Children's Mental Model as a Tool to Provide Innovation in Digital Products

Adriana Chammas(✉), Manuela Quaresma,
and Cláudia Renata Mont'Alvão

LEUI | Laboratory of Ergodesign and Usability Interfaces, PUC-Rio University,
Rio de Janeiro, Brazil
ttdri@yahoo.com.br, {mquaresma, cmontalvao}@puc-rio.br

Abstract. The technological development market is faced with the growing demand for products whose innovations break paradigms. The User-Centered Design approach is used with praise to cause incremental innovations in digital products, but it is not ideal to realize radical innovations. This article aims to present the state of the art in question and ask whether the mental model of children, whose creativity is evident, can be applied to the development process with a User Centered Design approach, and, if so, how to adapt this approach to accelerate the development of radically innovative products to the market.

Keywords: HCI · Methodology · Children · Creativity · Innovation

1 Introduction

This article discusses the role of creativity in the development of innovative digital products and questions if it can be caused, housed in a method. The market cannot keep the eagerness of users for new products, better and different. The User-Centered Design approach is used with praise to provoque incremental innovations in digital products, but according to Norman [16] is not ideal to realize radical innovations. Based on these scenario, this article questions whether the mental model of the children, whose creativity is evident, can be applied to the development process with User Centered Design approach, and, if so, how to adapt this approach to accelerate the development of radically innovative products to market.

2 Urgent Demand

In the era where certainties are constantly changing, the technological development market is faced with a growing demand for products with breaking paradigm innovations. The urgent demand makes incremental innovations launched sparingly, once companies prefer "save" the launch of the features of their product, so they always have an innovation as key to present, albeit incremental, and at least keep the market positioning against the competition. Aware of the demand, technological development market turns to innovative products new releases as rapidly as expected, but there are important differences between two kinds of innovations: incremental and radical. Norman and Verganti [17] explain the difference between them:

© Springer International Publishing Switzerland 2015
A. Marcus (Ed.): DUXU 2015, Part II, LNCS 9187, pp. 23–33, 2015.
DOI: 10.1007/978-3-319-20898-5_3

- Incremental innovations are small changes in a product that will improve its performance, reduce cost, increase the user desire to acquire it or that anticipate the launch of a new product.
- Radical Innovations happen through technology changes or meaning. These innovations break concepts, bring new areas, break paradigms and open field for significant changes.

Even knowing the importance of the user's voice in the product development process, Lettl [13] points out that the radical innovations considered by Von Hippel studies [25, 26] only reaches low to medium degree of innovation. Lettl [13] believes that this result can be explained by specific barriers of users in the context of radical innovations. They are the barrier of knowledge and the barrier of interest.

The first, the knowledge barrier, may be caused by excessive cognitive demands that may occur:

- In the idea generation phase, users may be "functionally attached" to the current context, which would make hard the development of radical ideas (Birch and Rabinowitz (1951) *apud* Lettl [13];
- Without any reference of existing products, it becomes very difficult for the user to deal with concepts and prototypes (Tauber (1974), Schoormans et al. (1995) and Veryzer (1998b) *apud* Lettl [13];
- Users may not be able to make a valuable contribution due to the major technological complexities involved [13].

The second barrier relates to motivation: according to the authors Sheth (1981), Ram (1987) and Sheth and Ram (1989) *apud* Lettl [13]; this gap of motivation may come from the fear of obsolescence of knowledge presented by the user. Norman and Verganti [17] illustrate the motivation barrier by placing that radical innovations that propose double changes, both technology as meaning, are dangerous, since users tend to resist massive changes. This is the ambiguous nature of innovation. It requires changes and with them, energy spent on learning.

Despite the barriers exposed above, it can be understood that clear comprehension of user characteristics significantly increases the effectiveness in finding the ideal profile for the research. Companies must identify what type of user is able to contribute, at different stages in the radical innovation process and identify how best to interact with them. It is noticed that the mental model of the user must be taken into account.

The studies (Sheth 1981; Ram 1987; Sheth and Ram 1989 *apud* Lettl [13]) have shown that companies focused on radical innovation benefit significantly by interacting with users, since users are able to act as inventors and co-developers of innovations. Saffer [19] agrees with user participation as co-author and cites the User-Centered Design, henceforth DCU, as the most popular of all product development approaches such.

3 Approaches

Different design theories have been adapted and adopted to actively involve children in the development of technological products for them (Nesset and Large 2004). The relevant theories, in addition to the DCU [11] are: Contextual Design [2], Participatory

Design [5, 15], Cooperative Inquiry [9, 10], Informant Design [21] and Learner-centered Design [15].

3.1 User-Centered Design

Classical approach, DCU [11] focuses on the impact that technology will bring to the wishes and needs of users, both in newer versions of existing products as well as new concepts. The DCU is an iterative process of rapid prototyping and testing in several cycles to ensure that products are appropriate for their users. The process begins with a deeply analysis of users' needs and tries to link these needs to most appropriate technologies (or methods) that can better satisfy them - or tailor products to new trends. For Nesset and Large [15], the issues that guide the User-Centered Design are: (a) Activities - What software does? (b) Tools - What tools are needed to accomplish the tasks? (c) Interface - What interface supports these tools?

DCU techniques are appropriate for incremental innovations. Norman [16], a pioneer in DCU, points out important limitations that this approach presents, when the goal is radical innovation. The DCU is a philosophy, not a precise set of methods. It assumes that innovation must come from users. Likewise, von Hippel [25, 26] points out the users as the highest sources of innovation. Druin [9, 10] and Nesset and Large [15] makes clear that the DCU users, whether adults or children, are involved too late to have some control in the development process. One of the critical points of the approach in question is the user involvement limitation, which is not able to create or modify the product really, just point out its problems. Another important point is the need to make adjustments in its methods to use them with children: Questionnaires can be boring or difficult to understand, for example.

Norman [16] defines mental models as concepts in the minds of people who represent the understanding they have of how things work. For the author, people may have different mental models for the same thing, action, activity, while the same person can have multiple mental models for the same thing, action, activity, each dealing with a different aspect of the operation. Mental models are valuable for allowing prediction and understanding of how things should behave. Norman [16] also points out that these models serve as guides to help designers achieve the objectives in "worlds" unknown. Saffer [19] believes that the best mental models allow a deeper understanding of how the "thing" works without the complexity of what makes it works. Ultimately, both related mental models to the core of innovation, the concept of creativity.

3.2 Contextual Design

The Contextual Design is an approach widely used to reveal details, constraints and user motivations in their work context [2]. In Contextual Design a database is created from observations of typical user activities and then exposed to the creative/development group, so the team can share it and use as a base to their design decisions. The researchers make their records and seek to conduct research while maintaining the

lowest possible interaction with users, just asking questions for clarification, if needed. This working model is pictorial, easy to see and can be understood quickly [15].

Based on the collected data, the work is structured for a new phase, in which the models will be consolidated and, with the identification of patterns (without neglect the individual variations) an affinity diagram is built. The team discussed about the consolidation of the collected data and how technology can benefit users. Storyboards are developed to understand how the user will interact with the new system and what impact this technology can bring to the user routine. Finally, low-fidelity mock-ups are developed and tested with users.

Considering the use of paper prototyping, pictorial and colorful diagrams and specific technical exercises, Nesset and Large [15] understand that the Contextual Design is appropriate to the context centered on the child.

3.3 Participatory Design

Iterative by premised, that said that no one approach is better than the users themselves to determine how to improve your routine. The objectives and strategies to achieve them are continually refined and there is no order default for your practice [5, 15].

There are two major themes for the implementation of the Participatory Design principles (Muller 1991; Muller, Wildman and White 1994 apud Druin et al. [9, 10, 15]: the "mutual reciprocal learning" where designers and users exchange knowledge and experiences about practical and technical possibilities; and the "design by doing", where interactions are experienced, modelled, supported and learned during practice. The Participatory Design mainly makes use of two techniques: modelling and the metaphor based design. The modelling occurs with the implementation of fantasies, criticism or what-if scenarios based on users' requirements. From these two techniques, Nesset and Large [15] choose the metaphor based design as the most practical and creative to represent the desired results because this process of conceptual prototyping is generated from metaphors that represent the present and future scenarios. Designers and users collaborate with each other in the process.

Although widely adopted, the great challenge of Participatory Design is the reluctance from the development staff to accept inputs from users. This challenge is also reflects when the design project is child-centered. Children should be considered true partners in design. Therefore, the Participatory Design process/techniques are suitable for children.

3.4 Cooperative Inquiry

Druin et al. [9, 10] understand that with the development of new technologies for children, their participation in research laboratories is gaining ground in the market and makes their inputs crucial in the design and development process. This understanding led the authors to develop a new methodology to enable the developer team to stop, listen and learn from the collaboration of children of various ages - and thus create exciting new and significant technologies for children, by children.

The Cooperative Inquiry is a combination of different techniques of useful approaches to apply with children. Based on exploratory studies and literature, adjustments were made in Contextual Inquiry, developed by Beyer and Holtzblatt [2]; the review of the Technology Immersion, the CHIkids developed by Boltman et al. (1998); [9, 10]; and defined the approach.

Druin [9] concludes that the major advantage of the approach is to collect data on true and sincere children's views not what the children believe adults want to hear. The adaptation of the technique must take into account the dynamics of a team composed by multiple generations. The Cooperative Inquiry orientation is to balance the team, always with more than one child and more than one adult. Adults should behave as adults when appropriate.

Druin et al. [9] considers 7 to 10 years the ideal age for Cooperative Inquiry, because at this age children are able to develop ideas of abstract concepts and, by the same time, are still open to explore new ideas. A little different than Druin et al. [9] and attentive to decrease the divergent thinking at around 09 years old, Lubart and Lautry 1996 *apud* Russ and Fiorelli [18] speculate that the development of rationality in this phase can affect the creative performance. Piaget (1962) *apud* Russ and Fiorelli, [18] says that "the creative imagination, which is the assimilation of the activity in the state of spontaneity, does not decreases with time. As a result of a related process of adaptation, creativity is gradually reintegrated into intelligence".

The Cooperative Inquiry notes users in context with, at least, two researchers participating. The first should be interacting with the child as a facilitator and the second will make the records out of the child's visual range. Among other techniques borrowed from other approaches, Druin et al. [9, 10], found that the construction of a "cartoon-like" flow chart is necessary, as the authors noted that children cannot comply events in the proposed order, and sometimes starts more than one task at a time, and complete them at random - or even complete it [15]. Druin et al. [9] considered the low-fidelity prototypes an effective tool when used along Cooperative Inquiry: it keeps the focus of the discussion centered on its purpose and become thrusters of collaborative brainstormings.

3.5 Informant Design

Developed by Scaife et al. [21], the Informant Design also considers the iteration ideal. This approach considers that each team member brings different inputs, at different stages of the project. The author makes adjustments on prototypes in order to adapt them to use with children [21]. The Informant Design advocates the use of several informants (adults and children, for example) to maximize the wealth of information. The approach is structured in three phases: (a) Elect the objectives and identify strengths and weaknesses of the project; (b) Adults and children are separated in different informants teams and designers evaluate the inputs of both teams. Then developers make a list of issues; (c) Low-fidelity prototypes are constructed and proposed only for the children's team. The inputs will be used to build high-fidelity prototypes for evaluation by both teams. Iterations are considered, if necessary.

Scaife et al. [21] point out the Informant Design as an alternative to User-Centered Design or Participatory Design and believes that this is the best approach to the design of digital products for atypical users or users who cannot be considered equal to developers, like children for example [15].

3.6 Learner-Centered Design

The approach proposed by Soloway, Guzdial and Hay (1994) *apud* Nesset and Large [15] says that the interface design should be adapted to the interests, knowledge and the style of it apprentices. The authors are all learners, whether professionals or students. The questions that guides the Learner Centered Design are: (a) Understanding - How will be the learning interaction? (b) Motivation - How to motivate the learner interface? (c) Diversity - How should be developed to different learners interface? (d) Growth - Since the interface can track user ripening?

To answer the questions listed above, Soloway et al. (1994) apud Nesset and Large [15] adapted the Scaffolding Technique for which they named TILT model of design software (Task, Interface, Learner's needs, Tools). The Scaffolding Technique is an instructional process oriented to promote a consistent learning, wherein the extent to which learners gradually internalize their learning, the support for the interaction disappears, until the user controls it completely. The natural orientation of the approach is the development of understanding, performance and user expertise [15].

4 Creativity and Children

Sternberg and Lubart [22] relate the concept of creativity to the process of generating new ideas that bring into existence new ways of thinking and doing. It is the ability to create, produce or invent new things; inventiveness and artistic creativity (Houaiss).

For Wright [27] all people have some creative potential, what differs is how much of that potential people are able to accomplish. The author exposes the creativity as a mental trait, a trait of personality. She [27] lists the personal qualities of creative people: the valuation of creativity, originality, independence, risk taking, ability to reset problems, energy, curiosity, attraction to complexity, artistry, open mind, desire to spend time alone, perceptiveness, concentration, mood and ability to resume childhood qualities. For the author [27], these personality traits are associated with thinking styles, which include: visualization, imagination, experimentation, metaphorical/analogical thinking, logical reasoning, profit prediction and consequences, analysis, synthesis and evaluation. Added to thinking styles mentioned, intrinsic motivation and commitment are key personal qualities for the development of creativity.

Csikszentmihalyi [7] believes that creativity refers to the significant change in some aspect of the field and it develops through interpersonal relationships, the relationship between the creative and their work and compass between the individual and other people (or institutions) that judge the quality of their work. For Csikszentmihalyi [7], which allows certain individuals to make memorable contributions to culture is the personal resolution to model their lives to achieve their goals rather than drift the

destination. It can be said that the most obvious of the creative achievements is that they have created for their own lives.

In a controversial paper at the time, Csikszentmihalyi [7] states that the purely rational application is inadequate, not only to explain the creativity, but cognition in general. The human mind cannot be understood only in terms of knowledge and heuristics, as to explain the genesis of the creative act, one must understand and include the complex interaction between the emotional and motivational dimensions. The ideal model, according to the author, is who balances all of the above elements and also takes into account the dynamics of the process. The most important revelation is what can motivate people to use their minds as they use in real life, not only in solving problems in controlled experiments. Barclay & Petitto [1] agree that decoupage cognition, emotion and motivation in the context of real life is an important strategy to untangle personal aspects, whether organic or environmental, but state that the decoupage does not imply disassociate these genuine dimensions, but to isolate elements of thinking without forgetting the interdependence between cognition and motivation.

Regardless of the discussion among the authors, it is clear that, for both the creative phenomenon that occurs with the task can be influenced by the audience or by the context in which it occurs. It is understood then that motivation is directly related to the creative phenomenon.

Simonton [20] points out that advances in research regarding creativity focus on the following topics: the cognitive process involved in this activity, the personal creative features, and finally the development and manifestation of creativity during the life of creative and social context.

Russ and Fiorelli [18] agree that contemporary creative research face the creative product as a result of a complex interaction between the individual and the context. The authors states that there are different variables in the processes that encourage creativity and that many of these processes can be observed and measured in children. Some of these cognitive and affective processes are divergent thinking, problem solving, flexibility of thought, accessories to emotion, and accessories to affect in fantasy. Much of what has been written on the development of children's creativity involves playing, and the greatest evidence of the creative act in children occurs during the play activity. Fein (1987), Sawyer (1987) and Vygotsky (1930/1967) *apud* Russ and Fiorelli [18] state that creativity and play are interconnected. The authors state that adult interventions can improve the play and conclude that the suggestion of similar techniques can be of great help in the development of creativity.

Russ and Fiorelli [18] point to several studies that suggest that children are creative from birth as soon as they are able to bring new ideas. The authors affirm that it should be considered many examples of routine creativity, also know as "little-c". Authors suggest some ways (present below) to incite the various processes involving the creativity in childhood, so they can become creative adults:

1. Allow time for the child to play pretend play - Incorporating conventional-imaginative play and symbolic play;
2. Encourage activities in different areas, so that the child can find What They deeply enjoy and Develop Their talents and abilities;
3. Strengthen and enhance routine creative acts;

4. Encourage independence in problem solving, keeping in mind the balance between challenge and frustration;
5. Encourage verbal expression of feelings, especially during games, so the child gets used to the practice of verbalization and can join the activity in the accessible memory.

It is common the link between the concepts creativity and children [3, 9, 10, 12, 23, 27]. Bruckman and Bandlow [3] state that the children's perception of the world of is radically different from the adults' perception and recommend that innovative projects become from surveys with this profile, whose imagination is peculiar. The authors state that personal qualities of the most creative people in history are inherent to children [9, 10, 20, 27].

Teachers agree with that, once inserted in a suitable context, children provide meaningful ideas on request, especially when they realize the value that their ideas can bring to the project in question and how much they can share with their peers [20]. The author points out that children's creativity can spark better solutions than adults' when asked to create their own version of existing objects [20]. It can be concluded that the exercise of redesign objects, real or virtual, encourages children's trust and ability to go beyond the world of art and design around adults and allows rethink possibilities even in objects that were not created yet.

Kelley and Littman [12] agree that it is fundamental for innovation to observe and talk with children. As co-authors in digital product development processes, children offer honest contributions with their own world views. They have different opinions, preferences and needs than adults opinions, preferences and needs. IDEO [12], a renowned Design company based in Silicon Valley, is dedicated to developing innovative products. In alternate weeks, IDEO invites children to be observed when interacting with their products and prototypes, believing that the uniqueness inherent in children cannot be found elsewhere. Druin et al. [9, 10] and Markopoulos et al. [14] emphasize that beliefs regarding what will be the behavior of children and what can be expected of them in the context of evaluation are odd. Both agree that the digital product development methodology must be appropriate to hear and interpret the contributions of children.

5 A Creative Proposal

Creative people are masters in accomplishing profitable findings of problems and fields of ideas that are not related. They perceive connections between data and ideas and turn these patterns in even better ideas. Csikszentmihalyi [7], in its publication on creativity, identified patterns in creative people that can be replicated in controlled conditions. According to the author's research, we bring further questions:

1. The identification of such patterns can be applied in children?
2. If it is possible to identify them from the patterns, is it possible to outline, transform the pattern into a replicable mental model and apply it in an adult?
3. The barrier of knowledge and the barrier of interest, both identified by Lettl [13] in the context of radical innovations, can be minimized if not annihilated, if the child mental model, free of preconceptions of adults is used?

4. Is the mental model of children better than the mental model of adult users in projects involving creativity required to produce radical innovations?
5. Can DCU techniques be adapted to children's mental model of the for radical innovations investigation?
6. Can innovation based on children's mental model be measured?

It is believed that the answers to the above questions will benefit those responsible for advanced technology development, to enable more and better innovative (disruptive) products for future consumption in the market. The results of this research can provide effective gains in digital solutions development processes and bring disruptive innovations that can transform the mindset of children in a process. Thus, in addition to monitoring the agility required by the market, the digital product development process tends to be satisfactory in terms of design and productivity, in which the end result should, in addition to ensuring the user a positive and enjoyable experience, provide revolutionary solutions.

6 Final Thoughts

Regarding specific discussions on methodology, children and creativity, this paper aimed to present the state of art of the topics in question and propose that children's mental model, and all creativity inherent in it, can be used in project development methodology for digital solutions for radical innovations. Kafai (1999 *apud* Nesset and Large [15]), believes that children have the ability to be more than just informants and become design process' participants. Many other researchers cited in this paper share thoughts with this author and the literature examined stresses the importance of children's participation in such projects.

Here were explored approaches commonly used in research with children and all depart from the DCU, each in his own way. Despite the UCD uncontestable value, it is noticed that, unlike Saffer [19] thinks when quotes that User Centered Design as the most popular of the digital product development approaches, the approaches previously explored urge that changes are needed in the classical approach, especially when it involves children - regardless of what role they have in the process.

The barrier of knowledge and the barrier of interest were revealed as obstacles to the urgent demand of radically innovative products. The barriers cited in this paper are presents less impact on children. It is believed that the barrier of knowledge caused by the excess of cognitive demands, suggested by Lettl [13] and listed below, can be minimized:

(a) Idea generation phase, when users may be "functionally fixed", can be overcome by the ability to create, to produce or to invent new things inherent to children [6, 9, 10, 12, 14, 15, 27].
(b) Up front the discussion over the decrescent divergent thinking at around 9 years old [18] recognize that children in general (in the range of age and development) have not had time yet to master the acquired knowledge in order to do more complex transformations or sublimation. But even without references over

existing products, children (especially from 07 to 09 years old) have the ability to deal with abstract concepts [6, 18] and can become effective source of creativity;

(c) Although users may not be able to offer valuable contributions towards technological complexities [13], children can make suggestions that will lead developers to adapt the technology to the operational reality and bring them to possible reality.

It is understood that the fear of obsolescence of knowledge, envisioned by the user featuring the barrier of motivation [13], will not be experienced by children. Therefore, it is understood that children's mental model can be the key to development of radical innovations. Companies interested in creating and developing this type of product can meet the profile of user who can contribute in the innovation process.

References

1. Barclay, C.R., Petitto, A.L.: Creative activity in the context of real life: a response to Csikszentmihalyi. New Ideas Psychol. **7**(1), 41–48 (1989)
2. Beyer, H.R., Holtzblatt, K.: Contextual design. Interactions **6**(1), 32–42 (1999)
3. Bruckman, A., Bandlow, A.: Human-Computer Interaction for Kids. In: Jacko, J., Sears, A. (eds.) The Human-Computer Interaction Handbook, vol. 1, pp. 428–440. Lawence Erlbaum, Hillsdale (2003)
4. Bruckman, A.: Teaching students to study online communities ethically. J. Inf. Ethics **15**(2), 82–98 (2006)
5. Carmel, E., Whitaker, R., George, J.: PD and joint application design: a transatlantic comparison. Commun. ACM - Spec. Issue Participatory Des. **36**(4), 40–48 (1993)
6. Chammas, A., Moraes, A., Teixeira, A.: Ergonomics and Usability for Children: Spore®: a Study Case. Ergonomia e usabilidade de interfaces para crianças: o estudo de caso do game Spore®. Dissertação (mestrado) – Pontifícia Universidade Católica do Rio de Janeiro, PUC Rio, Rio de Janeiro (2011)
7. Csikszentmihalyi, M.: Motivation and creativity: towards a synthesis of structural and energistic approaches to cognition. New Ideas Psychol. **6**, 159–176 (1988)
8. Dietrich, A.: Who's afraid of a cognitive neuroscience of creativity? Sci. Direct Methods **42**, 22–27 (2007)
9. Druin, A., Bederson, B., Boltman, A., Miura, A., Knotts-Callahan, D., Platt, M.: Children as our technology design partners. In: Druin, A. (ed.) The Design of Children's Technology, vol. 1, pp. 51–72. Morgan Kaufmann Publishers Inc., San Francisco (2006)
10. Druin, A.: Children as co-designers of new technologies: valuing the imagination to transform what is possible. New Dir. Youth Dev. Theor. Pract. Res. Youth Media Creators **128**, 35–44 (2011)
11. ISO 9241-210 (2010): ISO 9241-210. Ergonomics Of Human-System Interaction – Part 210: Human-Centred Design For Interactive Systems. Génève: International Organization Standarization (2010)
12. Kelley, T., Littman, J.: The Ten Faces of Innovation. IDEO's Strategies for Defeating the Devil's Advocate and Driving Creativity Throughout Your Organization. Doubleday, New York (2005)
13. Lettl, C.: User Involvement Competence for Radical Innovation. J. Eng. Tech. Manage. **24** (1–2), 53–75 (2007)

14. Markopoulos, P., et al.: Evaluating Children's Interactive Products: Principles and Practices for Interactions Designers. Morgan Kaufmann (Elsevier, Inc.), Burlington (2008)
15. Nesset, V., Large, A.: Children in the information technology design process: a review of theories and their applications. Sci. Direct Libr. Inf. Sci. Res. **26**, 140–161 (2004)
16. Norman, D.A.: Design of Everyday Things, Revised and Expanded: Basic Books. MIT Press (UK edition) New York, London (2013)
17. Norman, D.A., Verganti, R.: Incremental and radical innovation: design research versus technology and meaning change. Des. Issues **30**(1), 78–96 (2012)
18. Russ, S.W., Fiorelli, J.A.: Developmental approaches to creativity. In: Kaufman, J.C., Sternberg, R.J. (eds.) The Cambridge Handbook of Creativity, vol. 12. Cambridge University Press, New York (2010)
19. Saffer, D.: Designing for Interaction. New Riders, Berkeley (2010)
20. Simonton, D.K.: Creativity: cognitive, personal, developmental, and social aspects. Am. Psychol. Assoc. Am. Psychol. **55**(1), 151–158 (2000)
21. Scaife, M., Rogers, Y.: Kids as informants: telling us what we didn't know or confirming what we knew already? In: Druin, A. (ed.) The Design of Children's Technology. Morgan Kaufmann Publishers, Brighton (1999)
22. Sternberg, R., Lubart, T.: Investing in creativity. Am. Psychol. **51**(7), 677–688 (1996)
23. Szekely, G.: How Children Make Art: Lessons in Creativity from Home to School. Teachers College Press, New York (2006)
24. Villar, M.S., Franco, F.M.M.: Houaiss Portuguese Dictionary - Dicionário Houaiss da língua Portuguesa. Objetiva, Rio de Janeiro (2009)
25. Von Hippel, E.A.: The Sources of Innovation. Oxford University Press, New York (1988)
26. Von Hippel, E.A.: Democratizing Innovation. MIT Press, Cambridge (2005)
27. Wright, S.: Understanding Creativity in Early Childhood: Meaning-Making and Children's Drawings. SAGE Publications, London (2010)