* (IDC) 2009. Como, Italy.

Hofer, M. (2007). Goal conflicts and self-regulation: A new look at pupils' off-task behaviour in the classroom. *Educational Research Review*, 2(1), 28–38.

Holm Sorensen, B., Danielsen, O. & Nielsen, J. (2007). Children's informal learning in the context of schools of the knowledge society. *Education and Information Technologies*, 1(12), 17–27.

Hull, G. & Greeno, J. (2006). Identity and agency in nonschool and school worlds. In Z. Bekerman, N. Burbules, D. Silberman-Keller (Eds.). *Learning in places. The informal education reader* (pp. 77–97). New York: Peter Lang Publishing.

Huebner, E. S. (1991). Correlates of life satisfaction in children. *School Psychology Quarterly*, 6, 103–111.

Hyvönen, P. (2008). *Affordances of playful learning environment for tutoring playing and learning.* Doctoral dissertation. Acta Universitatis Lapponiensis 152. University of Lapland, Faculty of education, Finland. Rovaniemi: University of Lapland Printing Centre.

Hyvönen, P. & Juujärvi, M. (2004a). Anssi Kelaa hampaankolosta? – tyttöjen ja poikien ideoita leikin ympäristöistä. Teoksessa P. Hyvönen, M. Lehtonen, R. Rajala (toim.) *Lapset – seminaarin artikkelijulkaisu. Proceedings of the Lapset Seminar 2004* (pp. 56–70). Lapin yliopiston kasvatustieteellisiä julkaisuja 7. Rovaniemi: Lapin yliopistopaino.

Hyvönen, P. & Juujärvi, M. (2004b). Representations in Playful Learning: Children's Views of Playful Environments. In L. Cantoni & C. McLoughlin (eds.), *Proceedings of ED-MEDIA 2004 World Conference on Educational Multimedia, Hypermedia & Telecommunications* (pp.3591–3596). June 21–26, 2004; Lugano, Switzerland.

Hyvönen, P. & Juujärvi, M. (2004c). The Affordances and Representations of Playful Learning Environment. In B. Muchacka, K. Kraszewski & R. vad der Kooij (Eds.) *Play and Education Spiel und Pädagogik*. Abstract book (p. 57). 23rd ICCP World Play Conference. Krakow 2004.

Hyvönen, P. & Juujärvi, M. (2005a). Affordances of Playful Environment: A View of Finnish Girls and Boys. Proceedings of ED-MEDIA 2005: *World Conference on Educational Multimedia, Hypermedia & Telecommunications* (pp. 1563–1572). June 26–July 2, 2005. Montréal, Canada. CD-ROM. Electronic Version of Papers. Presented at ED-MEDIA 2005 Conference.

Hyvönen, P. & Juujärvi, M. (2005b). Keholla ja riemulla – uudenlainen oppimisympäristö. *Kide,* 5, 8–11.

Hyvönen, P., Juujärvi, M. & Latva, S. (2004). Taikinavuori ja kiemuralaava – kasvun mahdollistavat hauskat oppimisympäristöt. Teoksessa H. Turunen (toim.) *Parhaat*

paikalla, toimivia käytäntöjä arkeen. Interaktiivinen tekniikka koulutuksessa – konferenssi 2004, Aulanko. Hämeen kesäyliopiston julkaisuja, sarja B. Riihimäki: Riihimäen kirjapaino, 79.

Hyvönen, P., Juujärvi, M. & Latva, S. (2005). Tieto- ja viestintätekniikkaa lasten oppimisympäristöön? – kokemuksia testikentältä. Teoksessa M. Lehtonen & H. Ruokamo (Toim.). *Lapin tietoyhteiskuntaseminaarin tutkijatapaamisen artikkelijulkaisu 2004* (pp. 43–53). Rovaniemi: Lapin yliopistopaino.

Hyvönen, P., & Kangas, M. (2006a). Tutoring playing and learning (TPL) in a playful learning environment (PLE*). 9th Conference of EARLI's JURE. Models and Learning: Theory, Design and Application* (Abstracts) (p. 49). June 30–July 4, 2006, Tartu, Estonia.

Hyvönen, P. & Kangas, M. (2006b). Playfulness – a conceptual tool for evaluating playful learning environment (PLE) and activities. *9th Conference of EARLI's JURE. Models and Learning: Theory, Design and Application* (Abstracts) (p. 48). June 30–July 4, 2006, Tartu, Estonia.

Hyvönen, P. & Kangas, M. (2010). Children as experts in designing play environment. In E-L., Kronqvist & P. Hyvönen (Eds.), *Insights and outlouds: Childhood research in the North*. (pp. 143–170). Acta Universitatis Ouluensis E 107. Oulu: Oulu University Press.

Hyvönen, P. & Kangas, M. (accepted). Playfulness-based research: Involving children in research process of designing a playful learning environment. To appear in P. Hernwell (Ed.), Children and Youth's Digital Culture.

Hyvönen, P., Kangas, M., Kultima, A. & Latva, S. (2006). *Let's Play! Tutkimuksia leikillisistä oppimisympäristöistä*. Lapin yliopiston kasvatustieteellisiä raportteja 2. Rovaniemi: Lapin yliopistopaino.

Hyvönen, P., Kangas, M., Kultima, A. & Latva, S. (2007). *Let's Play! Tutkimuksia leikillisistä oppimisympäristöistä*. Lapin yliopiston kasvatustieteellisiä raportteja 2. Toinen korjattu painos. Rovaniemi: Lapin yliopistopaino.

Hyvönen, P. & Ruokamo, H. (2005a). The features of playfulness in the pedagogical model of TPL – tutoring, playing and learning. In H. Ruokamo, P. Hyvönen, M. Lehtonen & S. Tella (Eds.). *Proceedings of the 12th International Network-Based Education (NBE) Conference 2005: Teaching-Studying-Learning (TSL) Processes and Mobile Technologies – Multi-, Inter- and Transdisciplinary (MIT) Research Approaches*. (pp.103–113). Rovaniemi: University of Lapland Press.

Hyvönen, P. & Ruokamo, H. (2005b). Leikillisyyden ominaisuudet ohjaamisen, leikkimisen, pelaamisen ja oppimisen pedagogisessa OLPO-mallissa. Teoksessa R. Smeds, S. Tella, H. Ruokamo & J. Multisilta (Toim.). *Opetus, opiskelu, oppiminen. Tieto- ja viestintätekniikka tiederajat ylittävissä konteksteissa* (231–244). Lapin yliopiston kasvatustieteellisiä julkaisuja 12. Rovaniemi: Lapin yliopistopaino.

Jeffrey, B. (2003). Countering student instrumentalism: A creative response. *British Educational Research Journal*, 29(4), 489–503.

Jeffrey, B. & Craft, A. (2001). Introduction. The universalization of creativity. In A. Craft, B. Jeffrey & M. Liebling (Eds.), *Creativity in Educatio*n (pp. 1–13). London: Continuum.

Jeffrey, B. & Craft, A. (2006). Creative learning and possibility thinking. In B. Jeffrey (Ed.) *Creative learning practises: European Experiences.* London: Tufnell Press.

Jeffrey, B. & Woods, P. (2003). The creative school: A framework for success, quality and effectiveness. London: RoutledgeFalmer.

John-Steiner, V. (2000). *Creative Collaboration*. Oxford: Oxford University Press.

John-Steiner, V., Shank, C. & Meehan, T. (2005). The role of metaphor in the narrative co-construction of collaborative experience. In U. M. Quasthoff & T. Becker (Eds.). *Narrative Interaction* (pp. 169–195). Amsterdam: John Benjamins Publishing Company.

Johnston, J. (2006). What is creativity in science education? In A. Wilson (Ed.). *Creativity in Primary Education* (pp. 88–101). Glasgow: Learning Matters.

Joubert, M. M. (2001). The art of creative teaching: NACCCE and beyond. In A. Craft, B. Jeffrey, & M. Liebling (Eds.), *Creativity in Education* (pp. 17–34). London: Continuum.

Juujärvi, M. & Hyvönen P. (2005) Esikouluikäisten tyttöjen ja poikien kuvauksia toiveiden leikkiympäristöistä. Teoksessa J. Levonen & T. Järvinen & S. Kaupinmäki (toim.). Hypermedialaboratorion verkkojulkaisuja – Hypermedia Laboratory Net Series; 8, (pp. 165–172), Tampere: Tampere University Press.

Juujärvi, M., Kultima, A. & Ruokamo, H. (2005). A Narrative View on Children's Creative and Collaborative Activity. In H. Ruokamo, P. Hyvönen, M. Lehtonen & S. Tella (Eds.) *Proceedings of the 12th International Network-Based Education (NBE) Conference* (Former PEG) 2005: *Teaching–Studying–Learning (TSL) Processes and Mobile Technologies – Multi-, Inter-, and Transdisciplinary* (MIT) Research Approaches. (pp. 203–213), Rovaniemi: University of Lapland Press.

Kafai, Y. B. (2006). Constructionism. In R. K. Sawyer (Ed.) *The Cambridge Handbook of the Learning Sciences*. (pp. 35–46). New York: Cambridge University Press.

Kafai, Y. B., Franke, M., Ching, C. & Shih, J. (1998). Games as interactive learning environments fostering teachers' and students' mathematical thinking. *International Journal of Computers for Mathematical Learning*, 3(2), 149–193.

Kangas, M. (2010). Kohti tulevaisuuden oppimisympäristöjä – luovuus, leikillisyys ja teknologia opiskelun innoittajana. Ilmestyy teoksessa K. Kumpulainen & E-L. Kronqvist (Toim.) *Lasten elämä, oppiminen ja hyvinvointi muuttuvissa ympäristöissä*. WSOY.

Kangas, M., Hyvönen, P. & Latva, S. (2007). The Space Treasure outdoor game in the playful learning environment: experiences and assessment. In H. Ruokamo, M. Kangas, M. Lehtonen & K. Kumpulainen (Eds.) *Proceedings of the 2nd International NBE Conference: The Power of Media in Education* (pp.181–196). Rovaniemi: University of Lapland Press.

Kangas, M., Korva, S. & Ruokamo, H. (in progress). An international study on Finnish, Dutch and American students' conceptions of learning. To be submitted to the scientific journal.

Kangas, M. & Kultima, A. (2006). Co-creative learning processes in school settings – A case of the game concept of a "Different World". *9th Conference of EARLI's JURE. Models and Learning: Theory, Design and Application* (Abstracts) (p. 50). June 30–July 4, 2006, Tartu, Estonia

Kangas, M., Kultima, A. & Ruokamo, H. (2006). Co-Creative Learning Processes (CCLP) – Children as Game World Creators to the Outdoor Playground Contexts. In J. Multisilta & H. Haaparanta (Eds.) *Proceedings of the Workshop on Human Centered Technology HCTo6* (pp.14–21). June 11–13, 2006, Pori, Finland, Tampere University of Technology, Pori. Publication 6.

Kangas, M., Randolph, J. & Ruokamo, H. (2009). *An International Mixed-Method Investigation into Student Satisfaction with Playful Learning Environments*. Paper presented at 2009 AERA (American Educational Research Association) Annual Meeting, April 13–17, San Diego, California, U.S.

Kangas, M., Randolph, J. & Ruokamo, H. & Hyvönen, P. (2010). *An International Investigation into Playful Learning Environments and Academic Achievement*. Paper presented at AERA 2010 (American Educational Research Association) Annual Meeting, 30th of April – 4th of May, Denver, U.S.

Kangas, M. & Ruokamo, H. (2010). *Playful Learning Environment(s)*. Manuscript submitted for Encyclopedia of the Sciences of Learning. (Seel, M., Editor-in-Chief)

Kansanen, P. (1999). Teaching as teaching-studying-learning interaction. *Scandinavian Journal of Educational Research*, 43(1), 81–89.

Karmiloff-Smith, A. (1992). *Beyond modularity*. Cambridge: MIT Press.

Kershner, R. & Pointon, P. (2000). Children's views of the primary classroom as an environment for working and learning. *Research in Education*, 64, 64–77.

Kieff, J. E. & Casbergue, R. M. (2000). *Playful Learning. Integrating Play into Preschool and Primary Programs* Boston: Allyn and Bacon.

Kirshner, P. A. (2004). Design, development, and implementation of electronic learning environments for collaborative learning. *Educational Technology Research & Development*, 52(3), 39–46.

Kolodner, J. (2006). Case-based reasoning. In R. K. Sawyer (Ed.) *The Cambridge Handbook of the Learning Sciences*. (pp. 225–242). New York: Cambridge University Press.

Korva, S. (2008). *Mediakasvatuksen näkökulmia leikillisessä oppimisprosessissa*. Masters Thesis. University of Lapland, Faculty of education, Finland. Rovaniemi: University of Lapland Printing Centre.

Kultima, A. (2006). Designing an open-narrative game concept for an outdoor learning environment. *In Proceedings of the IPSI 2006 Conference, 2006,* February 10–13, Marbella, Spain.

Krajcik, J. S. & Blumenfeld, P. (2006). Project-based learning. In R. K. Sawyer (Ed.) *The Cambridge Handbook of the Learning Sciences*. (pp. 317–334). New York: Cambridge University Press.

Könings, K., Brand-Gruwel, S. & van Merrienboer, J. (2005). Towards more powerful learning environments through combining the perspectives of designers, teachers and students. *British Journal of Educational Psychology*, 75, 645–660.

Lauriala, A. & Laukkanen, M. (2010). Boys' motivation at school and future orientation in Lapland. In E-L., Kronqvist & P. Hyvönen (Eds.), *Insights and outlouds: Childhood research in the North.* (pp. 9–20). Acta Universitatis Ouluensis E 107. Oulu: Oulu University Press.

Lemke, J. L. (2002). Becoming the village: education across lives. In G. Wells & G. Claxton (Eds.) *Learning for Life in 21st Century. Sociocultural Perspectives on the Future of Education* (pp.34–45). Cambridge, MA: Blackwell.

Leu, D. J., Jr., Kinzer, C. K., Coiro, J. L. & Cammack, D. W. (2004). Toward a theory of new literacies emerging from the internet and other information and communication technologies. In R. B. Ruddel & N. Unrau (Eds.). *Theoretical models and processes of reading* (5th Ed.). Newark, DE: International Reading Association.

Lieberman, J. N. (1977). *Playfulness: its relationship to imagination and creativity*. New York: Academic Press.

Lim, C. P. (2008). Spirit of game: Empowering students as designers in school. *British Journal of Educational Technology*, 39(6), 996–1003.

Linn, M. C. (1997). Learning and instruction in science education: Taking advantage of technology. In D. Tobin & B. J. Fraser (Eds.). *International Handbook of Science Education* (pp. 265–294). The Netherlands: Kluwer.

Livingstone, D.W. (2006). Informal learning. Conceptual distinctions and preliminary findings. In Z. Bekerman, N. Burbules, D. Silberman-Keller (Eds.). *Learning in places. The informal education reader* (pp. 203–227). New York: Peter Lang Publishing.

Lomborg, K. & Kirkevold, M. (2003). Truth and validity in grounded theory – a reconsidered realist interpretation of the criteria: fit, work, relevance and modifiability. *Nursing Philosophy*, 4, 189–200.

Loveless, A. (2003). The interaction between primary teachers' perceptions of ICT and their pedagogy. *Education and Information Technologies*, 8(4), 313–326.

Loveless, A. (2006). Thinking about creativity: Developing ideas, making thing happen. In A. Wilson (Ed.). *Creativity in Primary Education* (pp. 19–32). Glasgow: Learning Matters.

Lyle, S. (2000). Narrative understanding: developing a theoretical context for understanding how children make meaning in classroom setting. *Journal of Curriculum Studies*, 32(1), 45–63.

Mahn, H. & John-Steiner, V. (2002). The gift of confidence: A Vygotskian view of emotions. In G. Wells, & G. Claxton (Eds.), *Learning for Life in 21st Century. Sociocultural Perspectives on the Future of Education* (pp. 46–58). Cambridge, MA: Blackwell.

Malin, A. (2006). *School differences and inequities in educational outcomes*. PISA2000 results of reading literacy in Finland. Jyväskylä: Jyväskylä University Press.

Martikainen, M. & Haverinen, L. (2004). Grounded theory -menetelmä kasvatustieteellisessä tutkimuksessa. Teoksessa P. Kansanen & K. Uusikylä (Toim.). *Opetuksen tutkimuksen monet menetelmät* (pp. 133–157). Jyväskylä: PS-kustannus.

Mercer, N. (2000). *Words and minds. How we use language to think together*. London: Routledge.

Mercer, N. (2002). Developing dialogues. In G. Wells & G. Claxton (Eds.) *Learning for Life in the 21st Century* (pp.141–153). Oxford: Blackwell Publishers.

Mitra, D. (2008). Balancing power in communities of practice: An examination of increasing student voice through school-based youth-adult partnership. *Journal of Educational Change*, 9(3), 221–242.

National Board of Education (2004). *Finnish National Core Curriculum*. Helsinki: Author.

Natriello, G. (2007). Imagining, seeking, inventing: The future of learning and the emerging discovery networks. *Learning Inguiry*, 1, 7–18.

Natvig, G. K., Albrektsen, G., & Qvarnstrom, U. (2003). Associations between psychological factors and happiness among school adolescents. *International Journal of Nursing*, 9, 166–175.

Niemi, H. & Kumpulainen, K. (2008). *Tieto- ja viestintäteknologian hyödyntäminen opetuksessa ja opiskelussa. CICERO Learning -selvitysraportti*. Helsingin yliopisto. Available: www.cicero.fi/documents/CICERO_TVT-selvitysraportti.pdf

OECD (2007). Organisation for Economic Co-Operation and Development Center for Educational Research and Innovation (CERI). *Understanding the brain: The birth of learning science*. Paris: OECD Publishing.

OECD (2008). *Work on future educational environments*. PEB Exhange 2008/11. Available: www.oecd.org/dataoecd/4/11/41533001.pdf

Oksanen, A. (2005). Bodies in chains: Consumer culture as black pedagogy and body dissatisfaction among Finnish, Swedish and Norwegian children. In T. Hoikkala, P. Hakkarainen & S. Laine (Eds.). *Beyond health literacy – Youth Cultures, Prevention and Policy* (pp. 63–88). Helsinki: Finnish Youth Research network: Finnish Youth Research Society.

Paavola, S, Lipponen, L. & Hakkarainen, K. (2004). Models of innovative knowledge communities and three metaphors of learning. *Review of Educational Research*, 74(4), 557–576.

Pajula, M. (2004). *Täyttä leikkiä*. Kotivinkki, 10, 92–95. Haastateltavana Pirkko Hyvönen ja Marjaana Juujärvi.

Papert, S. (1993). *The children's machine: Rethinking school in the age of computer*. New York: BasicBooks.

Partanen, E. (2004). *Uudet leikin oppimisympäristöt*. Radio Suomi, Pohjois-Karjalan Radio. Haastattelu kasvatustieteen päivien 2004 yhteydessä. Haastateltavana Pirkko Hyvönen ja Marjaana Juujärvi.

Piispanen, M. (2008). *Good Learning Environment. Perceptions of Good Quality in Comprehensive School by Pupils, Parents and Teachers*. Doctoral Thesis in Pedagogics. University of Jyväskylä. Faculty of Pedagogics. Kokkola University Consortium Chydenius.

Palincsar, A. S. & Ladewski, B. G. (2006). Literacy and the learning sciences. In R. K. Sawyer (Ed.) *The Cambridge Handbook of the Learning Sciences*. (pp. 299–314). New York: Cambridge University Press.

Policastro, E. & Gardner, H. (1999). From case studies to robust generalizations: An approach to the study of creativity. In R. J. Sternberg (Ed.). *Handbook of Creativity* (pp. 213–225). Cambridge: Cambridge University Press.

Polkinghorne, D. (1995). Narrative configuration in qualitative analysis. In J. A. Hatch & R. Wisniewski (Eds.). *Life history and narrative* (pp. 5–23). London: Falmer.

Prensky, M. (2008). Students as designers and creators of educational computer games: Who else? *British Journal of Educational Technology*, 39(6), 1004–1019.

Price, S. & Rogers, Y. (2004). Let's get physical: The learning benefits of integrating in digitally augmented physical spaces. *Computers and Education*, 43(1–2), 137–151.

Quintana, C., Shin, N., Norris, C. & Soloway, E. (2006). Learner-centred design: Reflections on the past and directions for the future. In R. K. Sawyer (Ed.) *The Cambridge Handbook of the Learning Sciences*. (pp. 119–134). New York: Cambridge University Press.

Randolph, J., Kangas, M. & Ruokamo, H. (2008). Predictors of Dutch and Finnish students' satisfaction with schooling. *Journal of Happiness Studies*, 11, 193–204.

Randolph, J., Kangas, M. & Ruokamo, H. (2009). The Preliminary Development of the Children's Overall Satisfaction with Schooling Scale (COSSS). *Child Indicators Research*, 2, 79–93.

Rantala, T. (2005). Oppimisen iloa etsimässä – Kokemuksen etnografiaa alkuopetuksessa. (*Seeking the Joy of Learning – the Ethnography of experience in Elementary In-*

struction). Doctoral dissertation. Acta Universitatis Lapponiensis 88. University of Lapland, Faculty of Education, Finland. Rovaniemi: University of Lapland Printing Centre.

Resnick, L. B. (1987). Learning in school and out. *Educational Researcher*, 16, 13–20.

Resnick, M. (2003). *Playful Learning and Creative Societies*. Available: www.education-update.com/archives/2003/feb03/issue/child_playfullrng.html

Resnick, M. (2006). Computer as paintbrush: technology, play and the creative society. In Singer, D. Golikoff, R. & Hirssh-Pasek, K. (Eds.). *Play=learning: How play motivates and enhances children's cognitive and social-emotional growth*. Oxford University Press. Available: http://web.media.mit.edu/~mres/papers/playlearn-handout.pdf

Resnick, M. (2007). *Sowing the seeds for a more creative society*. Learning and Leading with Technology. Retrieved from http://web.media.mit.edu/~mres/papers/Learning-Leading.pdf

Rojas-Drummond, S., Mazon, N., Fernandez, M. & Wegerif, R. (2006). Explicit reasoning, creativity and co-construction in primary school childrens collaborative activities. *Thinking Skills and Creativity*, 1(2), 84–94.

Roth, W-M. (1998). *Designing Communities*. Boston: Kluwer Academic Publisher.

Rudd, T. (2008). *Futurelab Handbook: Reimagining outdoor learning spaces. Primary capital, co-design and educational transformation*. Available: http://publication.becta.org.uk/display.cfm?resID=37346.

Runco, M. A. & Sakamoto, S.O. (1999). Experimental studies of creativity. In R. J. Sternberg (Ed.). *Handbook of Creativity* (pp. 62–92). Cambridge: Cambridge University Press.

Ruokamo, H., Korva, S. & Kangas, M. (2010). A Case study of Students' Views on Learning: What it is? Where it Takes Place? How it Happens? and Why it is Important? The paper presented at AERA 2010 (American Educational Research Association) Annual Meeting 30th of April – 4th of May, Denver, U.S.

Sawyer, R. K. (2003). *Group Creativity: Music, Theatre, Collaboration*. Mahwah, NJ: Lawrence Erlbaum Associates.

Sawyer, R. K. (2004). Creative teaching: Collaborative discussion as disciplined improvisation. *Educational Researcher*, 33(2), 12–20.

Sawyer, R. K. (2006a). Educating for innovation. *Thinking Skills and Creativity*. 1, 41–48.

Sawyer, R. K. (2006b). Introduction: The new science of learning. In R. K. Sawyer (Ed.) *The Cambridge Handbook of the Learning Sciences*. (pp. 1–116). New York: Cambridge University Press.

Sawyer, R. K. (2006c). Conclusion: The schools of the future. In R. K. Sawyer (Ed.) *The Cambridge Handbook of the Learning Sciences*. (pp. 567–580). New York: Cambridge University Press.

Sawyer, R. K. (2008). Learning music from collaboration. *International Journal of Educational Research*, 47, 1, 50–59.

Scardamalia, M. & Bereiter, C. (2006). Knowledge building: Theory, pedagogy and technology. In R. K. Sawyer (Ed.) *The Cambridge Handbook of Learning Sciences*. (pp. 97–115). New York: Cambridge University Press.

Schrage, M. (1990). *Shared minds: The new technologies of collaboration*. New York: Random House.

Schugurensky, D. (2006). "This is our school of citizenship". Informal learning in local democracy. In Z. Bekerman, N. Burbules, D. Silberman-Keller (Eds.). *Learning in places. The informal education reader* (pp. 163–182). New York: Peter Lang Publishing.

Sefton-Green, J. (2006). Chapter 8: Youth, Technology and Media Cultures. *Review of Research in Education*, 30, 279–306.

Sensio, M. (2005). *Leikkiminen on sallittu!* YLE Nettiradio Mikaeli. Haastateltavana Pirkko Hyvönen ja Marjaana Juujärvi. Julkaistu 13.5.2005.

Sfard, A. (1998). On two metaphors for learning and the dangers of choosing just one. *Educational Researcher*, 27(2), 4–13.

Siegel, D. (1999). *The developing mind. Toward a neurobiology of interpersonal experience*. New York: The Guilford Press.

Sillito, D. (2005). BBC-TV. Interviewed Pirkko Hyvönen & Juhani Ikäheimo. Available: www.smartus.fi/

Smees, R. & Thomas, S. (1998). Valuing pupils' views about school. *British Journal of curriculum & Assessment*, 8(3), 8–11.

Smeets, E. (2005). Does ICT contribute to powerful learning environments in primary education? *Computers and Education*, 44, 343–355.

Smith, A. & Parr, M. (2007). Young people's views on the nature and purposes of physical education: a sociological analysis. *Sport, Education & Society*, 12(1), 37–58.

Soloway, E., Guzdial, M. & Hay, K. E. (1994). Learner-centred design. The challenge for HCI in the 21st century. *Interactions*, 1, 36–48.

Songer, N. B. (2006). An animated conversation on the development of curricular activity structures for inquiry science. In R. K. Sawyer (Ed.) *The Cambridge Handbook of the Learning Sciences*. (pp. 355–369). New York: Cambridge University Press.

Spikol, D. & Milrad, M. (2008). Physical activities and playful learning using mobile games. *Research and Practice in Technology Enhanced Learning*, 3(3), 275–295.

Spillane, J. P. (1999). External reform initiatives and teachers' efforts to reconstruct their practice: The mediating role of teachers' zones of enactment. *Journal of Curriculum Studies*, 31(2), 143–175.

Sternberg, R. J. & Lubart, T. I. (1999). The concept of creativity: Prospects and paradigms. In R. J. Sternberg (Ed.). *Handbook of Creativity* (pp. 3–15). Cambridge: Cambridge University Press.

Stone, L. D. & Gutiérrez, K. D. (2007). Problem articulation and the processes of assistance: An activity theoretic view of mediation in game play. *International Journal of Educational Research*, 46(1–2), 43–56.

Strauss, A. & Corbin, J. (1990). *Basics of qualitative research: Grounded theory procedures and techniques*. Newbury Park, CA: Sage.

Strauss, A. & Corbin, J. (1998). *Basics of qualitative research*: *Grounded theory procedures and techniques* (2nd ed.). Newbury Park, CA: Sage.

Suldo, S. M., Riley, K. N., & Shaffer, E. J. (2006). Academic correlates of children and adolescents' life satisfaction. *School Psychology International*, 27(5), 567–582.

Sutton-Smith, B. (2001). *The Ambiguity of Play*. Cambridge: Harvard University Press.

Säljö, R. (2004a). Learning and technologies, people and tools in co-ordinated activities. *International Journal of Educational Research* 41, 489–494.

Säljö, R. (2004b). From learning lessons to living knowledge. Instructional discourse and life experiences of youth in complex society. In A-N. Perret-Clermont, C. Pontecorvo, L. Resnick, T. Zittoun, & B. Burge (Eds.) *Joining Society. Social Interaction and Learning in Adolescence and Youth* (pp.177–191). Cambridge: Cambridge University Press.

Säljö, R. (2005). *Lärande i praktiken: ett sociokulturellt perspektiv*. Stockholm: Norstedts Akademiska Förlag.

Säljö, R. (2006). *Learning and cultural tools: Modelling and the evaluation of a collective memory*. Presentation at EARLI JURE06 conference 4th July 2006, Tarto, Estonia.

Thomas, S., Smees, R., MacBeath, J., Robertson, P & Boyd, B. (2000). Valuing Pupils' Views in Scottish Schools. *Educational Research and Evaluation*, 6(4), 281–316.

Trigwell, K., Prosser, M. & Waterhouse, F. (1999). Relations between teachers' approaches to teaching and students' approaches to learning. *Higher Education*, 37, 57–70.

Tuomi, I. (2007). Learning in the age of networked intelligence. *European Journal of Education*, 42(2), 235–254.

Tynjälä, P. (1999). Developing education students' conceptions of the learning process in different learning environments. *Learning and Instruction*, 7(3), 277–292.

Tynjälä, P. (2008). Perspectives into learning at the workplace. *Educational Research Review*, 3, 130–154.

Uljens, M.(1997). *School didactics and learning. A school didactic model framing an analysis of pedagogical implications of learning theories*. Hove: Psychology Press.

Vass, E. (2004). Understanding collaborative creativity: Young children's classroom-based shared creative writing. In K. Littleton & D. Miell (Eds.). *Collaborative creativity. Contemporary perspectives*. (pp.79–95). London: Free Association Books.

Vass, E. (2007). Exploring processes of collaborative creativity – The role of emotions in children's joint creative writing. *Thinking Skills and Creativity*, 2, 107–117.

Verhaegh, J., Soute, I., Kessels, A. & Markopoulos, P. (2006). On the design of Camelot, an outdoor game for children. *Proceeding of the 2006 Conference on Interaction Design and Children* IDC '06 (pp. 9–16). ACM Press.

Vygotsky, L. S. (1978). *Mind in society*. Cambridge: Harvard University Press.

Vygotsky, L. S. (1986). *Thought and language*. Cambridge: The MIT Press.

Vygotsky, L. S. (1998). *The collective works of L. S. Vygotsky. Volume 5. Child Psychology*. (Ed. Robert W. Rieber). New York: Plenum.

Välijärvi, J. & Sahlberg, P. (2008). Should 'failing' students repeat a grade? Retrospective response from Finland. *Journal of Educational Change*, 9(4), 385–389.

Wang, F. & Hannafin, M. J. (2005). Design-based research and technology-enhanced learning environments. *Educational Technology Research and Development*, 53(4), 5–27.

Watson, E. (2007). Who or what creates? A conceptual framework for social creativity. *Human Resource Development Review*, 6, 419–441.

Wardle, F. (2003). *Introduction to early childhood education: A multidimensional approach to child-centered care and learning*. Boston: Allyn and Bacon.

Warrington, M., Younger, M. & Bearne, E. (2006). *Raising Boys' Achievement in Primary Schools. Towards a holistic approach*. Berkshire: Open University Press.

Wegerif, R. (2005). Reason and creativity in classroom dialogues. *Language and Education*, 19, 3, 223–238.

Wegerif, R. (2006). A dialogic understanding of the relationship between CSCL and teaching thinking skills. *Computer-Supported Collaborative Learning*, 1, 143–157.

Wegerif, R., Littleton, K., Dawes, L., Mercer, N. & Rowe, D. (2004). Widening access to educational opportunities through teaching children how to reason together. *Westminster Studies in Education*, 27(2), 143–156.

Wegerif, R. & Mercer, N. (1997). A dialogical framework for researching peer talk. In R. Wegerif & P. Scrimshaw (Eds.), *Computers and talk in the primary classroom* (pp. 49–65). Clevedon: Multilingual Matters.

Wegerif, R., Mercer, N. & Dawes, L. (1999). From social interaction to individual reasoning: An empirical investigation of a possible socio-cultural model of cognitive development. *Learning and Instruction*, 9(5), 493–516.

Wells, G. (2002). Inquiry as an orientation for learning, teaching and teacher education. In G. Wells & G. Claxton (Eds.) *Learning for Life in the 21st Century: Sociocultural Perspectives on the Future of Education* (pp. 197–210). Oxford: Blackwell Publishers.

Wells, G. & Claxton, G. (2002). Introduction: Sociocultural perspectives on the future of education. In G. Wells & G. Claxton (Eds.) *Learning for Life in 21st Century. Sociocultural Perspectives on the Future of Education* (pp. 1–17). Cambridge, MA: Blackwell.

Wenger, E. (1998). *Communities of practice: learning, meaning and identity*. Cambridge: Cambridge University Press.

Whyte, H. (1981). The value of narrativity in the representation of reality. In W. Mitchell (Ed.). *On narrative* (pp. 1–24). Chicago: University of Chicago Press.

Williams, S. & Bendelow, G. (1998). Malignant bodies: Children's beliefs about health, cancer and risk. In S. Nettleton & J. Watson (Eds.), *The body in everyday life*. (pp. 103–123). London: Routledge.

Wood, E. & Attfield, J. (2005). *Play, learning and the early childhood curriculum*. London: Paul Chapman Publishing.

Woods, P., & Jeffrey, B. (1996). *Teachable moments: The art of creative teaching in primary schools.* Buckingham: Open University Press.

Yore, L. D. & Craig, M. T. (1995). Middle school students' metacognitive knowledge about science reading and science text: An interview study. *Reading Psychology*, 16(2), 169–213.

APPENDIX 1. Narratives and emotional play environments created in playful co-design sessions (Studies I and II).

Group of children	**Narratives built up in collaboration**	**Narratives built up individually or in weak collaboration**
Group 1	Valley of baboons – amusement	Play world – excitement
Group 2	-	Unique train track – amusement
Group 3	Volcano land – excitement	Jungle adventure – excitement A haunted house – scariness
Group 4	Animals' world – care	-
Group 5	Fighting pirates – aggression Rockets all around – aggression	Play of Indians – excitement
Group 6	The big house – excitement Burning house – aggression	-
Group 7	Upside-down world – amusement Horror world – scariness	Unique slide – excitement
Group 8	Lovely animals – happiness Volcano slide – excitement Ghost train – scariness	-
Group 9	Nice wild animals – happiness Ghost valley – scariness Fairy tale land – happiness	-
Group 10	Magic world – happiness	Flying ghosts – scariness
Group 11	Sunny world – happiness	-
Group 12	Ground and storm – excitement	Digimon land – aggression
Group 13	Hot nature – amusement	-
Group 14	-	High slide – excitement Peter Pan land – excitement
Group 15	-	Water slide – excitement
Total	**19 narratives**	**11 narratives**

ORIGINAL PUBLICATIONS

From bogey mountains to funny houses
Children's desires for play environment

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THIS STUDY ANSWERS the following questions: 'In what kinds of environments do preschool children want to play?' and 'In what kinds of environments do boys and girls want to play?' Methodologically, the study draws on grounded theory, with data collected among Finnish preschoolers through 15 creation sessions with 49 children from six to seven years of age. Children prefer emotional play worlds, where excitement and amusement can be experienced and where collaborative activities and nature are afforded. Girls created scary and happy play worlds and boys created worlds of aggression and care. Emotional worlds indicate: (1) rich and varied emotions; (2) a desire for physical activity and nature; and (3) common and divergent emotional worlds of the genders. The outcomes have been utilised in designing pilot playful learning environments (PLE) and they will be useful in developing PLEs and play to meet the challenges of education.

Introduction

THE AIM OF THE CORE curriculum in Finnish pre-primary education (National Board of Education, 2000) is to improve children's capacity for learning when they are taught new facts and new skills through play. The term 'preschool', as used in Finland, refers to voluntary but formal preparatory education in primary school or day care centres. Children should experience a vast array of play opportunities in schools, and the play environment should be designed to maximise play (Johnson et al., 2005). This is based on the importance of play in overall development: play is seen as a crucial part of children's physical, cognitive, emotional and social development, and it also encourages creativity and learning (Kieff & Casberque, 2000; Meadows, 1992; Vygotsky, 1978; Wood & Attfield, 2005).

Play covers a broad category of activities—social games, pretence games, playing with toys, and unspecified indoor and outdoor play—and it can be stimulated in different contexts (Pellegrini, 1988, 2005; Wood & Attfield, 2005). Play is also seen as a tool in producing and reproducing culture (Corsaro, 2003, 2005). This view adapts the sociocultural perspective of children's activities and thus attempts to overcome the dualism of the child and the environment by blending them together (Johnson et al., 2005).

Today's children in the industrialised countries are getting short-changed in respect of opportunities to play, and they do not spend much time playing out-of-doors (Scarlett et al., 2005). Although there are numerous criteria for play environments (Wardle, 2003), they are mainly set by adults and municipal authorities; children's authentic perspective is somewhat missing. To find out what outdoor environments should afford, we let the children's voice to be heard. In this study, we look for the children's perspective and an answer to the following research question: 'In what kinds of environments do preschool children want to play?' A sub-question follows: 'In what kinds of environments do boys and girls want to play?' We examine the outdoor play environment and the play interests of girls and boys in the context of pre-primary education.

Gender play

Gender is defined as a cultural construction that comes into being by doing, and it is considered as the way of interacting (Butler 1990; Thorne 1993), in our case in collaboration through play and games. Children themselves are active in reinforcing and weakening gender borders (Corsaro, 2003). Schoolyards and playgrounds are places where those processes are particularly intriguing. Children learn gender as a social

category: the culture that is 'natural' for one's own gender. They know clearly that they belong either to the group of males or to the group of females and that their identity is bound into this membership (Maccoby, 1988). The membership is important, but not sufficient. Through joint activities children have possibilities to learn of and from the opposite gender.

Generally, boys and girls seem to play separately because of different play styles (Dunn, 2004). In the school context, children are used to playing separately; girls with girls and boys with boys (Dunn, 2004; Maccoby, 1988; Thorne, 1993). The crowded and public nature of schools and the continual presence of power and evaluation make the separation of genders more probable (Thorne, 1993). Adults working with children see boys and girls qualitatively dissimilar (Martino et al., 2004), and educators are almost always unaware of the biased behaviour they exhibit (Lee-Thomas et al., 2005; Sanders, 2003). These findings lead to gendered cultures, although the whole process is more multifaceted. That is why it is important to conduct research in which children's views are highlighted and gendered interests examined.

Research methodology

The empirical data consists of drawings by children aged from six to seven and of discussions with them. The children were told that the results of their creative ideating would be used for real purposes: to design new types of playgrounds in their home town. We collected data from five preschools around the city of Rovaniemi in the northern part of Finland. The preschools were chosen randomly, and those children (N=49; 31 boys and 18 girls) who had written permission from their parents took part in the study. We arranged a total of 15 creation sessions, each lasting 30 to 45 minutes and involving six groups of boys, five groups of girls, and four mixed groups. During the creation sessions we sat on the floor and told a frame story in order to stimulate the children's imagination. We asked them to describe the environment where they would like to play: what kinds of activities it affords and what kinds of elements there are.

After the frame setting, the children drew pictures and discussed animatedly, adopting the role of playground designer.

We named this method 'image crafting', because during the process the children form an image of the ideal play environment. In doing this their imagination and the whole body is involved: they talk, play, draw, suggest and look around to boost their inspiration. Crafting refers to the means through which the image is processed into a visible form. Image crafting suits children because imagining, drawing, colouring and playing are natural ways for them to express their intentions and desires. The data from the creation sessions functions well as qualitative material for the grounded theory, and the method is suitable for purposes whose goal is to identify concealed or unfamiliar phenomena (Glaser, 1978; Strauss & Corbin, 1998). In this case, the intention was not to create a theory of the individual; rather the emphasis was on finding new ways to look at children's play environments and the hidden structures of boys' and girls' interests.

Theoretical sampling and coding process

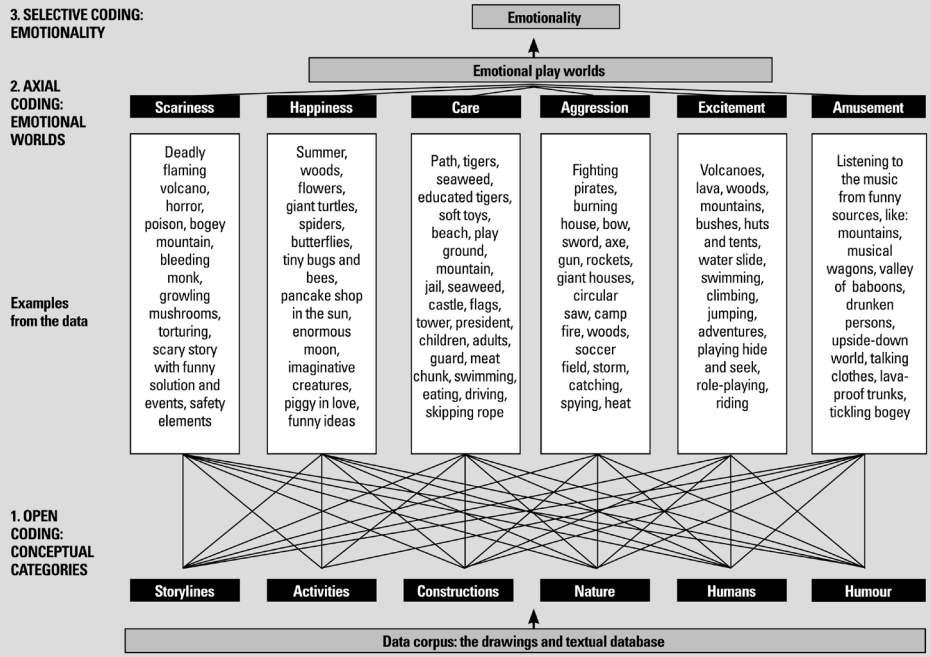
Theoretical sampling, which includes data collection, aims to maximise the opportunities to explore emerging concepts; and it continued until each category was saturated (Glaser, 1978). The coding process, which was executed using the N*Vivo qualitative analysing software, is described in the following figure (1).

The first phase, (1) open coding, involved identifying categories and properties of the data, and each category is a conceptual element of a theory. The categories and properties were generated by comparing the features of the activities and elements of the play environments (Glaser & Strauss, 1967). Although the words, themes and single pictures and sets of pictures were relevant as units of analysis, the storylines were considered and taken into account as one category. As a result of the inductive and comparative process, the categories of the first phase of the coding process included storylines, activities, constructions, nature, humans and humour (Hyvönen & Juujärvi, 2004, 2005).

The next phase, (2) axial coding, overlaps with the open coding process. The aim of axial coding is to reassemble the concepts of open coding with propositions about their relationships. Axial coding requires constant questioning: what is this about (Glaser, 1978)? In our case, we looked for answers to questions such as: What is the meaning of the president or mushroom-shaped slide? What is the causal connection between jail, persons and animals? We found that the answers were related to emotional play worlds, where environment and activities are intertwined. An emotional world is seen as a whole entity which contains a storyline and tells about the quality of the play environment. The quality was seen in the way children played, once they had designed the environment, and in the incidents along the storyline.

The children did not just design the environments with different facilities and activities, but used their imagination and ability to pretend; so they played during the designing. Play expressed not only social behaviour but also strong emotional tones. That is one reason play environments became emotional worlds of play, and emotions were chosen as the core category of (3) the selective coding process. The generation of theory takes place around the core category (Glaser, 1978), and consequently three different views were conveyed (Figure 3). As a theoretical result of this study, emotional play worlds indicate three

Figure 1. Illustration of the coding process and the phases of (1) open, (2) axial and (3) selective coding



views: 1) emotions and emotional worlds are rich and various; 2) there is an obvious desire for physical activity and nature; and 3) genders are related to common and divergent emotional worlds, where stereotypical, hidden and joint interests arise.

Results

In what kinds of environments do preschool children want to play?

The children created the following six emotional worlds during the sessions. We have named the worlds using the children's own expressions. The first world is 'pretend torture'.

'Pretend torture'—scariness

Children discussed scariness, horror and fear in 11 out of 15 sessions. Fear appeared more as a positive than a negative feeling, and it was accompanied by an element of safety; for example, protective adults, guards, the president or mother. Children, especially girls, want to feel fear; for instance, in a dark and narrow hut, inside a crocodile's mouth accompanied by a bleeding monk, on a huge slide, or in the bogey mountains. They also used words such as long nails, burning dogs, dying, spiders, scorpions, crying, attacking tigers, huge fireplaces, forest fires, haunting, angry and nice ghosts, dangers, skeletons and frightening noises.

During the sessions the children played with the idea of frightening situations. Even the music coming from the mushroom-shaped radio was considered as fearsome, because the designed environment itself had the same property: fearsomeness. The very first suggestion of one girl's group was to offer haunting places with lots of ghosts to represent fear and horror. According to the characteristics of mature play (Bodrova & Leong, 2003), themes should be flexible in imaginary situations in order for children to be able to negotiate on the plot, roles and themes, and adjust their interaction with frightfulness. It seems that children are able to regulate the relation between fear and safety, once they find the environment trusting and once they are committed to role-playing and the plot. Girls created scary stories taking place in scary environments, but once the imaginative environment became too frightening, they changed the plot cleverly from fear to harmless activities.

'The sun is always shining'—happiness

Although boys drew flowers and hearts they did not generate larger entities of happiness and beauty. Girls developed peaceful and joyful feelings of summer, beach, magic and the four seasons. Fantastic woods, flowers, tiny bugs, butterflies, imaginative creatures, rainbows, animals, flying dresses and several suns can be found in these environments. The swing is so huge that it throws children to the sun; actually, there are 10 suns in one of the play worlds. In the sun there is a shop selling pancakes. Girls portrayed how they can jump to the sun, fry pancakes, and then go into a hut to eat pancakes. The sun is seen as a place where play is possible; 'the sun has feet' and it is holding traffic signs. There is also a kind of trampoline which makes a way to an enormous moon. The girls described their play world by saying 'This is a fairyland'. The fairyland does not comprise aggression or negative-toned emotional qualities, but highlights happiness, which may describe girls' regulatory behaviour in presenting themselves as 'good'. Especially in peer groups, girls collectively regulate normative femininity, which includes qualities such as nice, truthful and good behaviour (Kehily et al., 2002).

'I think it eats seaweed'—care

In their drawings, girls and boys designed play areas where animals are free and children take care of them. Boys played the role of a rescuer or helper, for instance by planning a safe and comfortable home and an environment for the turtle and his friends. The home lies in a castle high in the mountains. As well, nutrition is taken care of: Nick drew a path to the sea and then some seaweed. 'Look, Eric! There is seaweed, food for the turtle. One bunch of that is enough for one day'. Eric says: 'Here is a little pool. He can go from there and get here … He swims here and collects his food there'.

Care is understood as commitment, relatedness, and physical, emotional and social care (Vogt, 2002). Care in the form of giving and receiving belongs to the area of emotional attachment, which is crucial in the child–parent relationship (Oatley & Jenkins, 2003). In this case, the boys practised emotional attachment as caregivers for pretend, humanised animals. According to Oatley and Jenkins (2003), caregiving always has an object, which here was to make sure that the turtle is content, by means of nurture, help and support. As a whole, animals seem to be an essential part of children's play worlds, because both girls and boys created lots of animals into their environments and described nature mainly as a shared realm of animals and children. Animals have different roles: they represent 'me', a friend, parents, children, or are just animals. Animals are described as interactive, emotional and intentional humans who can talk and think.

'The fighting ships' and 'a rocket that sets a park on fire'—aggression

In two sessions the boys showed aggressive, destroying, noisy and competitive patterns of behaviour by playing fighting pirates or by making an aggressive mess in a burning house. Although the activity of one boy group was based on competition in an environment of fight, they still had to engage in problem-solving during the combats against one another's pirate ships. The activity transformed into collaborative role-playing, and so the empathy in the context was strong. Although the play activity demonstrated aggression, the boys themselves were not aggressive but playful. The world of aggression should be considered against the theory of rough-and-tumble play (RT), which is quite common in outdoor play environments. The play patterns in this study do not meet all the features connected with RT. However, it is seen as a behavioural strategy used for the most part by boys to gain and maintain a certain status (Pellegrini, 1988, 2005). Although Pellegrini sees RT as a positive force in children's development, the line between good and bad play is sometimes difficult to draw (Johnson et al., 2005; Scarlett et al., 2005).

'Lava-proof trunks are needed'—excitement

The world of excitement includes feelings of enthusiasm and joy. Typical excitement worlds include imaginative situations where nothing is impossible. Both boys and girls wish to experience excitement in many ways. Their fantasies take place in a fascinating environment composed of real and imaginative features. For example, volcanoes, which children realise are dangerous, are favoured by boys and girls in vivid and playful ways. 'Spiral lava' and 'a lava slide' are some examples of the exciting features in their planning. They wanted to have narrow, high, dark, hot, or wide components in their play area. Children prefer a place where they can create emotionally powerful adventures that are terrifying but safe and fun.

During the drawing sessions, a group of boys designed a hot environment. Suddenly the boys became heated, too. This example shows that, in pursuance of idea-generation and imagined play, children put their souls into the environment and into the conditions it affords, and feel them very concretely, even at the bodily level. The following extract shows that Peter felt heated up when the boys created a hot atmosphere for their play world.

> Peter: I'll put [draw] some brown here, because it is so hot in here.
>
> Henry: Ha-ha! I'm going to make this hot too.
>
> Andy: I'm going to put some smoke here.
>
> Peter (leaves the others and goes under the table nearby): It is too hot, so I'm sitting here.

'Even the eyes are standing upright'—amusement

Common for both girls and boys were play worlds of amusement and humour, where 'fooling around' and playing with ideas characterised the activities. Humour was mostly expressed verbally and behaviourally instead of by drawing funny ideas on paper. Although humour appeared in different forms among boys and girls, a common conclusion can be

drawn: unusual and exceptionally imaginary phenomena make children laugh. Some children had a private idea of humour which they kept secret. They gave hints about funny things but never revealed the secret behind them. This indicates that humour is a cognitive, emotional, and social phenomenon (McGhee, 2002); even if the secret itself is not revealed, the situation is shared. In our research, the sense of humour and imitation of other children are emphasised as the triggering power of imagination and creative processes (Hyvönen & Juujärvi, 2005).

The environments related to the girls' presentations of humour include places where everything is upside-down or closets contain talking clothes. Girls also invented funny things, such as 'piggy in love' and 'the mountain that sings Finnish pop songs of a certain type'. In the traffic theme, girls found novel purposes for traffic lights: they can be funny and used to regulate children's turns at a playground. Among girls, humour is considered as one type of play, in which an enjoyable, unreal world of humour performs the same cognitive, social and emotional functions as play in general (Scarlett et al., 2005).

Among the boys, situations of idea-generation and shared laughter arose easily. The boys' humour elements included semi-wicked ideas, for example 'the valley of baboons'. Playing with words indicates a child's verbal competence, and McGhee (2002) defines it as the fourth stage of humour development. At the highest stage (fifth) the child begins to understand that the humour has a meaning; that the absurd has a cognitive sense. Another group of boys was a bit anxious and laughed and shouted easily. They obviously tried to show their competence within the social hierarchy of the group; that is they tried to be 'cool guys' (Pellegrini, 1988, 2005). The boys found the following conversation very amusing:

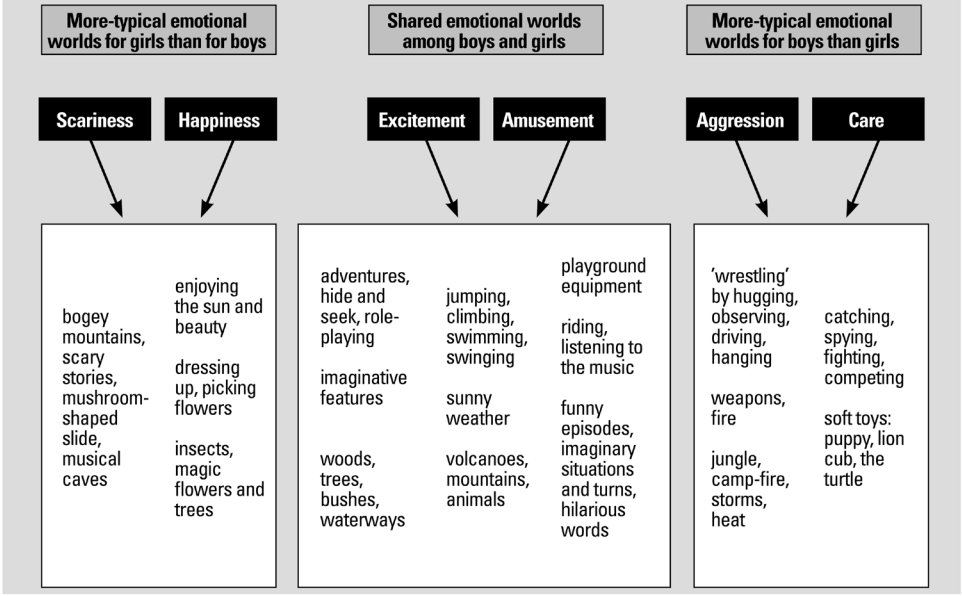
> Henry: Volcano! It's going to erupt!
>
> Researcher: Can one play in this volcano, Henry?
>
> Henry: Oh no, no way!
>
> [Other boys laugh]
>
> Henry: Well, your bottom will be burnt in there!
>
> [Other boys laugh]

After a good laugh they settled down and carried on with the session.

In what kinds of environments do boys and girls want to play?

Femininity and masculinity are mainly fictitious conceptions that conceivably relate to fantasies deeply embedded in the social world (Walkerdine, 1990, 1991); the results of this study brought up both masculine and feminine interpretations of the prevailing culture, but in addition, border crossing appeared as well (Hyvönen & Juujärvi, 2004, 2005). In the following figure (2), we have summarised the interests of the boys, the girls and their common objects of interest.

Figure 2. Common and separate themes of boys and girls



Common themes for boys and girls found in the play worlds were excitement and amusement, both accompanied with a feeling of safety. Activities, adventures, role-playing and nature—imaginary situations can be found in these worlds. Common themes are the basis for collaborative activities. The worlds of care and aggressive destruction and competition were more typical of boys, while the worlds of happiness, beauty, fairy features and scariness were more characteristic of girls. In the drawing situations, boys followed other boys and girls followed other girls. This pattern was often seen and it illustrates the cultural ways of gender construction.

Ambivalent emotional worlds were characteristic of both genders. On the one hand, the girls experienced themselves as parts of the worlds of happiness and summer. On the other hand, they felt they were parts of the worlds of fright and horror. Boys also enjoyed two opposite worlds. On the one hand they constructed a home environment and expressed care and nurture; on the other they competed, broke and destroyed. The experiences were very different, and yet very strong. As Bakhtin (1984) illustrates, the world is ambivalent, having two opposite poles, and these two poles are also seen in the interests of boys and girls. It is interesting to consider the boys' worlds of aggression and humour against Bakhtin's explanation of carnivals and marketplaces, where laughing together, shouting and aggression were the ways of having fun.

Aggression and care characterised more boys than girls

The boys' world, based on aggression, destruction and competition, is an interesting issue from the point of view of play environments. Although the boys' play can be seen as interaction between individuals, the question arises as to what extent it is ethically appropriate to encourage children to destruction and aggression. If there are destructive elements, they should be balanced with constructive ones. Attention should be paid to guided, cooperative actions, where interactional skills, such as impulsivity control, can be safely practised. A game in which common good, instead of individual pursuit of benefit, is rewarded might provide one example. Also, humour in play provides children socially appropriate means of expressing anger and affords alternative ways to cope with socially demanding situations (McGhee, 2002).

It was interesting to notice that boys especially were ready to create a play world founded on the ideas of care and nurture. The boys were concerned with caring and nurturing roles which corresponded with social positions that exist in society (Corsaro, 2003, 2005); in this case the play resembled family role-playing, including the roles of friends, soldiers, pets, the president etc. In our view, the cultural 'stigma' attached to boys generally restricts the experiencing and signalling of elements such as care and nurture. Care is often linked to the hegemony of femininity (Rodriques et al., 2006).

Happiness and scariness characterised more girls than boys

The girls mentioned that their emotional play world is like a fairyland full of fantasies, fiction, wishes and romance, resembling mostly classic fairy tales (Walkerdine, 1991). The fantasies of girls are often related to sexuality and a desire to find a prince of their dreams or a boyfriend (Boyle et al., 2003; Walkerdine 1991), but this data did not indicate wishes concerning heterosexual relations.

Fright, uncontrollability, unpredictability, dangerousness and disgustingness bear a relation to fear (Armfield, 2006). In accordance with Armfield's model of the etiology of fear, girls constructed a scary environment and storyline, but they controlled the situation, predicted the events, and regulated the danger and 'disgustingness' of the situation. In this manner they didn't feel real fear or anxiety, only entertaining scariness.

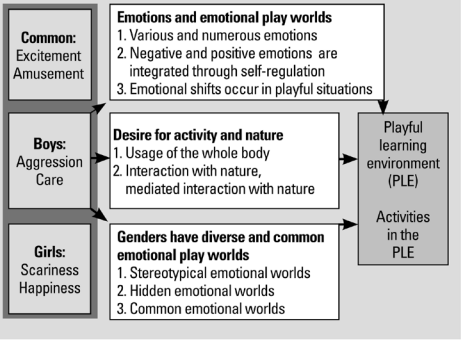
Theoretical summary: Emotional worlds as play environments for preschool children

The aim of this theoretical summary is to provide a theoretical basis for play environments in the preschool context. The theory is an integrated set of propositions comprising three views on emotional worlds (Figure 3): (1) emotions and emotional words are rich and various; (2) there is an obvious desire for physical activity and nature; and (3) the genders have diverging and common emotional worlds.

As illustrated in Figure 3, the theory is applicable in the context of outdoor playgrounds called Playful Learning Environments (PLE), which provide an alternative to classrooms as learning environments in pre-primary and basic education. The goal of the PLEs is to increase children's play and games during the school day. Play facilities can be augmented using Radio Frequency Identification Devices (RFID), although the PLE is also effective without these. Some ready-tailored games are programmed to comply with both the RFID system and outdoor equipment. In the near future, children will be able to tailor new games with play-creator software and construct play worlds according to their interests. PLEs are designed and constructed in the city of Rovaniemi, Finland.

The theoretical summary offers explanations to phenomena (Strauss & Corbin, 1998); in this case the summary describes emotional worlds created by children in playful situations. Children's emotional worlds are rich and diverse. In addition, bodily activities and nature are important in play environments. Finally, the genders'

Figure 3. The theoretical summary of this study



emotional play worlds represent stereotypical forms, but also hidden and combined forms. The theoretical summary is an integrated set of hypotheses and its credibility should be won through integration, relevance and workability (Glaser, 1978). Glaser and Strauss (1998) see that 'fit' is the strength of grounded theory in indicating credibility, and it is a powerful condition for understanding and usefulness. 'Fit' expresses the correspondence to social reality and serves the central function of enabling external validation of research in social processes (Lomborg & Kirkevold, 2003). As Strauss and Corbin (1998, p. 25) state, 'The theory does more than provide understanding or paint a vivid picture. It enables users to explain and predict events, thereby providing guides to action.' Consequently, the following arguments illustrate phenomena related to play environments and gender preferences. They also provide guidelines for educators, researchers and playground designers.

Emotions and emotional play words are rich and diverse

Children's drawings, discussions and creative processes represent a huge variety of different emotions. For instance, the world of happiness includes so many different variations of emotions that no term seemed to be extensive enough to illustrate the whole world. However, the question of positive and negative emotions became blurred because the so-called negative emotions were also experienced as positive ones, and different emotions were intertwined and controlled by self-regulation. The positive–negative dimension is somewhat confusing, however, and therefore dimensions indicating approach or achievement are more adequate (Oatley & Jenkins, 2003).

This research indicates that play also takes place in children's bodies and imagination. The emotional intensity was occasionally so strong that the children, who were at first playground designers, could not stay in this role but started to play with the paper they were drawing on; they walked on it and used their toes, fingers and voices in play. This leads to the conclusion that the most simplified play environment exists in a child and his/her current environment, where creativity is afforded and encouraged. In addition to shifting the role from designer to player, the children shifted the focus in another direction: they focused on those for whom they were designing the environment. For instance, one group of boys shifted their focus from 'what would I like to have' to 'what the animal needs'. Little by little, the desires and needs of 'me' turned to the needs of someone else.

It seemed unusual to the children to stay outsiders; instead, they involved themselves in playing and seeing things from another view. This indicates that this kind of play, where creativity is essential, provided possibilities to empathise and to experience situations from the perspective of others.

How to take into account the abundance of emotions related to play environments? Interaction between children and the environment is crucial (Moyles, 1989; Price & Rogers, 2004): the environment should offer elements that can be processed for diverse purposes through imagination. The children were fascinated, for example, by big stones, water, heat, coldness, darkness, tricky situations and collisions into walls. These elements afford tactile, emotional, social and cognitive opportunities in play.

An obvious desire for physical activity and nature

According to our data, both genders want to play and engage in physical activities. Only two girl groups referred to inert behaviour (lying like a cat, lying under the sun) in their playing environment. Both boys and girls want to climb, jump, slide, swing, role-play, respond to music, play hide-and-seek and have adventures. Furthermore, boys want to run, swim, catch (a special version was 'linear catch'), spy, ride, drive, observe, fight, compete, dive, 'wrestle' by hugging and hang on stall bars. Girls want to ride, swim, dress up, pick flowers and enjoy the sun. However, the differences between boys and girls are not significant.

Almost all the ideas are connected to nature: the scene (woods, meadows, lakes, ponds, rivers, rocks, jungle etc.); the details of the weather (storm, sun, rain etc.); and different kinds of plants are described. When asked why the woods are so much fun, Lucy answered: 'I like to climb trees and upon one big rock.' Ghost stories, created mainly by girls, take place in a mountain area. Even music is combined with nature in the form of lightning. The expectations

of Finnish children are often connected with nature, because they are close to nature in their activities. How could we take this special relationship into account in the construction of new playgrounds? A built environment can never replace the relationship that a child has with nature, but it may support knowledge and understanding of nature by affording activities that engage children in the exploration of natural phenomena.

The genders have diverse and common emotional worlds

Our goal was to find themes that are hidden under the stereotypical assumptions in respect of boys and girls. It was interesting to find out that boys showed care and nurture, and girls were attracted by scariness. We conclude that boys should be afforded play environments where care and nurture can be freely expressed in a way suitable for them. The process of constructing a home-like environment and creating characters who live there seemed to be important and natural for the boys. For girls, a scary but still safe play world is an exciting way to bring imagination into play and to interact physically with the environment. However, emotional worlds are multifaceted and ambivalent.

Another goal was to find common interests for boys and girls and to encourage them to play together. Collaborative play facilitates learning from each other, especially the learning of languages (Tannen, 1995), habits, attitudes, interactive style, emotion regulation and play patterns (Maccoby, 1988) that are culturally somewhat different with boys and girls. On the basis of this material, the shared domains of interest are natural environments where physical activity, adventures, excitement and humour can be experienced comprehensively and safely. In addition, music and imaginative features seem to play a vital role for both girls and boys. Adventures enable children to test their skills and capabilities in challenging and imaginative environments.

Boys and girls seem to need plenty of activities, and most of the activities highlight togetherness and collaborative goals. The collaborative activities can be supported by developing new games and plays in which cooperative action is needed and where the activities traverse the traditional gender borders. By cooperating and transcending these value-laden borders, children can learn things that are rarely brought out in one-gender groups. Children's emotional play worlds made us think about how encouragement, motivation and support of the expectations of both genders can elicit children's tacit talent and creativity.

Conclusion

This study was conducted in the context of pre-primary education, where learning takes place through play. We found that entertainment and excitement—found in physical activities, adventures and nature—are in many ways common interests for boys and girls. We also concluded that playgrounds should offer possibilities for fantasy, delight and imagination. These findings are significant in the contexts of joint activities and outdoor playground design.

As a theoretical summary of this research, playground designers, educators and researchers are encouraged to consider that children's emotions and emotional play worlds are rich and vivid, that physical activity and nature are important to children, and that the common interests of boys and girls—excitement and entertainment—could provide a base for collaborative play. The preliminary outcomes have already been utilised in designing pilot playful learning environments (PLE) in Rovaniemi, Finland. They will also be useful in developing PLEs further for school settings and in designing various play and game applications to meet the challenges of education. The outcomes should be of use in the work of practitioners and researchers. The impacts on children will appear when educators recognise gender choices; otherwise children's play might be inhibited (Lee-Thomas et al., 2005).

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References

Armfield, J. M. (2006). Cognitive vulnerability: A model of the etiology of fear. *Clinical Psychology Review, 26*(6), 746-768.

Bakhtin, M. (1984/1968). *Rabelais and his work*. Bloomington, IN: Indiana University Press.

Bodrova, E., & Leong, D. J. (2003). The importance of being playful. *Educational Leadership, 60*(7), 50-54.

Boyle, D. E., Marshall, N. L., & Robeson, W. W. (2003). Gender at play. Fourth-grade girls and boys on the playground. *American Behavioral Scientist, 46*(10), 1326-1345.

Butler, J. (1990). *Gender trouble: Feminism and the subversion of identity*. New York: Routledge.

Corsaro, W. A. (2003). *'We're friends, right?': Inside kids' cultures*. Washington, DC: Joseph Henry Press.

Corsaro, W. A. (2005/1997). *The sociology of childhood*. Thousand Oaks, CA: Pine Forge Press.

Dunn, J. (2004). *Children's friendships: The beginnings of intimacy.* Malden, MA: Blackwell.

Glaser, B. G. (1978). *Theoretical sensitivity: Advances in the methodology of grounded theory. Mill Valley, CA: Sociology Press.*

Glaser, B. G., & Strauss, A. L. (1967). *The discovery of grounded theory: Strategies for qualitative research.* New York: Aldine de Gruyter.

Hyvönen, P., & Juujärvi, M. (2004). Representations in playful learning: Children's views of playful environments. In *Proceedings of the ED-MEDIA 2004 World Conference on Educational Multimedia, Hypermedia and Telecommunications,* Switzerland (pp. 3591-3596).

Hyvönen, P., & Juujärvi, M. (2005). Affordances of playful environment: A view of Finnish girls and boys. In Proceedings of ED-MEDIA 2005: *World Conference on Educational Multimedia, Hypermedia and Telecommunications,* Montreal (pp. 1563-1572).

Johnson, E. J., Christie, J. F., & Wardle, F. (2005). *Play, development and early education.* Boston: Pearson.

Kehily, M. J., Mac An Ghaill, M., Epstein, D., & Redman, P. (2002). Private girls and public worlds: Producing femininities in the primary school. *Discourse: Studies in the Cultural Politics of Education, 23*(2), 167-177.

Kieff, J. E., & Casbergue, R. M. (2000). *Playful learning and teaching: Integrating play into preschool and primary programs.* Boston: Allyn and Bacon.

Lee-Thomas, J., Sumsion, J., & Roberts S. (2005). Teacher understanding and commitment to gender equity in the early childhood settings. *Australian Journal of Early Childhood, 30*(1), 21-27.

Lomborg, K., & Kirkevold, M. (2003). Truth and validity in grounded theory—a reconsidered realist interpretation of the criteria: Fit, work, relevance, and modifiability. *Nursing Philosophy, 4,* 189-200.

Maccoby, E. E. (1988). Gender as a social category. *Developmental Psychology, 24*(6), 755-765.

Martino, W., Lingard, B., & Mills, M. (2004). Issues in boys' education: A question of teacher threshold knowledges? *Gender and Education, 16*(4), 435-454.

McGhee, P. (2002). *Understanding and promoting the development of children's humor.* Dubuque, IA: Kendal/Hunt.

Meadows, S. (1992/1986). *Understanding child development.* London: Routledge.

Moyles, J. R. (1989). *Just playing? The role and status of play in early childhood education.* Milton Keynes, UK: Open University Press.

National Board of Education (2000). *Core curriculum for pre-school education in Finland.* Helsinki: Author.

Oatley, K., & Jenkins, J. M. (2003). *Understanding emotions.* Cambridge: Blackwell.

Pellegrini, A. D. (1988). Elementary-school children's rough-and-tumble play and social competence. *Developmental Psychology, 24*(6), 802-806.

Pellegrini, A. D. (2005). *Recess: Its role in education and development.* Mahwah, NJ: Lawrence Erlbaum.

Price, S., & Rogers, Y. (2004). Let's get physical: The learning benefits of integrating in digitally augmented physical spaces. *Computers & Education, 43*(1/2), 137-151.

Rodriques, M. C., Pena, J. V., Fernandes, C. M., & Vinuela, M. P. (2006). Gender discourse about an ethic of care: Nursery school teachers' perspectives. *Gender and Education, 18*(2), 183-197.

Sanders, J. (2003). Teaching gender equity in teacher education. *The Education Digest, 1,* 25-29.

Scarlett, W. G., Naudeau, S., Salonius-Pasternak, D., & Ponte, I. (2005). *Children's play.* Thousand Oaks, CA: Sage.

Strauss, A., & Corbin, J. (1998). *Basics of qualitative research.* Thousand Oaks, CA: Sage.

Tannen, D. (1995/1984). *Conversational style: Analyzing talk among friends.* Norwood, NJ: Ablex.

Thorne, B. (1993). *Gender play: Girls and boys in school.* Buckingham, UK: Open University Press.

Vogt, F. (2002). A caring teacher: Explorations into primary school teachers' professional identity and ethic of care. *Gender and Education, 14*(3), 251-264.

Vygotsky, L. (1978). *Mind in society: The development of higher psychological processes.* Cambridge, MA: Harvard University Press.

Walkerdine, V. (1990). *Schoolgirl fictions.* New York: Verso.

Walkerdine, V. (1991). Some day my prince will come. In A. McRobbie & M. Nava (Eds.), *Gender and generation* (pp. 162-184). Basingstoke, UK: Macmillan.

Wardle, F. (2003). *Introduction to early childhood education: A multidimensional approach to child-centered care and learning.* Boston: Allyn and Bacon.

Wood, E., & Attfield, E. (2005/1993). *Play, learning and early childhood curriculum.* London: Sage.

A Narrative View on Children's Creative and Collaborative Activity

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The aim of this paper is to examine children's ideating processes of creating playground of their dreams from the viewpoint of narrativity and narrative thinking. The children aged 6-7 were asked to express their ideal outdoor playing environments and a large number of narratives emerged. This study concerns how these narratives were constructed through creative processes and what affect narrative thinking has on the process. The research process consists of 15 playful ideating sessions, during which the children (N = 49), through play, expressed their thoughts by drawing and telling stories. Our starting point is the pivotal nature of narrative thinking in creative and collaborative activities, we also aim at a closer theoretical examination of this phenomenon. Through narratives the children structured their experiences and the products of their imagination into larger entities. The children were enchanted by exceptional ideas and their imagination was stimulated by integrating fact and fiction. We realized that in situations where the children were emotionally committed to building a story and functioned in a reciprocal manner, refining and elaborating ideas together, there was collective thinking, which in this context can be regarded equal to shared narrative thinking. Based on the interaction between data and theories we present our theoretical model of narrativity and consider possible applications of this model into the context of school. The results will be utilized in the design of learning environments consisting of playgrounds with information and communication technologies, as well as based on play and games.

Keywords: narrativity, narrative thinking, collaborativity, creativity, frame play, Information and Communication Technologies (*ICT's*)

1 Introduction

What type of activity should tomorrow's learning environment encourage and what kind of stimuli should it provide for a developing individual? We assume that the challenges of a future's society are particularly linked to supporting creativity and collaboration in activities. If we think of a global society of the future as based on interactive creativity, what becomes relevant is not new technology but the new ways of acting (see Himanen 2004). Also into the *Finnish National Core Curriculum for Basic Education* (2004) is written a goal to renew thinking and ways of action. It can be based on a creative collaboration, which is best characterised as a trust on others, playfulness and support for taking risks (Uusikylä 2003). It is therefore reasonable to pay attention to socially shared activity (cf. distributed cognition, Oatley 1990), for which creativity is essential.

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Within this article we examine the roles of narrativity and narrative thinking within the collaborative process, as well as the challenges of the learning environment from this angle. The focus of the analysis was children's ideating processes of their dream playing environments. During these sessions, which were similar to *frame play* (Broström 1996; 1999), the children ideated playing environments based on e.g. humour, fear, taking care, summer fantasy and adventure (e.g. Juujärvi & Hyvönen 2005; Hyvönen & Juujärvi, in print). Into these emotional surroundings of play, the children created stories, thus narrativity turn out to be an essential element of the creative and collaborative action.

Our starting point is the pivotal nature of narrative thinking in creative and collaborative activities. The study of narrative is multidisciplinary, it is divided within the focus of many disciplines such as literature or psychology. According to our experiences narrativity needs more *interdisciplinary* and *transdisciplinary* research (cf. Ruokamo & Tella, in print). Within this article we intertwine educational and philosophical aspects of narrativity and get closer to both a versatile theoretical examination of this phenomenon and a transdisciplinary research. We are not trying to define the borders of a story – such as what is considered as story and what is not – but rather accept it as a relative term.

For our theoretical background we present a few theoretical views of narrative thinking (e.g. Bruner 1986, 1990, 1996; Mateas & Sengers 2003), socio-cultural views (e.g. Vygotsky 1978; Wertch 1991; Wells 1999; Wells & Claxton 2002) on collaborative activity, concept of creativity (e.g. Amabile 1996; Cropley 2001; Uusikylä 1999) and philosophical aspects of possible worlds (e.g. Kripke 1980; Lewis 1986) and thought experiments (e.g. Gendler 2000; Bokulich 2001).

This article forms part of the Let's Play project studies. The aim of the project is to design, develop and build playful learning environments within the school grounds. Pilot environments are going to be built during the year 2005 utilizing information and communication technologies (ICT), but which will primarily begin with Identification Technologies. Playful and activity based learning environments will contain innovative and interactive applications for *play* and *games* (cf. *playfulness*; Hyvönen & Ruokamo, in print), which can be used in preschools and elementary school. Therefore we will consider how the use of technology in playful learning environments can, at its best, offer varied possibilities for the support of children's narrative thinking and creativity.

2 Aims and objectives

Focus of this paper is to clarify how children's narrative thinking appears in creative and collaborative activity, to glean what are the main points emerging from the interaction of theories and data. We will develop a theoretical model of narrative thinking and creativity and in future work we will develop a pedagogical model for the school context. Based on these models we will consider the prerequisites for play and game applications for playful learning environments. But first let us define the main concepts used in the article: narrative thinking, collaboration and creativity.

3 Main concepts

3.1 Narrative thinking from a multidisciplinary perspective

Narrative perspectives in analysing thought processes have become more popular in recent years (example Lyle 2000; Mateas & Sengers 2003.) Narrative thinking refers to a thought process of creating a story. With narrative thinking events and experiences are organised into plotted structures (Bruner 1990). With the help of plot characters, surroundings and activities are connected to each other (Bruner 1986). In this way story is functioning as a tool for constructing meanings about the surrounding world and thinking gains a narrative form, becomes explicit and easier to manage (Bruner 1996; Egan 1986). Thus, stories help us in deal with more complex meanings (Schwartz 1996).

Narrative thinking is natural and one of the earliest forms of thinking for the human mind (Bruner 1990; 1996). Narrative thinking is not only connected to lingual structures, because it is present in the pre-lingual stage in the child's development. This can be observed in children's play, when they mould the story verbally and with different creative actions like drawing or making gestures. Thus, in narrative thinking emotions, imagination, memory and thinking is combined (Bruner 1996; 2002).

Narrativity has a close relationship with possible worlds. When constructing a story one builds parts of another possible world. Understanding, that things could be differently needs elaborative thinking, constructing and active thinking wholes that can be thought of as "worlds". Thinking of other worlds involves thinking more complicated notions, such as relations between individuals. Complex notions such as this are, for example, causality and time. One may perceive that possible

worlds are only stipulated entities (Kripke 1972), or that they are physical entities (Lewis 1986). In the latter, the limits of language are not limiting the very idea of possibility – imagining a possible world does not have to be only a verbal act.

Narrative thinking is not only something that is present in the early development of thinking processes, as in children, but also in story-like experiments within science and philosophy, termed thought experiments. It is believed that thought experiments play an essential part in testing a theory's consistency and explanatory power (Bokulich 2001). Making thought experiments is essentially a process of refining the theory (Gendler 2000), executing a thought experiment is an act of make believe. This process can also be collaborative (Bishop 1999). In this sense playing can be thought of as making a thought experiment where an imaginary setting puts certain views of the actual world to a test. With narrative thought process one can make sense of unusual (Bruner 1990) or new.

3.2 Collaborative activity

The nature of collaboration is dependent on whether the participants are sharing a common idea or task (Engeström 1992). In our case, this means children's commitment to the ideation of the *same* playing environment by connecting their own ideas or thoughts with the ideas of others. Narratives from the viewpoint of collaborative activity, is thus not only the sum of the narratives of individuals, but the active building of narratives collaboratively. In this case the focus is not to transform one's own structures of mind, but to contribute and refine shared narrative information (cf. Bereiter 2002).

Collaborative activity has been the focus of educational research and is well known both in the study of play and learning. An advantage of collaborative activity is based on Vygotsky's (1978) concept of the *Zone of Proximal Development* (*ZPD*) in which children are challenged with the graduated zones, which are slightly above their current individual level of functional competence. However, the present view of an educational reform is that the role of each of participant as learner and tutor in a collaborative activity is emphasised (e.g. Wells 1999), in which case the *ZPD* is at the same time a potential challenge for everyone despite of the level of development.

Neil Mercer (2000; 2002) highlights the intermental perspective in collaborative activity, which means that common pursuits are based on *Intermental Development Zone* (*IDZ*). The term describes social activity, where the meaning of the constructing of common view is highlighted. By emphasizing collaborative activity socio-emotional factors are also significant. Therefore *ZPD* also consists of action, thinking and emotions (Wells 1999). In successful collaboration emotional scaffolding concludes *the gift of confidence*, the sharing of risks in the presentation of new ideas. (Mahn & John-Steiner 2002).

3.3 Creativity

Creativity is essentially associated with the activity of producing something novel, imaginative and satisfying to oneself. (Cropley 2001; Uusikylä 1999). In addition the product of creative action should be appropriate to the given task. In the context of creativity it is usual to discuss divergent thinking (Cropley 2001; Russ 2003) that involves non-logical processes and novel situations in which there may be several relevant answers (see Eysenck 1994). Furthermore, the prerequisite for creativity is a heuristic process. The goal is not to reach a predetermined answer, but where solutions may develop through a number of paths (Amabile 1996). There appears to be a relationship between creativity and narrative thinking. When children play they often share their fantasy world and construct the stories of play through collective activity. Thus narratives are tools for thinking and creativity. From the point of view of frame play children from the age of 6 become more conscious of the situation of imaginary play and they reach an awareness of the purpose of play when adults can easily join in with imaginary situations (Broström 1996; 1999).

Creativity is supported if the situation is not stressful. Thus it is important to encourage children to play with ideas and to test solutions rather than pursue one correct goal. From the point of view of creative imagination children's thinking is usually suppressed. One obstacle in playing with ideas is a fear of mistakes and the use of existing models based on the thoughts of adults (Hakkarainen 2002). Within this research ideating sessions were constructed with an atmosphere that nurtured children's creativity and imagination. The ideating sessions of designing playing environments were organised in a playful way, because it allows more possibilities to create hypothesis and inventions. It is argued that in creative activity playfulness has had positive influences (Lieberman 1977; Christie & Johnson 1983).

4 Data collection and analysis methodology

The empirical data was collected during autumn 2003, from 15 ideating sessions, in which children (N=49) aged 6 to 7 years expressed the kind of playing environment of their dreams. A session involved a group of 2 to 5 children that consisted of either all boys, all girls or was mixed. The children ideated by drawing and discussing around a large drawing sheet spread on the floor (figure 1). Researchers also participated in the process and emphasized that the playing environments would be outside. Sessions lasted 30 to 45 minutes and were recorded on videotape. Videotapes were transcribed afterwards and all the drawings were photographed.

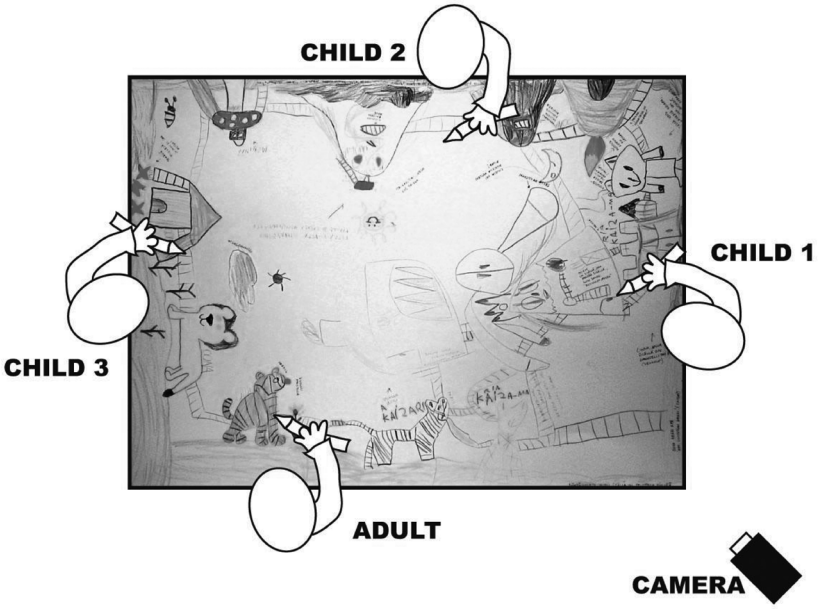

Figure 1. Example setting from an ideating session.

The playful nature of ideating sessions were similar to Stig Broström's (1996; 1999) description of *frame play*, in which an adult may also participate in the construction of the plot and imaginary situation. *Frame* refers to the participants' conscious and joint plan of the imaginary play situation. During the ideating sessions researchers participated by listening, discussing and drawing with the children. Researchers also asked about aspects of the playing environment and what the children would like to do there. In this sense data collection sessions were similar to participant observation. Adults joined in the storyline, but the children's ideas and initiatives held the main role around the drawing paper.

The study is based on *narrative analysis* (e.g. Polkinghorne 1995) and *grounded theory*, according to which a phenomenon is approached through data-based information and the interaction of different theories (Strauss & Corbin 1994). In our case, the intention is not to create a theory of the individual thinking, but weight is put on the processes within group thinking. Since there were several children involved in the ideating sessions, analyzing the process by means of videotape or transcribed data is ambiguous. The fast pace of the children's activities and the difficulty of interpreting non-verbal communication make the interpretation of collaborative activity comparatively challenging.

Analysis of the data was based on the qualitative analyses of the ideating sessions. Through video and transcription of the children's dicussions, drawings and their activity during the sessions were evaluated. The constructed narratives of the

children were set apart so that one narrative unit consists of one story with a clear plot or a connected whole. Thus, one narrative could be a short description of environment and activity or the whole environment ideated on the paper.

5 Results

The children were eager to ideate environments of their dreams: the 30 narratives were collected over 15 sessions, averaging two narratives per session. In these processes children often shared their narrative thinking and constructed narratives with a high level of collaboration. Narratives emerged in the levels of play, verbal action and emotions and these became more complex and more emotional during the collaboration. Below we will present the results starting with the playfulness in the sessions and finishing with the descriptions of shared narrative thinking and the theoretical model of narrativity.

5.1. Narrative thinking as playing

Frame play sessions inspired children to insert narratives into the playing environments. Narratives were represented as drawings, descriptions and discussions about the playground of their dreams and connected activities. Many stories were born of the creative and playful processes and can be thought of as an indication of children's narrative thinking and a way of organising new experiences into plot-like shape. Sometimes narratives were born so that children imagine activities in the environments and were the narrators of those situations. Sometimes children played in the roles of the narrative as in extract 1 below. Figure 2 shows the children's common narrative.

Extract 1. Aapo, Tomi and Juho are structuring the narrative "The ship fires a ship and the rocket fires a park" by playing

Aapo*: What Im gonna do?... well there is no canon!*
Tomi: *Yes, there is none.*
(notices that he also has none and draws a canon on his ship)
Aapo*: Theres going to be a bang!*
Tomi: Mine is shooting there, look, it shoots directly at pirate ship.
(indicates the pirate ship of Aapo) … *Big ammo… shoots kind of really far, doesnt it?*
Aapo*: Mine too…*
Tomi: *Little rocket!*
Juho*: Oh geez! If that rocket… oh no!*
Aapo*: Rocket goes, it brakes that in a minute and then all of those!*
Tomi: *Yes it does! The ship shoots ship and rocket shoots park.*
Aapo*: Look.*
Juho: *My pirate ship gets revenge.*
Tomi: *Yeah! But not this, this shoots u into outerspace. And that flies to space certainly*

Figure 2. The ship fires a ship and the rocket fires a park.

Extract 1 demonstrates that most of the narratives that arose from the ideating sessions were created through collaboration, showing that two or more children share an imaginary situation in a collective way. The most rich and complex narratives emerged in playful situations characterized as spontaneity, a manifestation of joy and a sense of humour, which interrelate with divergent thinking (see Lieberman 1977). Below we present the main features of children's narrative thinking and shared narrative thinking.

5.2 Children's narrative thinking in collaboration

From the data we distinguish four features in children's narrative thinking: entity, fascination with surprise and integration of fact and fiction, and emotions. In addition, we perceived five properties of children's shared narrative thinking (see table 1).

Table 1. The main features of narrative thinking and shared narrative thinking.

Narrative thinking		**Shared narrative thinking**	
Category	Implication	Category	Implication
Entity	*Tendency to form meaningful entities*	Imitative	*Construction of common imagination and common ground*
Surprise	*Meaning in the stimulation of thinking*	Associative	*Creating narrative through associations*
Integration of fact and fiction	*Tendency to generate imaginative situations*	Productive	*Creating narratives through collaborative ideating*
Emotional	*Essential role of emotion in the ideating sessions*	Transformative	*Refining and elaborating ideas through collaboration*
		Emotional	*Emotional commitment to shared idea*

Through narratives children structured and organised their experiences and products of imagination into **entities** through which the ideated environments acquired a meaning. In narrative thinking an element of **surprise**, that is, presenting surprising alternatives inspired the children's imagination and narrative thinking. For example in one session each of the children first drew a tiger, and when the researcher asked if the animals could speak, the children didn't react much to the question, but after that the animals became climbing frames in which you could slide down from the animal's tongue. So, we argue that, in this case, surprise – asking if tigers could speak – stimulated the children's imagination, but this only happened when children found the ideas proposed appealing. We noticed that surprise is closely connected to **integration of fact and fiction** in narrative thinking. Indeed, combining fact and fiction seemed to inspire children and tended to exclude the conventional in the narratives. Extract 2 below shows an example in which two boys ideate an environment by combining fact and fiction. Figure 3 shows the children's ideal playground corresponding to this narrative.

Extract 2: Paavo, Niko are structuring the narrative "Lava proof swimming trunks are needed" - fact and fiction

Paavo*: I'll make a volcano!*
Niko*: Yeah, I'll make volcanoes, too!* (giggle)
Paavo*: But these are not real ones. They're fake volcanoes!*
Niko*: I'll make a big one, at least! Lava is splattered there!*
Paavo*: Hmm, this is fun!*
Researcher*: Why is there lava?*
Niko*: Hmm…you can swim there.*
Researcher*: In lava?*
Niko*: Yeah.*
Paavo*: Then* swimming *trunks are needed!*
Niko*: Yes!*
Paavo*: And lava proof ones!*
Researcher*: Ooh. Super trunks.*
(boys laugh)

Paavo*: There could be coloured water, red water.*
Researcher*: Yeah, it could be fake water.*
Paavo: *Yeah, is it ok Niko?*
Niko: *Yes.*
Paavo*: Like red cloth you could jump into.*
Researcher*: Exactly. So your clothes don't get wet and the lava doesn't burn.*
Paavo*: Then we could play volcano climbing!*
... What an unusual climbing place!

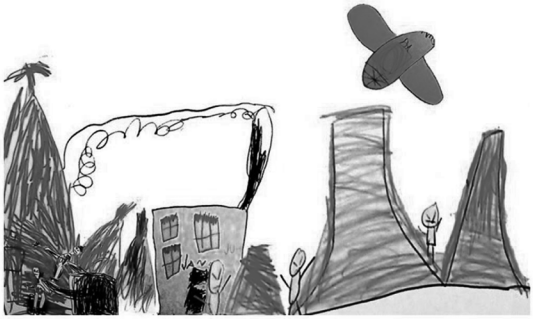

Figure 3. "Lava proof swimming trunks are needed"

In extract 2 children differentiated between reality and fiction but seem to be fascinated with the more fictitious surroundings. The more fantastic assumptions, like swimming in lava, stimulated a greater refining and elaboration of the narrative turning it into descriptions of other possible worlds. Integrating fact and fiction turns views of reality into a test of possible worlds by making thought experiments. As in frame play, an adult joined the imaginative situation but allowed the children to construct a common narrative for themselves. Thus, in one socially shared story, narrative thinking or some aspects of it created by many children were represented. We assume that high quality collaboration arose where constructing a story was based on the *Intermental Development Zone* (*IDZ*, Mercer 2000; 2002). Stories that were versatile and rich in content were mostly constructed collaboratively, and, especially in situations where children's narrative thinking was **socially shared**, their imagination, memory, thinking and emotions came together. In this case the representations of shared narrative thinking were not only verbal but included the movements, actions and drawings during the process. According to the data, *shared narrative thinking* can be categorized into imitative, associative, productive, transformative and emotional intermental phenomenon.

When children shared ideas for the narrative, refined it and developed it further, they were acting as guides and innovators, but also as targets for copying and learning from each other. In all sessions shared ideating was based on **imitation**, which appeared to be meaningful, especially in the shared reciprocal state, collective imagination and in constructing a common view. It is possible that for children at this age imitation is one of the ways in which they signal to their partner that they accept the stated idea (see Faulkner & Miell 2004) and in this way an *IDZ* is created. It was also typical that the stories were created **associatively**, for example, in one session a child drew a house upside down and the other elaborated on it turning it into an amusement park building associatively from her own experiences. In addition, shared narrative thinking can be said to have been **productive**. This is shown in the sessions as rich and imaginative output.

Due to the collaborative nature of *elaborating and refining ideas,* shared narrative thinking is **transformative**. During the collaborative process of constructing a narrative, the ideas of others were not taken per se but constructed and refined further. In this case transformative narrative thinking is connected to divergent thinking and to the creativity. Thus in the ideating sessions acquired *IDZ* was made possible, along with narrative thinking, *Intermental Creative Zone* (*ICZ*). The *reciprocal creativity* idea is refined so that none of the children can create it alone.

The data supports the assumption that emotions are closely linked to imagination (see Egan 2005) and narrative thinking (see Bruner 1996). During the sessions children welcomed the ideas that attracted them emotionally, like those associated with humour, fear or adventure. We agree with Egan (1992) in that children's imagination is best stimulated by stories with a content that affects them at the emotional level. Shared narrative thinking represents **emotional commitment** to the same idea. For example, if one of the children or adults came up with an exciting idea, others took part in the imaginary situation

by eagerly making gestures and empathizing with the idea intensively. Common humour and excitement functioned as emotional stimulations to the collective imagination and play.

In the ideating sessions children ideated playing environments spontaneously sharing only *relevant thoughts*. This is enough for understanding because in social interaction a story can carry both meaning and context, i.e., surroundings for the meaning. The story itself is actually broader than is explicitly expressed. For example in the session where Niko and Paavo created the volcano environment, Niko's "*you can swim there*", is based on the assumption that then you'll need swimming trunks and swimming in lava is possible in play. Implicit assumptions are starting to broaden the story into a whole other possible world.

5.3 Towards a model of narrativity

Based on the perspectives that arise from the data and the theories of narrativity, we developed a three-dimensional model of narrativity (figure 4). This model includes the dimensions of meaning, activity and collaboration. The model introduces a flexible idea of narrativity, starting from separate entities and moving towards whole worlds, leaving narrativity somewhere in between. The 30 narratives found during the sessions were situated in this model.

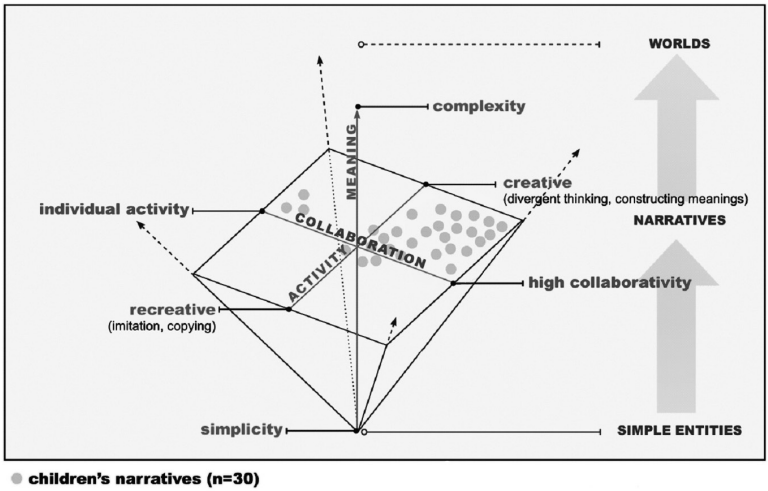

Figure 4. Model of narrativity

At the bottom of the model are the simplest meanings, such as characters and things. Moving up, the act of combining simple elements with different kind of relations, such as time, causality and so on, introduces a narrative. At the top, narrative expands into a whole possible world. As we approach the narrative level, which shouldn't be thought of as a definite level with real borders but as a continuum, the meaning of the axes of collaboration and creativity grows. The narratives were hard to fit into the figure because of the very complex nature of all three dimensions. It seems that most of the narratives are concentrated in the creation-collaboration corner, i.e., the corner of *shared narrative thinking*. In the creative sessions of this study, children were not told to collaborate, it happened naturally through stimulation by the *entities* contributed by others and through *association*, *surprise* or the *integration of fact and fiction*. The activities observed can be categorized as *imitative, productive* and *transformative*. Presumably, expansion into broader worlds occurred, but the more explanatory level, that is, the level of narrative, was our main focus.

6 Conclusions

This study showed that in creative and collaborative activity the children's narrative thinking was shared and it arose especially by playing and refining imaginative situations. Through shared narrative thinking children entered the *Intermental Creative Zone* (*ICZ*) and, in this way, crossed the borders of individual imagination. It is through *reciprocal creativity* that most of the children create the playing environments of their dreams and include in them meaningful narratives in the shape of actions. Therefore, it is important to develop playful environments that are based on *narrative activities*, the children's own activity and collaboration. Based on this, we are developing our *Model of Reciprocal Creativity*, which we will test in the pilot playing environments. We also have further plans to introduce new technological elements to them.

It is important that children refine possible worlds that are relevant to their current views of reality. When constructing possible worlds by means of narrative, children gain an understanding of more complex meanings and learn to create new meaningful wholes. Playing is fertile ground to develop children into flexible thinkers and actors of the future. Thus, play can be properly regarded as a relevant context for shared narrative thinking and divergent thinking.

The role of the adult in this process is to emotionally support creativity and stimulate divergent thinking, taking care to allow space for the children's own natural narrative activities. As our data showed, surprise and integration of fact and fiction was one of the most important factors in narrative thinking. Reacting to surprising stimuli, constructing a world, they became more elaborative. Interesting and exciting conflicts between fact and fiction produced more shared narrative thinking.

The surprise factor could also be supported by technology, by providing random inputs in time, challenging the children's narrative thinking. *Information and Communication Technologies* (*ICTs*) could support this kind of collaboration between remote places. Most of the content of the narratives should still come from the children. *ICT* would just provide a more dynamic environment – children as collaborative constructors of their own worlds and technology making it more alive and offering more possibilities. Thus *ICT* would serve to support and stimulate imagination.

Supporting children's narrative thinking thus creates many challenges for future learning environments and for the use of ICT. The learning environment of the future should be adaptive, flexible and customizable in order to create support for the children's own narrative activity and creativity. It should also provide possibilities to easily include learning processes into the play and narrative activity. The question of building a pedagogical model for narrative learning experiences therefore requires further study. The theoretical model of narrativity introduced here also requires more interdisciplinary and transdisciplinary research.

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References

Amabile, T. M. (1996) Creativity in Context. Boulder (CO): Westview Press.

Bereiter, C. (2002) Education and Mind in the Knowledge Age. Hillsdale, NJ: Erlbaum.

Bishop, M. A. (1999) Why Thought Experiments are not Arguments? Philosophy of Science, 66, 534541.

Bokulich, A. (2001) Rethinking thought experiments. Perspectives on Science vol. 9 no. 3. Cambridge: The MIT Press.

Broström, S. (1996) Frame Play with 6 Year-old Children. European Early Childhood Education Research Journal, 4, 1, 89–101.

Broström, S. (1999) Drama games with 6-year-old children: Possibilities and limitations. In Y. Engeström, R. Miettinen & R-L Punamäki (eds.) Perspectives on activity theory. New York: Cambridge University Press, 250–263.

Bruner, J. (1986) Actual minds, possible worlds. Cambridge: Harvard University Press.

Bruner, J. (1990) Acts of meaning. Cambridge: Harvard University Press.

Bruner, J. (1996) The Culture of Education. Cambridge: Harvard University Press.

Bruner, J. (2002) Making stories: Law, Literature, Life. New York: Farrar, Strauss & Giroux.

Christie, J. & Johnson, E. (1983) The role of play in social-intellectual development. Review of Educational Research, 53, 93–115.

Cropley, A. J. (2001) Creativity in education & learning. London: Routledge.

Engeström, Y. (1992) Interactive Expertise: Studies in Distributed Working Intelligence. University of Helsinki, Department of Education, Research Bulletin, Vol. 83.

Egan, K. (1986) Teaching as story telling. An alternative approach to teaching and curriculum in the elementary school. Chicago: The University of Chicago Press.

Egan, K. (1992) Imagination in Teaching and Learning Ages 8-15. London: Routledge.

Egan, K. (2005) An imaginative approach to teaching. San Francisco: Jossey-Bass.

Eysenck, M. W. (eds.) (1994) The Blackwell Dictionary of Cognitive Psychology. Oxford: Blackwell.

Faulkner, D. & Miell, D. (2004) Collaborative Story Telling in Friendship and Acquaintanceship Dyads. In Littleton, M., Miell, D. & Faulkner, D. (eds.) Learning to Collaborate, Collaborating to Learn. New York: Nova Science Publishers, 7–29.

Finnish National Core Curriculum for Basic Education 2004. National Board of Education. Retrieved 21st January, 2005, from http://www.oph.fi/info/ops

Gendler, T. S. (2000) Thought Experiment. On the Powers and Limits of Imaginary Cases. New York: Garland Publishing.

Hakkarainen, P. (2002) Kehittävä esiopetus ja oppiminen. Jyväskylä: PS-Kustannus.

Himanen, P. (2004) Välittävä, kannustava ja luova Suomi. katsaus tietoyhteiskuntamme syviin haasteisiin. Tulevaisuusvaliokunta, teknologian arviointeja 18. Eduskunnan kanslian julkaisu. Retrieved 21st June, 2004, from http://www.eduskunta.fi/fakta/julkaisut/ekj4_2004.pdf

Hyvönen, P. & Juujärvi, M. (in print) Affordances of playful environment: a view of Finnish girls and boys. Proceedings of ED-MEDIA 2005. Montreal, Canada. World Conference on Educational Multimedia, Hypermedia & Telecommunications. AACE.

Hyvönen, P. & Ruokamo, H. (in print) Leikillisyyden ominaisuudet ohjaamisen, leikkimisen, pelaamisen ja oppimisen OLPO-mallissa. Teokseen (Toim.) Smeds, R., Tella, S., Ruokamo, H., & Multisilta, J. Oppiminen ja tieto- ja viestintätekniikka opetuksessa ja opiskelussa.

Juujärvi, M. & Hyvönen P. 2005. Esikouluikäisten tyttöjen ja poikien kuvauksia toiveiden leikkiympäristöistä. Teoksessa J. Levonen & T. Järvinen & S. Kaupinmäki (toim.) Tampere University Press, Hypermedialaboratorion verkkojulkaisuja - Hypermedia Laboratory Net Series; 8. http://tampub.uta.fi/tup/951-44-6038-3.pdf

Kripke, S. A. (1972) Naming and Necessity. Cambridge: Harvard University Press.

Lewis, D. (1986) On the Plurality of Worlds. Blackwell Publishing.

Lieberman, J. N. (1977) Playfulness: its relationship to imagination and creativity. New York: Academic Press.

Lyle, S. (2000) Narrative understanding: developing a theoretical context for understanding how children make meaning in classroom settings. Journal of Curriculum Studies, 32 (1) 45–63.

Mahn, H. & John-Steiner, V. (2002) The gift of confidence: A Vygotskian view of emotions. In G. Wells & G. Claxton (eds.) learning for life in 21st Century. Sociocultural perspectives on the future of education. Cambridge, MA: Blackwell, 46–58.

Mateas, M. & Sengers, P. (2003) Narrative Intelligence. In M. Mateas & P. Sengers (eds.) Narrative Intelligence. Amsterdam: Benjamin cop, 1–25.

Mercer, N. (2000) Words and Minds. How we use language to think together. London: Routledge.

Mercer, N. (2002) Developing Dialogues. In G. Wells & G. Claxton (eds.) Learning for Life in the 21st Century. Cornwall: Blackwell Publishing , 141–153.

Oatley, K. (1990) Distributed Cognition. In H. Eysenck, A. Ellis, E Hunt & P. Johnson-Laird (eds.) The Blackwell dictionary of cognitive psychology, Oxford: Balckwell, 102–107.

Polkinghorne, D. (1995) Narrative configuration in qualitative analysis. In J. A. Hatch & R. Wisniewski (eds.) Life history and narrative. London: Falmer, 5–23.

Ruokamo, H. & Tella, S. (in print) A MIT Research Approach to Network-Based Mobile Education (NBME) and Teaching–Studying–Learning Processes: Towards a Global Metamodel. IPSI Transactions on Advanced Research Journal's Special Issue on E-Education: Concepts and Infrastructure.

Russ, S. W. (2003) Play and Creativity: developmental issues. Scandinavian Journal of Educational Research, 47, 3, 291–303.

Schwartz, P. (1996) The Art of the Long View. Planning for the Future in an Uncertain World. New York: Bantam Doubleday Dell Publishing Group.

Strauss, A. & Corbin, J. (1994) Grounded Theory Methodology. In N. Denzin & Y. Lincoln (eds.) Handbook of Qualitative Research. Thousand Oaks: Sage, 273–285.

Tella, S. & Ruokamo, H. (in print) Monitieteinen mobiiliverkko-opetus, -opiskelu ja oppiminen: MOMENTS-projektin integroitu metamalli. Teokseen (eds.) Smeds, R., Tella, S., Ruokamo, H., & Multisilta, J. Oppiminen ja tieto- ja viestintätekniikka opetuksessa ja opiskelussa.

Uusikylä, K. (1999) Luovuus. Taito löytää, rohkeus toteuttaa. Jyväskylä: PS-viestintä OY.

Uusikylä, K. (2003) Vastatulia. Inhimillisen kasvatuksen ja koulutuksen puolesta. Jyväskylä: PS-kustannus.

Vygotsky, L. S. (1978) Mind in society. Cambridge: Harvard University Press.

Wells, G. (1999) Dialogic inquiry: Towards a sociocultural practice and theory of education: Cambridge: Cambridge University Press.

Wells, G. & Claxton, G. (eds.) (2002) Learning for Life in the 21st Century. Oxford: Blackwell Publishing

Wertch, J. V. (1991) Voices of the mind: A sociocultural approach to mediated action. Cambridge MA: Harvard University Press.

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Book CHAPTER

CHILDREN'S CREATIVE COLLABORATION – A VIEW *of* NARRATIVITY

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Introduction

It is assumed that one of the core drivers of knowledge and progress in society is creativity, and that one of the key missions of schools is to educate for the creation of knowledge and innovation (Craft, 2005; Sawyer, 2006, 2008). Innovations that spring from groups and teams that contain diverse perspectives, share goals and knowledge, and engender creative collaboration in classrooms is regarded by many scholars as being aligned with the important and pivotal nature of innovation in today's economy and society (e.g., Claxton, Craft & Gardner, 2008; Sawyer, 2006, 2008). Children's worlds are increasingly populated by intelligent technologies, and formal and informal technology-enriched play and learning environments. If we think of the global society of the future as being based on collaborative creativity, what becomes relevant is not only the new technology, but also the modes and processes of acting and participating in collaborative activity and knowledge co-creation.

In this chapter, we argue that narration is a key aspect of meaning-making (Bruner 1996; 2002) and a specific kind of interaction (Becker & Quasthoff, 2004) that provides an important viewpoint from which to discuss collaborative activity and creativity (cf. John-Steiner, Shank & Meehan, 2004). We examine the roles of narrativity and narrative thinking within the creative and collaborative process, as well as the challenges for the future innovative learning environment from this perspective. We will present the study that started the research and development process whereby children were given a voice for gaining information for the real and meaningful purpose of developing and creating innovative learning environments that correspond with today's technology, and that provide the children with novel tools and skills for them to act confidently in a creative society.

The study presented here has two aims: one is to study children's creative collaboration and the role of narrativity in authentic co-design processes; the other is to use the findings as a basis for developing a 'playful learning environment' (PLE) and a theoretical framework for it. A playful learning environment (PLE) is defined as *a technology-enriched play and learning environment* which provides novel opportunities for integrating creativity, playfulness and physical activities with a curriculum-based education (e.g., Kangas, 2010; Kangas, Randolph and Ruokamo, 2009). The pedagogical conception of the PLE as including a technology-enriched playground derives from multidisciplinary Finnish research and design projects[4] for developing an innovative outdoor playground in which learning can take the form of play and games, as well as own content creation. The PLE is also referred to as SmartUs – a commercial technology-enriched playground complex that integrates not only modern technology and playground equipment, but also outdoor playgrounds and computers inside the classroom. Hence, the affordances of the environment are subsequently extended to the classroom, providing tools, including the Internet, through which students can themselves create content and design games. Pilot outdoor envi-

ronments consist of a novel playground facility located in the schoolyard and enhanced with RFID (radio frequency identification device) technology. The technological elements of SmartUs can be integrated into non-technological playground equipment, or located in a natural environment near the school, such as in woods.

One crucial point in designing and developing new learning environments is that they should support the play, learning, and physical activities of children in a variety of ways. The starting point from an educational point of view for this research study was to listen to children's voices, and to let them contribute to our research and design work. The data collection started with children of six and seven years of age (i.e., pre-primary children in Finland) because their viewpoint is usually missing in the design of play provisions (Armitage, 2001); for children of that age, play is a natural way of expressing oneself. The empirical data were collected from five preschools in 2003. The goal was to discover what children expect from a favorable and ideal play environment, and the activities that would be involved in play. This information was needed to better understand the features of the PLE, and related play and learning activities. Later, in the next phase of the PLE-studies, children participated in testing the pilot environments in various play and learning settings. These empirical studies have been reported in other research articles (e.g., Kangas, Hyvönen and Latva, 2007; Hyvönen, 2008; Kangas, 2010).

In this chapter, we draw on an empirical study in which children (in small groups) designed the features of their ideal outdoor play environment by drawing and talking. We asked children in *playful co-design sessions* to imagine, conceptualize, and describe the environment in which they would most like to play, what kinds of activities it would afford, and what kinds of elements there would be (see also Hyvönen and Kangas, 2007). These situations provided us with a rich context from which to study children's creative collaboration and the role of narrativity in authentic and playful settings. The group of children worked around

a large drawing sheet that was spread on the floor. A total of 15 playful co-design sessions were arranged, each lasting 30 to 45 minutes and involving six groups of boys, five groups of girls, and four mixed groups of children. The sessions were video recorded, the discussions were transcribed, and the drawings were photographed.

Analysis of *what* children expected from their ideal play environment revealed play environments, or rather 'play worlds,' that provided physical activities with friends, that were close to nature, and that were emotionally rich and vivid (Hyvönen and Juujärvi, 2005; Hyvönen and Kangas, 2007). The children prefer play environments that consist of several physical structures, such as those related to sport and nature, and playground artifacts (e.g., soccer fields, forests, various slides, huts etc.). In nature, children emphasize animals, trees, woods, flowers, rocks, and mountains. An interesting result of the data collection was the discovery that children's play environments in fact reflect rich emotional play worlds. Although the children designed accurate artifacts and play areas, their play worlds and the design process were generally rather more emotional than physical (Hyvönen and Kangas, 2007; 2010).

In answering the question 'What did the playground designers suggest?', six different emotional types of play world were found, which bring out happiness, scariness, care, aggression, excitement, and amusement (Hyvönen and Juujärvi, 2005; Hyvönen and Kangas, 2007). These emotional tensions were involved in and evident from the narratives that the children created during the sessions. The girls preferred to design play worlds that were characterized by both *scariness*—with various bogey features and episodes—and *happiness*—with summer and beauty. Boys had worlds of *care,* with domestic play, *aggression,* and *competition*. Play worlds shared by boys and girls represented *excitement* and *amusement.* Nature, including animals, provided fascinating environmental features for both boys and girls (Hyvönen and Kangas, 2007; Hyvönen, 2008). The findings also show that in many cases children were collaboratively engaged in mutual design and story creation during the co-

design sessions: they created a large number of stories around the play worlds. In other words, the co-design sessions inspired or gave an opportunity for the children to co-create and insert plot-shaped narratives into their designed and drawn play environments. Thus, in addition to discerning *what* the children designed and created (see Hyvönen and Juujärvi, 2005; Hyvönen and Kangas, 2007), it was also meaningful to explore *how* the play worlds were generated in small-groups.

On the above grounds, we will discuss, in this chapter, the role of narrativity and narrative thinking within the co-design processes of children. We will also consider the challenges for future innovative learning environments from this angle. Following Jerome Bruner (2003: 45), the founder of narrative psychology, we are interested in how narrative as an instrument of mind operates in the construction of reality, and how this emerges in children's creative and collaborative activity. We endeavour to intertwine the educational and philosophical aspects of narrativity, and to get closer to a versatile theoretical examination of both the phenomenon of narrativity, and collaborative creativity. However, as put forward by Sawyer (2008), to explain and understand the creativity of complex collaborating groups, we need a theoretical framework that allows us to better understand how groups of people work or design together, and how the collaborative activity results in a final created product.

Narrative Thinking within Creative and Collaborative Processes

One of the central aspects of narrativity is its inherent interdisciplinary nature; many different disciplines, such as art psychology, cultural studies, and literary studies, have an interest in narrative (Mateas and Sengers, 2003). The words *narrative*, *narration* and *narrate* have Latin roots that suggest a close connection with knowledge and skilful practice (Whyte, 1981). Recently, narrative is defined as *a mode of thinking*;

a continuous account of a series of events or facts that shapes them into an emotionally satisfactory whole (Bruner, 1996; Egan, 2005). Narrative thinking refers to the thought process involved in creating a story; events and experiences are organised into plotted structures (Bruner 1990). Hence, the concept of narrative thinking relies on an argument that it is a key way of making sense of experience and the world (Bruner, 2003, 2002, 1996; Egan, 2005). With the help of a plot and characters, surroundings and activities are connected to each other (Bruner, 1986). This kind of thinking is also evident in children's pretend play. In this way, story functions as a tool for constructing meaning about the surrounding world, and thinking gains a narrative form, and becomes explicit and easier to manage (Bruner, 1996; Egan, 1986). Stories also help one in dealing with more complex meanings (Schwartz, 1996).

According to Bruner (1990, 1996), narrative thinking is natural and is one of the earliest forms of thinking for the human mind. It is not only connected to lingual structures because it is present in the prelingual stage of child development. This can be observed in children's play, when they mould the story verbally and with different creative actions such as drawing or making gestures. Thus, in narrative thinking, emotions, imagination, memory, and thinking are combined (Bruner, 1996, 2002). Narrative thinking is not only something that is present in the early development of thinking processes in children. It is also pertinent to story-like experiments within science and philosophy; these are termed 'thought experiments'. It is believed that thought experiments play an essential role in testing a theory's consistency and explanatory power (Bokulich, 2001; Gendler, 2000). Hence, it can be assumed that narrativity has a close relationship with several possible worlds.

When constructing a story, one can build parts of a possible world. Understanding that things can be different requires the existence of elaborative thinking, constructing, and active thinking constructs that can be thought of as 'worlds.' As we will show later, the play worlds designed by the children provide examples of these 'worlds.' Thinking

of other worlds involves considering more complicated notions, such as the relations between individuals, causality, and time. One may perceive that possible worlds are only stipulated entities (Kripke, 1972), or that they are physical entities (Lewis, 1986). In the latter case, the limits of language do not limit the possibilities — imagining a possible world does not have to be only a verbal act. In this respect, play can be thought of as making a thought experiment whereby an imaginary setting puts certain views regarding the actual world to the test. In this research study, playful co-design sessions were organised in a playful way, because such an environment affords greater possibilities for creating hypotheses and generating inventions in collaboration. The sessions were constructed with an atmosphere that allowed and nurtured children's creativity and imagination.

Although creativity is interpreted in many different ways, recent scholars see it as involving the generation of novel and imaginative ideas (e.g., Craft, 2005; Cropley, 2001). Imagination has an essential role in this process, with a close relationship between imagining possible worlds and generating novel ideas. Vygotsky (1998) considered imagination as a process directly connected with meaning-making. It is 'the ability to think of things as possible—the source of flexibility and originality in human thinking' (Egan, 2005: 220). Hence, we assume imagination as well as narrative thinking are sooner the source of and vehicle for creativity than synonyms.

Creativity and play are linked in numerous ways, as are creativity and playfulness (e.g., Russ, 2003; Liebermann, 1977). Considerable evidence demonstrates that a playful approach to the task at hand increases the likelihood of producing creative results (Amabile, 1983; Bruner, Jolly & Sylva, 1976). Liebermann (1977) was among the first who proposed a relationship between playfulness and creativity, and identified five aspects of the quality of playfulness: cognitive, social, physical spontaneity, the manifestation of joy, and a sense of humour. Physical spontaneity refers to coordination and motor activity levels. Social spontaneity

refers to qualities of the interaction, and cognitive spontaneity refers to the use of imagination. Manifestation of joy involves enthusiasm, exuberance, enjoyment, and lack of restraint. Sense of humour captures behaviours such as joking and clowning. Playfulness can be associated with the creation of imaginary play worlds through role-play, and being open to playing with ideas and new possibilities (Egan, 2005; Craft, 2001). Hence, playfulness may help children think about and reflect on the world in a way that is free from constraints. One form that this can take is word play or humour between participants to create common ground. Playing with words and ideas assumes a context of mutual trust and support, where each participant knows that what he or she says (draws, performs, etc.) will be accepted (Wegerif, 2005).

Recently, as with learning, scholars consider creativity not only as an individual phenomenon, but also as a socially shared phenomenon (e.g., Littleton and Miell, 2004; Sawyer, 2006; Vass, 2004). Creativity cannot simply be reduced to processes of individual thinking. Rather, a proper study of creativity necessitates an understanding of both personal factors and how the individual engages in collaborative activity. When children's creative acts manifest collaboration, this requires the participants' commitment to the same task during the collaborative process. For instance, Schrage (1990) defines collaboration in terms of two or more individuals with complementary skills interacting to create a shared understanding that no-one had previously possessed, or could not have acquired on their own. The term 'knowledge co-creation' illuminates this phenomenon, referring to jointly constructed knowledge, interaction with others and with cultural tools (Vygotsky, 1986), and the collective construction of artefacts (Paavola et al., 2004). In this study, knowledge is represented by ideas and narratives that children co-create; knowledge and understanding are not only shared, but also socially generated and validated in groups of children. Following Rojas-Drummond and colleagues (2006), knowledge can be defined as the product of the joint negotiation of the participants, using a variety of communicative

strategies to construct a shared understanding. The research discussed in this chapter illustrates how, using a play framework, co-design sessions provided children with an opportunity to create knowledge collaboratively through the discussions and stories, and to create artefacts, such as drawings, of their ideal play environments. In this case, a large sheet of paper on the floor and coloured pencils represented the cultural tools.

Collaborative creativity and creative collaboration have been the focus of considerable educational research, and are of great interest to research of both play and learning (e.g., Littleton & Miell, 2004). In joint activity, learners can become more reflective by serving as 'revealing mirrors' to each other (John-Steiner, 2000). An advantage of collaborative activity is also illustrated by Vygotsky's (1978) concept of the Zone of Proximal Development (ZPD), in which children are challenged with graduated zones that are slightly above their current individual level of functional competence. However, in collaborative endeavour, the role of each participant as learner and tutor is emphasised (e.g., Wells, 1999); in such a case, the ZPD, which consists of action, thinking and emotions, is at the same time a potential challenge for everyone. It is argued that shared activity in collaboration with others gives rise to *inter-mental understanding* which then leads to the development of individual (*intra-mental*) knowledge and skills (Vygotsky, 1978; Mercer, 2002). It is also argued that joint activities in learning and creativity are enhanced when the interactions between participants are supported by 'the gift of confidence', the sharing of risks in the presentation of new ideas, constructive criticism, and the creation of a safety zone (Mahn & John-Steiner, 2002).

Methodological considerations

At the beginning of the co-design sessions, a frame story was told to the children in order to stimulate their imaginations and provide an atmosphere of creativity. The frame story made the situation more play-

ful, while at the same time it oriented the children to think about the world in a way essentially free from constraints. The approach of each frame story was decided on according to the situation, since the children's readiness to engage with the sessions varied among the groups. In an imaginary world, any kind of play is possible and any kind of environment can be ideated. After the frame stories were established, the children drew pictures and discussed vividly, adopting the roles of designers and players.

The playful nature of the design sessions was similar to Stig Broström's (1996, 1999) description of frame play, in which an adult may also participate in the construction of the plot and imaginary situation. The 'frame' refers to the participants' conscious and joint plan of the imaginary play situation. During the design sessions, the researchers participated by listening, discussing, and drawing with the children. The researchers' role was to orient the children into the task, listen to them carefully, and encourage and inspire them to imagine and draw. Researchers also asked questions about different aspects of the playing environment, and what the children would like to do there. Adults contributed to the storyline, but the children's ideas and initiatives held the main role around the drawing paper (see Figure 1).

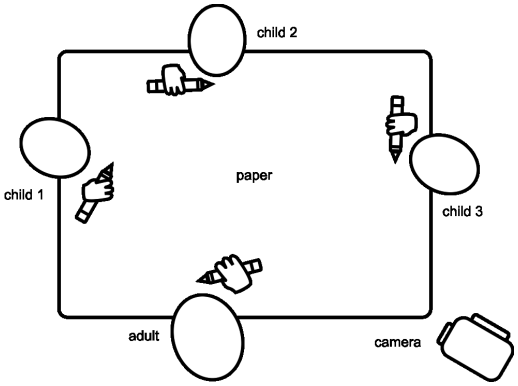

Figure 1. Example setting prom a playful design session.

The method used for the design sessions is called *playfulness-based research* (PBR) (Hyvönen & Kangas, accepted). The method provides a meaningful way of gathering data from children by engaging them to work and design in creative collaboration. It is a tool to facilitate young children's meaning-making, to encourage and solidify their ideas and creative thoughts, and to understand their construction of reality. It can also serve as a valuable basis for research where sharing understandings among children and researchers is valued. Participating in playful co-design sessions suits children, because imagining, drawing, colouring, and playing are natural ways for them to express their intentions and desires. Thus, the idea of the research method follows Kieran Egan's (2005) underlying idea that the learner works as an integrated whole, with the inclusion of not only the mind but also the body, emotions, and imagination.

For the purposes of the narrative analysis, the data from the discussions about play environments were restructured in the form of narratives so that the talk around a certain play idea formed one narrative episode. The built narratives were set apart so that one narrative unit consisted of one story with a clear plot or a connected whole. Thus, one narrative could be a short description of the environment and an activity, or the whole environment ideated on the paper. In addition, the narratives were analysed according to whether they were generated in collaboration, or whether they were individually constructed. The criteria for collaboration included: 1) jointly generated ideas and plots of the play environment, 2) shared emotions, and 3) reciprocal activity in the design situation. From all the sessions, nineteen narratives out of thirty in total were generated in collaboration, showing that two or more children construct the storyline and share an imaginary situation in a collective way. This was based on the assumption that collective thinking, where ideas are not just shared but also jointly generated, is closely based on children's narrative thinking and its appearance in playful co-design sessions.

Empirical Findings: Narrative Thinking in Creative Collaboration

The pre-school-aged children were eager to ideate the environments of their dreams. In these processes, the children often amalgamated their play ideas, shared their narrative thinking, and constructed narratives with a high level of collaboration. Narratives emerged in the levels of playfulness, verbal action, and emotions, and these became more and more complex and emotional as the collaborative process proceeded. We will now present the results, starting with the issue of playfulness in the sessions and finishing with descriptions the characteristics of narrative thinking, and the concept of shared narrative thinking. We then introduce our conclusions regarding the role of narrative thinking in creative activity at a theoretical level.

Narrative Thinking as Playing

Playful design sessions inspired the children to insert narratives into the play environments under generation. Narratives were represented as drawings, descriptions, and discussions about the play environment of their dreams and connected activities. Many stories were born of the creative and playful processes. Such stories can be thought of as an indication of children's narrative thinking, and a way of organising new experiences into a plot-like shape. Sometimes, narratives were born with children imagining activities in the environments, and acting as the narrators of those situations. Sometimes, the design process became increasingly integrated into play activities during the episode, and children shared their common narratives. The following episode (Extract 1) illustrates the design process in which the researcher has an important role in creating appropriate conditions for children's collaborative creativity by being encouraging, inventive, and creative.

Extract 1. Caroline, Sabrina, and Madeleine are designing the play environment of the 'Volcano slide.'

Caroline (to researcher): Would you draw here, sand for instance? Make it a volcano, for instance. Use red colour here.
Researcher: Would you help me a little bit?
Caroline: Yeh, I will.
Researcher (suggesting): Would it probably be a play park with a volcano? Isn't that at all frightening?
Caroline: Sure! It would be frightening.
Researcher: But if it were a false volcano?
Madeleine: It would be made of sand.
Researcher: Would it then provide lava?
Caroline: Yes, it will.
Sabrina: It is false lava indeed, which is not burning at all.
Caroline: Yeah!
Sabrina: Would we pretend that…
Caroline: Here as well, lava erupts
Sabrina: Would we figure out that this lava is a certain slide?
Researcher: It would be quite nice… slide made of lava, it is a really good idea!
Caroline: That kind of spiral lava ladders (twisted ladders composed of lava).
Researcher: Spiral lava ladders?
Caroline: Yes.
Sabrina: Yeh, we could climb upwards by using those spiral lava ladders.

The extract shows that the children are increasingly involved in a collaborative design process that starts to resemble play (Juujärvi et al., 2005). Generating a common narrative leads them to the possibility of engaging more intensely in the play world and acting as players. Sometimes,

children played the roles of the narrative, and it was more difficult to distinguish drawing and ideating from role-play activities (Kieff & Casbergue, 2000). This is illustrated in the extract below (Extract 2).

Extract 2. Alex, Tom, and John are structuring the narrative 'Fighting pirates,' (where the ship fires at another ship, and the rocket fires at a park) by playing (see Figure 2):

Alex: What am I gonna do?... Well there is no canon!
Tom: Yes, there is none. (notices that he also has none, and draws a canon on his ship)
Alex: There's going to be a bang!
Tom: Mine is shooting there, look at it, it shoots directly at the pirate ship. (indicates the pirate ship of Alex) … Big ammo… shoots kind of really far, doesn't it?
Alex: Mine too…
Tom: Little rocket!
John: Oh geez! If that rocket… oh no!
Alex: Rocket goes, it breaks that in a minute, and then all of those!
Tom: Yes it does! The ship shoots ship, and rocket shoots park.
Alex: Look.
John: My pirate ship gets revenge.
Tom: Yeah! But not this, this shoots you into outer space. And that flies to space certainly.

In Extract 2, destructive, noisy, and competitive patterns of behaviour emerge when the children are playing fighting pirates on the sea. Although the activity was based on competition and the confrontational topic of fighting, it transformed into collaborative role-playing in the same narrative context. Play and playful situations facilitated creativity and the use of the imagination. Children's imaginations and their whole

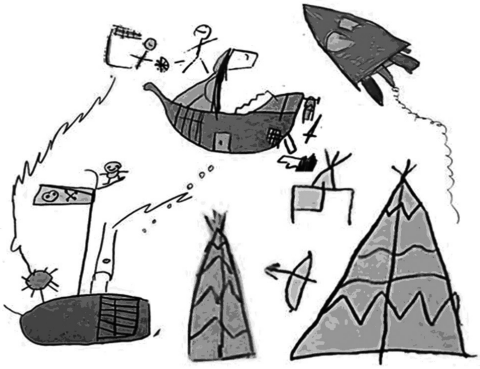

Figure 2. Image of fighting pirates, where the ship fires at a ship, and the rocket fires at a park.

bodies were involved in the activity; they talked, played, drew, suggested, and acted out their images in an integrated manner.

Narrative Thinking as Collective Thinking

Through narratives, children structured and organised their experiences and the products of their imaginations into entities through which their created environments acquired meaning. From these narrative episodes, we distinguished four features in children's narrative thinking, namely *entity*, *fascination with surprise*, *integration of fact and fiction*, and *emotions*. In addition, we perceived five properties of children's *shared narrative thinking*, and built this concept into the study (see Table 1).

Once the children simultaneously drew, discussed, and played in the situation, their *narratives formed meaningful entities*. Children also made perceptions about the affordances of play worlds (Hyvönen, 2008; Hyvönen and Kangas, 2010), and the possibilities for action that their ideas provided. They constructed affordance compilation; in other words, they connected various play affordances in order to create a larger entity for play—'play world'. This happened collaboratively in many sessions.

Table 1. The main features of narrative thinking and shared narrative thinking

Narrative thinking		**Shared narrative thinking**	
Category	*Implication*	*Category*	*Implication*
Entity	*Tendency to form meaningful entities*	**Imitative**	*Creating narratives through imitations for construction of common ground*
Surprise	*Meaning in the stimulation of thinking*	**Associative**	*Creating narratives through associations*
Integration of fact and fiction	*Tendency to generate imaginative situations around formal knowledge*	**Productive**	*Creating narratives productively through collaboration*
Emotionality	*Essential role of emotions in the play worlds*	**Transformative**	*Refining and elaborating ideas through collaboration*
		Emotional	*Emotional commitment to a shared idea*

In narrative thinking, an element of surprise, that is presenting surprising alternatives, inspired the children's imagination and narrative thinking. For example, in one session, each of the children first drew a tiger, and when the researcher asked if the animals could speak, the children did not react much to the question. Shortly afterwards, however, the animals became climbing frames from which you could slide down from the animal's tongue. In this narrative episode, the children integrated fact and fiction, and created a slide that was part of the 'bogey mountain'; it was a lion-like animal with a very long tongue. Children climb to the mountain on the back of the animal, they become very excited, and they finally slide down on the long tongue. Slides, as a whole, were a very fascinating element for children to modify with their knowledge of nature, for instance with volcanoes (Extract 3). Therefore, we argue that surprise—such as asking if tigers could speak—stimulated

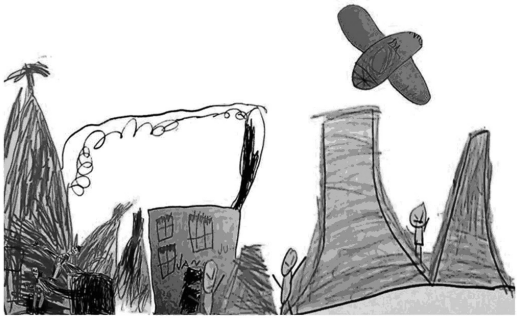

Figure 3. Image of Volcano land (where lava proof swimming trunks are needed).

the children's imagination, but this only happened when the children found the ideas proposed appealing.

We also noticed that surprise is closely connected to the *integration of fact and fiction* in narrative thinking. The following (Extract 3) illustrates how formal knowledge is intensely integrated with fiction. Indeed, combining fact and fiction seemed to inspire the children, and tended to exclude the conventional in the narratives. Figure 3 shows the children's ideal playground corresponding to this narrative.

Extract 3. The children are structuring the narrative of 'Volcano land':

Paul: I'll make a volcano!
Nico: Yeah, I'll make volcanoes, too! (giggle)
Paul: But these are not real ones. They're fake volcanoes!
Nico: I'll make a big one, at least! Lava is splattered there!
Paul: Hmm, this is fun!
Researcher: Why is there lava?
Nico: Hmm…you can swim there.
Researcher: In lava?
Nico: Yeah.
Paul: Then swimming trunks are needed!

Nico: Yes!
Paul: And lava proof ones!
Researcher: Ooh. Super trunks.
(boys laugh)
Paul: There could be coloured water, red water.
Researcher: Yeah, it could be fake water.
Paul: Yeah, is it ok, Nico?
Nico: Yes.
Paul: Like red cloth you could jump into.
Researcher: Exactly. So your clothes don't get wet and the lava doesn't burn.
Paul: Then we could play volcano climbing! … What an unusual climbing place!

In Extract 3, the children differentiated between reality and fiction, but seem to be fascinated with the more fictitious surroundings. The more fantastic assumptions, like swimming in lava, stimulated a greater refining and elaboration of the narrative, turning it into descriptions of other possible worlds. Integrating fact and fiction turns views of reality into a test of possible worlds by making thought experiments. An adult joined the imaginative situation, but allowed the children to construct a common narrative for themselves. Thus, in one socially shared story, narrative thinking, or some aspects of it created by many children, was represented. Extract 4 illustrates another situation where children's prior knowledge and fiction are intertwined. However, certain cognitive and emotional conflicts are in evidence (Hyvönen and Kangas, 2010); the children have a knowledge base about foxes, but they lack confidence in how to use the information in this playful situation (Extract 4). The children are generating the play world of 'Lovely animals' (see Figure 4), where possibility thinking starts from the conflict of fact and fiction.

Figure 4. "Lovely animals" and other narratives of happiness.

Extract 4. The children are structuring the narrative of 'Lovely animals.'

Researcher: Do you think if there would be any animals in the forest?
Sandra: Yeah, there are foxes, I guess.
Researcher: Foxes?
Sandra: They are kind of nice foxes.
Researcher: Kind foxes (repeats)
Caroline: …which are afraid of people.
Researcher: They are afraid of people?
Sandra: No, no. They are nice, they won't be afraid.
Madeleine: Animals, indeed, they are afraid of people.
Sandra: Yeah, they easily do so. However, these animals are such as they are not afraid of people.
Researcher: It can be possible.
Caroline: Except for leopards.
Madeleine: Bears are afraid as well.
Sandra: Yes, but once they have a baby bear and it is newly born, which they have to protect against humans, then they won't be afraid.
Researcher: What would the foxes do there?

Caroline: One can only stroke them, otherwise their mother gets angry.
Sandra: No, I wouldn't suggest to stroke either.
Caroline: But can.
Sandra: Yes but… pretending could, but not for real.

In this conversation, the children propose formal knowledge about animals and their behaviour. They also propose fictional knowledge about animals. The episode illustrates the negotiation, whereby the children's narrative thinking, by means of possibility thinking and creating possible worlds, is formed step-by-step. At the end of the episode, Sandra's utterance *'Pretending could, but not for real'* involves the suggestion of an imaginary play world where everything is possible. The same children later continue the discussion of the same play world, and finally successfully generate a common play environment with which each child is very satisfied. In this case, the conflict of fact and fiction facilitated the creation of imaginative situations around formal knowledge, and inspired the children to think about possibilities. This kind of interaction is valuable from the viewpoint of knowledge co-creation. The talk identifies a meaningful learning space whereby one child's imagination feeds that of another, and nurtures the possibility of thinking (Kangas, 2010).

We assume that high quality collaboration arose where a story was constructed based on collaborative creativity and on shared narrative thinking. In other words, it was assumed that stories that were versatile and rich in content were mostly constructed collaboratively. Especially in situations where the children's narrative thinking was socially shared, their imagination, memory, thinking, and emotions came together. Representations of shared narrative thinking are not only verbal, but also included the movements, actions, and drawings during the process. Based on an analysis of the narratives that were built with a high level of collaboration, shared narrative thinking is characterised as being *imitative, associative, productive, transformative,* and *emotional*.

When children shared ideas for the narrative, refined them, and developed them further, they were acting as guides and innovators, but also as targets for copying and learning from each other. In all sessions, shared ideating was based on *imitation*, which appeared to be meaningful (especially in the shared reciprocal state), on collective imagination, and on constructing a common view and ground. It is possible that, for children at this age, imitation is one of the ways in which they signal to their partner that they have accepted the stated idea (Faulkner and Miell, 2004). It was also typical that the stories were created *associatively*. For example, in one session, a child drew a house upside down and the other elaborated on it by turning it into an amusement park, building associatively from her own experiences. *Associative* refers to narration construction through reciprocal associations.

In addition, shared narrative thinking can be said to have been *productive* when it pertains to numerous ideas formed in collaboration. This is manifested in the sessions as rich and imaginative play worlds. Due to the collaborative nature of elaborating and refining ideas, shared narrative thinking seems to be *transformative*. During the collaborative process of constructing a narrative, the ideas of others were not taken *per se,* but rather were constructed and refined further. In this case, transformative narrative thinking is connected to the idea of reciprocal creativity; ideas are refined in such a way that none of the children could ever create them alone.

The data supports the assumption that emotions are closely linked to imagination (Egan, 2005) and narrative thinking (Bruner, 1996). During the sessions, children welcomed the ideas that attracted them emotionally: the findings support Egan's (1992) notions that children's imagination is best stimulated by stories with content that influences them at the emotional level. Shared narrative thinking represents *emotional commitment to the same idea*. This supports the arguments of John-Steiner and colleagues (2004), and originally from Vygotsky (1986), that verbal patterns, and in this case also play patterns, vary according to the degree

of emotional and intellectual closeness. For example, if one of the children or adults came up with an exciting idea, the others took part in the imaginary situation by eagerly making gestures and empathizing with the idea intensively. Common humour and excitement functioned as emotional stimulations to the collective imagination and play.

The study also showed that shared narrative thinking was reached especially in situations where the children knew each other well, and where they were used to collaborating and playing with each other. This notion supports Vygotsky's (1986) argument that depth of understanding emerges between people who have close psychological contact, and who are able to communicate with each other using condensed verbal means. These results provide an interesting standing point for a consideration of the situations and conditions required for successful knowledge co-creation.

Towards a Model of Narrativity

In the co-design sessions, the children generated play environments spontaneously, sharing only relevant thoughts. This is enough for understanding, because in social interaction a story can carry both meaning and context (i.e., the surroundings for the meaning). The story itself is actually broader than is explicitly expressed. For example, in the session (Extract 3) where Nico and Paul created the volcano environment, Nico's 'You can swim there,' is based on the assumption that you will need swimming trunks, and that swimming in lava is possible in play. Such implicit assumptions start to broaden the story into a whole other possible world.

Based on the perspectives that arise from the data and the theories of narrativity, we developed a three-dimensional model of narrativity (Figure 5). This model incorporates the dimensions of meaning, activity, and collaboration. The model introduces a flexible idea of narrativity;

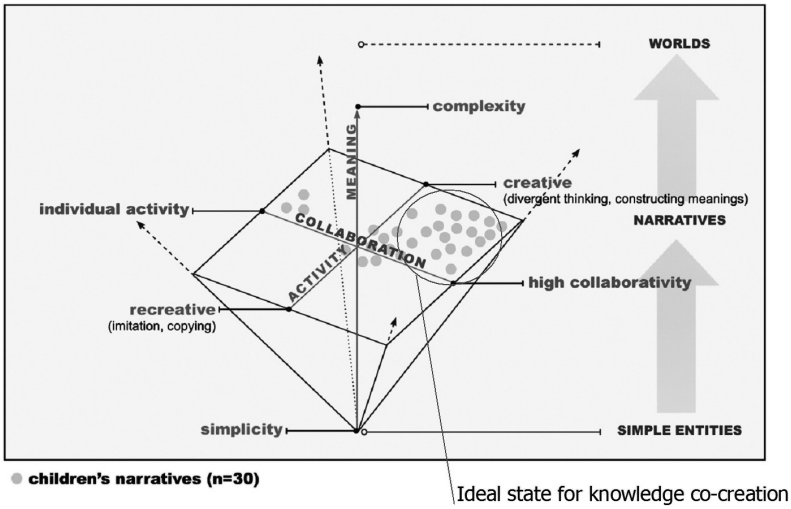

Figure 5. A three-dimensional model of narrativity.

it starts from separate entities and moves towards whole worlds, with narrativity lying in between these two poles. The thirty narratives found during the sessions were situated in this model.

At the bottom of the model are the simplest meanings, such as characters and things. Moving up, we see the act of combining simple elements with different kinds of relations, such as time, causality, and so on, introducing a narrative. At the top, the narrative expands into a whole possible world. As we approach the narrative level, which should not be thought of as a definite level with real borders but rather as a continuum, the meaning of the axes of collaboration and creativity grows. The narratives that emerge in collaboration were hard to fit into the figure because of the very complex nature of all three dimensions. Most of the narratives (nineteen) are located in the *creative-collaboration* corner (i.e., the corner of *shared narrative thinking*). In the small-group design sessions, the children were not told to collaborate. The collaboration happened naturally through stimulation by the entities contributed by the peers and researchers, and through association, surprise, or the

integration of fact and fiction. The activities observed can be categorized as imitative, productive, and transformative. Presumably, expansion into broader worlds occurred, but the more explanatory level (i.e., the level of narrative) was our main focus in this study. We also assume that shared narrative thinking is an ideal state for knowledge co-creation. We separated the concepts of shared narrative thinking and creative collaboration. Narrative thinking emphasizes a state of joint thinking embedded by emotional factors, and is a vehicle for creative collaboration, whereas creative collaboration is a more target-oriented activity.

Discussion and Conclusion

In this article, we presented the findings of the study in which we paid attention to the narrativity of the co-design sessions where children designed their ideal play environments. We took for a starting point that narrativity and a tendency to create plot-shaped stories are essential elements of creative and collaborative action. We concentrated on how these narratives were constructed through creative and playful processes, and on the effect that narrative thinking has on the processes. We were not trying to define the borders of a story—namely what is considered as a story and what is not—but rather accepted it as a relative term. Following Bruner (2003, 2002, 1996), we were interested in how narrative as an instrument of mind operates in children's playful co-design processes where they, in small groups, create their own ideal play environments.

The study showed that most of the children created the play environments of their dreams through creative collaboration, and they included in them meaningful narratives in the shape of actions. The study also showed that children's narrative thinking can be shared, and that joint activity arose especially by playing and refining imaginative situations. Through shared narrative thinking, the children crossed the borders

and limitations of individual imagination. As our data showed, surprise and integration of fact and fiction were among the most important factors in narrative thinking. We noticed that combining fact and fiction seemed to inspire children, and tended to exclude the conventional in the narratives. Interesting and exciting conflicts between fact and fiction produced more shared narrative thinking. Possibility thinking emerged as an imaginative way of testing and integrating fact and fiction while the children drew and talked in small groups.

In their investigations of the dynamics of creative collaboration, John-Steiner and colleagues (2004) found that collaborators who established the most integrative relationships relied on the largest number of jointly constructed utterances. The authors note that it was as if the collaborators were inside each other's heads, and were completing their partner's unfinished thoughts. In our case, this refers to the children's commitment to the creation and design of the same play environment by connecting their own ideas or thoughts with the ideas of others. Narratives from the viewpoint of collaborative activity are thus not only the sum of the narratives of individuals, but the active collaborative building of narratives. Further, in this case the focus was not on transforming one's own structures of mind, but on contributing to and refining shared narrative information (Bereiter, 2002).

The study has theoretical and methodological advantages. It has contributed substantially to the development of the theoretical and pedagogical approaches underpinning creative and playful learning (CPL) by generating further interest and understanding in how narrativity, creativity and imagination should be included in learning in the PLE setting (Kangas, 2010). On the basis of the findings, we concluded that the PLE should be adaptive, flexible and customizable if it is to support children's own narrative activity and creative collaboration. It is important to give children the opportunity to refine possible worlds that are relevant to their current views of reality and their interests. When constructing possible worlds by means of narrative, children gain an under-

standing of more complex meanings and learn to create new meaningful worlds. This was tested in the pilot teaching experiment in the PLE setting in a-week-long intervention where curriculum-based learning was extended from the classroom to an outdoor playground, and where children's narrativity and imagination were supported by various fact-and-fiction-based learning methods (e.g. Kangas, Kultima and Ruokamo, 2006; Kangas, 2010). The results of the teaching experiment were encouraging, although further empirical research is required.

In addition, the theoretical model of narrativity introduced here requires further interdisciplinary research. Considering thought processes from a narrative viewpoint has aroused special interest in recent years. As a theoretical support for narrative thinking, one can also use the philosophical analysis of the semantics of possible worlds. This is related to Jerome Bruner's argument, which states that the essence of narrative thought processes are to clarify anything that deviates from the ordinary practice.

The playful co-design sessions provided us[5] with a fascinating opportunity to explore creative collaboration and knowledge co-creation in authentic settings. Hence, another advantage of the study lies in the richer understanding that it yielded of the role of peers and adults in creative collaboration. The study showed that collecting data from groups of young children is a meaningful way of encouraging children to present their views and images, as well as of generating new suggestions and ideas collaboratively. However, interacting with children in this way often requires a good tutor (an adult or a peer) who is sensitive to the creative situation, and who can stay in the background and actively participate in discussions and activities when needed. Indeed, the researchers' participation and engagement in the design sessions was very important. They acted as interviewers, designers and researchers, but first and foremost as facilitators, inspirers and motivators.

Play and playful situations are rich grounds on which to develop children into flexible thinkers and actors for the future. Innovations

spring from groups and teams that contain diverse perspectives, and that share goals and knowledge (Claxton et al., 2008; Sawyer, 2006, 2008). We also concluded, consistent with the assumption of Egan (2005), that playfulness during activity may help children to think about and reflect on the world in a way that is free of constraints.

References

Amabile, T., 1983. *The social psychology of creativity*. New York: Springer-Verlag.

Armitage, M., 2001. The ins and outs of school playground play: children's use of 'play spaces'. In: J. Bishop & M. Curtis, eds. *Play today in the primary school playground* Buckingham: Open University Press, pp. 37–57.

Becker, T. and Quasthoff, U. M., 2004. Different dimensions in the field of narrative interaction. In: U. M. Quasthoff and T. Becker, eds. *Narrative Interaction*. Amsterdam: John Benjamins Publishing Company, pp. 1–11.

Bereiter, C., 2002. *Education and mind in the knowledge age*. Hillsdale, NJ: Erlbaum.

Bokulich, A., 2001. Rethinking thought experiments. *Perspectives on Science,* Vol. 9, Num. 3. Cambridge: The MIT Press.

Broström, S., 1996. Frame play with 6 year-old children. *European Early Childhood Education Research Journal*, 4 (1), pp. 89–101.

Broström, S., 1999. Drama games with 6-year-old children: possibilities and limitations. In: Y. Engeström, R. Miettinen and R-L. Punamäki, eds. *Perspectives on activity theory* New York: Cambridge University Press, pp. 250–263.

Bruner, J., 1986. *Actual minds, possible worlds*. Cambridge: Harvard University Press.

Bruner, J., 1990. *Acts of meaning*. Cambridge: Harvard University Press.

Bruner, J., 1996. *The culture of education*. Cambridge: Harvard University Press.

Bruner, J., 2002. *Making stories: law, literature, life*. New York: Farrar, Strauss & Giroux.

Bruner, J., 2003. The narrative construction of reality. In: M. Mateas & P. Sengers, eds. *Narrative Intelligence*. Amsterdam: John Benjamins Publishing Co, pp. 41–62.

Bruner, J., Jolly, A. and Sylva, K., 1976. *Play*. London: Penguin.

Claxton, G., Craft, A. and Gardner, H., 2008. Concluding thoughts. Good thinking—education for wise creativity. In: A. Craft, H. Gardner and G. Claxton,

eds. *Creativity, wisdom and trusteeship. Exploring the roles of education*. Thousands Oaks: California, pp. 16–34.

Craft, A., 2001. Little c creativity. In: A. Craft, B. Jeffrey and M. Liebling, eds. *Creativity in education.* London: Continuum, pp. 45–61.

Craft, A., 2005. *Creativity in schools: tensions and dilemmas*. Abingdon: Routledge New York.

Cropley, A. J., 2001. *Creativity in education & learning*. London: Routledge.

Egan, K., 1986. *Teaching as story telling. An alternative approach to teaching and curriculum in the elementary school*. Chicago: The University of Chicago Press.

Egan, K., 1992. *Imagination in teaching and learning ages 8–15*. London: Routledge.

Egan, K., 2005. *An imaginative approach to teaching*. San Francisco: Jossey-Bass.

Faulkner, D. and Miell, D., 2004. Collaborative story telling in friendship and acquaintanceship dyads. In: K. Littleton, D. Miell and D. Faulkner, eds. *Learning to collaborate, collaborating to learn*. New York: Nova Science Publishers, pp. 7–29.

Gendler, T. S., 2000. *Thought experiment. On the powers and limits of imaginary cases*. New York: Garland Publishing.

Hyvönen, P., 2008. *Affordances of playful learning environment for tutoring playing and learning.* Ph.D. Acta Universitatis Lappoensis 152. Rovaniemi: University of Lapland.

Hyvönen, P. and Juujärvi, M., 2005. Affordances of playful environment: a view of Finnish girls and boys. In *Proceedings of ED-MEDIA 2005: world conference on educational multimedia, hypermedia & telecommunications.* Montréal, Canada, June 26–July 2, 2005. CD-ROM. Electronic Version of Papers, pp.1563–1572.

Hyvönen, P. and Kangas, M., Playfulness-based research: involving children in research process of designing a playful learning environment. Proposal accepted for an edited collection of "Barn och ungas användning av digital teknologi i vardagen".

Hyvönen, P. and Kangas, M., 2010. Children as experts in designing play environment. In: E-L., Kronqvist and P. Hyvönen, eds. *Insights and outlouds: Childhood research in the North.* Acta Universitatis Ouluensis E 107. Oulu: Oulu University Press, pp. 143–170.

Hyvönen, P. and Kangas, M., 2007. From bogey mountains to funny houses: children's desires for play environment. *Australian Journal of Early Childhood* (AJEC), 32(3), pp. 39–47.

John-Steiner, V., 2000. *Creative collaboration*. Oxford: Oxford University Press.

John-Steiner, V., Shank, C. and Meehan, T., 2004. The role of metaphor in the narrative co-construction of collaborative experience. In: U. M. Quasthoff and T. Becker, eds. *Narrative Interaction.* Amsterdam: John Benjamins Publishing Company, pp. 169–195.

Juujärvi, M., Kultima, A. and Ruokamo, H., 2005. A narrative view on children's creative and collaborative activity. In: H. Ruokamo, P. Hyvönen, M. Lehtonen and S. Tella, eds. *Proceedings of the 12th international network-based education (NBE) conference: teaching-studying-learning (TSL) processes and mobile technologies—multi-, inter- and transdisciplinary (MIT) research approaches*. Rovaniemi, Finland, University of Lapland Press, pp. 203–213.

Kangas, M., 2010. Creative and playful learning: learning through game co-creation and games in a playful learning environment. *Journal of Thinking Skills and Creativity* 5(1), pp. 1–15.

Kangas, M., Hyvönen, P. and Latva, S., 2007. Space treasure outdoor game in the playful learning environment: experiences and assessment. In: H. Ruokamo, M. Kangas, M. Lehtonen and K. Kumpulainen, eds. 2007. *The power of media in education. Proceedings of the 2nd international network-based education conference.* Rovaniemi, Finland 13–15 June 2007. University of Lapland, Publications in Education 17, pp.181–194.

Kangas, M., Kultima, A. and Ruokamo, H., 2006. Co-creative learning processes (CCLP)—children as game world creators to the outdoor playground contexts. In: J. Multisilta and H. Haaparanta, eds., *Proceedings of the workshop on human centered technology HCT06.* Tampere University of Technology, Pori, Finland, Publication 6, pp. 14–21.

Kangas, M., Randolph, J. and Ruokamo, H., 2009. *An international mixed-method investigation into student satisfaction with playful learning environments*. Paper presented at 2009 AERA (American Educational Research Association) annual meeting, April 13–17, San Diego, California.

Kieff, J. E. and Casbergue, R. M., 2000. *Playful learning. Integrating play into preschool and primary programs.* Boston: Allyn and Bacon.

Kripke, S. A., 1972. *Naming and necessity*. Cambridge: Harvard University Press.

Lewis, D. 1986., *On the plurality of worlds*. Blackwell Publishing.

Lieberman, J. N., 1977. *Playfulness: its relationship to imagination and creativity*. New York: Academic Press.

Littleton, K. and Miell, D., 2004. Collaborative creativity: contemporary perspectives. In: D. Miell & K. Littleton, eds. *Collaborative creativity: contemporary perspectives*. Sidmouth: Chase Publishing Services, pp. 1–10.

Mahn, H. and John-Steiner, V., 2002. The gift of confidence: a Vygotskian view of emotions. In: G. Wells and G. Claxton, eds. *Learning for life in 21st century. Sociocultural perspectives on the future of education.* Cambridge, MA: Blackwell, pp. 46–58.

Mateas, M. and Sengers, P., 2003. Narrative intelligence. In: M. Mateas and P. Sengers, eds. *Narrative intelligence*. Amsterdam: Benjamin cop, pp. 1–25.

Mercer, N., 2002. Developing dialogues. In: G. Wells and G. Claxton, eds. *Learning for life in the 21st century*. Cornwall: Blackwell Publishing, pp. 141–153.

Paavola, S., Lipponen, L. and Hakkarainen, K., 2004. Models of innovative knowledge communities and three metaphors of learning. *Review of Educational Research*, 74(4), pp. 557–576.

Rojas-Drummond, S., Mazon, N., Fernandez, M. and Wegerif, R., 2006. Explicit reasoning, creativity and co-construction in primary school children's collaborative activities. *Thinking Skills and Creativity*, 1(2), pp. 84–94.

Russ, S. W., 2003. Play and creativity: developmental issues. *Scandinavian Journal of Educational Research*, 47(3), pp. 291–303.

Sawyer, R. K., 2006. Educating for innovation. *Thinking Skills and Creativity*, 1, pp. 41–48.

Sawyer, R. K., 2008. Learning music from collaboration. *International Journal of Educational Research*, 47(1), pp. 50–59.

Schwartz, P., 1996. *The art of the long view. Planning for the future in an uncertain world*. New York: Bantam Doubleday Dell Publishing Group.

Schrage, M., 1990. *Shared minds: the new technologies of collaboration*. New York: Random House.

Vass, E., 2004. Understanding collaborative creativity: young children's classroom-based shared creative writing. In: D. Miell and K. Littleton, eds. *Collaborative creativity: contemporary perspectives.* Sidmouth: Chase Publishing Services, pp. 79–95.

Vygotsky, L. S., 1978. *Mind in society*. Cambridge: Harvard University Press.

Vygotsky, L. S.,1986. *Thought and language*. Cambridge: The MIT Press.

Vygotsky, L. S., 1998. *The collective works of L. S. Vygotsky. Volume 5. Child Psychololgy*. (Ed. Robert W. Rieber). New York: Plenum.

Wegerif, R., 2005. Reason and creativity in classroom dialogues. *Language and Education*, 19(3), pp. 223–238.

Wells, G., 1999. *Dialogic inquiry: towards a sociocultural practice and theory of education*: Cambridge: Cambridge University Press.

Whyte, H., 1981. The value of narrativity in the representation of reality. In: W. Mitchell, ed. *On narrative.* Chicago: University of Chicago Press, pp. 1–24.

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4 The SmartUs project included Let's Play (education), WePlay (industrial design), UbiPlay (software), Moto+ (physical exercise) and PlayTech (technologies). The products and software were produced by Lappset R & D of Lappset Group Ltd., a playground manufacturer. www.smartus.fi

5 Marjaana Kangas, Annakaisa Kultima and Heli Ruokamo

FINNISH CHILDREN'S VIEWS *on* THE IDEAL SCHOOL *and* LEARNING ENVIRONMENT

Abstract

This grounded-theory study reports on an investigation of how Finnish children describe their ideal school and learning environment and considers how their notions should be valued in the development of schools to better respond to the challenges of the future. The schoolchildren, aged 10 to 12, participated in the study by writing a story about a school in which they would be happy to study. Ninety-three children's stories were coded and analyzed, and a model of the ideal school and learning environment based on their ideas was developed. This model school is called a Broadening and Empowering Learning Environment (BELE), and is designed to contribute to children's physical, educational, cultural and socio-emotional well-being, and offer opportunities for fantasy and innovation, and employs creative and sports-based learning methods, among others, in both formal and informal settings. The study shows that children, as educational stakeholders, are well aware of the potential of modern schools and of the different aspects that would enhance their ability to learn and their satisfaction with schooling.

Keywords: ideal school; learning environment; children's notions; grounded-theory study; the future school

List of figures:

Figure 1. Illustration of coding process and categories embodied in the study
Figure 2. The core concept and its features

1 Introduction

Over thirty decades ago Illich (1971) argued that schools are designed on the assumption that there is a secret to everything in life, and that quality of life depends on knowing that secret. The aim of education is still now, as it was then, as being to prepare children for future adult lives, although views of education and society have changed a lot since then, and the traditional functions of schools has been challenged. In international comparisons, Finnish schoolchildren are consistently academically successful, achieving the highest scorers in the PISA (OECD Program for International Student assessment) surveys. Still, as Välijärvi & Sahlberg (2008) point out educational excellence about more than statistical averages of student achievement: it also requires that students *enjoy learning in school*. This is a significant challenge. Educators in Finland and elsewhere are worried about children who do not enjoy school or find it meaningful (Hyvönen 2008; National Board of Education 2004; Malin 2006). Moreover, young people in many countries appear unenthusiastic about what education has to offer them, something that is not reflected in official policies (Säljö 2004).

Referring to current educational discourse, some pivotal ideas pertaining to the challenges of school learning, and to school as a learning environment, need to be elaborated. First, based on a socio-cultural approach (Vygotsky 1978; 1986; Säljö 2004; 2005; Wells & Claxton 2002; Wenger 1998), learning can be seen as a phenomenon that cannot be isolated from the activity, culture, and context in which it takes place. It is thus as tool-dependent and social phenomenon. This makes the focus not only the individual but also the social community; students share experiences of their environment through communication (Wells & Claxton 2002; Wenger 1998). Learning is less a repetition of what is already known and more the production of something new, interesting and relevant (Säljö 2004). In this respect, schools are under increasing pressure to focus, not just on delivering academic curricula, but also

on establishing and maintaining school cultures and learning environments that best foster *students' proficiency as future citizens,* as Claxton (2002) describes it. This means that alongside the acquisition of academic knowledge and skills, schools have to consider the development and well-being of the whole person (cognitive, emotional, social, physical and cultural). An example of this change of emphasis is UNESCO's definition of education for 21st Century through four pillars: 'learning to know, learning to do, learning to live together and learning to be' (Delors, Mufti, Amagi, Carneiro, Chung, Geremek et al. 1996). This holistic approach underlines the close relationship between physical and intellectual well-being, and the close interplay of emotional and cognitive learning in making the best of the brain's plasticity (see OECD 2007).

Second, traditional school functions are being challenged by the rapid development of information and communication technology and media, and their effects on everyday life. It is widely acknowledged that learning is increasingly taking place in multiple contexts in everyday life – in other words in various *informal learning environments,* which are recognized as important in young people's knowledge acquisition (Anderson, Lucas & Ginns 2003; Ash & Wells 2006; Bekerman, Burbules & Silberman-Keller 2006; Hull & Greeno 2006). As a result of this, the following developments can be observed. [1] Formal education and schools have lost their monopoly on education and the acquisition of knowledge. [2] In some respects, young people have better access to information about the world than previous generations did. [3] A gap has developed between the understanding gained from everyday experiences and the approach to understanding offered by formal education (Aittola 2000; Säljö 2004). As a consequence of the rapid and far-reaching social changes of recent decades many governments have realized that the current structure of their education systems may not capable of responding to 21st century challenges (Awartani, Whitman & Gordon 2008). This means that traditional methods and thought models need to be revised

to make formal education correspond with societal development (Claxton 2002).

Definitions of *formal*, *nonformal* and *informal* learning for a developing individual are relevant to discussions about the role of the school. Schugurensky (2006) defines *formal education* as an institutionalized system, which generally means compulsory basic education, whereas *nonformal* education refers to all organized programs that take place outside the formal school system and is usually short-term and voluntary. Both formal and nonformal education involve some degree of institutional design and organized teaching efforts which, according to the author, makes them 'education'. Informal *learning* is defined as occurring outside the curricula of educational institutions, courses or clubs offered by educational or social agencies. Informal learning refers to many things that students learn in school, intentionally and unintentionally, that are not part of the curriculum (Livingstone 2006; Schugurensky 2006).

The emphasis in educational research is shifting between interest in formal learning and everyday experiences. For example, according to Ash and Wells (2006), some researchers have recently begun applying learning theory based on classroom work to informal environments, and conversely research on participation in informal settings has advanced understanding of topical learning theories. Schugurensky (2006) states that most research and policy initiatives still tend to concentrate on formal education and, to a lesser extent, nonformal education, while informal learning is undervalued and seldom recognized. He notes that much of the most relevant, useful and personally meaningful learning acquired in life is obtained through informal learning. Resnick (1987) considered differences between school learning and learning out of the school, and concluded that school practices are mostly based on individual activities while, in contrast, much activity outside school is socially shared. Moreover, school learning is mostly symbol-based and 'thought-based'. In out-of-school contexts, actions are usually intimately connected with objects and events, and it is more typical to use a variety

of physical and cognitive tools. In school children generally study from a textual reality (Säljö 2004), which means that Finnish children study most subjects from school books, through individual learning activities.

The official definition of a learning environment in Finland, as stated in the curriculum for basic education (National Board of education 2004), is a combination of the physical environment, mental factors and social relations, where studying and learning take place. The physical learning environment consists of the school buildings and facilities, the instructional tools and the learning materials. These can include elements of information technology, such as computers, mobiles and data networks. It also includes the wider constructed environment – the school's yards and neighboring areas – which are considered to be increasingly important, especially for science and physical education, and the surrounding natural environment. Studying takes place mainly inside classroom.

Basic education in Finland is a nine-year general education that starts during the year the child turns seven years old. The National Board of Education decides on the goals and main content by setting the national core curriculum and the guidelines that govern all education providers. Schools also develop their own curricula in which teachers define the specific content and objectives of the courses. Therefore, teachers and schools can act quite independently, although the educational systems used by schools are rather uniform. They typically structure the school day similarly: after one or two forty-five minute lessons there is a fifteen minute break when the schoolchildren usually go out into the school yard. Many new socio-cultural learning practices have, little by little, gained ground alongside the Finnish core curriculum, since the reform of basic education in 2004. As a result, it is now more usual for students to play a more active role in their learning, characterized by their participation in goal-oriented, collaborative and self-assessment activities.

In recent years, a holistic approach has been applied to the learning environment, seeing it as more than a fixed objective entity. Researchers

have increasingly come to realize that the individual and the environment can't be separated into distinct conceptual entities, without giving rise to both theoretical and methodological problems (Roth 2000; Barab & Roth 2006). Accordingly, the starting point of the present study is that people don't act in an objectively extant learning environment, but rather act, respond to and interpret the environment as they subjectively perceive it. Thus, learning environments cannot be defined in terms of such observable characteristics as school buildings, materials used for instruction, and observed interactions between and among learners, but can be understood through students' subjective perceptions (Frenzel et al. 2007; Roth 2000).

There is increasing recognition of the importance of giving children an active role in contributing to learning conditions and involving them in the process of improving and designing learning environments (e.g. Awartani et al. 2008; Flutter 2006; Meskanen 2008; Mitra 2008). In the past few years many studies have focused on listening to what children and young people say about the conditions of learning in schools and classrooms, on the basis that students are both intelligent and articulate observers of their learning environment (Burke 2007; Kershner & Pointon 2000; Piispanen 2008; Smees & Thomas 1998; Smith & Parr 2007, Thomas, Smees, MacBeath et al. 2000). These studies have enabled researchers and practitioners to gain insights into the relationship between the school environment and learning. Students' perceptions of learning environment have, for instance, been found to be associated with a range of important outcomes, such as the subsequent learning behaviors of the students, and the quality of their learning outcomes (Anderman 2002; Doppelt & Schunn 2008; Frenzel et al. 2007; Könings, Brand-Gruwel & van Merrienboer 2005).

Awartani et al. (2008) ask "How can we create learning environments that nurture the well-being of children and young people?" and, in answer, present the "Voice of Children" toolkit to monitor children's and young people's perceptions of their well-being in school and in

their learning environments. They found that students see well-being, defined as "the realization of one's physical, emotional, mental, social and spiritual potential", as closely related to learning environment." The "toolkit" is intended to be an instrument to allow young people to be involved in taking data to policy-makers to discuss possible school improvements. Flutter (2006) has emphasized the role of student consultation and participation in the process of improving the physical environment in schools, and highlighted that fact that if the objective is to construct school environments based on theories of learning that embrace and enact democratic principles, then student involvement should be both genuine and sustained. It has been suggested that research in this field should aim to deliver tools that help to create more powerful learning environments, especially by stimulating a reciprocal relationship between educational designers, teachers and students (Könings et al. 2005). However, it is apparent that schoolchildren, teachers and parents take different approaches to the subject. Pupils seem to stress the importance of the physical learning environment; parents highlight the social and psychological learning environment; teachers tend to stress the importance of the pedagogical learning environment (Piispanen 2008). Examining Finnish middle school teachers' visions of improving the existing working methods at school reveals that the teachers chiefly considered the merging of existing school subjects, use of outside experts and networks, and teaching outside the school (Engeström, Engeström & Suntio 2002).

The study presented in this paper, contributes both theoretically and practically to the studies pertaining to schoolchildren's opinions. The study provides insight into schoolchildren's ideas and expectations of a learning environment that would make them happy to learn. The children were given an opportunity to depict their thoughts in writing. The goal of the present research was to identify the children's perceptions of the characteristics of an ideal school and learning environment, and thus explain their perspective on existing school learning environ-

ments. The children taking part in the study were 10 to 12 years old and had therefore had several years of experience of formal schooling. They therefore had many ideas to offer. The primary method for investigating the schoolchildren's notions was grounded theory (Charmaz 2006; Glaser & Strauss 2007; Strauss & Corbin 1990; 1998), a qualitative research method designed to aid in the systematic collection and analysis of data, and in the construction of a theoretical model of the desired learning environment. As a socio-cultural approach emphasizes, individuals' activities (the schoolchildren's writings in this case) can reveal subjective perceptions of the learning environment and the school culture they are involved in. Because individuals also reproduce their culture in their actions (Bruner 1986) the essays about the ideal school are expected to produce new tools for defining and designing future schools and learning environments.

2 Research Method

2.1 Grounded Theory

Methodologically, this study is based on *grounded theory* (Glaser & Strauss 2007; Glaser 1978; Strauss & Corbin 1990; 1994; 1998; Charmaz 2006) in which the subject under consideration is approached through data-based information and the interaction of current theories. Grounded theory is an inductive method that allows the researcher to develop a theoretical account of the general features of a topic while grounding the account in empirical observations. It is useful in organizing and comparing concepts and it is relevant in theory building: a grounded theory is inductively derived from the study of the phenomenon under consideration it represents. The aim is not to test prevailing theories, but to develop new ones. As Strauss & Corbin (1998, 25) state: *The theory does more than provide understanding or paint a vivid picture. It enables users to explain and predict events, thereby providing guides to action*.

Creativity on the part of the researcher in data coding and analyses, is a vital component of the method (Glaser 1978; Strauss & Corbin 1998). According to Charmaz (2006) the coding process involves at least two phases: an initial phase involving naming each segment of data and a selective phase that identifies the most significant or frequent initial codes and uses them to organize the data. The analysis includes three coding procedures: open, axial, and selective coding (Strauss & Corbin, 1990). Open coding is the process of identifying, naming and categorizing the essential concepts applicable to the subject being studied. Axial coding follows the development of a major category and specifies the properties and dimensions of that category; it aids the understanding of relationships within the subject. Selective coding develops the theoretical model that best explains the subject under study. In its entirety, coding is the pivotal link between collecting the data and developing an emergent theory that explains it data (Charmaz 2006; Strauss & Corbin 1998).

2.2 Data Collection

The empirical data was collected in the autumn of 2004 at three typical Finnish schools in Rovaniemi, in northern Finland. The research was conducted during the school day in the children's own classrooms. Altogether five groups from three schools participated in the writing sessions which lasted one lesson. The children's parents were asked to give permission to involve their children in the study. The 93 pupils, typical representatives of Finnish schoolchildren, were aged 10 to 12; there were 43 girls and 50 boys, and they participated in this study by writing a story about the school of their dreams. The children were prompted to imagine the kind of school and environment in which they would like to study. The guiding open-ended questions were: "*Imagine the kind of school you would be eager to study in. What does the school look like? What kind of activities does the ideal school offer?* The children were allowed to use fantasy in their descriptions. The 93 stories produced varied from 25

to 400 words. All the handwritten stories were transcribed and transformed to digital form for the purpose of analysis.

2.3 Data Analysis

The data was coded using *NVivo* qualitative research software, designed for the grounded theory approach (Strauss & Corbin 1998). The data was broken down, conceptualized, and put back together in new ways (Strauss & Corbin 1990; 1998). Thus, the analytic process was based on repeated data sortings, codings and comparisons. *Open/initial coding* is the first part of the analysis and pertains specifically to the naming and categorizing of the subject of study through a close examination of the data. The open coding (1) resulted in seventeen categories, detailed with examples in Figure 1. The next phase, (2) axial coding, overlaps with the open coding process. The main categories and subcategories were extracted from the open coding categories through constant and systematic comparison and bringing data back together in a coherent whole (Strauss & Corbin 1998). This process sifted the most frequent codes from the data, and from this the specific properties of each category could be identified. Thus, the axial coding process produced four **main categories – dimensions** for the ideal school and learning environment. It also yielded subcategories that consist of most common expectations with percentage values for the frequency with which these were expressed (see Figure 1). Finally, the selective coding (3) phase defined, *the core concept* and identified its key features and the implications for the ideal school and learning environment. Relating the core concept to all major categories was central to the procedure (Strauss & Corbin 1998).

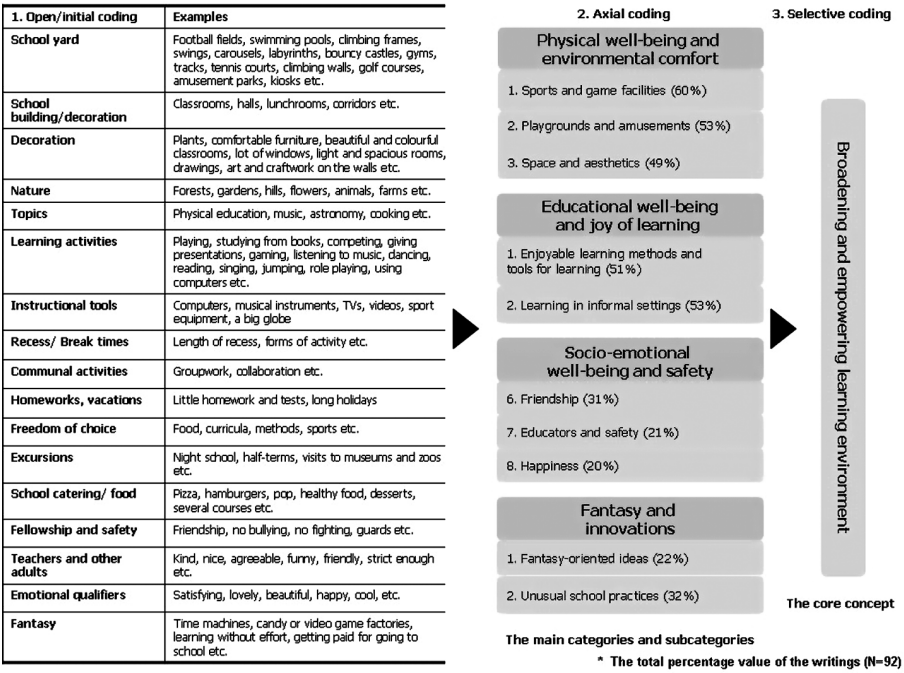

Figure 1. Illustration of coding process and categories embodied in the study

3 The Findings

Four elements of the ideal learning environment were identified. They consisted of the following, partly overlapping aspects: *1) physical well-being and environmental comfort*; 2) *educational and cultural well-being*; 3) *socio-emotional well-being and the joy of learning*; 4) *fantasy and innovations*. In spite of the holistic concept of the learner as part of the learning environment, I decided to use the term 'well-being' as central to learning environments where children are happy to study. This is because the schoolchildren's ideas and desires clearly reflected these four forms of well-being. Well-being is closely related to one's environments and because of this there is a growing expectation that education must

take responsibility for the development of the whole person and his or her well-being (Awartani et al. 2008).

3.1 "More Space and Outdoor Climbing Walls": The Physical Well-Being and Environmental Comfort

The ideal school and learning environment enable *physical well-being and environmental comfort,* which is linked to the following factors: 1) *sports and game facilities, 2) playgrounds and amusements, 3) space and aesthetics*. Mostly the children wanted various physical **sports and games facilities** (60% in total). Both girls (62%) and boys (56%) regarded sport as an almost equally important factor. Swimming pools, football fields, gyms, tracks, tennis courts, golf courses, climbing walls, climbing places, trampolines and roller coasters are examples of the sports facilities desired. The finding illustrates the children's need for lots of physical activity within the school setting, as well as the need for plentiful *co-curricular activities* (Waring, Warburton & Coy 2007). On top of this, 43% of the children wished for more *physical education* (PE). This result will comfort and support those concerned by sedentary health trends and keen to get children more physically active. The following extract is an excellent example of the children's ideal school rising to the challenge of physical well-being. It sets some appealing requirements for PE and for other subjects, and for pedagogical arrangements.

> *"School starts at nine every morning. We begin usually with a light PE class and dip into the school's swimming pool. The pool is quite large and deep, and there are diving boards and two water slides. The second class is arts, and we paint landscapes outside. When you're finished you can go jump on the trampoline; there are four big ones and four that are a bit smaller. The third class, English, is held indoors. We also study math because we practice selling in English at the school kiosk. The last class is PE, again. This time we do horseback riding. The class is split in two groups of different levels, and the beginners go first.*

Meanwhile, the others can jump on the trampolines or play football. When the class is over, we pick up the things and go home. Some days are more difficult and some are easier, but there is always something fun. And there should be at least one PE class each day. "

Over half of the children (53%) depicted **playgrounds and amusements** in their ideal school providing, multiple outdoor activities and thus also contributing to physical well-being. Swings, carousels, climbing frames, labyrinths, bouncy castles, revolving disks, and wild rides were all imagined in the ideal school playground. The outdoor activity ideas represented enjoyment. The children even envisioned a huge amusement park located on the school playground: "*There were all kinds of fun things outside; the school was like an amusement park with a rollercoaster, carousel, and all other kinds of really neat stuff!"* Roger Caillois's (2001) definitions of play, especially *ilnix* as one type of it, apply well to the children's need for exciting physical experiences. Caillois divided games roughly into four groups according to the type of player experience. Ilnix stands for physical achievement-based games that can offer experiences of vertigo and enjoyment. The findings described above clearly relate to the children's need to experience ilnix in their play activities.

The pupils' thoughts about **learning space and aesthetic factors** (49%) mainly referred to requirements for environmental comfort. Learning places need to make it easy to be inspired and happy. The children demanded a lot of space both inside and outside the school building: larger classrooms, wider playgrounds, and larger areas for exercise and physical education. They even wished for a more spacious lunch room! John Dewey (1957) had pointed out some decades ago that the ordinary classrooms have very little space for children's activities. The traditional classroom is not a space in which children can work – it is a space in which they can listen. Since then, classrooms have not changed much.

To be aesthetically pleasing the school and the classrooms should be beautifully decorated. Plants, comfortable furniture, pictures, beautiful and colourful walls, drawings, art and craftwork on the walls, and good lighting were suggested. Nature and the surrounding natural environment can also provide aesthetically pleasing experiences, especially given enough space. Forests, rivers, gardens, hills, the sun, flowers, and animals represent nature-related environmental expectations in the ideal school. The following extract illustrates one pupil's prerequisites for environmental comfort.

> *"Our school is really big. It's green and has two stories, unless you count the cellar and the attic. There are many trees in the schoolyard, mostly birches. There are many cool things, such as a swimming pool inside and a smaller one outside, many swings and a trampoline. And everything else. When the bell rings, everybody goes inside. The classrooms are big and bright. The pupils have large desks in which the books fit nicely, and soft, comfortable chairs..."*

3.2 "We Were Allowed to Take a Math Exam Outside, on the Trampoline": The Educational and Cultural Well-Being

Expectations of various **enjoyable learning methods and tools for learning** (51%) were equaled by expectations of *learning in informal settings* (53%) in the children's stories. These fall into the categories of educational and cultural well-being. The children wrote about traditional learning methods, such as reading school books, but they also expected playful, creative, and exploratory ways of learning: "*Math and other subjects we would learn in some pleasant way*", "*We have an opportunity to study through games. Studying will be easy and playful and we will listen to music, and the music would be pop music that will teach us biology, for instance*." According to Cropley (2004), learning methods and activities that emphasize branching out, finding out, or inventing – such as discovery learning, learning under play like conditions and learning with

the help of fantasy – can be more effective than traditional methods such as face-to-face lecturing or rote learning. Learning methods that emphasize creativity can therefore have beneficial effects on students' motivation as well as their attitudes to school.

Educational and cultural well-being is also associated with the *tools for learning*. Following the socio-cultural approach, learning, in this study, is defined as a tool-dependent phenomenon whereby the role of cultural tools and artifacts is central in acting and learning (e.g. Vygotsky 1978; Wertch 1991; Säljö 2005). Säljö (1999; 2004) has stated that schools should adapt new resources as they become available. According to him, the traditional textbook, the core of education, has gradually become outdated as new information on almost anything can be collected from databases, the Internet, the television or through other channels. Some of the children's wishes are in line with this viewpoint: "*We don't have to study everything from books, but we are allowed to explore the Internet and to use the computer in our studies",* and "*All pupils should have the opportunity to study "in the modern way" and "to use modern devices" at school."* The writings of the children dealt with media and other technological tools: computers, laptops, digital games, the Internet, TV, videos, DVD devices, digital cameras etc. In addition, a range of laboratory facilities, musical instruments, sports devices, and even a huge globe for geography were expected. Educational and cultural well-being also refers to an environment where homework is minimal. A fifth of the children wrote about a school where teachers give either very little, or no homework at all.

Traditionally, teaching and studying takes place mainly in classrooms. This study shows the desire to study in multiple contexts and places around the school building. This is in line with recent studies of informal learning and learning in informal settings (e.g. Ash & Wells 2006; Hull & Greeno 2006). The desire for **learning in informal settings, with** formal and informal learning activities fluently intertwined in the school work, was commonly expressed: W*e have an opportunity to*

study foreign languages by selling sweets in English in the school kiosk". Following Schugurensky (2006) the concepts of 'learning in informal settings' and 'informal learning' are seen as separate in this case: informal learning is not merely knowledge acquired in informal settings but also in formal, nonformal and informal settings. Learning in informal settings refers to the circumstances where formal, nonformal or informal learning is occurring outside the classroom, for instance in the playground or in museums. The next extract illustrates well the children's expectations concerning formal and informal learning in informal settings, and the joy of learning. The extract also demonstrates how this age group regard the outdoors as a comfortable learning environment, and that they really are willing to get involved in play and playful actions during the school day:

> *"Now the school has been revised, and it's got everything. The first class is math, and we practice working in a shop. A kind of kiosk has been built outside and everyone gets a chance to be the salesperson. Next, in the Finnish class we go inside and read the first paragraph. As a surprise, we get to dress up as fairytale figures. The next class is music, and we go into the woods to play the recorder. We compose songs from the woods, all by ourselves. All the classes have been so much fun that we haven't had a recess until now. In the schoolyard I whoosh down a spiral slide, jump on a bouncy castle, swing with lianas, build a sand castle in a large sandbox, and run along a track that requires balance and precision. Then the bell rings and it's time for biology; we examine our own garden and taste different kinds of vegetables. Each class has its own patch of land."*

As the extract above shows, the children regard learning in formal and informal settings as equal learning activities, and presume that informal learning activities can be fluently integrated with curriculum-based learning. In addition to *school kiosks, shops, gardens and forests,* the chil-

dren mention *outdoor playgrounds, museum*s, and *science or game centers* as informal learning places. Moreover, all the described excursions to informal places, and wishes for longer recess periods encompassed expectations of learning and play activities in informal settings. During longer recess periods, for instance, children expected to play on the school playground or engage in various sports activities that could likewise support learning activity and cognitive, social, and emotional development.

3.3 "And it'd be fun if you didn't know anything about quarrels": The Socio-Emotional Well-Being and Joy of Learning

Alongside their desires for their physical environment and the instruction methods in their ideal school, the children also highlighted important social and emotional aspects of the ideal learning environment. Their requirements regarding socio-emotional well-being and the joy of learning school fall into the following categories: 1) *friendship*, 2) *educators and safety*, and 3) *happiness*.

A third of the children wrote about **friendship** (31%): *"Everybody would be friends and nobody would be left alone."* A friendly, favorable, and pleasant atmosphere was considered a requirement for an ideal school. These qualifiers among others relate to an engaging learning community. The following extract illustrates the ideal socio-emotional atmosphere:

> *Since the school was neat, the pupils were also nice and diligent. It wasn't the end of the world if you sometimes hadn't done your homework or forgot to bring a book to school. The pupils were not wicked, but every now and then a quarrel would break out, there was no stopping that. Other pupils didn't belittle or scold those who may have looked a bit different or be different in some other way.*

The importance of socio-emotional well-being and safety was also evident from the children's expectations regarding **the educators and the school's safety** (18%). Teachers should be kind, nice, agreeable, gracious, funny, and friendly, but also strict enough. They should have a sense of humour, they should not get angry too easily, and they should be pedagogically gentle. Several studies have shown that teacher likeability is strongly associated with school satisfaction (Samdal, Nutbeam, Wold & Kannas 1998; Randolph, Kangas & Ruokamo 2009; Veruyten & Thijs 2002). The head teachers, school guards and other staff were also experienced essential educators in the ideal and safe school. The results indicates the importance of the teachers' and other adults' roles as creators of a safe and communal learning environment.

Kershner and Pointon (2000) have discussed the importance of achieving an environment which children are happy to enter. Social relationships build the happy learning environment. The children emphasized the **happiness** (20%) and positive feelings that would exist in their ideal school: "*When you come to school, everybody is in a good mood", "Everything would be amusing and easy"* and "*After these changes I will really love school!"* The ideal school was also associated with the following emotion-related qualifiers: *satisfying, lovely, smiling, beautifulness, happy, cool, nice, amusing* and *funny*. Happiness, in this case, refers to general satisfaction in an enjoyable learning environment. Happiness also refers to the joy of learning which builds up when students are *satisfied with their activities* in a learning environment. Rantala (2005) studied the joy of learning in her own classroom and shown that students don't feel it through listening to teachers but by having an active role in learning. The positive emotional feelings that the children related to their ideal school, however, show that schoolchildren regard socio-emotional factors in school life as important. In addition, these positive emotions reveal that the children enjoyed envisaging an "imaginary school reform" – the task was inspiring, rousing and provided satisfaction.

3.4. "Knowledge Would be Accrued by Eating Pills": Fantasy and Innovations

Because the children were allowed to use their imagination, fantasy-oriented, and impractical ideas were expressed in their descriptions of the ideal school. This category was divided into the two subcategories: 1) *Fantasy-oriented ideas* (22%) and 2) *unusual school practices* (32%).

Fantasy-oriented ideas and unrealistic expectations included sweet and game factories, huge sports arenas around the school (e.g. Formula 1 tracks and ice hockey halls), amusement parks, and time machines. Some of the fantasy-oriented ideas related to junk food, such as getting sweets and ice cream for lunch. Being paid for going to school and given 160 courses of free food were also brought up. Some of the ideas were possible, some impossible: every student having their own laptop computer being an example of the former, while history being studied by using a time machine is an example of the latter. An opportunity to learn without effort emerged in a few writings: knowledge would be accrued by eating pills or using a special helmet every once in a while: "… *and like a strange helmet would be put on your head, and you would learn all the things you will need in your life, and you don't need to study at all!*" Some of the children suggested excursions to foreign countries, to the past, to space, and into the Earth. These suggestions can be considered innovative, given that future technologies and new media may offer the chance to realize at least some of them. In addition, some fantasy-oriented ideas may reflect the children's need for more playful and creative learning situations within the school.

The results also show that quite *unusual school practices* were desired. Mostly those expectations related to sweets and candy kiosks providing an unhealthy school environment. In addition, school practices were extended to make it an entertainment service provider. For example, a cinema, shops, beauty salons, banks, and game halls were included at the school. This suggests that some children see tomorrow's school as part of an extended cultural and societal whole, not just as a formal,

curriculum-based learning environment. Formality and informality in education are thus viewed in relation to an increasing variety of learning sites: libraries, museums, popular culture, the media etc. (Bekerman et al. 2006). Some of the ideas concerning school rules and practices were arbitrary. A few of the children want to do whatever they want: to surf the Internet and play digital games for the entire school day or to decide when the school day or the period will start and end.

4 Conclusion: The Broadening and Empowering Learning Environment(s)

The purpose of the study was to define the ideal school and learning environment of schoolchildren. In analysis four different categories were distinguished according to their meaning for learning: *1) physical well-being and environmental comfort*, 2) *educational and cultural well-being*, 3) *socio-emotional well-being and joy of learning*, and 4) *fantasy and innovations*. Drawing on grounded theory (Charmaz 2006; Glaser 1978; Strauss & Corbin 1994; 1998), after the formation and definition of those categories **the core concept** and its main features were defined. Hence, the ideal learning environment was conceptualized as *a broadening and empowering learning environment* (BELE) with attributes that contribute extensively to schoolchildren's well-being and their joy in learning (see Figure 2).

The 'broadening and empowering learning environment' (BELE) builds on the most general descriptions of the Finnish schoolchildren's ideas for the ideal school and learning environment. On the basis of the study, the term *broadening* refers to the following BELE's definers:

1. The learning environment as a physical environment expands from classroom and school building to include the outdoors

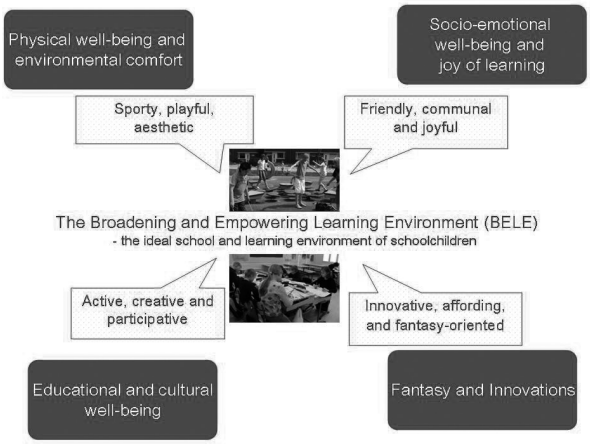

Figure 2. The core concept and its features

and other purposeful learning places, and to respond in a versatile way to the challenge of young people's physical well-being.

2. The learning environment as an educational and cultural environment expands to cover both formal and informal learning places, and to integrate formal and informal learning.
3. The learning environment as a socio-emotional, fantasy-oriented and innovative environment expands schoolchildren's minds to learn (cf. Claxton 2007).

Empowering in the BELE refers to following learner–environment–aspects:

1. The learning environment provides potential for various informal and formal learning *experiences*
2. The learning environment promotes children's emotional well-being, emotional security, and school satisfaction. This means that children find it an encouraging environment.

3. The learning environment affords innovations and rises to challenges. This refers to the term "affordance network" (Barab & Roth 2006), and to available modern cultural resources.

The BELE can be elaborated in terms of the four categories and in the light of various aspects of well-being.

Physical well-being and environmental comfort. Following Awartani et al. (2008), physical well-being refers to "feeling comfortable with one's body and physical ability, and being in healthy physical state and a healthy physical environment". As the present study shows, the schoolchildren clearly expect the space and the opportunity to engage in and express themselves through physical activity. Therefore the BELE must provide a variety of *sporty, playful* and *enjoyable learning experiences* and promote both physical well-being and environmental comfort. Outdoor play is important because many activities, such as exploring, or learning cross-motor skills, can be learned through outdoor play only (e.g. Johnson et al. 2005). Due to the need for schoolchildren to practice their motor skills the BELE offers a range of diverse *formal and informal learning places and spaces* in the school settings. It provides purposeful indoor and outdoor spaces and places for *physical exercise and sport* as well as for *play and games*. The game-, play- and amusement- related learning activities can be divided into two sets – *pedagogically oriented* and *enjoyment oriented* – when the emphasis of pedagogical or academic goals varies. For example the idea of *taking a math exam outside, on the trampoline"* implies both the pedagogical and enjoyment aims, suggesting that in addition to physical well-being and amusement, the playground can offer a place for curriculum-based learning. The BELE, as an ideal environment also offers aesthetically pleasing and inspiring learning places and spaces such as those facilitated by nature or personalized common spaces.

Educational and cultural well-being. The BELE promotes *activity, creativity,* and *participation* and responds to the challenge of develop-

ing the children's educational and cultural well-being. Educational well-being refers to methods and practices which responses to the children's desire to be active, playful, creative and participative in learning. Cultural well-being refers primarily to use of various available and purposeful cultural tools while learning in school. Those tools can include the use of novel places, tools, methods, practices and resources that promote students' learning. Various types of learning activity, more or less curriculum-based, in multiple contexts are therefore relevant. Following Livingstone's (2006, pp. 206) definition of informal learning as: "*any activity involving the pursuit of understanding, knowledge, or skill that occurs without the presence of externally imposed curricular criteria*", both informal learning and learning in informal settings can be seen to promote educational and cultural well-being. Studying in the school garden or in the playground is thus as important as face-to-face lectures for one's learning and development. Curriculum-based, cross-curriculum and co-curricula activities are fluently integrated. Ownership and relevance, which are important factors for creative learning (Craft 2005; Jeffrey & Craft 2006), are essential. Practicing English authentically by selling in a school kiosk, for example, would provide both ownership and relevance to learning. Encouraging children to explore alternative ways of doing relevant activities and constructions provides opportunities for learning within the child's frame of reference (Woods 2002).

Socio-emotional well-being and the joy of learning. The BELE is also a *communal, friendly, and joyful* learning environment that contributes to socio-emotional well-being and offers the joy of learning. It facilitates social and emotional scaffolding and partnership by enabling dialogue and by guiding and encouraging children to work as members of a group, and by offering a warm and safe atmosphere in which support from teachers and other adults is important. In an ideal situation emotional scaffolding leads to 'the gift of confidence' – the sharing of risks in the presentation of new ideas (Mahn & John-Steiner 2002). In this respect, socio-emotional well-being is defined as feeling good about

relationships (peers, teachers, other adults) and feeling safe, competent and happy in a learning community, and in a physical learning environment. Studies have shown that at least one intimate friend at school is strongly correlated with positive well-being (Konu, Lintonen & Rimpelä 2002). Emotional well-being is also seen as a predictor of effective social behaviour and as a key component of overall well-being and academic competence (Elias, Zins & Weissberg 1997). Further, *the joy of learning* is valued and extensively sought after in a broadening and empowering learning environment. Applying Awartani et al's (2008) definition, the joy of learning principally refers to motivation and capacity to learn, and to positive feelings such as the belief that learning activities are fun. Following Rantala's (2005) findings, the joy of learning can consist of feelings from the whole spectrum of emotional life depending on the learning activities at hand.

Fantasy and Innovation. The BELE represents fantasy and future possibilities envisioned by the children, which means that the ideal learning environment is also *innovative, affording, and fantasy-oriented*. These things promote schoolchildren's curiosity and creative citizenship. Education is always a unique combination of technological, social, and educational contexts and affordances (Kirschner, Strijbos, Kreijns & Beers 2004), in which technological affordances change most rapidly. Because of this young people need new practices to master current and new resources such as technological innovations and new media applications. Could students really have an opportunity some day to carry out excursions to foreign countries, to previous historical ages, or to space through realistic simulations? What might the future afford, given the development of the information age? Not surprisingly, there are no answers to these questions yet.

5 Discussion

The present study provides insights into to endeavors to develop the future school and its learning environments. The study showed that the children enjoyed letting their imagination run free in an imaginary school reform to create the school of their dreams. However, the children described their ideal school in quite a realistic way and suggested reforms based on properties that would engage them more closely with their schooling, enhance their well-being and increase their school satisfaction. The research confirmed previous findings that children have relevant and appropriate ideas regarding their learning environments; that they are well aware of the potential of schools, and that they fully understand that the learning environment has to support different aspects of their development (e.g. Kershner & Pointon 2000; Piispanen 2008; Smees & Thomas 1998; Smith & Parr 2007).

The Broadening and Empowering Learning Environment (BELE) presented here *represents the ideal learning environment of the schoolchildren*. The BELE supports the holistic approach of the learning environment and supports the schoolchildren's development in a versatile way. The findings are based on the view that the ideal learning environment facilitates well-being. Thus, the findings of this study identified the following categories of schoolchildren's well-being: physical, educational, cultural, and socio-emotional well-being. In addition, the joy of learning emerged as one of the key elements in the ideal situation. It is seen as a feeling of competence, curiosity, and belief that what one is learning is relevant (Awartani et al. 2008). Joy of learning, in this study, also refers to all of the other forms of well-being in the BELE and highlights the fact that emotional factors are important for all learning (cf. Claxton 2002).

The results indicate that some children think that school should be predominantly an entertaining place, where all activities are fun and easy and do not require learning effort. However, it is erroneous to as-

sume that children automatically learn when they are having fun, because activities that engage students without stretching them are not worthwhile; children have to sign up for some hard work, and understand why they should do so (Bereiter 2002; Claxton 2007). Indeed, as Claxton and Carr (2004) have pointed out, happy and active children who do standard things easily but avoid difficulty are wasting their time. Claxton (2007) uses the term 'potentiating learning environment' to describe a powerful learning environment that offers plenty of hard and interesting things to do, but accepts as normal that all students regularly get confused, frustrated, and stuck. This pertains as much to the learning of academic subjects, such as science or history, as to sport and play. In this respect, the joy of learning can consist of both positive and negative feelings that are intertwined in learning activities.

According to Claxton (2007) learning activities should to be selected and designed to stretch each aspect of learning capacity. Neither 'stretching' nor the joy of learning will occur by just listening to the teacher (Rantala 2005). Therefore, students should have an opportunity to *actively engage in* socio-cultural learning practices through explorative and playful tasks, such as group work and open-ended projects, with adequate technological tools, so that they respond to equivalent challenges in real socio-cultural life. Rantala (2005) writes that "although joy cannot be brought about by educators, a teacher through his/her actions can create the favourable conditions for the joy of learning". Maybe educators should also inform children more clearly that enjoyment is important in lifelong and life-wide learning and that this applies to all kinds of achievements: to physical and social activities, to knowledge co-construction, and so forth.

In addition, it is important for educators to determine the relationship between playful and joyful learning with pedagogical goals in mind, and pure entertainment – and their meaning for well-being. Both have a special role in the BELE because informal and formal learning are equally respected. There are also several studies proving that learn-

ing in informal settings and informal learning should be appreciated in education (Anderson et al. 2003; Ash & Wells 2006; Livingstone 2006; Noddings 2005). Pedagogically this means that informal learning and learning in informal settings could well be a part of curriculum-based learning. An innovative, technology-enriched playground, the Playful Learning Environment (PLE), would be an example of integrating play and physical games with outdoor learning activities for formal and informal purposes (Hyvönen 2008; Hyvönen et al. 2006; Kangas et al. 2006; Kangas et al. 2007).

These results are congruent with the latest recognition of the interdependence of physical and mental well-being (cf. OECD 2007); the education of bodies and minds is equally important. For BELE, the need for physical well-being, exemplified by the demand for sporty, playful and enjoyable learning activities, was strongly emphasized. As the Finnish National Core Curriculum (2004) states, the learning environment must be psychologically and socially safe, but it must also promote the pupil's health. The children's numerous desires concerning outdoor playgrounds, sports facilities and physical education support this statement. Many European governments (e.g. UK, Finland) are aware of problems with young people's physical condition and well-being, and have made recommendations for the promotion of physical activity and sports at school among all ages. Although school yards are often built to accommodate a variety of teaching purposes, such as physical education, schools generally are not delivering on their potential to effectively promote physical activity (Waring et al. 2007). However, various informal learning environments, such as playgrounds, can be effective places to promote children's physical activity level (e.g. Hyvönen 2008; Kangas et al. 2007; Ridgers et al. 2007).

What innovative, affording and fantasy-oriented enablers can BELE offer for education? Barab and Roth (2006) have extended Gibson's (1986) ideas regarding affordance and decided to use the concept of an *affordance network* in considering the school as an assemblage of curric-

ulum-based ecosystems. An affordance network can be considered part of the BELE if it consists of a novel and appropriate collection of tools, methods, practices, agendas, and people in the field of education. An agenda or method could be to enhance fantasy-oriented learning activities with high levels of creativity, such as thought experiments or using an imaginary setting to test certain views of the actual world (e.g. Bokulich 2001; Jeffrey & Craft 2006). In addition, the ideal school and learning environment, designed by the Finnish children, would need more staff (assistants, tutors, guides, club and physical trainers) to provide enough resources and better circumstances for educational, cultural and socio-emotional well-being. Knowledge acquisition in a foreign language would be guaranteed, for instance, by *"a Native English teacher who would visit every month"* as one of the children wrote. The important question is: Does the future school environment need to have special sport and game places or additional services offered by companies from different areas of expertise?

When evaluating the study, some limitations should be taken account. First, the study is based in Finland: its principle data being the accounts of Finnish schoolchildren. The study therefore offers material for refinement of the *Finnish national curriculum* specifically. It suggests that the Finnish national core curriculum should be partly revised to enable varying socio-cultural practices and working methods in the schools (Vitikka 2008). Although the study is based on Finnish data the results may be applicable to education and school development in other countries because only certain cultural characteristics are exceptional. Comparative studies are worth carrying out, with children in different countries and school systems being asked to state their ideas on the ideal school and learning environment: I intend to do a follow-up study to investigate this in the future. The present study provides some practical and conceptual tools to execute new research. The third limitation is that gender based differences in the data have not been analyzed, excepting the interest in sport. This is because the goal was to obtain an

insight into the schoolchildren's views in general, but work in this area may be valuable. Finally, it is worth recognizing that listening only to schoolchildren would lead to an inadequate understanding of what is required for a good learning environment for the future school. Older students, among others, will have somewhat different expectations and ideas. Views of cognitive and mental aspects of learning, such as the development of thinking skills, were not fully considered by the children and therefore do not have a big role in this study. However, the study has many implications for educational practitioners and policy makers. After listening to the children, it is easier to discover factors that influence school satisfaction, well-being and the joy of learning, as well as being easier to set new challenges for educational practices, places, and spaces in the development of information technology and new media.

The fact that the present study listened to the ideas of young people (e.g. Meskanen 2008) represents the first step. The next step could be educational research developing tools that facilitate the creation of more powerful learning environments, especially by stimulating the reciprocal relationship between educational practitioners, policy-makers, teachers, and pupils (cf. Könings et al. 2005). Clearly, the study offers a contribution to two areas of educational development:

1. the development of novel outdoor playgrounds and pedagogical contents for pre-primary and basic education (e.g. Hyvönen, Kangas, Kultima & Latva 2005; Hyvönen 2008; Kangas et al. 2006; Kangas, Hyvönen & Latva 2007; see also http://smartus.fi)
2. design of a multidisciplinary Future School Concept concerning practitioners from different scientific areas – architecture, information technology, and education (http:innoschool.tkk.fi).

More research is needed to understand age, gender and cultural differences, for instance pertaining to educational stakeholders' opinions

and expectations. In addition, because expanding young people's capacity to learn should predominantly involve questions regarding *why* one goes to school (Claxton 2007), research into this area with schoolchildren would interestingly complete an understanding of young people's thoughts about schooling. Due to the nature of the open written task, in which the use of fantasy was allowed the BELE represent a hypothetical model of the ideal school and learning environment. The findings reveal some schoolchildren's dreams and 'hidden' expectations. Still, the BELE doesn't consist of entirely unfeasible ideas, but presents a challenge to educational practitioners, designers of learning environments and policy makers to look toward the future. The question *how people engage* in the learning activity becomes more significant than how they learn (cf. Claxton 2007). The BELE lets us identify learning activities and well-being that would satisfy schoolchildren and empower them to be capable and confident, and thus better equipped for a changing world.

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References

Aittola, T. (2000). Possibilities of informal learning inside and outside the school. In P. Alheit, J. Beck, E. Kammler, R. Taylor & S. Olesen (Eds.) *Lifelong Learning Inside and Outside Schools*. Collected papers of the European conference on Lifelong learning (2nd, Bremen, Germany, February 25–27 1999). Roskilde: Roskilde University, 2000.

Anderman, E. (2002). School effects on psychological outcomes during adolescence. *Journal of Educational Psychology*, 94(4), 795–809.

Anderson, D., Lucas, K. & Ginns, I. (2003). Theoretical perspectives on learning in an informal setting. *Journal of Research in Science Teaching*, 40(2), 177–199.

Ash, D. & Wells, G. (2006). Dialogic inquiry in classroom and museum: Actions, Tools, and Talk. In Z. Bekerman, N. Burbules, D. Silberman-Keller (Eds.). *Learning in places. The informal education reader* (pp. 35–54). New York: Peter Lang Publishing.

Awartani, M., Whitman, C. & Gordon, J. (2008). Developing Instruments to Capture Young People's Perceptions of how School as a Learning Environment Affects their Well-Being. *European Journal of Education*, 43(1), 51–70.

Barab, S. A. & Roth, W-M. (2006). Curriculum-based ecosystems: Supporting knowing from an ecological perspective. *Educational Researcher*, 35(5), 3–13.

Bekerman, Z., Burbules, N., Silberman-Keller, D. (2006). Introduction. In Z. Bekerman, N. Burbules, D. Silberman-Keller (Eds.). *Learning in places. The informal education reader* (pp. 1–8). New York: Peter Lang Publishing.

Bereiter, C. (2002). *Education and mind in the knowledge age*. Mahwah, NJ: Erlbaum.

Bokulich, A. (2001). Rethinking thought experiments. *Perspectives on Science,* 9(3), 285–307.

Bruner, J. (1986). *Actual minds, possible worlds*. Cambridge: Harvard University Press.

Burke, C. (2007). The view of the child: releasing 'visual voices' in the design of learning environment. Discourse: *Studies in the Cultural Politics of Education*, 28(3), 359–372.

Caillois, R. (2001). *Man, Play and Games*. Urbana (III.): University of Illinois Press.

Charmaz, K. (2006). *Constructing grounded theory. A practical guide through qualitative analysis*. Thousand Oaks: Sage Publications.

Claxton, G. (2007). Expanding young people's capacity to learn. *British Journal of Educational Studies*, 55(2), 115–134.

Claxton, G. (2002). Education for the learning age: a sociocultural approach to learning to learn. In G. Wells & G. Claxton (Eds.) *Learning for life in 21st century. Sociocultural perspectives on the future of education* (pp.21–33). Cambridge, MA: Blackwell.

Claxton, G. & Carr, M. (2004). A framework for teaching thinking: the dynamics of disposition, *Early Years*, 24 (1), 87–97.

Craft, A. (2005). *Creativity in schools: tensions and dilemmas.* Abingdon: Routledge New York.

Cropley, A. J. (2004). *Creativity in education & learning*. London: Routledge.

Delors, J., A., Mufti, I., Amagi, I., Carneiro, R., Chung, F., Geremek, B. et al. (1996). Report to UNESCO of the International Comission on Education for the Twenty-first Century: Learning–The Treasure Within (Paris, UNESCO). Retrieved October 12, 2008, from http://www.unesco.org/delors.

Dewey, J. (1957). *Koulu ja yhteiskunta*. Helsinki: Otava.

Doppelt, Y. & Schunn, C. (2008). Identifying students' perceptions of the important classroom features affecting learning aspects of a design-based learning environment. *Learning Environments research*, 11, 195–209.

Elias, M., Zins, J., Weissberg, K., Greenberg, M., Haynes, N. Kessler, R., et al. (1997). *Promoting social and emotional learning: Guideliness for educators*. Alexandria: Association for Supervision and Curriculum Development.

Engeström, Y., Engeström, R. & Suntio, A. (2002). Can a school community learn to master its own future? An activity-theoretical study of expansive learning among middle school teachers. In G. Wells & G. Claxton (Eds.) *Learning for life in 21st century. Sociocultural perspectives on the future of education* (pp. 211–224). Cambridge, MA: Blackwell.

Flutter, J. (2006). 'This place could help you learn': student participation in creating better school environments. *Educational Review*, 58(2), 183–193.

Frenzel, A. C., Reinhard, P. & Goetz, T. (2007). Perceived learning environment and students' emotional experiences: A multilevel analysis of mathematics classrooms. *Learning and Instruction*, 17, 478–493.

Gibson, J.J. (1986). *The ecological approach to visual perception*. Hillsdale, NJ: Lawrence Erlbaum.

Glaser, B. (1978). *Theoretical sensitivity: Advances in the methodology of grounded theory*. Mill Valley, CA: Sociology Press.

Glaser, J. & Strauss, A. (2007). *Basics of qualitative research. Techniques and procedures for developing grounded theory*. Los Angeles: Sage publications Inc.

Glaser, B. & Strauss, A. (2007). *The discovery of grounded theory: Strategies for qualitative research. Hawthorne*, NY: Aldine.

Hull, G. & Greeno, J. (2006). Identity and agency in nonschool and school worlds. In Z. Bekerman, N. Burbules, D. Silberman-Keller (Eds.). *Learning in places. The informal education reader* (pp. 77–97). New York: Peter Lang Publishing.

Hyvönen, P. (2008). Affordances of Playful Learning Environment for Tutoring Playing and Learning. Dissertation. University of Lapland.

Hyvönen, P. Kangas, M., Kultima, A. & Latva, S. (2006). *Let's Play! Tutkimuksia leikillisestä oppimisympäristöstä*. Lapin yliopiston kasvatustieteellisiä julkaisuja 16. Rovaniemi: Lapin yliopistopaino.

Illich, I. (1971). Deschooling society. Middlesex, UK: Penguin.

Jeffrey, B. & Craft, A. (2006). Creative learning and possibility thinking. In B. Jeffrey (Ed.) *Creative learning practises: European Experiences*. London: Tufnell Press.

Johnson, J., Christie, J. & Wardle, F. (2005). *Play, development and early education*. Boston: Pearson Education Inc.

Kangas, M., Kultima, A. & Ruokamo, H. (2006). Co-Creative Learning Processes (CCLP) – Children as Game World Creators to the Outdoor Playground Contexts. In J. Multisilta & H. Haaparanta (Eds.) *Proceedings of the Workshop on Human Centered Technology HCT06* (pp. 14–21). June 11–13, 2006, Pori, Finland, Tampere University of Technology, Pori. Publication 6.

Kangas, M., Hyvönen, P. & Latva, S. (2007). Space treasure outdoor game in the playful learning environment: experiences and assessment. In H. Ruokamo, M. Kangas, M. Lehtonen & K. Kulmpulainen (Eds.) *The power of media in education. Proceedings of the 2nd Network-Based Education Conference,* 13–15 June, 2007, Rovaniemi, Finland.

Kershner, R. & Pointon, P. (2000). Children's views of the primary classroom as an environment for working and learning. *Research in Education*, 64, 64–77.

Kirschner, P., Strijbos, J., Kreijns, K. & Beers, P. (2004). Designing Electronic Collaborative Learning Environments. *Educational Technology Research and Development*, 52(3), 47–66.

Konu, A. I., Lintonen, T. P. & Rimpelä, M. K. (2002). Factors associated with schoolchildren's general subjective well-being. *Health Education research*, 17, 155–165.

Könings, K., Brand-Gruwel, S. & van Merrienboer, J. (2005). Towards more powerful learning environments through combining the perspectives of designers, teachers and students. *British Journal of Educational Psychology*, 75, 645–660.

Livingstone, D.W. (2006). Informal learning. Conceptual distinctions and preliminary findings. In Z. Bekerman, N. Burbules, D. Silberman-Keller (Eds.). *Learning in places. The informal education reader* (pp. 203–227). New York: Peter Lang Publishing.

Mahn, H. & John-Steiner, V. (2002). The gift of confidence: A Vygotskian view of emotions. In G. Wells & G. Claxton (Eds.) *Learning for life in 21st Century. Sociocultural perspectives on the future of education* (pp. 46–58). Cambridge, MA: Blackwell.

Malin, A. (2006). *School differences and inequities in educational outcomes*. PISA2000 results of reading literacy in Finland. Jyväskylä: Jyväskylä University Press.

Meskanen, S. (2008). *Future School – Through pupils' eves. Master thesis in Architecture*. Helsinki, University of Technology.

Mitra, D. (2008). Balancing power in communities of practice: An examination of increasing student voice through school-based youth-adult partnership. *Journal of Educational Change*, 9(3), 221–242.

National Board of Education (2004). *Finnish National Core Curriculum*. Helsinki: Author.

Noddings, N. (2005). *Happiness and education*. Cambridge: University Press.

Organisation for Economic Co-Operation and Development (OECD) Center for Educational Research and Innovation (CERI) (2007). *Understanding the brain: the birth of learning science* (Paris, OECD).

OECD. Programme for International Student Assessment (PISA). Retrieved March, 9, 2008, from http://www.pisa.oecd.org.

Piispanen, M. (2008). *Good Learning Environment*. Perceptions of Good Quality in Comprehensive School by Pupils, Parents and Teachers. Doctoral Thesis in Pedagogics. University of Jyväskylä. Faculty of Pedagogics. Kokkola University Consortium Chydenius.

Randolph, J. Kangas, M. & Ruokamo, H. (2009). Predictors of Dutch and Finnish Children's Satisfaction with Schooling. To be published in the Journal of Happiness Studies.

Rantala, T. (2005). *Seeking the Joy of Learning – the Ethnography of experience in Elementary Instruction*. Dissertation. University of Lapland.

Resnick, L. B. (1987). Learning in school and out. *Educational Researcher*, 16(9), 13–20.

Ridgers, N., Stratton, G., Fairclough, S. & Twisk, J. (2007). Long-term effects of a playground markings and physical structures on children's recess physical activity levels. *Preventive Medicine*, 44, 393–397.

Roth, M. (2000). Learning environments research, lifeworld analysis, and solidarity in practice. *Learning Environments Research*, 2, 225–247.

Samdal, O., Nutbeam, B., Wold, B. & Kannas, L. (1998). Achieving health and educational goals though schools–a study of importance of school climate and the students' satisfaction with school. *Health Education Research: Theory & Practice*, 13(3), 383–397.

Schugurensky, D. (2006). "This is our school of citizenship". Informal learning in local democracy. In Z. Bekerman, N. Burbules, D. Silberman-Keller (Eds.). *Learning in places. The informal education reader* (pp. 163–182). New York: Peter Lang Publishing.

Smees, R. & Thomas, S. (1998). Valuing pupils' views about school. *British Journal of curriculum & Assessment*, 8(3), 8–11.

Smith, A. & Parr, M. (2007). Young people's views on the nature and purposes of physical education: a sociological analysis. *Sport, Education & Society*, 12(1), 37–58.

Strauss, A. & Corbin, J. (1998). *Basics of qualitative research*. California: Sage Publications.

Strauss, A. & Corbin, J. (1994). Grounded theory methodology. An Overview. In N. Denzin & Y. Lincoln (Eds.) *Handbook of qualitative research* (pp. 273–285). London: Sage.

Strauss, A. & Corbin, J. (1990). *Basics of qualitative research: Grounded theory procedures and techniques*. Newbury Park; CA: Sage.

Säljö, R. (2005). *Lärande i praktiken: ett sociokulturellt perspektiv*. Stockholm: Norstedts Akademiska Förlag.

Säljö, R. (2004). Learning and technologies, people and tools in co-ordinated activities. *International Journal of Educational Research*, 41, 489–494.

Säljö, R. (2004). From learning lessons to living knowledge. Instructional discourse and life experiences of youth in complex society. In A-N. Perret-Clermont, C. Pontecorvo, L. Resnick, T. Zittoun, & B. Burge (Eds.) *Joining Society. Social inter-*

action and learning in adolescence and youth (pp.177–191). Cambridge: Cambridge University Press.

Säljö, R. (1999). Learning as the use of tools: a sociocultural perspective on the human-technology link. In K. Littleton & P. Light. (Eds.) *Learning with computers. Analysing productive interaction* (pp. 144–161). London: Routledge.

Thomas, S., Smees, R., MacBeath, J., Robertson, P & Boyd, B. (2000). Valuing Pupils' Views in Scottish Schools. *Educational Research and Evaluation*, 6(4), 281–316.

Verkuyten, M. & Thijs, J. (2002). School satisfaction of elementary school children: The role of performance, peer relations, ethnicity and gender. *Social Indications Research*, 59, 203–228.

Vitikka, E. (2008). The Finnish Curriculum Model of Basic Education – The Form of Content and Pedagogy in Curriculum Design. Paper presented at the Annual meeting of the American Educational Research Association, New York City, March 24–28, 2008.

Vygotsky, L. S. (1978). *Mind in society*. Cambridge: Harvard University Press.

Vygotsky, L.S. (1986). *Thought and language*. Cambridge: MIT Press.

Välijärvi, J. & Sahlberg, P. (2008). Should 'failing' students repeat a grade? Retrospective response from Finland. *Journal of Educational Change*, 9(4), 385–389.

Waring, M., Warburton, P. & Coy, M. (2007). Observation of Children's physical activity levels in primary school: Is the school an ideal setting for meeting government activity targets? *European Physical Education Review*, 13(1), 25–40.

Wells, G. (2002). Inquiry as an Orientation for Learning, Teaching and Teacher education. In G. Wells & G. Claxton (Eds.) *Learning for life in 21st century. Sociocultural perspectives on the future of education* (pp.197–210). Cambridge, MA: Blackwell.

Wells, G. (1999). *Dialogic inquiry: Towards a sociocultural practice and theory of education*. Cambridge: Cambridge University Press.

Wells, G. & Claxton, G. (2002). Introduction. In G. Wells & G. Claxton (Eds.) *Learning for life in 21st century. Sociocultural perspectives on the future of education* (pp.1–17). Cambridge, MA: Blackwell.

Wenger, E. (1998). *Communities of practice: Learning, meaning and identity*. Cambridge, United Kindom: Cambridge University Press.

Wertsch, J. (1991). *Voices of mind*. Cambridge: Cambridge University Press.

Woods, P. (2002). Teaching and learning in the new millennium. In C. Sugrue & D. Day. (Eds.) *Developing teachers and teaching practice: international research perspectives*. London and New York: Routledge Falmer.

Space Treasure Outdoor Game in the Playful Learning Environment: Experiences and Assessment

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This paper examines the Space Treasure outdoor game as part of the innovative Playful Learning Environment (PLE). The Space Treasure game was designed for educational contexts with an aim to increase children's physical activity and to enable learning through play in an informal setting. The game concept was planned for one playground device, the *wave platform* within the PLE. The basic idea of the game is to move on the platform by making mathematical calculations in the imaginative frame of a space theme. The aim of the study was to test the game in its natural context – within the PLE in a school yard – and to evaluate it through the socio-cultural framework and through the concepts of playability, enjoyability, usability, and learnability. Thus, the theoretical background of the study involves a transdisciplinary approach to examine a novel game concept designed for schoolchildren. Children (N = 18), aged 10 to 12 years took part in the tests by playing the game in groups of 3 to 4 children. The technological properties were tested only through simulations. The playing was videotaped and the children were interviewed after the playing. The results reveal that children by and large enjoyed the game and gave creative suggestions for making variations of it. According to the results also social collaboration seemed to have been fruitful during game sessions. Games that promote meaningful learning are valuable because a "new generation" is emerging, demanding new teaching and learning methods. Therefore, this study is important for educators and researches as well as those who develop game and outdoor learning environment.

Keywords: Game, Playful Learning Environment (PLE), playful learning, playability, enjoyability, usability, learnability

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1 Introduction

Children are becoming skilful technology users in today's society, but their physical activities are quite limited due to desk-bound activities in schools and at computers and consoles. Meanwhile, the impact of the outdoor learning environment on children's play has received increased attention (Barbour, 1999; Clements, 2004; Lindstrand, 2005). However, outdoor play is a minimized aspect in education, and even more so in the context of learning through play in particular (Lindstrand, 2005). This paper reports the outcomes of a study focusing on the innovative outdoor learning environment intertwined with learning through play and game. This setting was made possible by the Let's Play project[1] (2003–2006), in which we had an opportunity to take part in planning and designing a novel playground with technological tools and *playful learning* activities. We had a chance to develop, for instance, digital games and curriculum-based contents for the playground that we designated as the Playful Learning Environment (PLE) (e.g. Hyvönen et al., 2006; Hyvönen & Kangas, to appear). The PLE was designed for use in the school environment, and unlike desk-bound activities it affords various bodily activities in playing and learning.

The aim of this study was to investigate the use of the playful learning environment in curriculum-based education. In particular, the objective was to examine a game concept on the playground by testing it with schoolchildren and by assessing it from the following perspectives: playability, enjoyability, usability and learnability. These perspectives derive from Caillois' (2001) game definitions, Csikszentmihalyi's (1990; 2005; 2006) conception of the flow experience and a practical outlook on usability in the playground context. In addition, the game is evaluated through the socio-cultural views of learning (Vygotsky, 1978, Mercer, 2002, Säljö, 2005, Wells & Claxton, 2002).

2 Research Context and Game Concept

The Playful Learning Environment (PLE) is a new type of learning environment in that it combines outdoor playground equipment and technological tools, thus formulating an innovative setting for playing and learning (Hyvönen et al. 2006; Kangas et al. 2006). Consequently, the goal of the PLE in the school setting is 1) to offer possibilities for children to learn curriculum-based topics by playing on the outdoor playground, 2) to provide more opportunities to use physical and bodily activities during the school day, and 3) to make it possible for children and teachers to create their own (curriculum-based) games and contents for the playground and its game applications via classroom computers. The pilot PLEs were realized in the city of Rovaniemi, Finland. The basic playground elements include solutions of identification technology (RFID, Radio Frequency Identification Device): the main computer ("iStation" Central Unit), identifiers (tags look like key rings), iPost info poles (on the playground), and game development tools. All users carry identification tags in order to interact with the iPost info poles and the iStation on the playground (see http://www.smartus.fi). The players get instructions and information on the basic game applications via the computer screen. This study focuses on the testing of a game concept designed *for one of the PLE playground devices*.

The Space Treasure game concept and theoretical game design model were designed by Suvi Latva (2005). The game concept was designed for the wave platform (Figure 1.), which consists of wobbling steps to walk on. The game provides *physical activity*, *mathematical reasoning and practice*, and *treasure hunting* in the imaginative *frame of a space theme*. Basic mathematical calculations, such as multiplication and division, are included in the game concept.

Figure 1. The play equipment "Wave platform" for the game concept

The play equipment for which the game was created represents space and includes various types of challenges and incidents. Two to four children can play the game at once. There are four starting planets, one in each corner of the play equipment. The player who finds the hidden space treasure and brings it back safely to a home planet is the winner. On the voyage the players must beware of bandits; behind any step a bandit may appear and seize the sought treasure. Also, the treasure holder may be threatened by the other players during the game. For example, the following incidents may be lurking under any step:

- *Space treasure*, which is meant to be found and taken safely to a home planet.
- *Space bandits*, who can steal the space treasure. In this case the treasure is hidden again under any step.
- *Diplomatic immunity passport*, which can be beneficial, for example, when space bandits attack or other players try to seize the space treasure. The passport can be used only once.

Before the game, the players choose the planets of the solar system that the corners represent. The player may start from any corner; in this example the player starts from corner no. three. From there, the player may move to another step as long as its number can be used to multiply or divide the number from which the player left. According to the multiplication option, when the player is first standing on step 3 and moves to step 2, he or she must move to step six (3 x 2 = 6). Under this step, one of the already mentioned "incidents" will then emerge. If step 6 contains, for example, a "space treasure", the player's task is to try to take the treasure safely to the home planet. If the holder of the treasure has diplomatic immunity no-one can steal the treasure – even if they stood on the same step. The winner of the game is the one who manages to take the treasure safely to the home planet.

3 Theoretical Background

3.1 Playful Learning in an Informal Setting

In recent years, with the rapid development of novel learning environments enabled by digital technologies and digital games, a number of new concepts and theories have been built up in the field of learning. However, there is no game-related research on technology-enhanced playgrounds or playground equipment. In our educational studies we have concluded to use *playfulness* (cf. Liebermann, 1977) as a conceptual tool for evaluating the PLE and its activities (Hyvönen et al., 2006; Hyvönen & Kangas, 2006). According to Egan (2005) playfulness in learning processes may help to think about the world in a way freed from the constraints releasing the mind to reflect back on the world. Sutton-Smith (2001) classifies play according to the ways in which *persons develop within play*. The highest level of development is represented by playful forms of play. These forms of play are typically demonstrated by the variety and complexity of *playful transformations* during the game. PLE in school context provides exciting circumstances for *playful learning* that is mainly seen as a means for children to learn according to the curriculum in an informal setting.

According to Säljö (2005), it is not necessary to question whether children are learning while playing: instead, we should ask *what* they learn in playing situations. We highlight the socio-cultural approach (Vygotsky, 1978; Wells & Claxton, 2002; Säljö, 2005), which emphasises various cultural tools when acting and learning. The PLE comprises cultural artefacts (outdoor playground equipment, technological tools, and computer software), social networks, and mediated activity when children play and learn together. Thus, playful learning in the PLE is grounded on physical, social, emotional, cognitive, and cultural aspects and goals.

When using the PLE or the Space Treasure game in a school setting, the purpose is to combine the topic, play, and learning activities into a single entity. This is possible by integrating the topic or classroom activities seamlessly with playground activities. We have concluded in our studies that *playful learning processes* (PLPs) should consist of three phases: (1) *orientation*, (2) *playing*, and (3) *elaboration* (Hyvönen et al., 2006; Hyvönen, [Submitted]; Kangas et al., 2006). This was also applied in this study: first, the rules and plot of the game were introduced to the children (orientation), then the children played the game (playing), and at the end the researchers asked the children to state their experiences and reveal their new ideas (elaboration).

In this study we examine the game concept from a transdisciplinary perspective and from the viewpoint of diverse disciplines and theories. Therefore, the theoretical background is also based on four distinctive perspectives that have been proven critical in the design of PLEs as technology-enhanced and game-based learning environments. The following concepts were included: *playability, enjoyability*, *usability* and *learnability*.

3.2 Playability

Roger Caillois' (2001) definitions of play apply well to the examination of the Space Treasure game in the PLE setting. He has divided games roughly into four groups according to the types of player experiences. In accordance with the term *playability*, as used in this study, a game should afford experiences in all of the following four groups: 1) *Agon*, denoting games in which the central aspect is competition, 2) *alea*, which denotes chance- and luck-based games, 3) *mimicry*, denoting games based on imitation and simulation, and 4) *ilnix*, which stands for vertigo- and physical achievement-based games. Caillois also differentiates games with respect to their rules: there are games of free play (paidia) and rule-based games (ludus). His game definitions fit well with a physical, activity-based playground equipped with game applications.

When Caillois' game definitions are examined from Csikszentmihalyi's (1990; 2005; 2006) perspective of optimal *flow-experience*, it can be concluded that games offer the possibility to attain more than the usual play experiences *in four different ways*. For instance, in games belonging to the agon group the participants must stretch their skills in meeting the challenges that arise from their opponent's skills. In this case the individuals attempt to be more than they are in reality. This can be perceived as a clear connection with Vygotsky's (1978) notion of the Zone of Proximal Development (ZPD). He has defined the ZPD as the distance between current levels of comprehension and levels that can be achieved in collaboration with other people or powerful artefacts. Although flow does not necessarily require social interaction, its attainment forces the individual to higher performance levels and thus leads to self growth.

3.3 Enjoyability

The psychological significance of the flow-experience is based on the fact that it *brings enjoyment to the individual*. In order for playing to bring enjoyment, motivation must arise in the players themselves (Csikszentmihalyi, 1990). The game should offer sufficient challenges because supporting the flow experience to lead to states of enjoyment educational games should stretch a player's mind to its limits in his effort to overcome worthwhile challenges (Kiili & Lainema, 2006). When a player's interest is directed toward a type of activity which he or she is not yet able to perform, it can spark the flow state and at the same time be a sign of the activation of the ZPD. According to Csikszentmihalyi (2005; 2006), it is not significant what the actual challenges of a situation are. Rather, the important challenges are the ones the individual is *aware* of and believes can be attained. Thus, the realization of the flow state necessitates a balance between skills and the task at hand. It is therefore unnecessary to seek out increasingly challenging tasks in order to motivate learning and development. However, play could be seen not only as a source of pleasure but also as a bonus: it reduces stress and enhances children's motivation to learn (Sutton-Smith, 2001).

3.4 Usability – Challenges in Playground Settings

Usability within the outdoor playground context is quite an unfamiliar theme in scientific research so far. Generally, the user interface can be seen as a link service or application between the child or teacher and the system (Lankoski et al., 2002). It can be a computer keyboard and a mouse or a new piece of playground control equipment built for a playground concept. The traditional user interfaces of digital games, such as the keyboard, mouse and 'joystick', have recently been complemented by so-called *bodily user interfaces*. In this study, bodily user interfaces are defined as broad-bodied, moving and controlling user interfaces (Kuivakari et al., 1999). The technological tools realized in the PLE are based on RFID readers, which send feedback to the "iStation" on the playground. Also in this case the feedback channel is the iStations' computer screen. The existing RFID technology doesn't cover the play equipment designed for the Space Treasure game concept. Therefore, this paper presents *the testing results with a simple version of the game.*

A feasible user interface for the playground should differ radically from traditional, joystick-type digital game user interfaces, because it should be able to serve specifically children's activeness and sport activities. From the start, the SmartUs team[ii] has considered different solutions, amongst others touch-, weight- and tensile-based user interfaces, which are easy to integrate into several types of devices. We have done this because e.g. jumping and climbing are very typical forms of activity in the playground environment. For example changing symbols, lights, sounds, letters, and numbers are possible choices for the playground equipment. Usability tests have played a significant role in our effort to improve the usability of the PLE. Consequently, the results of this study are important in this respect. It also describes the ideal usability settings for the game concept at a hypothetical level.

3.5 Learnability

We refer to the term *learnability* in two ways: *how easy it is to adapt to the system and the games* and *how it promotes learning*. According to Laakkonen and Isomäki (2005), learnability is divided into three dimensions that measure learnability and define its objectives and properties. In our case, measuring (time, errors and rating) is not important; instead, it is necessary to know whether the idea of the game is understood. Regarding the properties of learnability, intuitiveness and overall learnability, it is important to consider when the game concept should be tested and implemented. User experiences are salient in the adoption of a system (Laakkonen & Isomäki, 2005); it is important to know what meanings the system provides for users. How do they adopt *the plot and the rules* of the system (the game)? And how do they adopt *physical activity* as an essential function in the game? In line with Laakkonen and Isomäki (2005), we emphasize *user satisfaction* and evaluate it against modern learning theories.

4 Aims and Research Questions

The aim of our study was to investigate the use of the Playful Learning Environment (PLE) in curriculum-based education. More precisely, the objective was to examine the Space Treasure game concept by testing the game with schoolchildren on the wave platform, for which the game concept was designed. We also assessed the concept from the following perspectives: playability, enjoyability, usability and learnability. The research questions are:

1) How does the Space Treasure game concept meet the challenges of playability, enjoyability, usability and learnability?
2) How do the children experience playing the Space Treasure game?

5 Methods

The study builds on *Design-based research* (Barab & Squire, 2004; The Design-Based Research Collective, 2003). It focuses on the *designed innovation* (the game concept) and its use within a naturalistic school setting. According to the Design-Based Research Collective's (2003) arguments, design-based research in education affords the following: 1) exploring the possibilities of creating novel learning and teaching environments, 2) developing contextually-based theories of learning and instruction, 3) advancing and consolidating design knowledge, and 4) increasing our capacity of educational innovation.

In addition, design-based research goes beyond merely designing and testing a particular intervention that embodies specific theoretical claims about teaching and learning, and reflects a commitment to understand the relationship between theory, the designed artefact, and practise (The Design-Based Research collective, 2003). Consequently, the study intends to produce new design principles, theories, and practices for PLE contexts by revealing the children's experiences of the game and by evaluating the game concept. The initial design focused on developing a game concept and game design model for playground settings (Latva, 2005). This was followed by cycles of redesign, implementation, and proto tests by the cross-disciplinary SmartUs team[ii]. After that, the game application was implemented and tested at Kauko Primary School in Rovaniemi, Finland, and the first research data was gathered. The study was conducted as follows: Children (N = 18) from the fifth and sixth grades (aged 10 to 12) played the game in groups of three or four. Ten boys and eight girls participated in the study. Most of them played the game several times.

The rules and the plot were explained to the children before the game was started. In addition, the children had a possibility to observe other children's play and to adopt the rules of the game also in this way. Because technological appliances were not available, *the researchers simulated technology* by shouting for instance "space-treasure" or "space-bandit" when a child landed on a step where the treasure or bandit would hide according to the pre-drawn plot. The children were able to see only numbers (2 to 12), which we attached on the 25 steps. They could move into all directions by using the available numbers for *multiplying* and *dividing*, and they were asked to verbalize the mathematical operations they made and allowed to suggest further rules to the game. The edges of the wave platform simulated the "home planet" of each player and were the starting points of the game. The aim was to avoid bandits, find the treasure, and bring it to the home planet. The researchers tutored and advised the children during their play. The data collection was carried out in February 2006.

The data was collected by observing and videotaping all the game implementations and by interviewing the children briefly after playing. They were asked to describe their emotional experiences and thoughts regarding the challenges, learning, and plot. The interviews as well as the video material of the game processes were recorded and transcribed. The focus of the

observations was on playability, usability, enjoyability, and learnability. The video material was analyzed through a content analysis that revealed two dimensions: one is related to the environment and the game, and the other to the children's skills that they practiced during playing.

6 Results: Experiences and Assessment of the Game Concept

In this chapter we consider the game concept and the results of the study through the socio-cultural framework and through four categories: 1) *playability*, 2) *enjoyability*, 3) *usability*, and 4) *learnability*. The categories are somewhat overlapping because the concepts relate strongly to one another.

6.1 Playability

Applying the Space Treasure game to the playing equipment involved all of the four game forms: *agon, alea, mimicry*, and *ilnix* (see Caillois, 2001). Of these, agon and alea were more dominant. ***Agon*** refers to competition and was manifest between the players; who would succeed in taking the treasure to a planet first. The study revealed that the children played, solved mathematical calculations, and made game strategies **by assisting and supporting each other**. Although the goal was to compete to find the treasure, they often seemed to collaborate to find it. In fact, the experiences of the game supported *the core idea of competition*. In other words, the word "compete" has its roots in the Latin words *con petire*, which mean "search together". Every player searches for the realization of their own potential, and this task is made easier if the players force each other to do their best. (Csikszentmihalyi, 2005; 2006.)

The following extract (1.) is a good example of the children's **collaboration** during the game. It was Matti's turn to make a calculation and move on the playground. Although one of the boys tried to trick Matti, the other children gave him advice. Moreover, although the calculations were quite easy for most of the children, creating an appropriate game strategy and making the right moves on the platform provided them enough challenges.

Extract 1. Noora, Kalle, Matti and Niko play the game

(It is Matti's turn to make a move.)

Noora:	Make it this way: two times three and jump there!
Kalle:	Wait a minute…
Niko:	Two times two is fourteen!
Noora:	Let me say,…jump to "two", and then, from here to "three"
Matti:	Wait! Two times three is…
The others:	Six!
Matti:	Six (jumps to the home planet)
Niko:	Right, Matti, two times three is six

Alea refers to *chance* and *luck* (Caillois, 2001). In this game chance and luck existed "beneath" the steps. The data shows that *alea* as a phenomenon seemed to improve the playability of the game: although treasure seeking was occasionally hard, it was the basic activity of the game. The children felt joy when they found the treasure and when they tried to prevent the others from finding it, or when they tried to avoid the space bandits. This made the game more exciting: You never knew where the treasure was and you never knew the intentions of the others. A clear strength of the game is that it is not founded on elaborate mathematical calculations – it is based on chance, as well. Thus, it provides low-achieving students an opportunity to practice their basic mathematical reasoning, and with the element of chance they can also be successful players.

Mimicry refers to *imitation* and *simulation*. In this study, it appeared in so far as the children put their souls into the plot and imagined themselves in space. The children were in an imaginary game world from time to time, although the testing procedure and the plot were very simplified compared to the original game concept. The observations and video analysis revealed that mimicry did not play a huge role in the children's activities during the game tests. For instance, the words the children created during the game built only on the key incidents: *the treasure*, *the bandit*, and *the home planet*. The space theme did not emerge in any other way. The children also wished for more props, such as lights and sounds, to the surroundings to experience more space-like feelings. According to Bodrova and Leong (2001), children need only minimal props for role-play. However, no props at all were provided in the test situation. Nothing but imagination was used to create space surroundings around the wave platform, and yet the children reported in the interviews that the plot was convenient and interesting.

Finally, *the motorically demanding wave platform* can be related to ***ilnix***, because the steps float and encourage stepping on and moving around. Floating steps require body balance skills. Particularly from the perspective of motor coordination, this is one of the most important qualities of the game; therefore, a game based on the wave platform provides opportunities for physical development. It's generally argued that coarse motor skill development can be seen as a base for the development of fine motor skills, and also for children's broader social and cognitive development (e.g. Rintala et al., 2005). During the study the children moved and jumped about actively throughout the entire play session. It was also possible to enhance the movement of the play equipment by waving a pole in the middle.

6.2 Enjoyability

The study showed that the children experienced the play equipment as more pleasant and interesting after it had been added to the narrative game plot. When they played the game they often tried to keep up the game by creating game strategies and calculations in collaboration with each other. These findings suggest that they tried to maintain the enjoyability of the game. According to Csikszentmihalyi (2005; 2006), enjoyability is realized in the optimal *flow experience* and in situations where an activity *contains rules*, *necessitates the learning of skills*, is *goal orientated*, offers *feedback*, and gives *an opportunity to control* the situation. The central purpose of flow experiences is to bring about enjoyment and experiments of joy. The game application offered feedback at various levels: a) initiative feedback on the target step (adults' guiding reaction; shouting), b) researchers' tutoring during the game and c) peer control relating to the steps and calculations. The players were willing to play the game again and again, and to challenge each other to hunt the treasure. Extract 2 shows the players' **willingness to create a common strategy** in order to prevent other players from winning and to prolong the joy of playing.

Extract 2. Noora, Kalle, Matti and Niko play the game

Niko: Matti, step two times two; it makes four (ponders the route at the same time)
Matti: Two times two is four (steps on the play equipment)
Niko: You should have stepped there (points at step 4)
Noora: You can't change the route anymore.
Kalle: What number do you have there?
Noora: Two.
Niko: Two times two is four (proceeds on the steps)
Kalle: You need step two there!
Noora: We have to block all steps number four!
Kalle: Yes, we do! Then he can't go there. (means Matti who is almost the winner)

During the tests the children were allowed to make propositions concerning the rules. They also suggested and tested several new ideas. According to Csiksezentmihalyi (1990), the experience of enjoyment relates to action particularly when children themselves are allowed to give input when a game is being constructed.

6.3 Usability and Learnability

Because moving along the steps is the basic function of the play equipment, it supports a user interface placed inside the steps. In this case, the platform provides intuitive information about its use (cf. Laakkonen & Isomäki, 2005). In this study the researcher simulated the technology by shouting the name of the incident when a child stepped on a tile. The results of the study show that this simulation didn't disturb the children while playing the game. Instead, it functioned well as feedback in the test situations. The cardboard numbers on the steps are a possible numbering solution, and none of the children mentioned this "man-made" digital technology as a problem. Based on these results we can say that the human adaptation to technology provided an adequate task match with regard to user control and informative feedback (cf. Laakkonen & Isomäki, 2005). In addition, the children understood the plot and rules of the game easily and asked detailed questions about the rules. This indicates that the *children adopted the innovation without difficulty* and were able to understand the "meaning" of the activity. The findings are promising even though it was not possible to test a real-life application of the game concept.

6.4 Views of Learning

From the educational perspective the results led to a significant finding: the game offered *a meaningful way to practice basic arithmetic skills in an informal setting*. Therefore, the power of the game also lies in the opportunities it offers to practice multiplication and division. We had chosen small numbers for the game tests, which is why the calculations were not challenging enough for most of the children. This was the clearest impediment of the tested game version. The children reported "too easy calculations" although they had sometimes difficulties in forming the calculations the right way. Consequently, it was no surprise that the children suggested varied calculation methods (addition, subtraction, multiplication, and division) and higher numbers for the next version of the game. Problems emerged especially when the children used divisions; perhaps for this reason they avoided divisions when moving on the platform. It was difficult to think what the order was and to remember that the step on which the player was standing began the calculation. Nevertheless, they enjoyed playing the game and felt they learned while playing. They reported to have learned *motor skills*, *mathematical reasoning*, and *logical thinking* in constructing the game strategies.

Because neither the play equipment nor the game application itself checks the received results, it forces the players to collaborate when solving problems. This became evident during the games. Every player had the opportunity and was challenged to solve equations created by others and to choose between different routes. Enabling social control also gave each player the possibility to speak out loud about the constructed equations. Sharing one another's mathematical reasoning through verbalized thinking appears to develop children's *metacognitive skills* (Flavell, 1976), i.e. the skills to control, monitor, and assess one's own activities. In addition, collaborative problem solving offers the possibility to acknowledge one's own and other people's decision-making and mathematical processes. These kinds of learning activities also provide potential for *socially mediated metacognition* (Goos et al., 2002). The next extract (3.) shows how **the players control, reflect on, and support one another's calculations**. An adult also participated in the discussion.

Extract 3. Matti, Noora and an adult

Noora: The treasure may be here!
Matti: (planning his own move) Two divided by six is three.
Adult: Two divided by six is three. (repeating)
Kalle: No, it's not! Can't be!
Matti: (thinking)
Adult: The other way around. Look, if you divide two by six…
Matti: Three divided by two is three (losing his thought)
Noora: No! (shows a route to Matti)
Matti: (finally finds the appropriate route, 6:2=3)

From the socio-cultural viewpoint, this kind of interaction during a game affords children to use language as a tool for thinking. It is argued that shared activity gives rise to *intermental understanding* and then leads to individual (*intramental*) knowledge and skill (Vygotsky, 1978; Mercer, 2002). Interaction within children's ZPD involves exposing them to more complex mental and physical activity than they can master on their own. Intramental knowledge in the game does not necessarily need to relate to mathematical operations only. Rather, it should relate to the plot of the game, the rules, the movements, the interaction skills, etc. From the perspective of learning, the strength of the game can be seen especially in its digital future versions: the game can accommodate students of different ages and skills. Moving from multiplication and division to more complex tasks adds to the challenge of the game and also enables learning processes in which the players can take active and reflective roles and thus develop their own understanding (cf. Wells, 2002).

7 Conclusions and Implications

In this article we have described the Space Treasure game concept as a part of the Playful Learning Environment. The goal of our study was to find ways to increase physical activity in the form of games in the school context. The study demonstrates that the outdoor PLE can be used successfully for that purpose. The study shows that outdoor game as a part of the PLE can be well applied to curriculum-based education employing the phases of orientation, playing, and elaboration (Hyvönen et al., 2006; Kangas et al., 2006; Hyvönen, accepted). The major outcomes and implications of the testing are illustrated in figure 1.

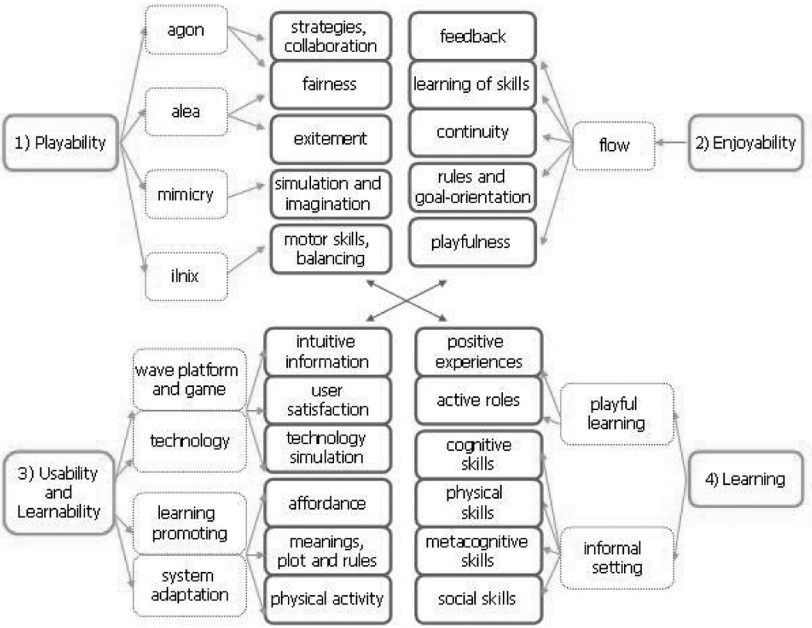

Figure 1. The outcomes and implications

(1) Playability is assessed from the viewpoints of Callois' (2001) definitions *agon*, *alea*, *mimicry,* and *ilnix* and the correlations found through testing. The play strategies, which were usually made collaboratively, correlate with *agon*. The children's aim was not primarily to win the game, but to carry on the play as long as possible; this manifests the features of mature play (Bodrova & Leong, 2003). Although the idea was to win the game by finding the treasure and by bringing it to a home planet, the process itself seemed to be more important: to play *collaboratively* and to prolong the *excitement* provided by playing. Hence, excitement refers to *alea*. In addition, the game was not based on mathematical operations only; it was based on chance as well. Thus, the game treats *fairly* players of different developmental levels.

The context of the game related to *mimicry*. It was *a simulation* of the space environment created through children's *imagination*. However, mimicry and fantasy could have been supported more. One option is to use appropriate technological solutions that provide a suitable atmosphere for imaginary game worlds and enhance the audiovisual properties of playing processes. One interesting option is to use StoryMat-type technology that "listens" to children (Cassell & Ryokai, 2001). During the game, children would make imaginary sounds relating to space and the Solar System, and tell brief narratives about the ongoing space adventure. In doing so the meaning of the moves from one step to another would be connected to the plot of the story.

During the tests the children used and practiced their *balancing* and *motor skills* that recount to *ilnix*. Body control and motor development relates closely to the common concern that there are not enough physical activities available to children during school days and leisure time. There is a great deal of games available, but only few of them are designed for outdoor use and provide physical activity. Alongside with the PLE and Space Treasure, the Camelot outdoor game (Verhaegh, et al., 2006) and Playware – intelligent and tangible play environment (Lund & Carsten, 2005) are examples of games that encourage children to physical activity.

(2) Enjoyability is examined in the light of Csikszentmihalyi's (1990) flow experience. Although the flow experience was not measured in detail and not necessarily even present in the testing, it was apparent that the children felt some sort of enjoyment. The *learning of new skills*, *goal-orientation*, *continuity*, *feedback*, *rules*, and *a possibility to create strategies* provided satisfaction and made the playing challenging enough. Hence, in spite of the easy numbering on the steps, the children found it challenging to create game strategies and to move around by dividing, for instance. The game caused enjoyment that is also typically related to *playfulness*: It generated clear goals, close attention, loss of self-consciousness, intrinsic motivation, and the belief that an experience is worthwhile for its own sake (Csikszentmihalyi, 1994; 2006). It is also noteworthy that bad playability could be seen decreasing the likelihood of the flow experience because the player has to sacrifice attention and other cognitive resources to the inappropriate activity (Kiili & Lainema, 2006). From this viewpoint, the Space Treasure game tests were promising because the children adopted the game quickly and focused on the calculations and hunting the space treasure.

(3) Usability was considered from two angles: we studied the usability of the wave platform and the game, and the usability of the technology. Learnability had also two dimensions: how the system is adopted and how it promotes learning. The Space Treasure game implemented on the wave platform was promising. The platform and the game could be used and played rather *intuitively*. *The tasks*, *the content*, and *the context matched* pretty well. The technology was merely *a simulation* of one potential technology. The simulation, however, succeeded sufficiently for test purposes. Enhancing the Space Treasure game with digital technology, along the lines of Camelot technology (Verhaegh et al., 2006), could yield opportunities to provide feedback and to make some of the game activities more challenging. On the grounds of this study, technology is an actual *affordance* for supporting learning, and quality of play. However, we need to be cautious when speaking of the affordances of new technologies and assuming that technology will automatically afford particular learning outcomes (John & Sutherland, 2005). Education is always a unique combination of technological, social, and educational contexts and affordances (Kirschner, et al. 2004).

(4) Playing and informal learning situations provided positive experiences for the children. They tutored each other and felt that they benefited from playing in the *physical* and *cognitive* areas. Test playing seemed to promote the children's *social skills* as they collaboratively negotiated the plot and the rules. Moreover, it promoted their *metacognitive skills* as well. The game experiences were consistent with the socio-cultural view of learning (e.g. Vygotsky, 1978; Wells & Claxton, 2002; Säljö, 2005): learning is a phenomenon whereby people share their experiences of their environment through various forms of communication. In all cases interaction between the players seemed to encourage collaboration and enhance the children's level of engagement (cf. Price, et al. 2003). Thus, peer interaction and collaborative activity proved to be salient in play (cf. Parr & Townsend, 2002) although the Space Treasure game had been designed to be a game in which only one player wins.

8 Discussion

Novel play and learning environments and computer-based game technologies seek to offer physically challenging and immersive play experiences (Höysniemi et al., 2005) and to create powerful and engaging learning experiences (Facerw et al., 2004). The findings of this study are interesting and provide opportunities to extend this field of research. The purpose of the PLE is to offer children more play, physical activities, and novel learning experiences in curriculum-based learning settings. The Space Treasure game can enhance learning both in formal and in informal contexts. This, however, requires proficient technological solutions modified for the wave platform and user-friendly applications with which educators and children can create games for their own purposes. In the Space Treasure game, the values on the steps should be chosen, mixed, and even combined with other numbers according to user preference. Using the classroom computer, it should also be possible to organize different adaptations of the game, to follow the playing and counting, and to evaluate the processes of play together with the children. This requires technical solutions that make the processes visible. Game creation via classroom computers is already possible in other applications of the PLE game technology, and this provides us more opportunities to study playful learning processes (PLPs) and playful learning, and to build theories on it. It is evident that the use of innovative technologies should complement children's natural play, which makes the PLE and similar innovations (e.g. Playware and Camelot) well-grounded solutions for learning by playing.

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References

Barab, S. & Squire, K. (2004). Design-based research: putting a stake in the ground. *The Journal of the Learning Sciences*, 13(1), 1–14.

Barbour, A. C. (1999). The impact of playground design on the play behaviors of children with differing levels of physical competence. *Early Childhood Research Quarterly*, Vol. 14 (1), 75–98.

Bodrova, E. & Leong, D. J. (2001). *The tools of the mind project: a case study of implementing the Vygotskian approach in American early childhood and primary classrooms*. Geneva, Switzerland: International Bureau of Education, UNESCO.

Bodrova, E. & Leong, D. J. (2003). The importance of being playful. *Educational Leadership*, 60 (7), 50–54.

Caillois, R. (2001). *Man, Play and Games*. Urbana (Ill.): University of Illinois Press.

Cassell, J. & Ryokai, K. (2001). Making space for voice: Technologies to support children's fantasy and storytelling. *Personal and Ubiquitous Computing,* 5, 169–190.

Clements, R. (2004). An investigation of the status of outdoor play. *Contemporary Issues in Early Childhood,* 5(1), 68–80.

Csikszentmihalyi, M. (1990). *Flow, psychology of optimal experience.* New York: Harper and Row.

Csikszentmihalyi, M. (1994). *The evolving self: a psychology for the third millennium*. New York: Harper Perennial.

Csikszentmihalyi, M. (2005). *Flow: Elämän virta*. Helsinki: Rasalas.

Csikszentmihalyi, M. (2006). *Flow: Den optimala upplevelsens psykologi*. Stockholm: Natur & Kultur.

Design-based Research Collective (2003). Design-based research: An emerging paradigm for educational inquiry. *Educational Researcher*, 32 (1), 5–8.

Egan, K. (2005). An imaginative approach to teaching. San Francisco: Jossey-Bass.

Facerw, K., Joine, R., Stanton, D., Reidz, J., Hullz, R. & Kirk, D. (2004). Savannah: Mobile gaming and learning? *Journal of Computer Assisted Learning*, 20, (6), 399–409.

Flavell, J. H. (1976). Metacognitive aspects of problem solving. In L. R. Resnick (Ed.) *The Nature of Intelligence*. Erlbaum: Hillsdale, 231–235.

Goos, M., Galbraith, P. & Renshaw, P. (2002). Socially mediated metacognition: Creating collaborative zones of proximal development in small group problem solving. *Educational Studies in Mathematics*, 49(2), 193–223.

Hyvönen, P. (Accepted). Teachers' expectations of playful learning environments (PLEs). Paper submitted to the NBE2007 Conference.

Hyvönen, P. & Kangas, M. From bogey mountains to funny houses: Children's desires for play environment. To appear in the *Australian Journal of Early Childhood.*

Hyvönen, P., Kangas, M., Kultima, A. & Latva, S. (2006). *Tutkimuksia leikillisistä oppimisympäristöistä*. Rovaniemi: Lapin yliopistopaino.

Höysniemi, J., Hämäläinen, P., Turkki, L. & Rouvi, T. (2005). Children's intuitive gestures in vision-based action games. *Communications of the ACM*, 48 (1), 44–50.

John, P. & Sutherland, R. (2005). Affordance, opportunity and the pedagogical implications of ICT. *Educational Review*, 57 (4), 405–413.

Kangas, M., Kultima, A. & Ruokamo, H. (2006). Co-Creative Learning Processes (CCLP) Children as game world creators to the outdoor playground contexts. In J. Multisilta & H. Haaparanta (Eds.), *Proceedings of the Workshop on Human*

Centered Technology HCT06. June 11–13, 2006, Pori, Finland. Tampere University of Technology, Pori. Publication 6, 14–21.

Kiili, K. & Lainema, T. (2006). Measuring flow experience in education games. In J. Multisilta & H. Haaparanta (Eds.), *Proceedings of the Workshop on Human Centered Technology HCT06*. June 11–13, 2006, Pori, Finland. Tampere University of Technology, Pori. Publication 6, 172–180.

Kirschner, P., Strijbos, J., Kreijns, K. & Beers, P. (2004). Designing Electronic Collaborative Learning Environments. *Educational Technology Research and Development*, 52 (3), 47–66.

Kuivakari, S., Huhtamo, E., Kangas, S. & Olsson, E. (1999). *Keholliset käyttöliittymät*. Helsinki: Tekes.

Laakkonen, M. & Isomäki, H. (2005). On the concept of learnability. In M. Ylä-Kotola, S. Inkinen & H. Isomäki (Eds.) *The integrated media machine. Aspects of future interfaces and cross-media culture*. Rovaniemi: University of Lapland, 207–232.

Lankoski, P. (2002). Elämysten suunnittelu ja paikkatietoiset palvelut. In P. Lankoski, L. Kirvesmäki (Eds.) Henkilökohtainen navigointi. Periaatteita käyttöliittymien ja käyttökokemusten suunnitteluun. Tampere: Tampere University Press, 109–120.

Latva, S. (2005). Digital games to support education in a playground context – the challenges for design. In H. Ruokamo, P. Hyvönen, M. Lehtonen & S. Tella (Eds.) *Teaching-Studying-Learning (TSL) Processes and Mobile Technologies - Multi-, Inter- and Transdisciplinary (MIT) Research Approaches*. Proceedings of the 12th International Network-Based Education (NBE) Conference. September 14–17, 2005, Rovaniemi, Finland, 133–141.

Lindstrand, P. (2005). *Playground and outdoor play. A literature review*. Stockholm Institute of Education, research report No. 43. Technology, Communication, Handicap.

Mercer, N. (2002). Developing dialogues. In G. Wells & G. Claxton (Eds.) *Learning for life in the 21st century*. Oxford: Blackwell Publishers, 141–153.

Parr, J. & Townsend, M. A. R. (2002). Environments, processes, and mechanisms in peer learning. International Journal of Educational Research, 37, 403–423.

Price, S., Rogers, Y., Scaife, M., Stanton, D. & Neale, H. (2003). Using 'tangibles' to promote novel forms of playful learning. *Interacting with Computers,* 15, 169–185.

Rintala, P., Ahonen, T., Cantell, M. & Nissinen, A. (Eds.) (2005). *Liiku ja opi*. Jyväskylä: PS-kustannus.

Sutton-Smith, B. (2001). *The ambiguity of play*. Cambridge: Harvard University Press.

Säljö, R. (2005). Lärande i praktiken: ett sociokulturellt perspektiv. Stockholm: Norstedts Akademiska Förlag.

Verhaegh, J, Soute, I, Kessels, A. & Markopoulos, P. (2006). On the design of Camelot, an outdoor game for children. *Proceeding of the 2006 conference on Interaction design and children IDC '06*. ACM Press, 9–16.

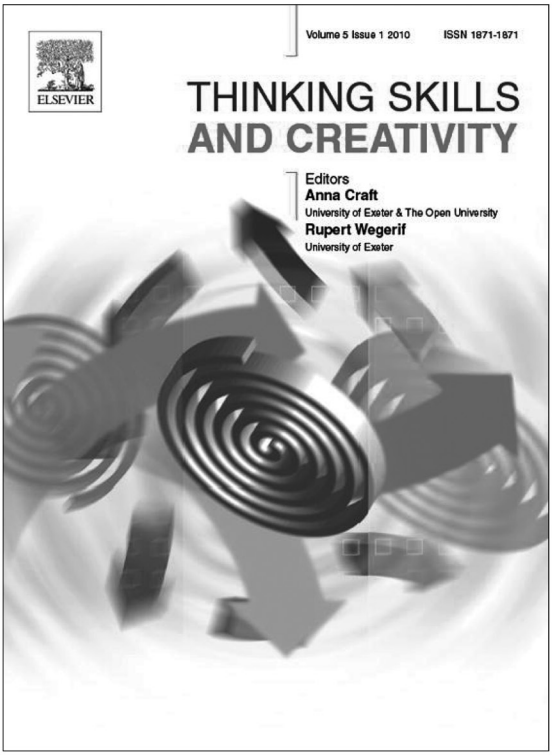
Vygotsky, L. S. (1978). *Mind in society*. Cambridge: Harvard University Press.

Wells, G. (2002). Inquiry as an orientation for learning, teaching and teacher education. In G. Wells & G. Glaxton (Eds.) *Learning for Life in the 21st Century*. Oxford: Blackwell Publishing, 197–210.

Wells, G. & Claxton, G. (2002). Introduction: Sociocultural Perspectives on the Future of education. In G. Wells & G. Glaxton (Eds.) *Learning for Life in the 21st Century*. Oxford: Blackwell Publishing, 1–17.

[i] Cooperation with the Smartus team [http://www.smartus.fi]

[ii] [http://geocitites.com/smartusteam/]



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Creative and playful learning: Learning through game co-creation and games in a playful learning environment

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ABSTRACT

This paper reports on a pilot study in which children aged 7–12 ($N = 68$) had an opportunity to study in a novel formal and informal learning setting. The learning activities were extended from the classroom to the playful learning environment (PLE), an innovative playground enriched by technological tools. Curriculum-based learning was intertwined with game co-creation, play, and computer games in the PLE. The results indicate that the children considered learning in groups, through co-creation and turning fact into fiction, to be a rewarding way to learn, practice group work and use their imagination for a common goal. Teachers felt their role was important and challenging, especially in terms of the amount of tutoring and lesson planning. The study shows that one way to foster activity, creativity, imagination, and group work skills-along with academic achievement-is to integrate fact and fiction and a playful learning environment in teaching, studying and learning.

1. Introduction

In the world of new technologies, the forms of education are changing, as are the sites on which education occurs. Some scholars argue that the school of the future should be based predominantly on innovation and interactive creativity with new technology and new ways of acting (e.g. Craft, 2005; Natriello, 2007; Sawyer, 2006a; Tuomi, 2007). This aim has been widely recognised globally in educational contexts, and it has been concluded that teaching approaches that are too formal may not match the methods that children and young people use in learning or working with media (e.g. Lemke, 2002; Sawyer, 2006a, 2006b). It also is argued that many students learn to solve specific types of problems but are unable to respond to unexpected situations, which inevitably arise in today's fast-changing world (cf. Cropley, 2004; Resnick, 2007). As Resnick (2007) and Sawyer (2006a) assert, most schools are not focusing on helping pupils develop as creative thinkers and are not teaching them how to *create* knowledge. Instead, in formal schooling, children are typically taught that knowledge is static and complete; they become experts at consuming knowledge (or media, as well) rather than producing and creating it (Sawyer, 2006a). Thus, innovative ways of using information, readiness to deal with the unexpected and flexible thought have taken on importance.

The present study contributes to the current educational debate by presenting a strategy for incorporating creativity, imagination and new technologies into education. The study offers an opportunity for children to co-create their own curriculum-based game content for play and for learning activities in a research-based and technology-enhanced playful learning environment (PLE). Many recent studies have focused on creativity in learning and concluded that classroom

Abbreviation: PLE, playful learning environment, an innovative outdoor playground enriched by technological tools, also called *Smartus*.

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discussions and participative activities can provide an ideal forum in which students may develop their creative thinking skills (Beghetto, 2007; Rojas-Drummond, Mazon, Fernandez, & Wegerif, 2006; Vass, 2007; Wegerif, 2005; Wegerif, Littleton, Dawes, Mercer, & Rowe, 2004). In keeping with this notion, and extending it, the present study explores the role of creativity and playfulness in collaborative learning using an innovative outdoor playground and its technological applications.

The playful learning environment (PLE) is a novel, pedagogically validated learning environment which combines information and communication technologies (ICTs) both in the classroom and outdoors in the playground. The PLE is also referred to as *SmartUs*, a technology-enriched playground system based in a combination of scientific research from the fields of education, physical exercise, technology and industrial design (see www.smartus.fi). The PLE forms the basis for a variety of learning experiences in local schools as well as for Internet games, which offer opportunities for learning in globally created learning environments. Children's views have been highly valued in defining the main characteristics of the environment and seeking a richer understanding of its potential in education (Hyvönen & Kangas, 2007; Hyvönen, Kangas, Kultima, & Latva, 2006; Kangas, Hyvönen, & Latva, 2007). Accordingly, the starting point for this study was to evaluate students' views and experiences of a pilot PLE and especially of the creative and playful learning processes which that setting provides for.

The PLE offers an opportunity to create one's own game content as well as ready-tailored games that aim to increase collaborative physical activity in the context of educational tasks. As a physical, educational and technologically affordable playground setting, the PLE enables children to actively take part in learning within a framework of creation, exploration, narration, imagination, collaboration and play. One of the goals of the present study has been to combine these perspectives on learning in order to create and to test *a game concept of the "Different World"* (Kultima, 2006) and to develop *a pedagogical framework of creative and playful learning* (Kangas, Kultima, & Ruokamo, 2006) that exploits the salient features of the PLE.

The present study focuses on the process of game design, knowledge co-creation and participation from the perspective of *creative and playful learning* (CPL), a theoretical and practical model that was developed as part of the research. The study embodies the first curriculum-based teaching experiment conducted in a PLE setting. The pilot learning environment was constructed in the yard of the Kauko School in northern Finland in 2006.[1] The students experienced learning content from a narrative perspective by creating a "what if" game world for the playground; they played in it and ultimately considered the differences between fact and fiction related to a topic in their syllabus. The goal of the study was to examine how students and teachers experience the PLE as a means to achieve creative and playful learning. Hence, the study recognises the importance of the educational stakeholder's views and contributions to understanding the way in which game co-creation, outdoor play, imagination and the PLE can offer settings that sustain creativity and playfulness in learning. The central question is: How does a playful learning environment foster creativity and what factors should be considered when developing pedagogies for creative and playful learning?

2. Theoretical background—creative and playful learning

According to Säljö (2005, 2006), learning may be seen as a tool-dependent and metaphorical concept and it should be specified in each theoretical framework. Creative and playful learning in the PLE setting refers to (1) learning that allows, stimulates and promotes learner creativity and knowledge co-creation, (2) learning through designing content for the PLE by using new technology, and (3) learning through a variety of playful and physical activities – hands-on and body-on – which take place in the PLE. Hence, learning is not only related to academic achievements, but also to all actions that take into account the person as a whole – body, mind and spirit – and the role of cultural tools (Säljö, 2004, 2005, 2006; Vygotsky, 1978; Wells & Claxton, 2002). The following features of learning that are based on earlier PLE-related studies (e.g. Hyvönen, 2008; Hyvönen & Juujärvi, 2005; Hyvönen & Ruokamo, 2005) are central for creative and playful learning:

- *Playfulness* refers to the learning actions and their qualities (e.g. Bodrova & Leong, 2003). It also refers to an attitude towards learning and a way of learning through play and games in the PLE settings. 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, 2006a).
- *Creativity* refers to creative knowledge building and learning creatively by using new technology and designing artefacts, games or media products (cf. Craft, 2005; Paavola, Lipponen & Hakkarainen, 2004). Creativity also refers to the use of *imagination* and *possibility thinking*; imagination is the ability to think of all things as possible (Craft, 2001; Cremin, Burnard, & Craft, 2006; Egan, 2005).
- *Narration* refers to a narrative mode of thinking and understanding as a key aspect of meaning-making (Bruner, 1996, 2002, 2003; Egan, 2005; Lyle, 2000). It follows from this that one way to make sense of experience and the world while learning is *narratives*. One strategy for stimulating and developing the imagination is 'narrative' (Egan, 1992), and thus narration is seen as part of creative learning.
- *Collaboration* emphasises knowledge co-creation and common design and play processes. Collaboration with peers encourages motivation and cognitive engagement (e.g. Blumenfeld, Kempler & Krajcik, 2006).

[1] The design and implementation of the teaching experiment was based on collaboration between Annakaisa Kultima and Marjaana Kangas, the researchers who, in addition to Pirkko Hyvönen and Suvi Latva, have worked in educational and scientific research projects that are closely linked to the development of PLEs.

- *Insight* refers to the opportunity to make discoveries and to solve problems (Hyvönen, 2008; Joubert, 2001).
- *Emotions* involve all human activity having a key role in thinking and learning (e.g. Mahn & John-Steiner, 2002; Vygotsky, 1978).
- *Embodiment* and *activity* refer to physical activities and the use of the whole body in learning processes where 'embodied knowledge' (see Hyvönen, 2008) can be achieved. The whole body is needed and used in learning activities. In the present study, the students engaged in their learning by participating in physical game-based learning in the outdoor playground and various hands-on activities when designing game worlds in the classroom.

Although the underlying rationale of the experimental design of this study was to integrate the partly overlapping above features on the theoretical level and in practice, the focus will be on the following approaches: *creative learning and knowledge co-creation, narration and possibility thinking in creative learning*. These will be discussed in more detail in what follows.

2.1. Creative learning and knowledge co-creation

During their formal schooling, children are expected to *understand* the issues at hand, that is, to be capable of seeing their application, which includes knowing how to present arguments for and against a case, being able to connect learning topics to wider contexts and observing phenomena from different angles (Ministry of Education, 2004). Increasingly, children are also expected to learn in collaboration, to negotiate with each other, to examine and elaborate different alternatives together and to construct knowledge together. From a sociocultural perspective, language is the main cultural tool for constructing knowledge (Mercer, 2000, 2002; Vygotsky, 1978), making an ability to communicate and to reason with others important for success in education (Wegerif et al., 2004). In creative collaboration, learners can become more reflective by acting as "revealing mirrors" to each other (John-Steiner, 2000). Rojas-Drummond et al. (2006) have defined knowledge as the product of the joint negotiation of the participants, who use a variety of communicative strategies to construct a shared understanding. Learning as a social process is assumed to occur first at the inter-mental level and next at the intra-mental level (Mercer, 2002; Vygotsky, 1978).

In this study, knowing and learning are viewed as a creative process (Craft, 2005; Säljö, 2004) that involves not only the individual but also the social community as a whole (Scardamalia & Bereiter, 2006; Wells & Claxton, 2002; Wenger, 1998). The concept of knowledge co-creation is thus a focal part of creative and playful learning. Learning is seen as a process of discovery in which the term "transformation" has a special meaning. As Säljö (2006) notes, it implies that learning is no longer repeating what is known, but creating something new. In this sense, learning and creativity are closely intertwined and learning is seen as taking place through creative practices. Anna Anna Craft (2005, 52) illustrates this interaction:

> 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.

The knowledge creation approach emphasises that *knowledge* is not only created via traditional learning but can emerge from the construction of *artefacts* (Paavola et al., 2004). In the present study, those artefacts take the form of a novel and appropriate collection of game and play contents that children designed for the PLE in their learning community. Playfulness can be associated with the creation of imaginary worlds through role-play and being open to playing with ideas and new possibilities (Egan, 2005; Craft, 2001). Hence, it may help children to think about and reflect on the world in a way that is free from constraints. One form which this can take is word play or humour between participants to create common ground. Playing with words and ideas assumes a context of mutual trust and support, where each participant knows that what he or she says (draws, performs, etc.) will be accepted (Wegerif, 2005). Wegerif (2005) argues that it is very hard to get children to perform any kind of task at school unless they are encouraged to be creative with language.

Viewed from these standpoints, *knowledge co-creation* entails a learning process where knowledge and understanding are not only shared but also jointly generated and socially validated. It refers to *action, dialogue and emotions* (c.f. Wells, 2002). Many similar concepts are used in research to refer to comparable understandings of the decentralisation of knowledge: learning involves activities that are shared, constructed and created in co-operation with others. These terms are, for instance, *collaborative knowledge building* (Wells, 2002) *knowledge co-construction* (John-Steiner, 2000; Wegerif, 2006; Wegerif et al., 2004) and *creative co-construction* (Craft, 2005). According to Egan (2005), imagination in learning processes is strongly tied in complex ways to learners' feelings. Thus, it can be assumed that in learning through knowledge co-creation, special roles are based not only on creativity and imagination, but also on emotions and narrative thinking.

2.1.1. Narration in creative learning

It has been argued that the use of narratives or story telling is one way to help learners make sense of experiences and the world around them (Bruner, 1996, 2002, 2003; Egan, 2005). The words *narrative*, *narration* and *narrate* share a Latin root that suggests a close connection with knowledge and skilful practice (Whyte, 1982). A narrative is *a mode of thinking*, a continuous account of a series of events or facts that shapes them into *an emotionally satisfactory whole*; it involves a sequence of events (Bruner, 1996; Egan, 2005). It follows from this that, in the process of learning, thinking needs to take on a shape in order for it to become explicit and thus easier to process (Bruner, 1996). In the present study, the children

were advised to co-create coherent narratives for their fictional play world and ready-made game templates facilitated story shaping. The starting point was for the children first to develop a coherent story-line to make the game and the play world in the playground more meaningful and to enhance their understanding of the topic. Through the narratives, the children created, constructed and validated their shared understanding of the topic as well as their common, imaginary play worlds (cf. Juujärvi, Kultima, & Ruokamo, 2005; Kangas, Kultima, & Ruokama, accepted).

Bruner (1996) points out that narrative is both *a mental structure* for organising information, thoughts and emotions into coherent entities and *a vehicle in the process of education*, particularly in science education (Bruner, 1990, 1996, 119). Bruner also observes that children are very skilful at creating narratives, especially about unusual specific events and things. In this light, narrative has a significant role in creative and playful learning and in knowledge co-creation. One way to develop narrative thinking in school teaching is to link pupils' imaginations to the material that is being learned and to stimulate children's imaginations *through fiction* (Bruner, 1996; Egan, 2005). This approach was applied in the present study.

2.1.2. Possibility thinking in creative learning

According to Craft (2000, 2001), "possibility thinking" – also involving knowledge co-creation processes – can be viewed as the core of creative learning. To facilitate understanding of new concepts or phenomena, learners should have the opportunity to develop multiple and flexible perspectives and to apply their knowledge creatively (Burleson, 2005; Joubert, 2001). The potential of *designing* in learning science is that the design task, for example, the creation of imaginary game worlds, provides a context for applying the scientific knowledge or content (Sidawi, 2007). In the present study, children were asked to *imagine a fictional world which had to deviate from the real world with respect to the science content that had been previously studied*. They had to consider the differences between factual and fictional worlds in their curriculum-based studies by testing their views of reality against possible worlds through *thought experiments* (Bokulich, 2001; Kultima, 2006). In philosophy, thought experimentation has been reported to play an essential part in testing a theory's consistency and explanatory power (Bokulich, 2001). Similarly, Jeffrey and Craft (2006) have pointed out that the construction of possible worlds is essential for creativity. For instance, if children first think about the fact that day and night are different on Earth, they might design a planet where it is day all the time. The reasons for and consequences of actions that learners put forward reflect their grasp of the phenomenon in question, providing insights into their understanding of the curricular topic (Kangas et al., 2006; Kultima, 2006). Although the basic idea of the teaching experiment was to enhance students' creative thinking, the focus was not on academic achievement, science learning or development of thinking skills as such; therefore, these were not tested either before or after the teaching experiment. Instead, the study focused on children's and teachers' *experiences* of creative and playful learning processes.

3. Aims and research questions

The goal of the study was to investigate the playful learning environment (PLE) in primary school settings and to examine how children experience creative and playful learning (CPL) processes that are based on game design and knowledge co-creation and on playing in an outdoor technology-enhanced playground. An additional aim was to consider teachers' experiences and views on CPL and to develop a model for CPL. The research questions addressed are the following:

(1) How do children and teachers regard the PLE and creative and playful learning that is based on game design, knowledge co-creation and integration of fact and fiction in PLE settings?
(2) What type of new knowledge does the teaching experiment yield for developing a pedagogical model for creative and playful learning?

4. Research setting: the playful learning environment

The pilot playful learning environment (PLE) where the present study was conducted is located at the Kauko Comprehensive School in the city of Rovaniemi, in northern Finland. The school playground was opened in March 2006. As the children and teachers at the school were the first users of this new type of learning environment, their role as designers and developers of the environment and the pedagogy was significant. The PLE provided at the school consists of different pieces of non-technological playground equipment, that is, the *exploration unit*, *stage*, *jungle gym*, *wave platform*, *stepping stones*, *drawing walls*, and *spinning mill*, and the *SmartUs* technology, comprising the *iStation*, *iGrid* and *iPosts* (see Fig. 1) and related software. During the teaching experiment the weather conditions were wintry and snowy, and therefore the outdoor playground area in the school yard was set up under cover so that all the playground equipment could be used.

The technology is located in the central console of the school yard, the *iStation,* which guides gaming with images and audio. The computer screen in the iStation is the same size as that of an ordinary desktop computer. Technology in the playground is also located in gaming posts, or *iPosts*, which provide gaming points for the play and learning environment. The technology includes Radio Frequency Identification Devices (RFID) in the iPosts that are located throughout the PLE and recognise tags on iCards, which children use as they play. RFID is also located in the *iGrid* jump mat that works together with the iStation. The *Smartus* Software, game creation tools in classroom computers and the Internet connection in the PLE form a system that gives children and teachers the opportunity to create games and play worlds for their own purposes and to implement them in the PLE. At the time of the study, the PLE consisted of a prototype version of the technological

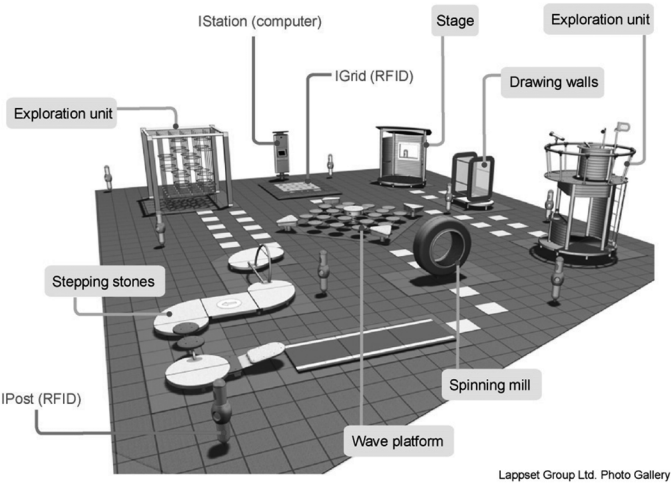


Fig. 1. A view of the *SmartUs* playground: a playful learning environment (adapted from an image provided by Lappset Group Ltd.).

applications and tools. The Internet connection and game development tools were still under development, and students could not yet create games via classroom computers. Instead, they designed their game and play worlds using templates and sheets of paper, and their ideas and plots for the narratives in the game world were transferred by the researchers[2] to the playground applications. In this regard, the experiences documented by the present study have had an essential role in PLE development, especially as regards the digital technologies, software and teaching methods that underpin the environment.

5. Method

Where methodology is concerned, this study is based on design-based research (Barab & Squire, 2004; Barab, 2006; Brown, 1992), an approach that goes beyond merely designing and testing particular teaching experiments. Design-based research is defined as "*a systematic but flexible methodology aimed to improve educational practices through iterative analysis, design, development, and implementation, based on collaboration among researchers and practitioners in real-world settings, and leading to contextually-sensitive design principles and theories*" (Wang & Hannafin, 2005, p. 7). That is, design-based research allows for the creation of new theories, artefacts and practices for PLE contexts. However, as mentioned earlier, the present "within-site" study comprises the first part of an iterative design cycle; redesigned "multi-site" studies of the educational uses of PLEs have since been implemented in another context (e.g. Kangas et al., 2007; Kangas, Randolph, & Ruokamo, 2009). Thus, the study presented in this article is best regarded as a qualitative case study focusing on the description and interpretation of the initial experiences of a game co-creation and a playful learning environment.

5.1. Participants, data collection and data analysis

A week-long teaching experiment was carried out at Kauko School in March 2006. The school is quite small and situated in a peaceful, rural area in the city of Rovaniemi, Finland, close to forests and a river. The school has a total of 68 students aged 7–12, as well as four full-time teachers, all of whom participated in the teaching experiment. Thus, each of the classes put all of its efforts for over 1 week into the project and studied according to the ideas of the Different World Game concept (Kultima, 2006) and creative and playful learning (Kangas et al., 2006). Classes in the school were divided such that third- and fourth-graders, and fifth- and sixth-graders, studied together, which meant four participating classes. For working and studying during the week, the children were assigned by the teachers to three- to six-person heterogeneous groups. The teachers were asked by the researchers to create groups that would each represent both genders as well as children with varying cognitive and social skills. These small groups of children co-created the main parts of the "what if" game worlds, which were validated afterwards at the classroom level. Hence, as a result of small-group and whole-group working, four different "what if" play scenarios – one per class – were co-created for implementation in the playground.

[2] Annakaisa Kultima and Marjaana Kangas.

Fig. 2. Views of creative and playful learning.

The data were collected using semi-structured thematic group interviews of children ($N = 38$; 15 girls, 23 boys) and the teachers ($N = 4$), participant observation in classes and the playground, and video recordings. During and after the 1-week teaching experiment, students from grades 3 and 4 and grades 5 and 6 were interviewed in pairs or in three-student groups in accordance with the interview themes: (1) experiences encountered at various learning phases, (2) experiences related to working in groups, (3) emotional involvement with the learning processes and (4) perceptions of learning outcomes. First and second graders were interviewed in informal ways as part of participant observation. Interviews were audiotaped, transcribed and analysed using *qualitative content analysis* in accordance with themes that emerged in the interviews. Content analysis involved the making of inferences about data by systematically and objectively identifying special characteristics and categories within them (Gray, 2004). These categories were derived from the model of creative and playful learning and its theoretical background.

Teachers ($N = 4$) were interviewed after the 1-week experiment by two researchers[3]: one interviewer acted as chairperson, who controlled the direction of the interview and asked semi-structured thematic questions, while the other took notes. The interviews were both audiotaped and videotaped. Design research usually collects large amounts of data, such as video recordings, in order to understand what is happening in detail (Collins, Joseph, & Bielaczyc, 2004; Confrey, 2006). Therefore, video recordings were also gathered at each of the learning phases during the teaching experiment. These data, as well as the notes from participative observation, were compared with the data obtained from interviews. Video recordings were also gathered from game co-creation sessions of the fourth class, comprising 9–10-year-old children ($N = 22$), who worked in five small groups. These data complemented the interview data encompassing children's experiences of group working and experiences of game design processes. The themes in the teacher interviews focused on the potential and challenges of applying creative and playful learning in teaching, on the role of teachers in PLE and in creative and playful learning processes, and on learning outcomes.

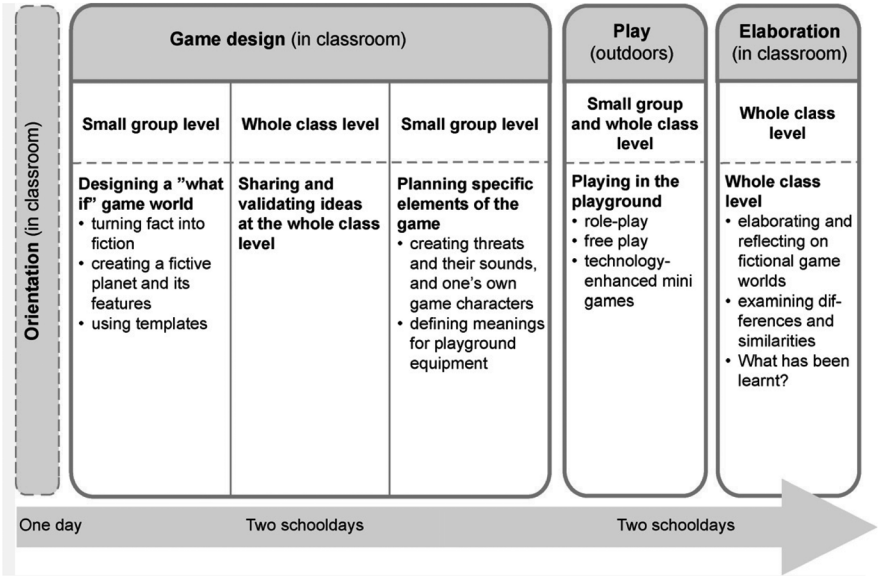
5.2. Research design

As mentioned in regard to the theoretical background, the teaching experiment followed the Different World game concept designed for the PLE and the pedagogical framework of creative and playful learning (Kultima, 2006; Kangas et al., 2006). In addition, the teachers of the Kauko School participated in planning and carrying out the experiment. The rationale for conducting the experiment at the Kauko School was based on previous collaboration during the PLE development and on the fact that the PLE was not yet in use at any other primary school in Finland or other countries. The teachers were motivated to implement the new outdoor learning environment in their school. They had also participated in the development of the PLE and so were able to offer their views on pedagogical issues in multidisciplinary research teams. However, the ideas underlying the Different World concept were new for them. Therefore, at the beginning of the implementation, the teachers were introduced to the rationale underlying the teaching experiment and the theoretical framework behind it. It was explained that even though the practical goal was to test the PLE in curriculum-based learning, the purpose of the experiment was to consider the differences between factual and the fictional worlds and in that way to deepen the children's understanding of certain curriculum-based topics. The practical pedagogical arrangements were planned in collaboration with the teachers, which is the ideal in design-based research: the design needs to be thought of as an integrated system, and the evaluation of the design is an ongoing process that changes as the design changes (Barab, 2006; Brown & Campione, 1996; Collins et al., 2004). The teachers modified the curriculum to fit the different ages of children and in so doing transformed it to some extent. The learning phases in the PLE are shown in Fig. 2.

The curriculum-based topics related to science, examples being space, the Solar System, and the concept of time. The learning methods used varied between classroom activities and playground activities and were divided into four phases: (1) studying the topics in diverse ways in the classroom (orientation phase), (2) planning a "what if" play world by turning fact into fiction (planning phase), (3) playing a common class game in the playground (play phase), and (4) reflecting on and evaluating both factual and fictional issues in the classroom (elaboration phase). The implementation of the phases varied slightly with grade in accordance with the children's ages and developmental stages. The teachers and researchers

[3] Annakaisa Kultima and Marjaana Kangas.

Table 1
Research design.



worked as co-ordinators, supporters, and guides during the processes of learning and co-creation. The aim was that the teachers would not give children ideas but would facilitate group thinking by asking about key points and posing questions. In the playground, the researcher's role was emphasised because of insufficient recourse to the technology at that time. For instance, the researchers simulated some parts of the games and guided the children in their play worlds. The process as a whole is summarised in Table 1:

5.2.1. Orientation

For the purposes of the intervention – to nurture children's imagination and creativity – it was important to ensure that all of the children would gain basic knowledge about the topic and would have access to essential information. In addition to listening to short lectures by the teachers, the children acquainted themselves with the themes by watching space videos and by studying space through books and the Internet. They also created topic-related art, consisting of drawings, representative art, and crafts dealing with space, the planets and the Solar System. Thus, in the orientation phase, children used a variety of information sources and tools for learning and they negotiated and discussed the issues at the small-group and classroom levels. The purpose of the orientation was to motivate and stimulate learners and to provide them with an opportunity to become acquainted with the relevant factual content of the topic. Moreover, forthcoming learning activities were framed in terms of questions such as, What are the purpose and the goals of the process and what phases are involved in the process? It was important to explain to the children at the outset how and why they were to continue with the theme in the PLE and in the classroom after their playground activities. These were significant issues in developing the children's abilities to reflect on their own learning.

5.2.2. Planning and play world design

Next, the children were asked to imagine a fictional world which would deviate from the real world with respect to the details that had been studied in the fact-based orientation phase. Prior to this, the teachers had composed a letter from an imaginary outsider, named Zed, who lived on another planet. The teachers collaboratively created a story for the play world setting; they composed a letter from Zed and decided to start the game planning phase by reading it aloud to their students. The children then had to imagine a different and a new kind of world and planet for Zed, as there were many reasons why he could no longer live on his planet. For the "what if" game of world design, the classrooms were organised by the teachers such that children worked in mixed groups of three to six girls and boys. To facilitate co-creation of their planet, the children were given a set of templates with all of the information needed to plan and design the play world. The children were asked to write and draw their ideas on these templates. Each small group designed the features, narratives, incidents or "threats", figures and characters for the game. When playing in the playground, each child assumed the role

Fig. 3. Free play and technology-based mini-games in the PLE.

of the character that he/she had created. The game world was first planned at the small-group level; the ideas were then shared and validated at the whole class level, with the class choosing the most sensible ideas and creating a common, narrative "what if" world. Following this, the children, working in the same small groups, devised "threats" to the common play world.

The process of creating the game world drew on a number of story-planning questions: What is the game world like? What does the playground equipment represent in the game world? What incidents or "threats" will be encountered in the play world, and how can they be overcome? An incident might be an invisible satellite that steals shadows from trees, buildings and occupants, for instance. In the game world of fourth–fifth graders' the exploration unit was Zed's weather station, the wave platform represented Lava Ocean, the drawing walls were the monster of the Naluki game world and the spinning mill was a language lab that the occupants, the players, used. The incidents emerged unpredictably during play and were averted by playing a small computer game designed by the researchers. Here, the children had to choose a multimedia sound element to represent the incident. An incident might be a hail of colourful flowers from the sky and the only way to counter it would be to succeed at individual computer games outdoors. Finally, the children planned their own game characters by drawing and naming them. All pictures, narratives and figures that related to the play world were copy-pasted and transformed into images that could be seen in the playground (see Fig. 3). Overall, the implementation of the orientation and planning phase took 3 days of the entire process.

5.2.3. Playing

When each class had reached the phase in which it had created its own game world with the basic features and "threats", it was time to head to the outdoor playground to play. The purpose was to engage in role-play – for children to use the playground equipment and to put their soul into the class's play world – and to save their own world when the randomly emerging incidents or "threats" appeared. Role-play took place in the small groups and five to six children played at each point – *exploration unit*, *stage*, *jungle gym*, *wave platform*, *stepping stones*, *drawing walls*, *spinning mill* (see Fig. 1) – at any one time. Role-play was based on the class's common narrative and the roles assigned to the equipment in the play world. The incidents or "threats" – as many as the number of groups in the class – had to be overcome by playing the technology-enhanced mini-games planned for and programmed into the playground system by the researchers. The mini-games lasted only a couple of minutes but they made the playing phase on the playground more physical and exciting. The games consisted of educational tasks that had to be solved by seeking the right answers from the iPosts in the playground (see Fig. 1). The researchers also decided the time when the incidents occurred and when the mini-games would start. An approaching incident, represented by a signal from the multimedia sound element, was announced by the researchers. The sound and the incidents or "threats" were familiar to the children, because they had planned them themselves in their classrooms. However, the timing of the incident and the content of the mini-games were impromptu. The narrative context of the play world, the representations of the playground equipment and the contents of the incidents were all displayed in the iStation (see Fig. 3).

When the sound of the "threat" emerged, the mini-game started and each of the children had to get through it in a certain time. The whole playground was in use during the game. The common score of the classes determined victory over or defeat by the "threats". The teachers tutored pupils in dealing with the tasks of the mini-games and participated in role-playing during the free play on the playground that represented the space-like "what if" world of each class. The entire play phase outdoors on the playground lasted for approximately one lesson and consisted of four to five mini-game phases depending on the size of the small groups and nature of the "threats" created in the classroom. This phase of learning was playful and imaginative and entailed the use of the whole body while playing and learning. Outdoor circumstances were very wintry, but as the playground was under cover, the children had quite comfortable conditions for their play. Fig. 3 illustrates the playing phase: children in their play activities on the drawing wall, on the wave platform, in the exploration unit and querying the iStation for mini-game instructions.

5.2.4. Elaboration

When the game on the playground was over, the children elaborated and reflected on the fictional world created by the class, as well as the real world and the studies from which the process had started. The differences and similarities were examined in small groups and recorded on the blackboard. In addition, the students in two of the classes were asked to make

a mind map outlining what they had learned during the process. The same children had been given an identical task as a pre-test. Teachers were asked to report on the tests in the interviews.

6. Results

6.1. Creative and playful learning potentials and challenges—children's view

Four exciting play worlds with their narratives and plots were created and acted out in the PLE. These imaginative play worlds, named *The Naluki*, *The Udeko*, *The PVEP* and *The Wonderland*, consisted of a variety of features, causal explanations and hypotheses for a "what if" world that consisted of both factual and fictional knowledge of the real world. The children felt that it was inspiring to design a common game world, to create narratives, to refine ideas and to elaborate a world that was "upside down". They reported they had learnt about space, the planets, the Solar System and the concept of time, that is, the curricular content. In addition, they felt they had learnt to use their imaginations and to collaborate, and that it was challenging to design and create knowledge collaboratively, because everyone contributed his or her own opinions; in fact, one can see all the facets of learning that learning in the sciences emphasises (see Sawyer, 2006c). On the basis of the children's views, five categories were posited that illuminate the learning potential and challenges that the children experienced during the experiment.

Intellectual potential and challenges relate to the creative and narrative processes as well as the use of imagination and possibility thinking, that is, skills that arose in turning fact into fiction and in composing stories. Most pupils thought they had had *an opportunity* to think imaginatively and creatively while learning. The replacement of traditional teaching methods by a range of creative and playful activities seemed to inspire the children. For instance, they reported being eager to study in this way because "you didn't have to use only workbooks" and "you were allowed to use your imagination". However, imagining a "what if" game world was not always regarded as a straightforward and easy experience; although using one's imagination was mostly considered exciting and fun, the necessity of doing so was sometimes regarded as quite strenuous and even stressful. Some pupils found it "hard to come up with something different" and difficult "to think about the relationships between fact and fiction". Thus, use of the imagination and making coherent narratives were not self-evident processes for all pupils and in all groups.

Participative potential and challenges related to small-group working and collaborative decision making in groups and at the classroom level. Working in groups and deciding the characteristics of a fictional play world collaboratively was considered a motivating experience, especially when there was a substantial flow of ideas. Since the objective was to create a common play world, it was necessary first to establish a common goal at the group level and then at the classroom level by making compromises, negotiating and deciding what ideas were to be included in the common plan. The children thought that they had learnt group work skills and felt that this was a good way to study and design, because they had an opportunity to "*talk and work things out with the group*". The results show that children conceived of learning outcomes in a way which is in line with the principle of creative and playful learning: they felt that they had learned about negotiation and respect for the ideas of others during the process, although they also had difficulties reaching a common understanding. As one noted, "*Sometimes we argued about stuff, but then like, you know, in the end... everyone agreed about it*". This is understandable, because no specific ground rules for negotiation skills in groups had been taught beforehand. On the other hand, misunderstandings and disagreements are central to learning and it is often erroneous to assume that children automatically learn better when collaborating. Mercer (2000), for instance, has acknowledged that shared knowledge and understanding can be equally attained through conflict or co-operation. Indeed, the considerable potential and challenge associated with participation were experienced simultaneously, as positive and negative elements: participation was a *chance to discuss and decide things collaboratively and brought the challenge of having to reach agreement*.

Potential and challenges in knowledge co-creation were categorised separately from the participatory approach, and were divided into two parallel processes: (a) fact-based co-creation and (b) fiction-based co-creation, which was emphasised in the planning and play phases. These processes seemed to compete with each other and teachers' and researchers' participation and questions in particular were able to create spaces for considering factual and fictional issues at the same time. The children reported that they learned that "everybody has individual ideas" that have to be taken into account, which is also true of challenges and potential in knowledge co-creation. Playfulness appeared in many ways, for example, in situations such as playing with language and expressing funny ideas. The following extract illustrates fiction-based co-creation. The children are talking about and designing the main features of their planet:

Girl 1: *It's the kind of planet that doesn't go around at all because it doesn't want to go around. Then on one side it is always night and on the other it's always day. And on the night side it's sort of scary and stuff and on the day side it's more fun and stuff.*
Boy 1: *And then there's like a ring around the planet where it always goes to the night side and day side.*
Boy 2: *And there on the night side there's a volcano and every time it erupts then out come these fiery men.*
Boy 3: *And then lightning comes out and when the lightning bolts hit the ground, they turn into these...*
Girl 1: *electric...*
Boy 2: *Yeah, electric men.*

The extract illustrates how the pupils' narrative and emotions are very much part of knowledge co-creation. The game world has to be scary and fun and has to have a clear plot. However, emotions were also reflected in action and in non-verbal communication. Depending on the quality of knowledge co-creation, the individual strategies and the teacher's or researchers' guidance during the processes produced qualitatively different possibilities for shared understanding. The teacher was involved in the excerpt below, where children (aged 9–10) are discussing the roles for playground devices in their play world, Naluki. Plans and narratives for devices have been created in small groups in the classroom, and the whole group is familiarising itself with those ideas and validating them at the classroom level. These discussions take place in the playground:

The teacher: . . .*and what is this device? The Spinning Mill* (the real name of the device).
Students all start to talk excitedly and in unison: *It's one of those Naluk language machines*. . .
Girl 1: . . .*This is one of those Naluk language learning machines, so that when you spin in it, it teaches you the Naluk language.*
The teacher: *Oh really, so this is like. . .a language studio? Yeah, a language studio for learning Naluk* (with excitement). . .
(Continues) *What else could it serve as?*
Girl 2: *Well, when you get to that Naluk planet, then you could go inside that and when it spins around like it does, then you could come out from the other side*. . .
Girl 3: *Like a planet ring.*
(The children demonstrate with the device.)
The teacher (specifies): . . .*So that when they come from there to this planet they learn the language at the same time*. . .
The children nod.
The teacher: *Well, what is this?* (Presents another device, the Wave Platform)
The children step and walk on the Wave Platform (see Fig. 3).
The children exclaim in unison: *It's one of those black hole doors*
The teacher: *Wow!* (with interest)
Boy 1: (continues). . .*so that when someone shakes it from the middle, you have to go fast*
Girl 4: (continues). . .*So that if you step in here* (demonstrates). . .
Boy 2: *then you fall*. . .
Girl 4: *then you fall into a black hole.*

This example shows that the entire process was based on imagination, a fictional representation of the planet Naluki. However, to promote understanding of the space-related terms, it was important to elaborate and reflect on the learning content after the planning and play phases, and to consider differences between fact and fiction in the classroom. The fact-based knowledge was dealt with and further co-created quite successfully at the classroom level by offering children an opportunity to ask related questions, which varied depending on the children's class level and age.

Emotional potential and challenges. The teaching experiment showed that the children could express a variety of feelings regarding their play worlds during the learning and design processes and both in the classroom and in action while playing in the PLE. However, playfulness, humour and joy were predominant. Positive feelings were associated with the active way of learning and involvement, designing imaginative things, group working, collaboration, and the opportunity to share the fictional game world with others in the playground. Designing a common game world was regarded as an enjoyable, fun, and "tops" experience, and playing in one's own world in the playground was considered especially rewarding and cool. Younger children seemed to enjoy the play phase more than older children did, who in a few cases regarded it as somewhat frustrating and childish. The children felt that filling in the templates and completing writing tasks in general were the most tedious tasks. In addition, as mentioned, turning fact into fiction caused difficulty and frustrations in some cases, although the overall result was worthwhile.

Physical potential and challenges. One of the main goals of creating the "what if" world was to get to play the game in the playground, which provided numerous opportunities for physicality. Running in the playground while playing the technology-enhanced mini-games was a very sporty phase. In addition, during free play children ran, jumped, and climbed in the outdoor playground that represented their own planet, with its novel places and tasks. The Wave Platform, which consists of wobbling steps to walk on, was envisaged by one group as a "the Lava Ocean of space", because moving on the steps required good balance. For the children, the game phase was motivating since, as one student commented, "You can play there. . .and you don't need to listen to the lesson. . .or take notes".

6.2. Creative and playful learning potential and challenges—the teachers' view

Since the idea of the intervention as a whole was new to all concerned, and was largely based on the children's free narrative and creativity (Juujärvi et al., 2005; Kangas et al., 2006; Kultima, 2006), it required a different type of instruction and tutoring from the teachers than that used in mainstream teaching. While they involved some individual and traditional working methods in the orientation phase, the learning activities mostly drew on creative collaboration and common decision making at the group and classroom levels. The teacher's role was felt to be challenging because precise planning of lessons, learning and play processes beforehand was not possible. Challenges were also linked to the fact that activity in the CPL is fairly pupil-centred and requires a lot of tutoring and guiding for the knowledge co-creation. Accordingly, the teachers

felt that they had to "stay very much on the alert" and that it was constantly necessary to be "105% wide awake", as one of the teachers put it. They felt that their role was very important, especially during the planning and elaboration phases, when dealing with cause-and-effect relations in the factual and fictional worlds. However, the teachers felt challenged when faced with the task of drawing a boundary between sufficient over-tutoring and tutoring when engaging and feeding the children's imaginations.

The teachers reported that they perhaps should have offered more tutoring and guiding for the children's group work. Only in the course of the process did they realise that they could have directed the children's groups somewhat differently, linked the ideas of the children's imaginary world more explicitly to the real world and, for example, sought logical explanations together with the children for the "threats". More time should have been allocated for this guidance, especially in the elaboration phase. As teachers reported, the elaboration phase should have been longer and more intensive in the classes, whereby it would have provided a better forum for transforming ideas and exploring and developing explanations relating to the factual and fictional worlds of the planets. In the next phase, when the structure and script of the game idea were more under control, the teachers stated that they could better predict the use of their time and could devote more of their attention to tutoring the groups. Having said this, they doubted whether they would have the time to incorporate such a learning method in their future educational practice.

The orientation phase was considered important for learning and planning the fiction-based play world. In this phase, the teachers were of the opinion that the children learned at least the topics that were dealt with during the teaching experiment, that is, the basics elements of the concepts of space and time; they believed these were made "different" in the process in that the children had to contemplate them from different angles. Although science learning or children's thinking skills were not measured in this study, it was important for the teachers to assess these learning outcomes in some way. At the beginning of the process, teachers asked the children to make a mind map to ascertain what they knew about space, the planets and the Solar System, and how they understood the relationships between these concepts. The pupils had been asked to note all of the things that came to mind and to write and draw them on the mind map. At the end of the teaching experiment, the children added to the mind map, in different colours, the new concepts, topics or relationships they had acquired. Examination of the concept maps revealed that learning at least had taken place at least in quantitative terms: the teachers reported that some children's concepts and topics had increased as much as tenfold. The teachers were satisfied with these findings, although the results of the mind map tests did not clearly reveal how children's thinking skills had developed or the extent to which qualitative changes had taken place in their understanding of the topics. With regard to the fact-and-fiction-based teaching method, the teachers stated that if the students were able to deliberate facts and explain them in collaboration, it could then be said that they had co-created knowledge and understood the subject matter, or at least that part which was covered in their plans and explanations.

The teachers reported that it was important that the children had learnt to negotiate and make decisions and to face the challenges related to participation. For example, they considered it important for children to learn to compromise on their own ideas while collaboratively planning the game. Another positive element reported was that the children had to give up on some of the ideas generated in their own group in order to create a common world: "Children ought to learn that not all their own ideas necessarily enjoy the support of the class as a whole". According to the teachers, the composition of the group was also important for knowledge co-creation: "In each group there was someone whose imagination could fly. . .when those whose feet are firmly planted on the ground could break loose a little." Here the teacher identifies a meaningful learning space where one child's imagination feeds another's and nurtures the possibility of thinking.

Although the experiment (around 20 h) only allocated 1 h in the playground, the teachers reported that the game play phase was the most important and rewarding for the children. The teachers reported that imagining was particularly successful in the playground environment, as it provided activities that embodied successful immersion into the co-created play world. However, the teachers thought that their role there should have been more active, as this would have engaged better with the classroom's imaginative world and participated in play with the children. According to the teachers, the technological gaps in the playground implementation did not significantly affect children's role-play and game playing,

7. Conclusion: a model of creative and playful learning (CPL)

In order to frame these emergent findings, and because the PLE is an innovative physical, virtual, formal and informal, indoor and outdoor learning environment, it became necessary to outline a theoretical and practical model for the use of PLE in curriculum-based teaching. The CPL model is based on physical and technological affordances provided by the PLE and the earlier pedagogical models related to PLE studies (Hyvönen, 2008; Hyvönen & Ruokamo, 2005; Hyvönen et al., 2006; Kangas et al., 2006, 2007) and is depicted in Fig. 4.

The orientation phase consists of framing the topic, the learning process, the methods and the tools, and collecting and creating the knowledge base. Students orient themselves to a given academic topic and this forms the knowledge base for the process. The present study has shown that ground rules for group-work and collaboration have to be elaborated carefully beforehand. For instance, the ground rules for exploratory talk (Wegerif & Mercer, 1997) or dialogical reasoning (Wegerif, 2006) can be incorporated into teaching to enhance the quality of knowledge co-creation. Similarly, orientation activities need time and careful planning and the use of well-known technological and other tools in the learning environment. *The game co-creation phase* emphasises imaginativeness, possibility thinking, and negotiation skills corresponding to the levels of narrative construction and collaboration. Students work together in small groups and create academically oriented or fact-

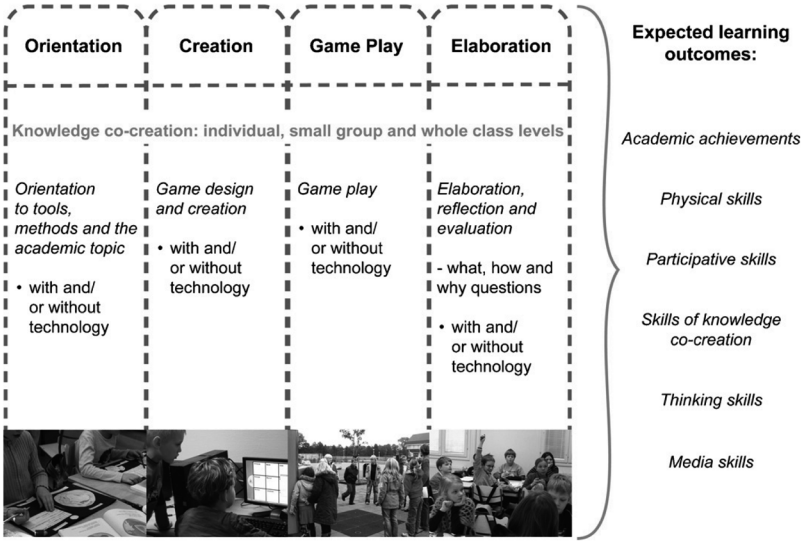


Fig. 4. The model of creative and playful learning (CPL).

and-fiction-based games or other content that can be implemented within a technology-enriched playground. For example, students might create a PLE game with geographical content by using first game development tools with Paint Brush, digital pictures and multimedia voices, and then go to the Internet to gather more information about the topic. Hence, in the game co-creation phase, various game creation tools and other media applications make learning more visible to others by shaping and sharing materials such as narratives, graphs, figures, thought maps, games and content for playing and evaluating.

The play phase involves physicality, active play and game playing in the PLE. Students might play both self- and peer-constructed games that can be non-technological or technology-enhanced. It is also important to offer a child an opportunity to reflect on and improve his or her game and play outputs if needed. *Elaboration* is an important phase for understanding, enabling the assembly and review of knowledge that has emerged in the earlier phases and to ask what, how and why questions. It affords the opportunity to reflect on, elaborate and transform knowledge and experiences. Each of the phases can be used for different learning purposes. For instance, the game co-creation phase or the play phase can be applied as orientation to a topic, for revision purposes, or to test understanding. In addition, technological tools and digital technology provide tools for knowledge co-creation in this phase. Applying the CPL model in PLE settings can support a variety of learning outcomes: academic achievements, physical skills, participative skills, skills of knowledge co-creation, thinking skills and media skills.

According to the CPL model, learning takes place through knowledge co-creation in an environment of imagination, playfulness and "media richness", which are essential for *proficiency as future citizens* (Claxton, 2002). The term "media richness" illustrates the use of media and new technology as a natural part of all curricula, such as those for mathematics, foreign languages or physical education. The term refers to a learning environment that caters to the needs and skills of today's children regarding media and new technology (e.g., digital cameras, ICTs, social media channels, the Internet, videos, mobile phones, iPods, computer games) and that emphasise a media production approach to learning. In the present study, technology did not play a large role, because game design and media production by computer were not available to the children, but the current version of the PLE did afford a variety of opportunities to create varied content. In fact, PLE use has recently been studied in a cross-cultural teaching experiment in which 331 Finnish and Dutch students used the game creation tools and new technology to produce and play games centring on a variety of subject matter (e.g. Kangas et al., 2009).

CPL is designed to integrate curriculum, subjects, environments, processes and methods. The teacher's role during the process can vary depending on how much the teacher emphasises the children's own contribution and activity both in the classroom activities and on the playground. CPL promotes knowledge creation for play and games as well as for meaning making: explicit reasoning, exploration, inventing, proposing and validating ideas. The alternation of working in small groups and at the classroom level is a good way of promoting the individual's and the group's collaborative understanding (cf. Wells, 2002). In keeping with Wells' (2002) idea of 'community of inquiry', the CPL model allows each group to present and explain

its thoughts and ideas to others. The other groups and the teacher pose questions for co-creating a common understanding of the focal game. The teachers have a special role as constructors of the groups and as tutors: they give emotional support, allow the children's imagination to run free, and encourage thought experimentation to flourish during the process of knowledge co-creation.

Subsequent design-based cross-cultural studies have proved that a teacher's sensitivity with regard to the pedagogical use of the PLE is an important classroom-level factor which influences student's satisfaction with the environment and methods of creative and playful learning (Kangas et al., 2009; Kangas, Randolph, & Ruokamo, accepted). In addition, children overall seem to be satisfied with learning through creative and playful learning processes in the curriculum-based PLE context. However, it is important to be aware of the dangers of creativity being perceived as no more than having fun or making pretty things, rather than being challenging, and often painful or frustrating, such as "hard fun" and "flow" (cf. Loveless, 2006; Csikszentmihalyi, 1990). This study demonstrated the existence of "hard fun" in fact-and-fiction-based learning processes that offer opportunities to reflectively analyse one's current knowledge and skills.

8. Discussion

The study yields insights into teaching curricular topics at the primary level using an approach that is novel in cultivating creativity and thinking skills in a playful learning environment. The research shows that one way to foster creativity, imagination and group work skills, alongside academic achievements, is to integrate fact-and-fiction and playfulness into teaching. It also provides an approach for meaningfully integrating various curriculum subjects and learning goals. In this study, physics, geography, arts and crafts, students' first language, physical education and media education were seamlessly integrated. The prevailing notion of formal learning – learning at a desk and learning individually about the world through textual reality (Säljö, 2004) – was challenged in a variety of ways, and the results were encouraging. However, teachers encountered many challenges in implementing the teaching methods that draw on CPL: firstly, they realised how their pedagogical orientation changed from teacher-directed to child-centred during the process. This required them to adopt a variety of roles, such facilitator, instructor and afforder, as well as learner. Secondly, they noticed how challenging it was to tutor and guide small group work indoors and outdoors while at the same time giving the children's imagination free rein. The teachers attributed difficulties with effective knowledge co-creation to differences between the individual pupils and to school traditions in which imagination is not always appropriate or allowed. They thought that getting used to various creative and playfulness-based teaching methods would help them and their pupils work creatively. They also found it quite challenging not to be able to plan their lessons beforehand in detail as is common practice in traditional teaching. Despite these misgivings, the teachers perceived no problem in incorporating this kind of method into school subjects, and were satisfied with the teaching experiment. Design-Based Research (DBR) requires that the researcher must systematically engineer the contexts of empirical studies in ways that allow for the advancement of new theory and pedagogical practice that will create an optimal learning environment (see Barab, 2006; Barab & Squire, 2004). Although the research-based evidence is still tentative, the results of the present study indicate that the use of the PLE and various combinations of the creative and playful learning methods are worthy of further research and implementation in educational practices.

Many practitioners have noted that novel learning environments are often received with high enthusiasm by students and teachers, but that this perception rapidly decreases with time and traditional methods reappear (Niemi & Kumpulainen, 2008). Indeed, the teachers in the present study felt that they needed more resources and support for their pedagogical thinking. Thus, further research is needed, as well as improvements in education, to better prepare teachers to implement and sustain instructional methods such as playful teaching (Hyvönen, 2008) or CPL, and to introduce novel learning environments such as PLEs into their pedagogical practices. The teachers' role was challenging during the teaching experiment, as it required a great deal of effort and time to carry out each of the learning phases, which included tutoring the small groups, as well as work with the whole class inside and outside the classroom. Although all teachers are naturally not ready for creating new learning environments based on creativity, innovation and new technology, it is clear that from teachers' perspective many trends of the future learning environments will require them to manage more diverse learning styles and therefore more diverse teaching strategies (see Natriello, 2007). Teachers' thinking usually involves a choice between different pedagogical alternatives (Kansanen, 2004). The CPL model offers tools for creative and playful teaching and the PLE provides a fascinating technology-enriched learning environment for learning through play and games, and for playing with new technologies in the educational sphere. Applying the CPL in the PLE settings requires that teachers have the skills and motivation to use innovative methods and learning environments, and work and "play" with technologies, just as young people today are accustomed to doing.

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References

Barab, S. (2006). Design-based research. In R. K. Sawyer (Ed.), *The Cambridge handbook of learning sciences* (pp. 153–169). New York: Cambridge University Press.

Barab, S., & Squire, K. (2004). Design-based research: Putting a stake in the ground. *The Journal of the Learning Sciences*, *13*(1), 1–14.

Beghetto, R. (2007). Does creativity have a place in classroom discussions? Prospective teachers' response preferences. *Thinking Skills and Creativity*, *2*, 1–9.

Blumenfeld, P. C., Kempler, T. M., & Krajcik, J. S. (2006). Motivation and cognitive engagement in learning environments. In R. K. Sawyer (Ed.), *The Cambridge handbook of learning sciences* (pp. 475–488). New York: Cambridge University Press.

Bodrova, E., & Leong, D. J. (2003). The importance of being playful. *Educational Leadership*, *60*(7), 50–53.

Bokulich, A. (2001). Rethinking thought experiments. *Perspectives on Science*, *9*(3), 285–307.

Brown, A. (1992). Design experiments: Theoretical and methodological challenges in creating complex interventions. *Journal of the learning sciences*, *2*, 141–178.

Brown, A., & Campione, J. (1996). Psychological theory and the design of innovative learning environments: On procedures, principles, and systems. In L. Schauable, & R. Glaser (Eds.), *Innovations in learning: New environments for education* (pp. 289–325). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Bruner, J. (1996). *The culture of education*. Cambridge: Harvard University Press.

Bruner, J. (1990). *Acts of meaning*. Cambridge: Harvard University Press.

Bruner, J. (2002). *Making stories: Law, literature, life*. New York: Farrar, Strauss & Giroux.

Bruner, J. (2003). The narrative construction of reality. In M. Mateas, & P. Sengers (Eds.), *Narrative intelligence* (pp. 41–62). Amsterdam: John Benjamins Publishing Co.

Burleson, W. (2005). Developing creativity, motivation, and self-actualization with learning systems. *Human–Computer Studies*, *63*, 436–451.

Claxton, G. (2002). Education for the learning age: A sociocultural approach to learning to learn. In G. Wells, & G. Claxton (Eds.), *Learning for life in 21st century. Sociocultural perspectives on the future of education* (pp. 21–33). Cambridge, MA: Blackwell.

Collins, A., Joseph, D., & Bielaczyc, K. (2004). Design research: Theoretical and methodological issues. *The Journal of the Learning Sciences*, *13*(1), 15–42.

Confrey, J. (2006). The evolution of design studies as methodology. In R. K. Sawyer (Ed.), *The Cambridge handbook of learning sciences* (pp. 135–151). New York: Cambridge University Press.

Craft, A. (2000). *Creativity across the primary curriculum: Framing and developing practice*. London: RoutledgeFalmer.

Craft, A. (2001). Little c creativity. In A. Craft, B. Jeffrey, & M. Liebling (Eds.), *Creativity in education* (pp. 45–61). London: Continuum.

Craft, A. (2005). *Creativity in schools: Tensions and dilemmas*. Abingdon: Routledge New York.

Cremin, T., Burnard, P., & Craft, A. (2006). Pedagogy and possibility thinking in the early years. *Thinking Skills and Creativity*, *1*, 108–119.

Cropley, A. J. (2004). *Creativity in education & learning*. London: Routledge.

Csikszentmihalyi, M. (1990). *Flow, psychology of optimal experience*. New York: Harper and Row.

Egan, K. (2005). *An imaginative approach to teaching*. San Francisco: Jossey-Bass.

Egan, K. (1992). *Imagination in teaching and learning ages 8–15*. London: Routledge.

Gray, D. E. (2004). *Doing research in the real world*. Los Angeles, CA: Sage.

Hyvönen, P. (2008). *Affordances of playful learning environment for tutoring playing and learning*. Doctoral Dissertation. Acta Universitatis Lappoensis 152. University of Lapland, Faculty of Education, Finland. Rovaniemi: University of Lapland Printing Centre.

Hyvönen, P., & Juujärvi, M. (2005). Affordances of playful environment: A view of Finnish girls and boys. In *Proceedings of ED-MEDIA 2005: World conference on educational multimedia, hypermedia & telecommunications* June 26–July 2, 2005. Montréal, Canada, (pp. 1563–1572). CD-ROM. Electronic Version of Papers

Hyvönen, P., & Kangas, M. (2007). From bogey mountains to funny houses: Children's desires for play environment. *Australian Journal of Early Childhood (AJEC)*, *32*(3), 39–47.

Hyvönen, P., & Ruokamo, H. (2005). The features of playfulness in the pedagogical model of TPL—tutoring, playing and learning. In H. Ruokamo, P. Hyvönen, M. Lehtonen, & S. Tella (Eds.), *Proceedings of the 12th international network-based education (NBE) conference 2005: Teaching-studying-learning (TSL) processes and mobile technologies—Multi-, inter- and transdisciplinary (MIT) research approaches* (pp. 103–113). Rovaniemi: University of Lapland Press.

Hyvönen, P., Kangas, M., Kultima, A., & Latva, S. (2006). *Let's Play! Tutkimuksia leikillisestä oppimisympäristöstä. Lapin yliopiston kasvatustieteellisiä julkaisuja* Rovaniemi: Lapin yliopistopaino.

Jeffrey, B., & Craft, A. (2006). Creative learning and possibility thinking. In B. Jeffrey (Ed.), *Creative learning practices: European experiences*. London: Tufnell Press.

John-Steiner, V. (2000). *Creative collaboration*. Oxford: Oxford University Press.

Joubert, M. M. (2001). The art of creative teaching: NACCCE and beyond. In A. Craft, B. Jeffrey, & M. Liebling (Eds.), *Creativity in education* (pp. 17–34). London: Continuum.

Juujärvi, M., Kultima, A., & Ruokamo, H. (2005). A narrative view on children's creative and collaborative activity. In H. Ruokamo, P. Hyvönen, M. Lehtonen, & S. Tella (Eds.), *Proceedings of the 12th international network-based education (NBE) conference 2005: Teaching-studying-learning (TSL) processes and mobile technologies—Multi-, inter- and transdisciplinary (MIT) research approaches* (pp. 203–213). Rovaniemi: University of Lapland Press.

Kangas, M., Kultima, A., & Ruokamo, H. (2006). Co-creative learning processes (CCLP) — Children as game world creators to the outdoor playground contexts. In J. Multisilta, & H. Haaparanta (Eds.), *Proceedings of the Workshop on Human Centered Technology HCT06* June 11–13, 2006, Pori, Finland, Tampere University of Technology, Pori, Publication 6, (pp. 14–21).

Kangas, M., Hyvönen, P., & Latva, S. (2007). Space treasure outdoor game in the playful learning environment: Experiences and assessment. In H. Ruokamo, M. Kangas, M. Lehtonen, & K. Kumpulainen (Eds.), *The power of media in education. Proceedings of the 2nd international network-based education conference* 13–15 June, Rovaniemi, Finland, University of Lapland Publications in Education 17, (pp. 181–194).

Kangas, M., Randolph, J., & Ruokamo, H. (2009). An international mixed-method investigation into student satisfaction with playful learning environments. In *The paper presented at AERA 2009 (American Educational Research Association) annual meeting* April 13–17, San Diego, CA.

Kangas, M. Kultima, A. & Ruokamo, H. (accepted). Children's creative collaboration—A view of narrativity. In D. Faulkner, & E. Coates (Eds.), *The expressive nature of creativity in childhood*, Routledge.

Kangas, M., Randolph, J., Ruokamo, H., & Hyvönen, P. (accepted). An international investigation into playful learning environments and academic achievement. *The paper accepted to AERA 2010 (American Educational Research Association) annual meeting.*

Kansanen, P. (2004). *Opetuksen käsitemaailma*. Juva: PS-kustannus.

Kultima, A. (2006). Designing an open-narrative game concept for an outdoor learning environment. In *Proceedings of the IPSI 2006 conference, 2006* February 10–13, Marbella, Spain.

Lemke, J. L. (2002). Becoming the village: education across lives. In G. Wells, & G. Claxton (Eds.), *Learning for life in 21st century. Sociocultural perspectives on the future of education* (pp. 34–45). Cambridge: MA: Blackwell.

Loveless, A. (2006). Thinking about creativity: Developing ideas, making thing happen. In A. Wilson (Ed.), *Creativity in primary education* (pp. 19–32). Glasgow: Learning Matters.

Lyle, S. (2000). Narrative understanding: Developing a theoretical context for understanding how children make meaning in classroom settings. *Journal of Curriculum Studies*, *32*(1), 45–63.

Mahn, H., & John-Steiner, V. (2002). The gift of confidence: A Vygotskian view of emotions. In G. Wells, & G. Claxton (Eds.), *Learning for life in 21st Century. Sociocultural perspectives on the future of education* (pp. 46–58). Cambridge, MA: Blackwell.

Mercer, N. (2000). *Words and minds. How we use language to think together*. London: Routledge.

Mercer, N. (2002). Developing dialogues. In G. Wells, & G. Claxton (Eds.), *Learning for life in the 21st century* (pp. 141–153). Cornwall: Blackwell Publishing.

Ministry of Education. (2004). *Finland's national core curriculum for basic education 2004*. Available from: http://www.oph.fi/info/ops/pops_enhlanti_index/index.pdf Accessed 30.01.07.
Natriello, G. (2007). Imagining, seeking, inventing: The future of learning and the emerging discovery networks. *Learning Inquiry*, *1*, 7–18.
Niemi, H., & Kumpulainen, K. (2008). *Tieto- ja viestintäteknologian hyödyntäminen opetuksessa ja opiskelussa. CICERO Learning -selvitysraportti*. Helsingin yliopisto. www.cicero.fi/documents/ClCERO_TVT-selvitysraportti.pdf.
Paavola, S., Lipponen, L., & Hakkarainen, K. (2004). Models of innovative knowledge communities and three metaphors of learning. *Review of Educational Research*, *74*(4), 557–576.
Resnick, M. (2007). Sowing the seeds for a more creative society. *Learning and Leading with Technology*,
Rojas-Drummond, S., Mazon, N., Fernandez, M., & Wegerif, R. (2006). Explicit reasoning, creativity and co-construction in primary school childrens collaborative activities. *Thinking Skills and Creativity*, *1*(2), 84–94.
Säljö, R. (2004). Learning and technologies, people and tools in co-ordinated activities. *International Journal of Educational Research*, *41*, 489–494.
Säljö, R. (2005). *Lärande i praktiken: ett sociokulturellt perspektiv*. Stockholm: Norstedts Akademiska Förlag.
Säljö, R. (2006). Learning and cultural tools: Modelling and the evaluation of a collective memory. In *Presentation at EARLI JURE06 conference* 4th July 2006, Tarto, Estonia.
Sawyer, R. K. (2006a). Educating for innovation. *Thinking Skills and Creativity*, *1*, 41–48.
Sawyer, R. K. (2006b). Conclusion: The schools of the future. In R. K. Sawyer (Ed.), *The Cambridge handbook of learning sciences* (pp. 567–580). New York: Cambridge University Press.
Sawyer, R. K. (2006c). Introduction. In R. K. Sawyer (Ed.), *The Cambridge handbook of learning sciences* (pp. 1–16). New York: Cambridge University Press.
Scardamalia, M., & Bereiter, C. (2006). Knowledge building: Theory, pedagogy and technology. In R. K. Sawyer (Ed.), *The Cambridge handbook of learning sciences* (pp. 97–115). New York: Cambridge University Press.
Sidawi, M. M. (2007). Teaching science through designing technology. *International Journal of Technology and Design Education*, *19*(3), 1–19.
Tuomi, I. (2007). Learning in the age of networking intelligence. *European Journal of Education*, *42*(2), 235–254.
Vass, E. (2007). Exploring processes of collaborative creativity—The role of emotions in children's joint creative writing. *Thinking Skills and Creativity*, *2*, 107–117.
Vygotsky, L. S. (1978). *Mind in society*. Cambridge: Harvard University Press.
Wang, F., & Hannafin, M. (2005). Design-based research and technology-enhanced learning environments. *Educational Technology Research and Development*, *53*(4), 5–23.
Wegerif, R. (2005). Reason and creativity in classroom dialogues. *Language and Education*, *19*(3), 223–238.
Wegerif, R. (2006). A dialogic understanding of the relationship between CSCL and teaching thinking skills. *Computer-Supported Collaborative Learning*, *1*, 143–157.
Wegerif, R., & Mercer, N. (1997). A dialogical framework for researching peer talk. In R. Wegerif, & P. Scrimshaw (Eds.), *Computers and talk in the primary classroom* (pp. 49–65). Clevedon: Multilingual Matters.
Wegerif, R., Littleton, K., Dawes, L., Mercer, N., & Rowe, D. (2004). Widening access to educational opportunities through teaching children how to reason together. *Westminster Studies in Education*, *27*(2), 143–156.
Wells, G. (2002). Inquiry as an orientation for learning. Teaching and teacher education. In G. Wells, & G. Claxton (Eds.), *Learning for life in 21st century. Sociocultural perspectives on the future of education* (pp. 197–210). Cambridge, MA: Blackwell.
Wells, G., & Claxton, G. (2002). Introduction. In G. Wells, & G. Claxton (Eds.), *Learning for life in 21st century. Sociocultural perspectives on the future of education* (pp. 1–17). Cambridge, MA: Blackwell.
Wenger, E. (1998). *Communities of practice: Learning, meaning and identity*. Cambridge, United Kingdom: Cambridge University Press.
Whyte, H. (1982). The value of narrativity in the representation of reality. In W. Mitchell (Ed.), *On narrative* (pp. 1–24). Chicago: University of Chicago Press.