Medium for Children's Creativity: A Case Study of Artifact's Influence

Nanna Borum, Kasper Kristensen,
Eva Petersson Brooks, and Anthony Lewis Brooks

Department for Architecture, Design and Media Technology, Aalborg University, Denmark
(nb,ep,tb)@create.aau.dk,
kkrist87@gmail.com

Abstract. This paper reports on an exploratory study that investigates 16 elementary school children's interaction with two different mediums for creativity, LEGO® bricks and paper collages, drawing on the previous creativity assessment test carried out by Amabile [1]. The study is based in a playful learning theoretical framework that is reflected in the means for analyzing the video material inspired by Price, Rogers, Scaife, Stanton and Neale [2]. The findings showed that the children explored the two mediums to the same degree, but that they were more structured in their planning and division on labor when working with LEGO bricks. It was also evident that the children assigned preconceived affordances to the two mediums. The results from this study should feed into to a technology enhanced playful learning environment and these are the initial steps in the design process.

Keywords: Creativity, Playful Learning, Play, Artifacts, Technology Enhanced Learning.

1 Introduction

Children are increasingly relying on interactive technology for learning and such technologies were believed to revolutionize learning. Schools have however in general, remained to a traditional instructional model of the teacher, written material and the textbook as primary sources of knowledge primarily conveyed through lecturing, discussion and reading. In line with this, the current development of intuitive technologies has enabled children to interact with contemporary technology as the most natural act in the world. This widespread "digital adoption" offers new opportunities for playful learning, which can be individual, together with parents, or in supervised peer-groups, and embedded education potentials to foster development of creative and innovative competencies.

Creativity has become a vital and highly valued aspect of science, technology, education, as well as everyday life by the end of the 20th century due to economic, social as well as technological drivers [3]. While there have been great expectations about the use of interactive technology to support learning and creativity in educational [4]

C. Stephanidis and M. Antona (Eds.): UAHCI/HCII 2014, Part II, LNCS 8514, pp. 233–244, 2014.

as well as professional settings [5], the creative and multimodal workflow of children provides a major obstacle to current use of technology-based systems and resources. Yet, while being an inherently knowledge-based process, creativity from this perspective is more than mere information processing but a direct involvement with artifacts aimed at transformation.

In this way, creativity links to play and, in particular, to the way the play activity is perceived by the player [6]. Accordingly, children's tendency towards play, or playfulness, has been linked to creative thinking skills [8], [9]. In line with Howard et al. [7], this paper suggests a distinction between the act of play and the sense of playfulness, which implies that the experience of playfulness is applicable to play as well as work. It is this sense of playfulness that can contribute to creativity, particularly in an educational context. "Whilst certain activities may appear more play-like, we can never be sure whether the individual is feeling playful." ([7] p. 5). If playfulness in this way constitutes an internal state that a child brings to an activity, it is important to understand the influence of the context and the way objects may foster playfulness. Price, Rogers, Scaife, Stanton and Neale [2] have defined a range of elements that are essential for playful learning, e.g. exploration through interaction, engagement, reflection, imagination, creativity and thinking at different levels of abstraction, and collaboration. These elements can be related to how children in their everyday life naturally, and often playfully, explore the world [10],[11]. It is envisioned that such playful explorations, based on children's own interests and desires, elicit creativity through their involvement with the world.

Building on this and on recent work in the field of creativity (e.g. [5], [12], [13], [14]), this study starts from a notion of creativity as a materially mediated practice. In line with this perspective, the focus is on the particular qualities of such practices rather than on particular methods or techniques. Hence, this paper addresses the question of how artifacts can evoke creativity and how this might afford a material linking between playful learning and creativity. In particular, this study examines how creativity turns into playful and productive activities through actual manipulation of two types of medium: Paper collage and LEGO®. In line with van Leeuwen [15] this approach includes an explorative investigation of how a specific medium is used and how the children talk about them, justify them, and critique them. In addition and based on this investigation, our intention is to discover and design a new digital playful learning medium fostering creativity in educational settings. This study focuses on the first step, which is to say how a specific medium is used, talked about and negotiated and how this gives input to the initial conceptual framework and design requirements.

2 Related Work

In this paper, we investigate the potential link between play and creativity suggested by a range of researchers ([16], [9]) and more specifically the potential link between perceived level of mastery of a medium and how it affects the level of creativity in a given task [2]. This build on a pragmatist notion of action (and interaction) as developed by Dewey [17] and offers an understanding of creativity as an emergent, situated

and reciprocal process comprising action and reflection as well as an interplay between the subject and the environment [18]. The pragmatist notion also shares basic premises with play theories. For example, play is commonly used as a motivator in learning situations where the adding of play elements to an activity targets an increased situational engagement and, thereby, motivation to participate in the specific activity [19]. This is in line with Chally [20] who states that such an engagement enhances self-agency through creative and playful assignments. Furthermore, Wood [21] underlines that play activities create affordance for learning. This is in line with what Resnick [22] describes as playful learning; situations where play is fully integrated in the learning activity and, consequently, an integral part of the learning experience. Still, though, many schools approach playful learning activities with resistance and skepticism considering them as 'just play' [22].

Bringing a playful learning perspective to creativity, involve that actions, objects as well as events must be understood in the context of the situation of which they are involved. In this regard, Dewey [23] emphasizes the notion of inquiry, acknowledged as a mode of action. This resonates with Beardon, Ehn & Malmborg ([24] p. 503) who argue that creativity constitutes a mode of interaction with the world rather than being a property of a person, process, product, or environment. Sullivan [25] states that play is an important mode of inquiry when the learning targets creativity. Howard et al.[6] and Broadhead and Burt [26] emphasize that a child initiated environment and its possibilities promotes less separation of play and learning resulting in playful learning. Petersson and Brooks [27] describe how toys contributed to an increased motivation to learn and had a potential to aid learning in a playful way; this perspective has substantial implications for the classroom habitus [28]. In line with this, we investigate how media in the form of LEGO® and paper collage, might elicit creativity through exploration and mastery. In doing so, we further the related work on creativity, play, and learning by emphasizing that playfulness in learning situations are not only connected to individual interests and desires, but also to the material affordances involved in such situations. In this sense, the affordances refer to the potential uses of a given medium, based on the perceivable features of this medium [29] and how these affordances are actualized in concrete social practices [15].

Conceptualizing creativity as a playful learning practice entails, among others, the following propositions:

- Creativity and playful learning is mediated by artifacts and results in a transformation of the physical world. Artifacts provide essential resources for agents to communicate, store, catalyze, evaluate and reflect on ideas while trying to overcome the indeterminate situation. Artifacts, from this perspective, are not mere carriers of information, but enable and constrain an actor's moves ([27], [18]).
- Creativity and playful learning goes along with the generation of new knowledge. As creative practices attempt to act upon a hitherto undetermined situation, the outcomes of this attempt necessarily add to the actors' body of knowledge either in that assumptions about the situation are contested or supported. Creative practice hence can be understood as a form of inquiry ([23], [30], [25]).

The focus of this study, how media creatively can be used in playful learning situations, hence is based on the assumption that in these situations are deliberately cultivated. This knowledge creates a basis for the design of a new digital playful learning medium fostering creativity in educational settings.

The aim of playful learning is to allow children to learn and apply learned knowledge to playful situations. Thus by applying and constructing new knowledge iteratively in play the child, in line with Gee [31], attains a deep practical knowledge of the subject at hand.

3 Method

The exploratory study took place in a private Danish elementary school (16 children, 11 boys, 5 girls, age 10-11 years) and it was carried out during a Danish class with the teacher of the class present in the room. It consisted of two sessions a) a collage test, and b) a LEGO®-building test. In each session, 20 minutes each, the 16 children were divided into 4 groups with 4 children in each. 2 groups were to work together and 2 groups worked individually. All groups had the same introduction to the activities on the day. They were instructed that they should have fun and be as creative as possible, and that they should try to produce something really silly and something that would be for the researchers to keep. In line with Amabile [1], the intention with silliness was to establish a fairly high baseline for creativity and also in an effort to reduce extraneous variables in the children's choice of theme.

In the collage test each table was provided with approx. 500 pieces of paper of different shapes and sizes that they were instructed to share, and also to be nice to each other and not hoard any specific piece or color of paper. In the LEGO-building test, the procedure was similar. Each table was provided with approx. 1600 pieces of LEGO of different size and shapes and again instructed to share as in the collage session. The children immediately started to investigate the materials, playing with them, touching them and talking about them. In general the children expressed a high level of interest in the materials. The sessions were video recorded with 5 cameras in total, having one camera at each table and one camera filming the whole scene.

After each session the children were asked to fill out 13 questions that were read aloud enabling them to ask questions on the wording to ensure understanding. The questions were partially from Amabile [32], [1], and Conti et al. [33] since no full questionnaire from Amabile [1] was accessible. Questions covered areas on intrinsic and extrinsic motivation, and their joy of the medium and had wordings such as "Was the activity more like play than work?", "Were you motivated more by your own interest in the collage/ LEGO or the instructions from the experimenter?", and "How much did you want to make a design that was better than the other kids' designs?".

3.1 Data Treatment

As a means to investigate the children's interactions with the artifacts and with each other an 'Interaction Analysis' of the video material was carried out [34]. The data

was transcribed, coded and analyzed by two researchers independently. The analysis focused on 5 topics related to playful learning developed by Price et al. [2]: (a) Exploration through interaction, (b) engagement, (c) reflection, (d) imagination, creativity and thinking at different levels of abstraction, and (e) collaboration, discussed below.

Still images of the creative contributions of the children were uploaded to an online questionnaire that was distributed to a group of experienced artists to assess the level of creativity through 16 artistic dimensions in accordance with Amabile [32] such as expression of meaning, degree of representationalism, and silliness. The results from the assessments together with the self-report data from the tests were examined to search for emerging trends and patterns. The results from this analysis will be presented in the findings when relevant.

4 Findings and Discussion

The findings from the data treatment, shows distinct differences between the creative products made from each artifacts as well as differences in the process of making them. The individual findings are discussed in the next sessions. The names of the participating children are anonymized for ethical reasons.

4.1 Exploration through Interaction

The two artifacts used for the sessions were familiar to all participants, as such there was not much basic functionality for the participants to discover and interpret, leaving room for more playful interaction.

Brooks and Petersson [35] make a distinction between exploration and play. Where exploration gave way to play the emphasis changes from the question of "what does this object do?" to "what can I do with this object?". Both mediums allowed for instances of peer learning. In the LEGO® session the children would instruct each other building patterns as exemplified:

- GL: Do it like this, build in this pattern, then it will hold better.
- BE: Can I see how you do it?

The two artifacts facilitated the assignment in different ways, each evidently pushing towards certain themes, of which the children chose to pursue. In the paper collage sessions all but one participant chose to create representations of creatures (often people) with a hint of fairytale such as a pirate or a strong man. This is interestingly compared to the LEGO session where the most common theme was houses, which half of all participants decided to do, and that all but one of the participants chose to create inanimate objects. One individual choose to create a human face that he however stated to be a mask and not a human (see figure 1).

As such each artifact seems to come with a preconceived framework of possibilities that are available within that medium. This could be a result of the perceived qualities of each artifact. LEGO bricks do not allow soft curves, and seemed associated with masonry, architecture and defined structures.

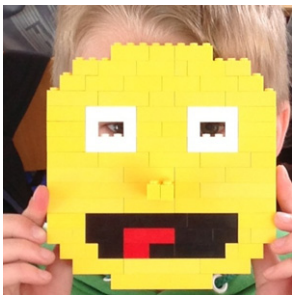

Fig. 1. Example of LEGO

Fig. 2. Example of paper collage

Similarly in the paper collage session the children had assigned preconceived assets to the mediums. They were handed a white paper to function as background for their creations. This paper constituted and functioned as a frame for many of the children. Most of the children chose to stay inside this frame, but two of them pushed the boundaries of the frame and let their creations move outside the frame (see figure 2).

Another preconceived asset the children seemed to have assigned to the mediums were the dimensions they supported. When the children constructed with LEGO they mainly build 3D constructions, except a single child (see figure 1). When constructing with paper none of the children tried to explore the medium and construct in more dimensions than two. They could easily have folded and glued the paper to construct 3D object but that did not appeal to any of them.

4.2 Reflection

Throughout the test the participants would communicate with each other and when needed with the researchers. These conversations serve as the primary report for the children's reflections and understanding of the assignment. When the children asked questions to the researchers the subjects showed what the participants perceived as normal use of each artifact. In the LEGO® session the children would ask if the creative product should be solidly build. While in the paper collage session the questions related to tearing and writing on the paper e.g.:

- TO: Can we tear them apart, we have tools for it (raises his hands in the air)
- AN: We tear a bunch of small ones.
- TO: They should be yellow so that they look like teeth.

Interestingly the children had strong opinion about LEGO; how good they were, and if they liked it. In the paper collage such opinion were absent. Also for the paper collage session there was a greater focus on detail; which shape to use for what, whereas in the LEGO session focus was on the look of the finished construction.

4.3 Imagination and Creativity

Each of the participants' concepts of creativity was most evident at the start of each collaboratory session. This was where participants had short conversations related to what they should create together. In these discussions the children often argued against the ideas that they did not consider creative:

- SA: We could build a bridge?
- VI: We could build a bridge!
- AU: Build a bridge, yes!.
- LA: No, it needs to be something new.
- VI: we could build a statue?
- LA: It should be something new!
- VI: A statue, a big beautiful statue.
- LA: That's not new.
- SA: A statue is actually a really good idea, we just need to put lots of stuff on it.

Here we see the children trying to align their concepts of a creative contribution, using the idea of newness as their primary criteria, and arguing that more detail is what makes a concept new.

The artists rated the collaboratory groups higher than their individual counterparts at average. Interestingly, the LEGO® session scored higher compared to the paper collage in the collaboratory groups, but the relationship was reversed for the individual groups. From the collaboratory LEGO sessions, where both groups made a house, it was apparent that the participants came to the decision through a compromise. They were however, able construct something unique, due to the fact that they were more people. This was not the case for the individual LEGO participants, who most often only had time for a basic construction. This could explain the difference between the individual LEGO group and collage paper. Collage paper is not as time intensive to use as LEGO bricks, allowing for multiple iterations and added detail.

4.4 Excitement

In line with Price et al. [2] excitement was assessed on the children's' verbal accounts on their expressed involvement and participation desire. In both the LEGO® session and the paper collage sessions the children generally showed interest in the tasks and were enthusiastic towards the medium. In the LEGO task one or two children at each

table expressed that they did not how to build with LEGO or that they did not feel skilled in building with LEGO bricks and their overall enthusiasm towards the task seemed to reflect this feeling, they would spend longer time on deciding a motive and would verbalize more negatively about their construction in process. It should be noted that this did not reflect in their self-report data on motivation afterwards. In the paper collage session the children did not have any similar statements regarding their skills. The children seemed to consider each other equally skilled in constructing with paper, and throughout the session they had positive exclamations towards both own work and the work of others e.g.:

— TO: It needs a jaw.
— ST: These will work. (ST hands TO a pile of triangularly shaped cut outs
— ST: Wow, this actually looks really good
— AN: It does not only look good, it looks superpower cool..

4.5 Collaboration

The focus when analyzing for collaboration between the children was on sharing of artifacts, the children's skills in receiving and giving instructions; their skills in turn taking and sharing roles, their skills in encouraging each other, and on their ability to scaffold on other children's' ideas.

In the LEGO® session there was generally more communication between the children. They discussed what to build and elaborated on each other's ideas and gave space to all having a say in the ideation process. In both sessions it however gave rise to a level of autonomy in the group members whose ideas were voted down. In some cases they constructed models that reflected bits of their own idea and in other cases they stayed out of the construction for a period of time as to show their disapproval. The other children seemed to accept the behavior and tried to encourage the disgruntled child by including him/her in specific tasks or including his/her construction in the shared construction. This is exemplified below:

(After LA have worked alone silently for a while):

— LA: I 've made a thing.
— VI: We could really use that in our house (places it in their shared construction). It could be a small bookshelf.
— LA smiles: I don't even know what it was supposed to be.
— VI: It looks like a bookshelf. Could you build some more interiors for the house?
— LA: smiles and starts finding more LEGO bricks.

In the building process the LEGO bricks allowed the children to construct in a parallel fashion, which means that often they built next to each other and then combined the different sections in the end. The children communicated on their design decisions along the way but seemed to feel ownership of the specific section and sought encouragement at each other but did not necessarily follow the instructions

Fig. 3. Example of three children working together

and recommendations from their peers. In another group in the LEGO session all the children were involved in not only the design decisions but also the assembling of LEGO bricks, resulting in situations where up to five hands were working on the same model simultaneously (see figure 3).

It is evident that when working with LEGO the children share the different roles easily and show excellent turn taking skills. The roles that emerge in the session include designer/ coordinator, brick finder, and construction worker. In the paper collage task the division of work and the roles the children differ between are similar to the LEGO session, however, the work seems more open-ended and less planned for giving the designer/ coordinator a weaker role in the creative work. On some occasions the group tended to work without a fixed goal and to allow the construction evolve along the way. This is evident in the conversation below between three of the children about the almost finished construction. The tone of the conversation is friendly:

— AN: Wow now it really looks like a lion!
— TO: yeah any animal will do.
— AN: perhaps we are done then?!
— TO: It looks cool. Wait a second; we could also… (ST cuts in)
— ST: Are we making a lion?
— AN: Now we are.
— TO: A MOUSE! It's a mouse.
— AN: No it isn't. It's a lion.
— TO: A lion with short teeth that is.

In general the children in the paper collage task communicated well with each other. Compared to the LEGO session they did it to a lesser degree and the conversations were more focused towards the task. There was only minimal small talk around the table as the paper collage affordance a more closed interaction. The children were bent over the pieces of paper gluing them together while in the LEGO task, the

children had a more open posture and they were working with the LEGO bricks in front of them. It seemed that the lesser degree of communication affected the level of collaboration between the children.

5 Conclusion

In the paper collage it was apparent the children made the creative contribution they immediately wanted to create, with little to no consideration of their own ability to carry out the work. As a result of these immediate decisions the most common depicted theme were characters, such as people and animals as opposed to constructions or landscapes. It was evident that the participants were more challenged in the LEGO® session. They were more constrained in their creativity, and for the collaboratory groups had a strong need for a coherent goal, and to delegate the tasks efficiently in order to finish within the assigned time. As a result there was generally more communication between participants in the LEGO sessions. In the collaboratory groups the participants in the LEGO session were observed to change their theme during construction. In both cases they went from a character design to a building, as such it is likely that if the children had been better supplied with a diverse allotment of bricks in the LEGO session, they would likely have preferred more animated designs.

In relation to the proposition that the perceived level of mastery with a media affects the creative process [2], the participants needs to be aware of what an artifact is able to do, before realizing what they are personally able to accomplish with the artifact [35]. The subjective judgments by the two experienced artists showed a decrease in creativity when the participants worked alone using LEGO compared to the group working alone using paper collage. This paired with the finding that the collaboratory LEGO groups changed their goal as a result of their own lacking mastery, suggesting that the individual participants had similar difficulty, and as a result defaulted to an output they felt able within, in this case creating houses. Interestingly the collaboratory LEGO groups scored relatively higher than their paper collage counterparts while still adapting their design to a house. This could indicate the participants were able to come up with a even better idea as a result of the initial challenge, or that LEGO being more time consuming simply benefits more from the extra hands present in the collaboratory groups.

In sum, the paper collage sessions showed more playful behavior. There was less dissent, and critical discussion between participants, but also less communication overall. The participants in the LEGO session were more critical in their decision-making, but shared the work more efficiently between them, which resulted in more communication.

References

1. Amabile, T.M.: Children's Artistic Creativity: Detrimental Effects of Competition in a Field Setting. Personality and Social Psychology Bulletin 8, 573–578 (1982)

2. Price, S., Rogers, Y., Scaife, M., Stanton, D., Neale, H.: Using 'Tangibles' to Promote Novel Forms of Playful Learning. Interacting with Computers 15, 169–185 (2003)
3. Craft, A.: Creativity and Education Futures: Learning in a Digital Age. Trentham Books Ltd., Westview (2010)
4. Loveless, A.M.: Creativity, Technology and Learning – a review of recent literature, Futurelab Series, No. 4 update (2007)
5. Shneiderman, B.: Creativity Support Tools – Accelerating Discovery and Innovation. Communications of the ACM 50(12), 20–32 (2007)
6. Howard, J.: Eliciting Young Children's Perceptions of Play, Work and Learning Using the Activity Apperception Story Procedure. Early Child Development and Care 172, 489–502 (2002)
7. Howard, J., Bellin, W., Rees, V.: Eliciting Children's Perception of Play and Exploiting Playfulness to Maximise Learning in the Early Years Classroom. In: Proceedings from BERA (British Educational Research Association) Annual Conference, University of Exeter, September 11-12, pp. 1–15 (2002)
8. Liebermann, J.N.: Playfulness and Divergent Thinking: An Investigation of Their Relationship at the Kindergarten Level. Journal of Genetic Psychology 107, 219–224 (1965)
9. Liebermann, J.: Playfulness: Its Relationship to Imagination and Creativity. Academic Press, New York (1977)
10. Vygotsky, L.S.: Mind in Society: The Development of Higher Psychological Processes. Harvard University Press, Cambridge (1978)
11. Bruner, J.S.: Nature and Uses of Immaturity. In: Bruner, J.S., Jolly, A., Sylva, K. (eds.) Play: Its Role in Development and Evolution, Penguin, New York (1972)
12. Fischer, G., Giaccardi, E., Eden, H., Sugimoto, M., Ye, Y.: Beyond binary choices: integrating individual and social creativity. International Journal of Human-Computer Studies 63(4-5), 482–512 (2005)
13. Brereton, M., McGarry, B.: An observational study of how objects support engineering design thinking and communication: implications for the design of tangible media. In: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, pp. 217–224. ACM (2000)
14. Brooks, E.P.: Ludic Engagement Designs: Creating Spaces for Playful Learning. In: Stephanidis, C., Antona, M. (eds.) UAHCI 2013, Part III. LNCS, vol. 8011, pp. 241–249. Springer, Heidelberg (2013)
15. Van Leeuwen, T.: Introducing Social Semiotics, pp. 219–247. Routledge, London (2005)
16. Dansky, J.L., Silverman, I.W.: Effects of Play on the Associative Fluency in Preschool-Aged Children. Developmental Psychology 9 (1973)
17. Dewey, J.: Democracy and Education: an Introduction to the Philosophy of Education. Cosimo Classics, New York (2005)
18. Biskjaer, M.M., Dalsgaard, P.: Toward a Constrating Oriented Pragmatism Understanding of Design Creativity. In: Proceedings of The 2nd International Conference on Design Creativity (ICDC 2012), Glasgow, UK, September 18-20, pp. 65–74 (2012)
19. Norman, D.: Emotional Design: Why we Love (or Hate) Everyday Things. Basic Books, New York (2004)
20. Chally, P.S.: Empowerment Through Teaching. Journal of Nursing Education 31, 117–120 (1992)
21. Wood, E.: Developing a Pedagogy of Play. In: Anning, A., Cullen, J., Fleer, M. (eds.) Early Childhood Education: Society and Culture, SAGE Publications Ltd., London (2004)
22. Resnick, M.: Edutainment? No Thanks. I Prefer Playful Learning. Associazione Civita Report on Edutainment (2004)

23. Dewey, J.: Democracy and Education. The Free Press, New York (1966)
24. Beardon, C., Ehn, P., Malmborg, L.: Design of Augmented Creative Environments. In: Proceedings of CSCL 2002, Boulder, Boulder, Colorado, January 7-11, pp. 503–504. Lawrence Erlbaum Associates, Hillsdale (2002)
25. Sullivan, F.R.: Serious and Playful Inquiry: Epistemological Aspects of Collaborative Creativity. Educational Technology & Society 14, 55–65 (2011)
26. Broadhead, P., Burt, A.: Understanding Young Children's Learning Through Play: Building Playful Pedagogies. Routledge, London (2012)
27. Petersson, E., Brooks, A.: Virtual and Physical Toys: Open-ended features for non-formal learning. Cyber Psychology & Behavior 9(2), 196–199 (2006)
28. Bordieu, P.: The Forms of Capital. In: Richardson, J. (ed.) Handbook of Theory and Research for the Sociology of Education, pp. 241–258. Greenwood, Westport (1986)
29. Gibson, J.J.: The Theory of Affordances. In: Shaw, R.E., Bransford, J. (eds.) Perceiving, Acting, and Knowing: Toward an Ecological Psychology, pp. 67–82. Lawrence Erlbaum Associates, Inc., Hillsdale (1977)
30. Schön, D.A.: The Theory of Inquiry: Dewey's Legacy to Education. Curriculum Inquiry 22(2), 119–139 (1992)
31. Gee, J.P.: What Video Games Have to Teach us About Learning and Literacy. Palgrave Macmillan, New York (2007)
32. Amabile, T.M.: Effects of External Evaluation on Artistic Creativity. Journal of Personality and Social Psychology 37, 221–233 (1979)
33. Conti, R., Collins, M.A., Picariello, M.: The role of gender in mediating the effects of competition on children's creativity. Personality and Individual Difference 30, 1273–1289 (2001)
34. Jordan, B., Henderson, A.: Interaction Analysis: Foundations and Practice. The Journal of the Learning Sciences 4, 39–103 (1995)
35. Brooks, A., Petersson, E.: Raw Emotional Signalling, via Expressive Behaviour. In: Proceedings of the 15th International Conference on Artificial Reality and Telexistence, Christchurch, New Zealand, pp. 133–141 (2005)