

# **Problem Based Game Design - Engaging Students by Innovation**

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## **ABSTRACT**

At Aalborg University's department of Medialogy, we are utilizing the Problem Based Learning method to encourage students to solve game design problems by pushing the boundaries and designing innovative games. This paper is concerned with describing this method, how students employ it in various projects and how they learn to analyse, design, and develop for innovation by using it. We will present various cases to exemplify the approach and focus on how the method engages students and aspires for innovation in digital entertainment and games.

## **Keywords**

Teaching, Engagement, Innovation, Development, Problem Based Learning, Interactive Media, Games, Entertainment, Social Interaction, Hologram, Multi Touch Surface, Game Balance, First Person Shooter, Real Time Strategy, Teaching.

## **INTRODUCTION**

For more than 35 years, the University of Aalborg in Denmark has based teaching on a special version of the Problem Based Learning method (PBL) (Kofoed and Kolmose, 2001). The method lets students learn various subjects by solving real-life problems. The PBL method was a relatively new approach in the seventies, but today PBL has made the university well known in a number of fields, including topics ranging from language, history, social science, psychology, biology and health to almost every brand of engineering. In 2003 the new section for Medialogy was created to meet the requirements of more highly educated students with a multidisciplinary knowledge of current and future digital media. The students at Medialogy are educated in a broad number of topics, there is however a large group of students who focus their interest on new forms of interactive entertainment and the future trends of computer games. As teachers and researchers we have followed the evolution of the education of students in this field at Aalborg University. It has come to our attention that the way PBL is applied to game design also results in students who are thinking in a constructive way when faced with a problem. We

**Proceedings of DiGRA 2011 Conference: Think Design Play.**

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have throughout the years seen many examples of not only innovative, but also very solid and well-designed solutions to problems and challenges within interactive entertainment and the new technology around it.

The entire Medialogy education is not only researching and teaching in the field of interactive entertainment, we are also increasingly using games and related media as means of teaching. Not all the students have a natural interest in computer science, so the development of games and other forms of interactive media is used as a motivating drive to engage the students in learning both artistic as well as technical topics. Games are also used as motivators in the daily courses that constitute the lecturing part of the teaching.

The students entering the education often have some experience in developing simple games or other interactive artefacts. The students are familiar with an approach of a much more product oriented nature, where the game development is initiated by a more or less finished design idea that through the implementation phase gets adjusted to fit the target group. The testing here tends to be either purely usability focused, functional or reduced to a level of investigating the appeal to the target group. As we hope to demonstrate through this paper, this is far from the results of a good problem based project.

## **PROBLEM BASED LEARNING**

The problem based learning method was introduced at Aalborg University in 1974. Like other pioneers (e.g. McMasters in 1968, Maastricht in 1972, and Linköping in 1972) the university introduced the method to educate the problem solvers of the future. Students would every semester use approximately half of their study time to solve a problem within a field selected as the overall theme of that semester. The other half of the time would be used on courses related to the topic or prerequisite for courses for an upcoming semester. Every semester the students would - independent of education - have to analyze the semester theme, find a relevant problem, develop a new theory, method or product, and after thorough testing evaluate if the problem had been solved.

Details vary between e.g. the humanistic and natural science projects and the remainder of this paper will thus focus on the structure used at Aalborg University, Department of Medialogy at the three campuses in Copenhagen, Esbjerg, and Aalborg.

## **Game Innovation, Medialogy PBL**

All teaching at Medialogy is conducted following the principles of the Aalborg PBL method. The students work in self-managed units of 3-6 members. They have complete control of their project tasks as well as managing their own time. A supervisor will once every week meet with the group to give a critical review of the latest progress of a report documenting the work, as well as advising on planned tasks for the coming weeks.

Following the Aalborg PBL method, the students will each semester be presented with a new semester-theme and a selection of courses, which support the theme. The different semesters have been designed so the students at the end of their bachelor should be able to combine all the aspects that were in focus on the earlier semesters and for example cover all elements of game development.

The problem based learning method dictates that the students' projects must aim at solving a problem. This approach challenges and engages the students by inspiring them to set up an objective, which they must accomplish through analysis, design, implementation, test and reflection. The first step is therefore always to find an unsolved

problem or an un-optimized area that could be improved or solved by a new approach. The study-plan furthermore requires the students to build an artefact or to implement an application that can serve as medium for a scientific test to either prove or disprove the claim that their new approach can solve the problem.

### *The initial problem statement*

The students will formulate an initial problem statement that includes both the problem and their broad idea for an approach that could solve it. This statement serves as the foundation for a preliminary analysis and a research of both the problem area and the technologies that could support the students' approach. With guidance from supervisors the students will continue this step until enough knowledge has been gathered on every relevant aspect and sub-area, of both the problem and technical state of the art supporting the construction of the artefact, such that the group can refine their initial problem statement into a testable final problem statement. The process of refining the initial problem statement into the final problem is done by considering a number of criteria. First and foremost the final problem statement should be phrased as a question that is both testable and can be answered based on the results of the test. The students have only two months of work to complete the entire project, it is therefore equally important to delimit the problem area, so the number of special alternate cases does not need to be tested in order to conclude.

### *The final problem statement*

Defining the initial problem and more importantly the final problem statement is one of the most critical aspects of PBL, and one of the areas where the experience of the supervisor can be vital for the success of a project. It takes experience to be able to formulate a clear problem statement that is to the point and possible to investigate fully and conclude upon within the limited timeframe. Very often inexperienced students try to 'save the world' in their first projects. Problem statements like: "Can global warming be solved by making and interactive installation?" is quite common. The problem here is of course that it is highly unlikely that the project will lead to any product and test that will enable the students to conclude anything on their problem statement.

The opposite case is often found even with more experienced students. If a problem statement becomes so simple to solve that is comparable with merely performing a task, and not solving a problem, the learning outcome will be minimal. Problem statements like: "Is it possible to create a game about DNA, using computer vision?" is not only trivial to answer for anyone with a little experience in games and computer vision. More importantly, there are almost an infinite number of solutions which will solve the problem statement equally well, and the students will therefore have no means to argue for their choices or anything to prove.

A good final problem statement is one that is based on a comprehensive preliminary analysis, so 'all' solutions or partial solutions to the initial problem statements are identified and that a focus for the final problem statement is established. Final problem statements can therefore be divided into two categories:

1. Trying to solve a problem where no solution currently exists. This category could include problem statements like: "Can x be measured in first person shooter games?" (where x is something which has not been measured before) or "Is it possible to accurately measure flow in y?" (where y is an artefact which has never been implemented before).

2. Trying to find a better solution to a problem where no optimal solution exists. If a non-optimal solution exists, the students might attempt to create a product that can verify that they have a better solution, or a better solution under certain conditions. Such a problem statement could be worded like: "Can x be improved by using y?". In special cases where it can be argued by simple logic that the new approach will result in a better solution, but the new solution might have certain extra costs or negative side effects, the question to answer becomes the degree of improvement to the primary objective. A problem statement for such a project could be worded as: "To which degree can x enhance y?". The latest case is not only risky because it can often be argued that all the selected elements of the test might cause a bias, it also requires more extensive testing.

Once the final problem statement has been attuned, it becomes the foundation for another analysis. This time the analysis is conducted with a direct focus on any knowledge needed to design and implement an artefact that will give the highest probability to solve the problem that motivated the project, and gain significant test results to support a discussion and conclusion.

Throughout the project, one of the most difficult and important skills for the students to practice is to constantly apply critical thinking. The students must at the exam be able to defend every source of information used and every decision made.

Since it is the intended goal of any PBL project to force the students to attempt to solve a problem that has either never been solved before, or never been solved by that specific approach before, it can be suggested that this in itself will increase the chance of something truly innovative to emerge. No attempts are made to conclude or postulate that PBL is superior to any other teaching method. It is however a strong belief of the authors that the knowledge obtained by the students through repeated practice in PBL has the potential to result in improved problem solving in real life projects. It has not been possible to identify any cases where PBL have caused a project to fail. The concept of applying PBL is to avoid failure. The discussion is therefore not if PBL is good or bad, but whether it is worth the effort. Would the time spend on repeated in-depth analysis have been better used in development and implementation? Students repeatedly request more time for hands on implementation practice. In almost every project done, another iteration is believed to improve the quality of the final product. One of the aims of PBL is however to avoid numerous iterations leading to a local optimum almost solving the problem, when more in depth analysis earlier would lead to a more solid solution.

This paper attempts to exemplify the benefits of PBL through case studies and the following three cases will describe how students at Medialogy are being engaged through the use of PBL in their bachelor project to design innovative entertaining games and applications.

## **CASE STUDIES**

The Medialogy section at the Copenhagen campus produces about 10 new projects every semester totalling almost 60 projects a year, on the bachelor studies alone. The amount of possible case studies is therefore considerable, and includes a large variety of both topics and students' skill level. We have chosen to include three different projects made on the 6<sup>th</sup> semester, where students have at least two years of experience with following the Aalborg PBL method, because they begin at either the 1<sup>st</sup> or the 3<sup>rd</sup> semester depending on previous educations.

The project is the last of the students' bachelor studies, and they are expected to not only find a problem that lie within the semester theme, but also to include elements from as many of their earlier semesters as possible while at the same time creating an innovative solution to their problem. Most projects are heavily influenced by the two major supporting courses: Artificial Intelligence and Integrated Systems Design (including Game Design Theories).

### **Case 1: "Petri<sup>3</sup>"**

*(Attempting to enhance direct social interaction in a competitive computer game)*

Final problem statement:

*"To which degree can an immersive computer based multiplayer game support direct social interaction?"*

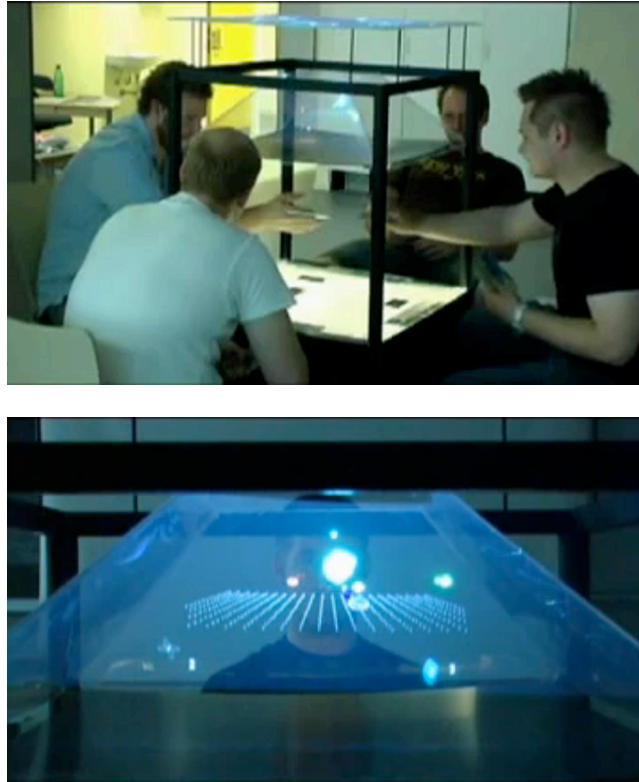
In the spring of 2007 a group of six students wanted to investigate if they could find a way to enhance direct social interaction in computer games (Fredslund et al, 2007). They had experienced that even if they had played a social computer game with their friends all sitting in the same room, it would be nowhere near the social experience they would get from a classic card or board game. The group began a preliminary study of games with a social aspect in general, and an analysis of the state of the art in social computer games. The students were questioning if there were some elements that computer game designers have simply 'forgotten' to use when designing. Using the PBL method, they decided to approach this problem by investigating if a computer game could be made, which would enable the same strong direct social interaction as board and card games.

After limiting their initial problem statement to focus their final problem on direct social interaction, the group began to analyze which elements would create social interaction in both board/card-games and popular multiplayer computer games. This analysis led to a comparison between the pros and cons of the two genres. One of the major findings was that players rarely take their eyes off the screen in a computer game, and the communication is therefore reduced to only speech. Facial expressions, body-language, eye contact, etc. is therefore completely missing. As the goal of the project was to investigate if the strong direct social interaction of board games could be transferred to the scene of multiplayer computer games, the group needed to specify exactly what elements of each genre would enhance such an experience. The detailed analysis led to a number of solution requirements that would work as a frame and boundary for the design process.

One of the main challenges for the group was that they wanted the players to be looking at each other as much as they would do playing a card or board game, but also at the same time take advantage of the graphical representations and information the computer games can offer. The inspiration for the solution came from fighter jets and numerous science fictions movies, as the group realized that what they really needed was a holographic representation of the game world floating between the players.

The solution was the construction of a game station with 45 degree angled glass plates what would allow the players to constantly keep eye contact while at the same time reflect four different views of the game world. This solution creates an illusion of a holographic display floating in mid air between the players. But at the same time each player can only see his own hologram, so personal information can be shown within the game world without other players being able to see it. The bottom part of the game-station was constructed with a semi-transparent glass plate and a bottom mounted web-camera facing

up. This allowed the players to be using real tangible playing cards, that when placed on the table could be recognized by the computer by the use of computer vision and pattern recognition.



**Figure 1:** Picture of the ‘Petri<sup>3</sup>’ game-station during final test. Notice the hologram hovering inside the glass-pyramid between the players (Fredslund et al, 2007).

The students did a test on several four person groups, who played with the card game, in order to investigate if they could observe a high level of direct social interaction. The conclusion was that not only did the players interact socially as much as they would be doing during most card or board games, the innovative game station also created a very strong positive feedback concerning the experience from all test players.

### ***Reflections***

Looking back at this project, and comparing it to some of the later attempts to combine or convert old board-games to a table-top, it seems clear to us that the focus on solving a problem forced the group of students to think out of the box. Only because the group had analyzed direct social interaction and the many levels of communication in a face-to-face conversation did they come to the conclusion that they needed to invent a low-cost holographic display to create the experience they believed would solve their problem. Even though not listed in detail in this paper, there were also numerous examples of how features of their game-play were designed to enhance direct interaction between players, as a result of the analysis of relevant card and board games. The group furthermore became engaged in solving the problem, due to the challenge of creating an innovative game interface.

## Case 2: “Oculusia”

*(Active collaborative gameplay on an affordable multi-touch tabletop surface by the use of PBL and iterative design)*

Final problem statement:

*“How will a co-located collaborative multiplayer game utilizing affordances of a multi-touch tabletop interface affect the player experience?”*

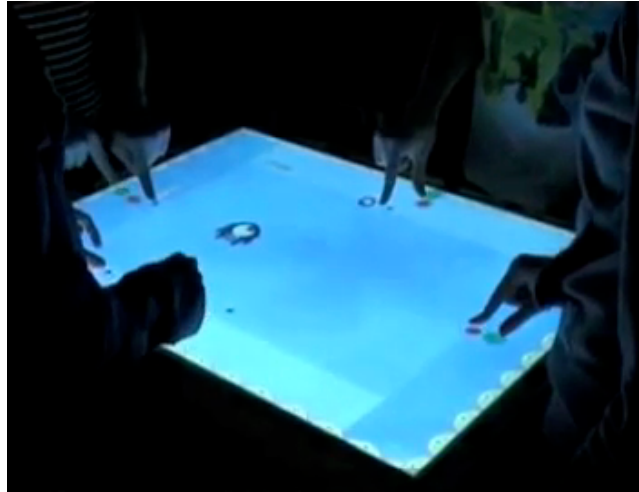
Before Microsoft Surface was released in April 2008, a group of students wanted to investigate the problem of how to make collaborative gameplay on a multi-touch tabletop surface. A part of the challenge was to create an equivalent solution to the new highly expensive multi-touch surfaces that made headlines one year earlier.

After deciding on the initial problem: “How can a computer game be created utilizing the affordances of a multi-touch tabletop interface.” (Fursund et al, 2008), an initial research was conducted with case studies of both multi-touch and touch games as well as types of gesture input. Two focus group interviews were conducted with the use of a mock-up plate instead of the digital version and the group explored which types of games the respondents could imagine would be suitable for tabletop games. The result of the case studies and the focus group interviews was a list of affordances (including some constraints), which could be used for deciding on the final problem statement. Concerning the game concept, the following affordances were found:

- Natural mapping - Close real-world physical correspondence between the players input and the graphical output.
- No haptic feedback - There is no feedback when touching, subtle visual and auditory feedback could support this.
- Occlusion of surface - With both front- and back-projected tabletops, hands can in part occlude the surface.
- Random access - Ability to access everywhere on the surface as fast as hands can move.
- Freehand drawing - The direct interaction with the surface makes it easier to control the precision.
- Handling of many objects - Large surface and direct control, makes it easier to control many objects.
- Gestures - As hands are used to interact with the table, gestures could be used to interact as well. (Fursund et al, 2008)

The social affordances became an important dimension to the project, and the following affordances were found:

- Social interaction - The confines of a shared playing field and co- location affords social interaction.
- Joint player collaboration – A shared playing field enables easy collaboration.
- Open information - All players are able to see all information, hand-held display devices could be used to communicate personal information (Fursund et al 2008).



**Figure 2:** Picture of the ‘Oculusia’ collaborative game on a multi-touch surface.

Based on these affordances the group decided that the game had to be multiplayer and it had to encourage social interaction between players through a collaborative game. The final problem was phrased as “How will a co-located collaborative multiplayer game utilizing affordances of a multi-touch tabletop interface affect the player experience?”. Through further analysis the group decided that the multiplayer gameplay should utilize multi-touch tabletop interaction affordances, be co-located, and be cooperative. Three various game concepts were then designed as paper mock-ups, each fulfilling the criteria from the final problem based on research from the preliminary analysis and a target group characterization. In this phase the group used rough game design concepts with no theme, only investigating game play and functionality. The three concepts were presented to a group of players, and through a focus group interview, the overall enjoyment of the three mock-ups were evaluated.

Through further iterations and yet another a series of focus group interviews, the final design for the game was refined and described, and further ideas from the focus group were added, thereby focusing on one concept for further development.

When the game concept’s design was decided upon, a prototype of the game was implemented by the use of Microsoft XNA and OpenCV while unstructured formative evaluations from players gave input for minor adjustments. The evaluations were conducted after every implementation and the results were discussed to try out different approaches in the next iteration.

The result of the implementation was the game “Oculusia” (Fursund et al 2008) which was a four person collaborative game. Each player should defend his or her side of the table, and shoot at the monster/boss moving around in the middle of the screen, while avoid hitting the other players on the other sides of the table.

The final test was concerned with investigating the player experience, how players interacted and played with the multi-touch tabletop platform, and how they interacted with each other. The theory behind Game Flow (Sweetser and Wyeth 2005) was used as an inspiration for the final test. This test showed that the gameplay became more interesting and that the game became more social, playable and fun due to the many iterations.

The group also managed to get a notable press-coverage after they were mentioned in the online game site Kotaku (Fahey, 2008)

### **Reflections**

The clear defined problem statement kept the group focused on their objective through numerous of smaller iterations. A common mistake for many of our new students is to get so inspired by a single new idea after each iteration, that they end up changing their concept so far from their original idea that they have as many unsolved problems as before their first iteration. By doing a thorough analysis, and finding the goal to aim for by defining the problem in a single statement, the group became engaged in creating an innovative solution and succeeded in remaining focused, and building an impressive and well balanced game in the short period of two months. This project also suggests that the use of PBL in combination with several iterations is a valuable mixture and that it is possible to implement a stable affordable alternative to high cost technology like the multi-touch Surface from Microsoft.

### **Case 3: “Rise of the Resistance”**

*(Testing if the PBL approach can solve the FPS vs. RTS dilemma)*

Final Problem statement:

*“Is it possible to create a competitive game composed of a matchup between the First Person Shooter- and Real Time Strategy genres, which is balanced fairly, while maintaining the most important aspects from each genre?”*

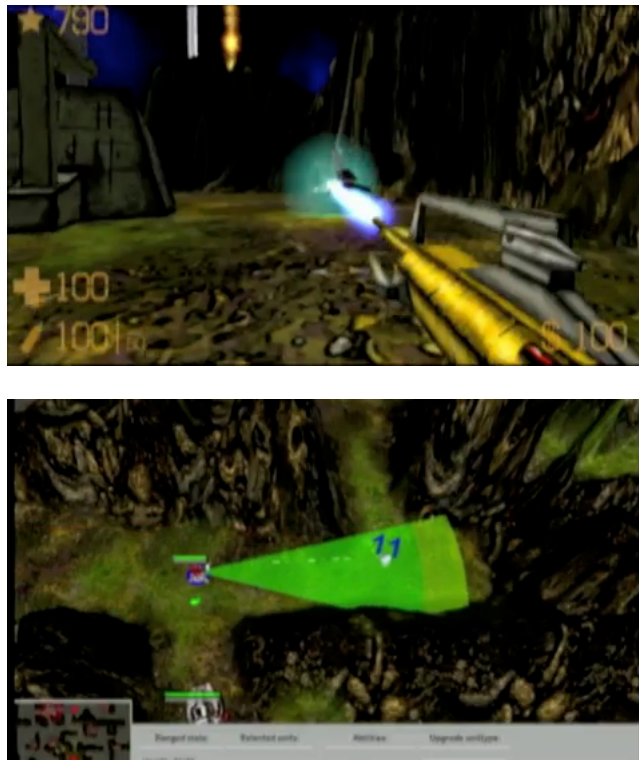
In the spring of 2010 a group of four students decided to attempt to create a solution for a problem that has caused every published game within this field to fail (Harder et al, 2010). It has for a long time been a dream to combine the two popular game genres: First Person Shooter (FPS) and Real Time Strategy (RTS) in such a way that the player can choose to enter the game as either of the two player types. Analysing the state of the art in this field, only very few published games were discovered, where the player can play the game as pure FPS or RTS without having to play some parts of the game as the other player type.

In the early preliminary analysis the students discovered that the few games able to isolate the two types in a competitive battle between FPS vs. RTS were forced to compromise so much in order to balance the strength between sides, that it no longer appealed to an experienced gamer of either type. The students decided to investigate if the use of problem based learning in the development of such a game could minimize the negative effects of the balancing compromises needed to combine the two genres.

The dilemma is that elements enhancing the player experience of one game type would decrease the experience for the other type. If all the classical traits of a RTS game were offered to the RTS player, it would make an unsuited enemy for the FPS player. The same would apply in reverse.

The first step was to analyze games and players of both game genres to detect every vital appealing game mechanic of popular FPS and RTS. A list of 20+ important game mechanics was collected for each genre through interviews and study of game literature. A final problem statement was formulated to focus on a single experiment:

*“Is it possible to create a competitive game composed of a matchup between the First Person Shooter- and Real Time Strategy genres, which is balanced fairly, while maintaining the most important aspects from each genre?”*



**Figure 3:** Two screen-shots from ‘Rise of the Resistance’. (top) The view of the FPS player. (bottom) The view of the RTS player. (Harder et al, 2010).

Common for both genres is that skills should be the deciding factor in order to attract experienced gamers. It is however very different traits that appeal to the FPS and RTS player types. Based on analysis of available literature the students attempted to synthesize definitions for both genres. Their result is shown in the tables below.

Several contradicting traits had to be present at the same time. So the students came to the conclusion that an approach using several user focused iterations would have the highest possibility of a positive result. After a phase of brainstorming, mixing ideas, and re-designing, the first implementation of the game was constructed using pen, paper, and scissors. The paper cut battlefield was presented to experienced gamers of both FPS and RTS games. The response of these interviews was positive, and a number of changes were done to the game-design based on the test data. In the following month graphics, 3D models, sound recording, synthesis, and thousands lines of code were build from scratch to construct a fully functional version of the game needed for the next testing phase. The game was deliberately constructed with the aim of testing and re-balancing. Every action done by either player would be sent to a server and logged for future analysis, and game balancing parameters were stored one place in the code so that adjustments could be made in seconds.

The First Person Shooter Genre	
Challenge:	Actions:
Killing/hitting enemies	Fast and precise physical actions/reactions, which result in aiming and shooting.
Stationary/Active obstacles/Dangers	Avoiding or manoeuvring the obstacles/dangers via moving.
Managing ammunition	Choosing when to shoot and with what weapons in the players inventory.
Replenishing resources	Exploring the game world in order to find resources such as health pack and ammo.
Tactical decisions on the fly	Choosing where to move, what available weapons and possibly additional inventory items to use, very quickly as the tactical situations present themselves.
A definition element of FPS that seem to lay outside the boundaries of challenges and action is the view: It must be a first person view.	

**Figure 4:** Traits of FPS, synthesized by numerous sources (Harder et al, 2010).

The Real Time Strategy Genre	
Challenge:	Actions:
Strategic conflict	A player may choose from a large variety of potential actions or moves at most points in the game, hence victory is achieved via greater decisions/actions.
Tactical	How exactly the overall strategy is approached through explicit actions, and how well the units are managed during combat. Note that the outcome should based on skill oppose to luck.
Logistical	Weapon production, research considerations and defending important locations etc.
Economic	Harvesting resources, and planning the rate of this harvest, while considering how it should be managed in relation to one's overall strategy.
Exploration	Manoeuvring units to locations in the game world, that are not yet revealed, while considering whether it's the appropriate time to do it.
A definition element of RTS that seem to lie outside the boundaries of challenges and action is the view: It should be a top-down view.	

**Figure 5:** Traits of RTS, (Harder et al, 2010).

A few weeks before the game was finished, the students sent around invitations, looking for experienced players of either FPS or RTS. In order to show that it is possible to mix pure FPS and RTS players in a single game their final test should not only show that it is

possible to slowly shift the balance from one player type to the other. They would also have to do this while the players still believed the game was fairly balanced, and at the same time including every game mechanics that would attract experienced gamers of both types.

The final test was conducted as a nine hour long tournament where eight FPS players would battle eight RTS players. After each battle all players would fill out an online questionnaire with their experience and perceived balance between the two sides. The game would then quickly be re-adjusted based on the results stored in the database and the test-players feedback.

The results of the test did not only prove that it was possible to balance the game, it also had the effect that even though the game was still an early prototype, after nine hours of playing, the test subjects were still engaged and wanted to continue playing the game.

### ***Reflections***

This case show very clearly the difference between students attempting to create a new game based on solving a problem and just realizing an idea for a new game. The group did not have the experience or time of the creators of the games they were trying to compete against. However, instead of trying out an idea for a finished game, and repeatedly trying to brainstorm ideas to close the gaps iteration after iteration, they located the common problem for all their predecessors and approached it by using PBL. The group furthermore became engaged in solving their problem because the solution demanded an innovative approach (since no commercial companies so far had achieved a successful game combining the genres). The students have recently started a small game company, and they are currently in the process of developing new game concepts by the use of PBL.

## **DISCUSSION AND CONCLUSION**

Even though only three case studies are presented in this paper it should be noted that the reflections and conclusions are based on years of teaching and personal supervision of almost a hundred student projects. The paper is motivated by a strong belief that not only is game development through problem based learning a powerful method to engage students in many fields of computer science, it has also shown to engage and challenge students to search for innovative solutions at the boundary between the known and unexplored areas in several fields of interactive entertainment. Many of the students who begin studying at Medialogy have an educational or professional background in product based game development which affords many creative and fun ideas for new games.

The objectives of games have through recent years however gone from being purely for entertainment to more serious purposes. Games and other forms of interactive entertainment are today accepted as a serious element in teaching in all levels of education. Simulations save thousands of lives, and improve the quality of living for millions. It is therefore important to educate the future game-designers so they can develop games that fulfil a number of specific real-life problem oriented goals. This requires a strong ability to solve problems and discover innovative solutions.

Because we constantly provoke the students to step over the border to the unknown or unstable outer borders of interactive media, they are often engaged by the challenge and forced to seek innovative solutions to the problems they have chosen to solve. A product that adds no new knowledge to the field of their semester theme is considered a failure or less important product, independent of its level of fun.

Common for all of the three case studies described here is that the problem based method forced students to find a solution to a challenging problem instead of just changing their design to avoid it. By analyzing the problem area in detail before initiating the design process, they were able to include all vital elements in their game-play and hardware construction, and as a result of this, their products became a success.

We believe that PBL is not only a source to engage students through innovation, but also result in an increasable amount of stable successful innovative creations. We hope the findings presented in this paper will not only inspire educational leaders and fellow educators to learn more about PBL, but also aspire constructive discussions and future research to reveal both the potentials and drawbacks of PBL in game design.

## **BIBLIOGRAPHY**

Fahey, M. 2008. "Students Explore Multi-Touch Gaming With Oculusia". Kotaku. Available at <http://kotaku.com/5017162/students-explore-multi+touch-gaming-with-oculusia> (Accessed July 2011)

Fredslund, A., Hjørland, P.P., Jensen, E.K.D, Lorensen, C., Schweitz, N., Pedersen, H.A.R. "Bringing Direct Socialization to Computer Games". Project Report. Aalborg University Copenhagen, Department of Architecture, Design and Media Technology, Section of Medialogy. 2007. Unpublished.

Fursund, J., Brogaard, T., Frøhlich, T., Miksa, T.D.T. "Multitouch gaming – An investigation into multi-touch gaming's effect on player experience". Project Report. Aalborg University Copenhagen, Department of Architecture, Design and Media Technology, Section of Medialogy. 2008. Unpublished.

Harder, K., Korsgaard, R.B., Grønning, S.K., Mikkelsen, J.M "Rise of the Resistance – Creating and balancing an asymmetric game composed of a matchup of the First Person Shooter and Real Time Strategy genres" Project Report. Aalborg University Copenhagen, Department of Architecture, Design and Media Technology, Section of Medialogy. 2010. Unpublished.

Kofoed, L. B. & Kolmos, A. "Empowering Transferable Skills in Problem Based Learning" in Little, P. Kandlbinder, P. (eds.). The Power of Problem Based Learning. PROBLARC. (2001), pp. 64-74.

Sweetser, P. M. and Wyeth, P. "GameFlow: A model for evaluating player enjoyment in games", ACM Computers in Entertainment vol. 3, no. 3 (2005), pp. 1-24.