The Playful and Reflective Game Designer

Gunver Majgaard
The Maersk Mc-Kinney Moller Institute, University of Southern Denmark, Odense, Denmark
gum@mmmi.sdu.dk

Abstract: A group of first-semester engineering students participated in a game design course. The aim of the course was to learn how to design computer games and programming skills by creating their own games, thereby applying their game-playing experiences to gain knowledge about game design. The aim was for students to develop a more critically reflective perspective on video games and game design. In applying their game experiences, they developed their own digital prototypes and participated in reflective discussions on the concept of games: what makes them interesting and how they are constructed. The students used the GameMaker programming tool, which can be used without any prior programming knowledge. The tool allows for the easy development of 2D game prototypes.The didactic approach was based on play as a lever for the design process, and on constructionistic and reflective learning philosophies. Playing games constituted an integral element of the design process; new code added to the program was tested by playing the game. The students were constantly alternating between playing and adding and revising code. The learning environment where games were played and developed could be considered to be a sandbox where experimentation was a motivational factor for the students, as they could make mistakes and try out creative ideas. Although the constructionistic learning approach promoted creative and innovative learning, it did not develop competencies in articulation and analysis. The aim was for students to reflect on games in order to promote explicit knowledge. Based on the theory, we consider retrospective reflective discussions in the classroom and their programming experiences reinforced the learning process. In summary, we present the students' first progression from native consumers in the game world to becoming reflective designers. Along their journey, they developed a reflective practice and an understanding of the profession they were entering. The article also throws light on the very dynamic and fruitful relationship that exists between playing games and designing games.

Keywords: Learning, play, constructionism, reflection, game-based learning, game design, serious games, university pedagogy

1. Introduction

A group of first-semester students participated in a course to design and programme games. The aim was to learn about game design and programming by creating, testing and playing their own games. The didactic approach was based on play as a lever in the design process, and on constructionistic and reflective learning philosophies.

They used the programming tool GameMaker, which can be used without any prior knowledge of programming (Habgood, 2006 and 2007). GameMaker is ideal for developing game prototypes in 2D. An integral part of the process of game development, involved the students playing the games. The idea was to provide both “low floor” (easy to get started) and “high ceiling” programming tools (to create increasingly complex projects over time) (Resnick, 2009). The intention was for the students to experiment, learn from making mistakes and create interesting games.

Papert (1993) used programming as a tool to teach children mathematics. By interacting with the programming tool, the children constructed programmes and developed their knowledge of mathematics. He thought of the programming tool as “an object to think with”. Our aim was to set up a similar learning process in this course.

Additionally, we wanted the students to convert some of their game-playing experiences to actively create knowledge about game design. It was intended to give students a more critical and reflective approach to computer games and game design.

Reference this paper as: Gunver Majgaard “The Playful and Reflective Game Designer” *The Electronic Journal of e-Learning* Volume 12 Issue 3 2014, (pp271-280) available online at www.ejel.org

The students in the study had all played a range of computer and console games since they were 5-6 years old and were, therefore, regarded as "native consumers" in the game world. These young people grew up playing video games as an integrated element of their everyday lives; some had played intensively, while others had played more sporadically.

In order to make the conversion from experience to knowledge, they had to distance themselves from the consumer role. They needed to develop the capacity to reflect on what constitutes a game, what it is that makes a game interesting and on how games are constructed. These reflections informed their development of interactive prototypes.

The students were enrolled on the three-plus-two engineering programme "Learning and Experience Technology" at the University of Southern Denmark. In addition to this course, they also followed lectures on game design and game theory, which included Fullerton (2007), Zimmerman & Salen (2004), Csikszentmihalyi (2005), Juul (2005) and Sicart (2008) in the reading list.

The research question in this article is: How can construction, play and reflection enrich the game design process for engineering students?

The research method is inspired by design-based research. The intention was to produce new theories and practices based on digitally-supported learning and teaching in naturalistic settings (Majgaard, 2011a; van den Akker, 2006; Barab, 2004). The method is interventionist, i.e. it involves an element of design, it takes place in naturalistic contexts, and it is iterative. In this study, we designed a new practice for creating games in the classroom. The study was based on interventions in the classroom, teaching materials and student products. Finally, we undertook a qualitative email interview with six students (Kvale, 1997). These interviews reflected the students' views on gaming and what they learned by playing and designing games. They were questioned about specific gaming experiences and how these affected the design.

Organisation of the paper: First we offer a brief summary of the course and reflections on the didactics. We then present the underlying theory, which focuses on the dynamics between play, reflection and active participation. The students' active participation promotes reflection and acquisition of new knowledge. This underlying theory is based, in particular, on Schön's ideas on the practitioner's active participation and reflection on practice (Schön, 2001; Argyris, 1978). In addition, the focus is on the relationship between tacit and explicit knowledge (Scharmer, 2000 and 2007). The dynamics between tacit and explicit knowledge are brought into play in innovative design processes. This is followed by a discussion of the learning potential that emerged in the study. The paper ends with a summary and conclusion. This article is an extended version of the ECGBL (European Conference on Games Based Learning) conference paper: "Creating Games in the Classroom – from native gamers to reflective designers" (Majgaard, 2013). In this version, we unfold the importance of play as a part of the design process. Additionally, we explain the terms reflection-in-games and reflection-on-games more clearly.

2. Background: Description of the course "Game Programming"

The course, intended for first-semester students with no prior programming skills, ran over 15 weeks, with two weekly one-hour lectures. The course combined theory and practice. The primary aim of the course was to teach the students basic game programming. A further aim was for students to gain knowledge of what makes games interesting and of game design methodology. They would also gain practical experience in iterative development processes.

The programming platform was the programming tool GameMaker. At the start of the course, the students imitated and copied already programmed games, in order to become familiar with game programming concepts, such as sprites, objects, structures, events, actions, rooms, sound and motion (Habgood, 2006 and 2007). The students played GameMaker games and subsequently developed their own versions of the games.

At first, their own versions were copies of existing example games, but gradually they developed creative variants.

In the fifth week, the students embarked on their first bigger project task – to develop their own game idea. The requirements for the game were: at least one level; at least two objects moving; sound; collisions handling; title page and dialogue box or a high-score list. They had three weeks to develop the first version; each week, there was a brief follow-up in the classroom.

At the end of the three weeks, the students presented their games in class. This led to a discussion of the strengths and weaknesses of the games and to the next project task: the students were to formulate a prioritised list of requirements for the next version of their game prototypes. The aim was to encourage the students work iteratively, set goals and assess what realistically could be achieved within a deadline. Most of the students carried out three iterations.

3. Game design and learning theory: Play, constructionism and reflection

Ideas around bringing games into the classroom are often based on the motivational nature of games; we further hoped to make the students' academic learning easier and more fun (Kafai, 2006). According to Kafai, there have been relatively few attempts to make games for learning – as opposed to playing games for learning. Kafai suggests that, rather than embedding "lessons" directly in games, students could be provided with greater opportunities to construct their own games. She suggests that constructionistic game design has equal if not more potential to engage learners' enthusiasm. An aspect of the learners' enthusiasm could derive from play.

3.1 Play and proximal development

The student might adopt a playful attitude when developing and playing their games. Play is an activity where the learner can use imagination and experiment. Play can become a framework that promotes experimental and exploratory participation (Bateson, 2000). Play potentially provides a special way of participating in an educational context that can promote co-creative and imaginative activities. When we made up our didactical plans, we wanted play to be a driver in the development process. We considered that play could be a motivational factor and provide a framework for experimentation. Vygotsky links play and learning. He is particularly known for the concept of "the zone of proximal development" (Vygotsky, 1978). The zone of proximal development is the distance between what the child can learn by itself and what can be learned in collaboration with peers or a teacher (Vygotsky, 1978:86). We applied Vygotsky's ideas in our study. The level of academic learning goals should match the learner's current academic level or be slightly above it. If academic goals are set beyond the zone, it might very well be too frustrating or impossible for the student to reach the goals. But then again students might have different levels of frustration.

Play creates space for the zone of proximal development. Vygotsky believes that the child's play often occurs in the zone of proximal development. Play can be used as a tool for learning and play can very well be a lever for learning. Play allows learners to do something they would not otherwise have been able to do on their own initiative.

> *Play creates a zone of proximal development of the child. In play a child always behaves beyond his average age, above his daily behaviour; in play it is as though he were a head taller than himself. (Vygotsky, 1978:102)*

In our didactical design, we planned for the students to play games as part of the design process. And we aimed for the students' zone of proximal development. Play provides the opportunity to simulate and explore imaginary situations in practice and in association with others. By playing, the learner develops a deeper

understanding of a given field. The game helps to develop abstract thoughts about the given field and gives the learner new forms of desires and interests (Vygotsky, 1978:100).

Vygotsky suggests that the learner can reach the zone of proximal development by playing, collaborating with peers or a teacher. It was our intention to create a space for all of these possibilities in the classroom. In the didactical design, we wanted to promote play by encouraging the students to play games as a part of the development process. We provided a metaphorical 'sandbox' for learning and experimentation.

While testing and playing games, the students were to develop game programmes. Programme development is, in our view, a constructionist and reflective process. This perspective is unfolded below.

3.2 Constructionism and reflection

The learning philosophy was based on constructionism, where the learner constructs knowledge while creating constructions in the real world (Papert, 1993). Constructionism was inspired by Piaget's concept of constructivism. Although Papert's focus was on learning mathematics, we employed his learning tools to support both physical and virtual constructions in game design. Resnick (2009) developed the idea of designing games and simulations and suggested programming as a fundamental skill to which everybody should be introduced. He proposed using the brick programming tool Scratch (Scratch, 2013). At our department, we have used both Scratch and App Inventor (App Inventor, 2013) for students without prior programming experience. Physical education students created games in Scratch as an interface for an interactive shoe sole. The App Inventor was used as a prototyping tool in a Human Computer Interaction course (Nielsen & Majgaard, 2013).

Constructionistic learning promotes creative and innovative constructions in the real world. However, it does not involve articulating and analysing competences. Besides creating constructionistic learning process, we also wanted to promote the students' analytic competences. We wanted the students to reflect on and articulate their design process. We believed the dialogue based on the academic theory and their programming experiences would reinforce the learning process. This is theoretically supported by Schön (2001) and Bateson (2000).

Knowledge evolves through active participation and reflection (Schön, 2001; Majgaard, 2011 and 2009). Active participation and the journey towards becoming a professional game-designer, are the key terms in creating games in the classroom. The knowledge achieved by the students was applied to actual designs of prototypes and to reflections on the process involved. Aspects of knowledge gained and applied is often difficult to put into words and can be described as tacit knowledge (Schön, 2001; Agyris, 1978).

The educational goals were to develop a new practice for the design of games. Knowledge-in-action is inherent in this practice and is difficult to make explicit in an adequate manner. It is, for example, difficult to explain how to use a hammer, or how to recognise a face in a large crowd. These are examples of actions that we spontaneously know how to perform in the actual situation.

The concept of knowledge-in-action alone is not sufficient in a learning process or in a field practice. This must be supported by more retrospective forms of reflection. In addition, the students reflect on their own learning strategy and they adjust to a given situation and context. It is a concept developed by Bateson (2000), and adapted for the current educational context (Gleerup, 2005). This type of reflection is deliberately used in teaching when students are asked to articulate what they have learned by designing a game and how to improve the learning strategy.

4. Learning potential based on the didactical approach

Our didactical approach was to use play, constructionism and reflection as a lever for the students' learning process. Their views on professional games changed during the course and they developed respect for the bigger game productions. The new level of respect was based on the knowledge they gained about designing games. They were also able to point to game elements which did not function optimally. This expresses an ability to evaluate and analyse, which requires distance and perspective. Reflection-in-action and reflection-on-action are prerequisites for learning by creating games in the classroom. The students' reflections alternated between reflection-in-action and reflection-on-action as part of the game design process. Reflection-in-action occurred when they were playing and developing games. They reflected-on-action when they evaluated and analysed the design process. The students took on different roles in the design process, e.g. game testers, developers and learners. Reflection-in-action and reflection-on-action are prerequisites for learning by creating games in the classroom.

The interplay between play, construction and reflection promoted several learning perspectives, highlighted below. First and foremost, the students changed their approach from a consumerist approach towards games to a participatory approach. They became creative, reflective and innovative contributors.

5. From digital native to becoming digital contributors and citizens

The students were between 4 and 10 years old when they played their first video games and the majority were between 5 and 6 years old. The games included Pinball, Super Mario, Pixiline, Magnus, and the Gnat and Mummy Trolls. At present half of the students highlight the bigger games such as World of Warcraft, GTA (Grand Theft Auto) or FIFA (European Football video game). The other half highlighted casual games such as Plant versus Zombies or Tetris. Virtually everyone mentioned that, at some point, they had played Counter Strike and Super Mario. Super Mario was even the inspiration for some of the game prototypes.

Today's students are often regarded as digital citizens or digital natives, since computers have been a part of their lives from a very early age. Resnick (2009) argues that everybody should be able to make their own interactive games, stories, animations and simulations in order to fully participate and understand the digital community:

> *"..everyone has an opportunity to become a fully fluent contributor to today's digital society." (Resnick 2009)*

He argues that everybody should be able to programme at least on a basic level. In creating one's own simple programmes, one gets a better understanding of the digital world and it becomes easier to influence the digital world. In Resnick's perspective the students do not fully become digital citizens until they have started to make interactive digital contributions – in this case digital games. The students might be digital natives and digital consumers, since they had been using computers for play for most of their lives. But becoming a digital citizen requires a deeper understanding of the digital world and it requires that the students become digital contributors, see Figure 1.

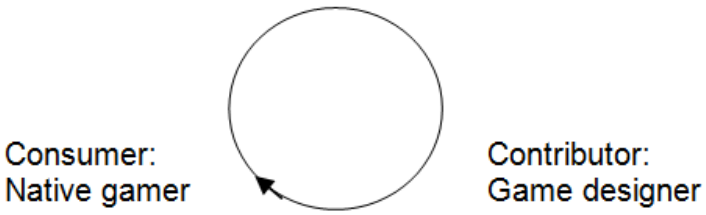

Figure 1: Digital citizenship

The figure visualises the students' voyage from digital native game consumers to becoming contributing game designers. The voyage gave them a new and more reflected view on playing games. When they play games in the future for pleasure or part of their study they will have gained a new and deeper insight on games. Our two didactical tools, constructionism and reflection, created a distance from the consumer role that allowed the students to become creative. And they transformed their game knowledge into new games.

6. The sandbox: gaming and learning simultaneously

How did we experience play in the classroom? In the classroom we took play and games very seriously. When the students suggested game ideas, such as lawnmowers vs. sheep, we seriously discussed gameplay strategies, balancing and programming details. The students explored and balanced the game play. They added new obstacles into to the game to make it more interesting. Play created a space where it was okay to come up with quirky ideas, and where imagination and experimentation had its own framework. This framework formed a metaphorical sandbox. The sandbox was a kind of safe haven for the students where they could make mistakes and conduct experiments without being judged. It was ok for the students to add psychedelic monsters into the game or simulate a paranoid schizophrenic world view. The sandbox relates to Bateson's theory of framing, where the learner ascribes or frames his context as being playful (Bateson, 2000:184). Gee (2003) also highlights sandboxes as safe havens that still look and feel like the real world, but with risks and dangers greatly mitigated.

The students played each other's games. They gave feedback and became inspired by the other students' games. There was a tendency for some students to make the intro play in their games too difficult for others to play. We believe one reason for this was because they were experienced, expert players in their own specific game. Feedback was often given to target the intro play appropriately for novice players.

Playing the games was a part of the design process. When the students added new code, the only way to test it was to play the game. The design process involved the students constantly alternating between playing and adding new code. The process actually pushed them into play and they were thereby pushed into the zone of proximal development (Vygotsky 1978). Their own homemade game became equivalent to a peer or a teacher. By entering the zone of proximal development, the students had the potential to learn more about programming and game development on their own. Often students will stop if things get too challenging. Play created a zone of proximal development which allowed the students to reach more of their potential on their own.

We believe that play created a sandbox for experimentation and that it was a motivational factor for the students. In this sandbox it was okay to make mistakes and have creative ideas. The students wanted to further solve programming problems, balance their game further and they thereby worked harder. In this way, the play became a lever for the students' learning.

7. The constructionistic and innovative perspective

As part of the course, the students played specific games developed in GameMaker. The students learned about games by exploring games and they constructed games while exploring and optimising. They learned about specific game mechanics by watching the code and experimenting with new code structures. The students played the games while they were imitating and developing new versions of specific game functionality. This was done by "trial and error" learning. They used, e.g., some of the predefined actions, and afterwards they evaluated the consequences by playing the game. Subsequently, they could balance an action and thereby optimise the game strategies. This can be compared with Bateson's learning 1 and 2, which are fundamental learning processes (Bateson, 2000). This also exemplifies how students learn while they are interacting and they are, in fact, using GameMaker as an object to think with. Papert (1993) discovered 20 years ago that programming tools were ideal as constructionistic learning tools, because the learners were

afforded an interactive object to think with. This also means that the students can learn more by themselves without teacher support.

Creativity and innovative designs: where does the inspiration come from? Pre-sensing, presence, and technological fascination. The students were inspired by their immediate environment, which required open-mindedness and presence. This is comparable to Scharmer's (2000 & 2007) pre-sensing, where you are present in the moment and are not so easily affected by habits and conventions. In addition, they were inspired by the technological possibilities, such as specific game mechanics, another game, something they read in the newspaper, learned from a movie or an experience as simple as walking down the road. In the summer of 2011, there was a cucumber crisis where a lot of people got ill by eating cucumbers, and one student used this as a game idea. Another student was inspired by a contemporary movie called Cowboys and Aliens and developed a 2D game where a spaceship sucked up cows.

8. Reflection-in-games and reflection-on-games

The educational goals were to develop a new practice for the design of games. Knowledge-in-action is inherent in this practice and is difficult to make totally explicit. For example, it was difficult for the students to explain how to avoid obstacles while playing their homemade games, but they did it spontaneously in the actual situations. The concept of knowledge-in-action alone is not sufficient in a learning process or in a field practice. This must be supported by the more retrospective process of reflection we suggest the term – reflection-on-games. Reflection-on-games helps the students to articulate conceptual knowledge on game programming and game design. In the retrospective reflection process, their own experiences are connected to emerging conceptual knowledge. And conceptual knowledge is used in the professional communication amongst peers.

9. Professional reflection is divided into two parts:

Reflection-in-games involves a merging of multiple knowledge, experience and intuition during actions. Reflection-in-games occurs in the context of game design, when a student solves programming problems here and now in the game, e.g. a programmed character disappears off the screen instead of being stopped by the game's virtual boundaries. This type of reflection is a here-and-now reflection, involving how to solve the here-and-now problems. This type of reflection might also occur during gameplay.

Reflection-on-games is the subsequent reflection and evaluation on the process that has occurred, and its potential consequences. It is precisely this type of reflection you want in the classroom as the evaluation of assignments and projects, for example, when the students analyse and present their prototypes. They reflect upon what happened in the design process, and how their experiences could be used in future designs. This type of reflection provides an overview of the design process. Furthermore, it offers an understanding of the design process and a holistic perspective. This type of reflection can be expressed in words and can be described as conceptual knowledge.

An example of reflection-on-games was a real live testing experience. The students gained insight into their own and others' gaming experiences by testing the games on a target group. One of the tests took place in a 6th grade school class. Some of the students tested for usability problems and others tested for engaging user experiences. But what really surprised most of the students was the users' approach. They had other game strategies and other ideas on what was meaningful in the games. The students really learned how difficult it was to predict user behaviour. They also recognised that a designer does not necessarily get the same gaming experience by playing, because he/she knows his/her own games too well.

Both reflection-in-games and reflection-on-games were applied during the course. It is in the interplay between these forms of reflection that the skilled game designer develops his potential, where innovative processes evolve and where students achieve a depth of learning.

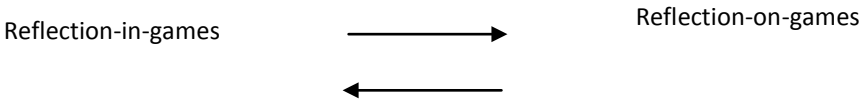

Figure 2: Interplay between types of reflection

Reflection and playing games may appear to be polar opposite actions. In playing a game, one is present and not thinking about strategies for learning. However, reflection-in-action can easily occur in the play situation be (Schön, 1983). For example, in playing a strategy game, you are continually considering what alternatives provide for the best game performance. In a teaching situation, we can analyse and evaluate a specific game, e.g. game mechanics, fun factors, the pros and cons of strategic choices and ethical aspects. The process then changes from reflection-in-games to reflection-on-games. In this case, the students were transformed from game consumers into reflective learners and future game designers.

During the course, the students analysed a game from their childhood. A group of students chose Super Mario, and they used the tools from game design theory to analyse rules, gameplay, and dramaturgy (Fullerton, 2004). The learning goal was to transform the students' own user perspectives on the games into professional and reflective perspectives. The assignment was rooted in something they already knew, and they evaluated it from a new angle with professional tools. This provides for meaningful learning processes. It exemplifies how learning processes can link a playful context and a professional game-design context. It is also an example of how games can provide a lever for the learning process.

In this interplay, it is also important to bring the students' game experiences into play in terms of game design. What makes a game interesting in the student's eyes, how can it be translated into new games and how does it fit with the theory?

10. Summary and Conclusion

In this article, we described how a group of engineering students set out as native consumers in the game world and journeyed towards becoming reflective designers. In the learning process, they needed to distance themselves from the consumer's role in order to process the new knowledge on game design, e.g., how to implement interesting game strategies. In addition, they read a lot of theory on what games are and what makes them interesting. To transform this knowledge into new games was hard work. In this process, they alternated dynamically between play, construction and reflection. The theory on games also gave them tools to analyse the potential and weaknesses of their own games. Their background as digital natives gave them insights and motivated them to create ideas in the design process. They became digital contributors and citizens of the game designers' community.

The didactics were organised in order to support play as a lever in the design process, constructionism, reflection-in-action and reflection-on-action. Playing games was a part of the design process, in which the students constantly alternated between playing the game and adding new code. Playing and developing games created a sandbox for experimentation, where it was okay to make mistakes and have creative ideas. We introduced the terms reflection-in-games and reflection-on-games. The terms are a further development of Shcön's ideas in a context of game design. Reflection-in-games are a here and now reflection on game design, occurring when the student solves programming problems, plays, develops, balances and tests the game. Reflection-on-games is the subsequent reflection and evaluation on the game design process that has occurred. We wanted the students to explore and become aware of the iterative design process. Our teaching strategy was for the students to develop their creative and experimenting competences instead of us lecturing on programming commands and theory on methodology, etc. This required a programming tool with a "low floor" and a "high ceiling". It also required structured activities in the classroom. The structuring activities

focused on making the iterative design phases visible. The activities also focused on retrospective reflections on how to balance their games, discussions on test results, etc. The constructionistic approach supported the following: exploring and optimising ways of learning; creativity and innovative designs; and the double perspective of simultaneous playing and learning. The reflection on action supported insights into others' gaming experiences and awareness of the design process.

In summary, we described the students' first voyages from being natives in the game world to becoming reflective designers. During the journey, they developed a reflective practice and an understanding of the profession they were entering. The article also shows a very dynamic and fruitful relationship between playing games and designing games. Furthermore, they develop the professional's professional humility and an understanding of the mission being developed in their profession.

In subsequent semesters on this engineering programme "Learning and Experience Technology", the students will study about learning and design of digital systems for use in learning processes and, later, they will explore the serious games from both a learning and gaming perspective.

References

App Inventor, (2003). http://appinventor.mit.edu/ last retrieved May 2nd, 2013

Argyris, C., Schön A. D., (1978). *Organizational learning: A theory of action perspective*. Reading, MA: Addison-Wesley

Barab, S., Squire K., (2004). "Design-Based Research: Putting a Stake in the Ground." *The Journal of the Learning Sciences*, 13(1), 1–14

Bateson, G., (2000). *Steps to an Ecology of Mind: Collected Essays in Anthropology, Psychiatry, Evolution, and Epistemology*. Chicago Press. ISBN 0-226-03906-4

Csikszentmihalyi, M., (2005). *Flow – Optimaloplevelsens psykologi*. København: Munksgaard.

Fullerton, T., (2008). *Game Design Workshop. A playcentric approach to creating innovative games*. Morgan Kaufmann

Gee, J. P., (2003): What Video games have to teach us about learning and literacy. New York: PalGrave-McMillan.

Gleerup, J., (2005). "Gyldighed, oprigtighed og ærlighed – om viden og læreprocesser." *Læring – en status*. Klim

Habgood, J. et al, (2006). *The Game Maker 's Apprentice: Game Development for Beginners*. Apress.

Habgood, J., (2007). *The effective integration of digital games and learning content*. Thesis submitted to the University of Nottingham for the degree of Doctor of Philosophy July 2007

Kafai, Y. B., (2006). "Playing and Making Games for Learning Instructionist and Constructionist Perspectives for Game Studies". Games and Culture Volume 1 Number 1. January 2006 36-40. Sage Publications

Kvale, S., (1997). *Interview - en introduktion til det kvalitative forskningsinterview. 1. udgave*, Hans Reitzel. ISBN-13 978-87-412-2816-7

Juul, J. (2005). *Half-real: video games between real rules and fictional worlds*. Cambridge, MA: MIT Press

Majgaard, G. (2013). Creating Games in the Classroom: from native gamers to reflective designers. In Proceeding of the 7th European Conference on Games Based Learning (ECGBL 2013). Porto, Portugal. (pp. 253-258). UK: Academic Conferences and Publishing International Limited.

Majgaard, G., (2011b). "Læreprocesser og robotsystemer. Design af læreprocesser med robotter som medier og børn som med-designere". (Learning Processes and Robotic Systems – Design of Educational Tools and Learning Processes using Robotic Media and using Children As Co-Designers) PhD-thesis

Majgaard, G., Misfeldt, M., Nielsen, J. (2011a). "How Design-based Research, Action Research and Interaction Design Contributes to the Development of Designs for Learning." *Designs for Learning*

Nielsen J. & Majgaard G. (2013) Merging Design and Implementation in a First Semester HCI-course for Engineering Students. IADIS Interfaces and Human Computer Interaction 2013

Papert, S,. (1993): *Mindstorm – Children, Computers, and Powerful Ideas*. Basic Books

Resnick, M. et al (2009): "Growing up Programming: Democratizing the Creation of Dynamic" Interactive Media

Salen, K., Zimmerman E., (2004). *Rules of Play: Game Design Fundamentals*. MIT Press 2004

Scharmer, C. O., (2000). "Self-transcendending knowledge: Sensing and Organizing Around Emerging Opportunities." in: *Journal of Knowledge Management - Special Issue on Tacit Knowledge Exchange and Active Learning*. http://www.ottoscharmer.com/docs/articles/2000_STK.pdf (retrieved on 020211)

Scharmer, C. O., (2007). "Executive Summary: Theory U: Leading from the Future as it Emerges" (17 pages). http://www.ottoscharmer.com/publications/articles.php (retrieved on 020209)

Schön, A. D., (2001). *Den reflekterende praktiker. Hvordan professionelle tænker, når de arbejder.* Klim

Sicart, M., (2008). "Defining Game Mechanics." *The International Journal of Computer Game Research*, volume 8 issue 2 December 2008, ISSN:1604-7982

Scratch, (2003). http://scratch.mit.edu/ last retrieved May 2nd, 2013

van den Akker, J. (2006): *Educational Design Research*. Routledge

Vygotsky, L., S., (1978): Mind in Society. The Development of Higher Psychological Processes. Havard University Press.