A Course on Interaction Games and Learning for Interaction Design Students

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ABSTRACT
The design of serious games involves many different skills and designers of such games can come from many different backgrounds, such as education, computer science, or communication. In this paper, we present the structure, format, and outcomes from a new 8-week course called Interaction, Games, and Learning for master students in the Interaction Design Programme at Chalmers University of Technology in Gothenburg, Sweden. Although the course was rather successful in teaching several evaluation models as well as letting students design a serious game and write a paper about it, there are several lessons to be learned, both for improvement of this specific course as well as for other teachers developing similar courses.

Categories and Subject Descriptors
D.3.2 [**Computers and education**]: Computer and information science education – computer science education

General Terms
Design, Human Factors.

Keywords
Serious game development, education

1. INTRODUCTION
Whether you would like to call them 'educational games', 'persuasive games', or 'serious games', all such games share a common intention: they aim at something more than just entertainment. In this paper we will stick to the general term 'serious games' to indicate games with such an additional purpose.

Designers of serious games may come from many different backgrounds, such as computer science, cognitive science, and pedagogy, and therefore design teams are also likely to consist of a mix of designers and developers with different backgrounds. The challenge that these groups of designers face is to balance the entertainment value with the serious aim of the game.

Very few serious games have actually been successful in balancing these factors, and even fewer games have undergone empirical studies in authentic settings in order to prove their effectiveness and efficiency. However, students entering the field of serious games are usually very eager to start creating these games without fully grasping the complexity of this endeavor.

We designed the Interaction, Games and Learning course within the master's programme Interaction Design at Chalmers University of Technology in Gothenburg. Students in this master's programme come from various backgrounds but should have a keen interest in the interaction between humans and digital artifacts. Although all students have followed one or more courses on game design, most of them do not have any formal education related to pedagogy. The course has the following main goals for the students:

- Being able to describe a rich set of examples of relevant artifacts, and be able to explain why and how or why not they work toward their given aim.
- Being able to describe how current pedagogical theories can be applied in design of relevant artifacts
- Being able to discuss the problems and possibilities related to creating and evaluating designs for learning, reflection or change of attitudes or behaviors.
- Being able to criticize existing designs in terms of relevant theories and models.
- Being able to criticize existing designs in terms of constructive suggestions for improvements.
- Being able to design interactive artifacts such as games that aim for learning specific activities or content, reflection or change of attitudes or behaviors.

Ultimately, the goal of the course is not to provide students with a stepwise procedure for how to create serious games, but to give them a feeling for the complexity and broadness of the field, as well as the rich research base that this field builds on.

2. BACKGROUND
There are relatively few research articles on how to successfully develop a course on serious game design. Two notable exceptions are Brown et al. [1] and Chaffin and Barnes [2]. Brown et al. describe a capstone course for students with a variety of backgrounds, emphasizing the acquisitions of soft skills and the ability to work in multidisciplinary teams in a serious game design course. Chaffin and Barnes describe the setup of their Serious Games Research and Prototyping course emphasizing the students' ability to design and evaluate a serious game, as well as

write and evaluate research papers. Although the advice of Chaffin and Barnes was very valuable their course ran for 14 weeks while ours only ran for 8 weeks. Therefore we had to adapt our course to these external frames.

Similar to Brown et al. our students had varying the backgrounds, coming from different bachelor programmes. As recommended, we formed teams from the very first course day and we also urged students to use the first three steps of Chaffin and Barnes' educational game design method when describing their initial game concepts [2]:

1. Identify the target concept/purpose for the game
2. Identify specific measurable objectives for players to the gameplay
3. Create a metaphor that ties the target objectives to the gameplay

We planned for regular supervision with both teachers once the students started working on their games. Finally, since programming skills were not required for this course, we scaled back the project requirements and offered students the possibility to use a simple free tool for making games, as Brown et al. also recommend. The tools we recommended were Scratch (http://scratch.mit.edu/), Kodu Game Lab (http://www.microsoft.com/en-us/download/details.aspx?id=10056) and The Games Factory 2 (http://www.newgrounds.com/wiki/creator-resources/game-dev-resources/the-games-factory-2). An additional reason for advising these tools was that we wanted to underline that the focus in the course was not on programming the game but on making informed design choices in order to create a serious game that really works towards the given serious objectives.

In several aspects we did not follow Chaffin and Barnes' example. Since the students in our programme were not necessarily familiar with programming concepts we did not restrict them to work on either games that promote learning computer science or exercise; students were allowed to choose any serious topic they liked. Furthermore, we reasoned that pedagogy would probably be a particularly underdeveloped topic. Therefore we paid explicit attention to this topic, but always returning to its relevance for games. Finally, because of the external framing of 8 weeks for the course we did not deem it feasible for the students to test their game prototypes thoroughly (either formative or summative), although we did pay attention to how this could and should be done. This is of course a major drawback, but the complexity of such an endeavor calls for much more dedicated time. It is therefore not uncommon to have separate courses on evaluation, as for example in the master program on serious games at the University of Skövde, Sweden.

3. SETUP OF THE COURSE

The course started with a lecture on pedagogical perspectives, based on a similar lecture by Jonas Linderoth. At the end of the lecture the students received a fictive map of theories of learning (Figure 1). Before the next course meeting the students had to play five games (*Lure of the Labyrinth* (2009), *Darfur is Dying* (2006), *Sweatshop* (2011), *Immune Attack* (2008), and *Algebots* (2004)) and place them on this map by considering the following questions:

- What is the developers' view on knowledge?
- What is the view on learning?
- What is the view on transfer?

The students received Egenfeldt-Nielsen's [3] article as an additional resource for this classification. At the next meeting the results of their analyses were discussed in a seminar.

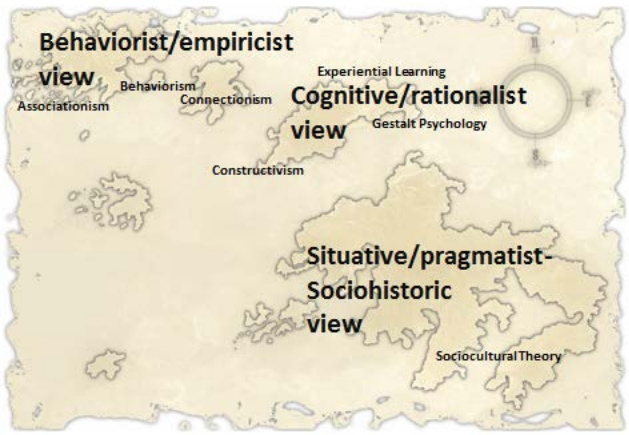

Figure 1. A fictive map (adapted from Ragir, DeviantArt) of theories of learning in which to place the five games to be evaluated

The week thereafter the students were required to read Becker's paper on the Magic Bullet model [4] and Mitgutsch and Alvarado's paper on the Serious Game Design Assessment (SGDA) framework [5] and perform evaluations of the five games with both models. A seminar was organized to discuss the results.

During these first weeks the students had to start thinking about their own game based on the lectures and the obligatory literature [6-9]. This literature was chosen to give students a feeling of the broadness of the field, as well as indicate that the field is not as immature as they might think since it actually has been discussed since the early eighties.

At the beginning of the third week the students had to pitch one or more game ideas in front of the class. They received feedback from both teachers as well as from an invited guest lecturer from a company. The guest lecturer also held a lecture on the serious games market. This was done to make students understand more about the constraints under which many serious games are made. As pointed out in [3], serious games based on research usually present new approaches and strong learning outcomes while they cannot compete with commercial titles because of budget constraints. Companies creating serious games also have to deal with small budgets and therefore they often choose to reuse existing concepts.

During the weeks that followed there were lectures on game rules and learning, partially based Rules of Play [10], persuasive gaming, and (ethical) evaluation and testing (see Table 1). The students also had to read two articles [11, 12] in preparation for a lecture on ecological psychology. With this lecture we wanted to show them that a completely different take on learning can suddenly question whether players are really developing skills while playing, as is indicated by Gee [13]. Because of the complexity of ecological psychology as a theory for learning we did not choose to include this in the introductory lecture on pedagogical perspectives.

One week before the end of the course the students had to present their final games in class after which they received feedback from the other students, the teachers, and the company guest lecturer who had also been present during the pitch. An important deliverable that should be handed in after the final presentation was a paper for the CHI Student Game Competition in the category Games for a Purpose. The description of the papers in this category is as follows [14]: 'Students that submit games to this category should be prepared to explain their design and evaluation process in the Extended Abstract—what background research informed their design choices (in particular grounding in the target application area and existing game-based efforts in this domain), and how they will know if they've achieved the impact they seek (evaluation strategies).' Although we were aware that the students would not have had time to evaluate their games, this paper would force them to at least propose an evaluation strategy. We therefore explicitly required a paragraph on how to evaluate the game. Writing such a paper can be considered an authentic ill-structured group assignment, which can promote higher order thinking [15]. After handing it the final reports for the games, each student received a take-home exam which was to be done individually.

Table 1. 8-week Interaction, Games and Learning course schedule

Weeks	Activities
All	• Work on own game
1	• Lecture on pedagogical perspectives • Form teams • Analyze 5 games within the teams to determine their pedagogical perspectives • Discuss pedagogical perspectives in a seminar • Use Becker's Magic Bullet model and Mitgutsch and Alvarado's framework to analyze the games
2	• Discuss analyses of games in a seminar • Lecture on rules, games and learning • Read literature
3	• Pitch game concept(s) • Lecture on marketing of serious games by company • Play several persuasive games • Lecture on persuasive games by company
4	• Supervision in groups
5	• Supervision in groups • Lecture on (ethical) evaluation • Lecture on ecological psychology
6	• Supervision in groups
7	• Final presentation of games • Handing in of report in CHI format • Handing out of the take-home exam
8	• Handing in of the take-home exam

4. RESULTS AND DISCUSSION

Although 18 students signed up for the course, only 11 of them really showed up for the first course meeting, and 8 of them remained on the whole course. Those were 7 male students and one female student. They formed two teams of four students. We will now turn to some observations from the different assignments.

During the first seminar, in which the students had to map out the five given games in the map of pedagogical perspectives, we discovered that the difference between Experiential Learning and Situated Learning was not completely understood by all students. They had translated this to mean that if there the player becomes involved in a virtual environment, then the game should be positioned closer to the sociocultural perspective than the cognitive perspective.

The analyses of the games with the two given models were slightly superficial, especially for the SGDA model [5]. The Magic Bullet model [4] lead to more interesting discussions about the possible effects of the games.

4.1 The Games

4.1.1 Team 1: The Nutrition Game

This team presented the nutrition concept already at the first pitch. The idea was that different dishes and types of food contain different amounts of carbohydrates, fat, and protein and that the player should learn about that by choosing different dishes from a conveyor belt. The player should try to balance the intake of the types of nutrition, never coming above or below the ideal intake, as is shown in Figure 2. If the player would keep the meters too long in the red area he/she would lose the game. At the final presentation they were able to present a working first level of the game. They didn't use any of the suggested programming environments but chose a programming language some of them had experience with.

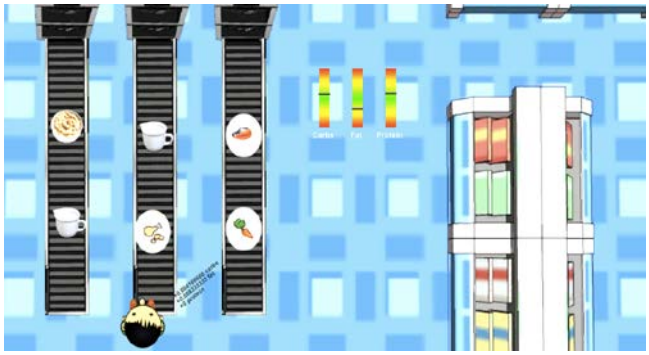

Figure 2. The Nutrition game with the conveyor belts from which to pick food and the nutrition meters to indicate the nutrition levels

Discussions after their presentation and during supervision were about whether to include different meters than the ones presented here to make a better case for a balanced food intake. For example, consuming too much vitamin A could actually be harmful to some people while consuming too much vitamin C would not be as harmful. The informative value of the meters was also discussed; since the players' attention will most likely be on the moving conveyor belts will the player be able to notice the influence of the type of food on the meters? The group therefore added this information to the plates. However, this information was hardly readable and only contained text.

During the final presentation it was suggested that using different colors for each nutrient in the meters as well as for what each type of food on the conveyor belts contains would have been more

informative and easier to understand. It is interesting to notice that such grounding rules for information visualization, which interaction design students should be acutely aware of, are easily forgotten in the process of creating the serious game.

Another comment was that the speed of the conveyor belts was relatively high, making the player focus on trying to catch the plates of food without having much time to reflect on what nutrients they contain. More intensive play testing would of course have been very beneficial in order to choose an appropriate speed as well as making sure that the given information is understandable.

4.1.2 Team 2: The Recycling Game

The other team had several ideas, which they presented at the pitch. They were thinking e.g. about a game to learn English and a game about recycling. Their initial game concept for the recycling game was that pieces of trash would fall down, and that the player would have to put different pieces of trash having different forms in containers to form a row that would disappear, as in Tetris. The feedback from the audience was that adapting the game to limitations of the Tetris concept would not get the correct message across.

During the following weeks they worked on creating a construction game in which to freely create pathways to sort the trash using trampolines, ramps, and platforms. This was partly an effect of them finding a programming environment that supported such physics effects. It was clear that there was friction within the team with some members focusing on the programming and some on playability. The supervisors warned them that no one in the team seemed to be feeling responsible for the educational goal of the game, which could result in a focus on gameplay and programming only. Finally it was decided that allowing the players to construct their own pathways made the game hard to develop and was also changing the focus too much on the construction aspects instead of the correct sorting. At the final presentation, the group was able to present two playable levels and a functioning statistics screen.

In the final game several pieces of trash would fall down at each level and the player had to select the correct valve by opening and closing shutters (see Figure 3 and Figure 4) or blowing the trash to one side with a fan. At the end of each level the player would receive statistics on how many of the pieces of trash were sorted correctly and incorrectly (see Figure 5). The feedback from the company expert was that the game did not look flashy enough to be attractive to the target group. The feedback from the company expert was that the game did not look flashy enough to be attractive to the target group.

Figure 3. The Recycling game in which the trash is sorted correctly

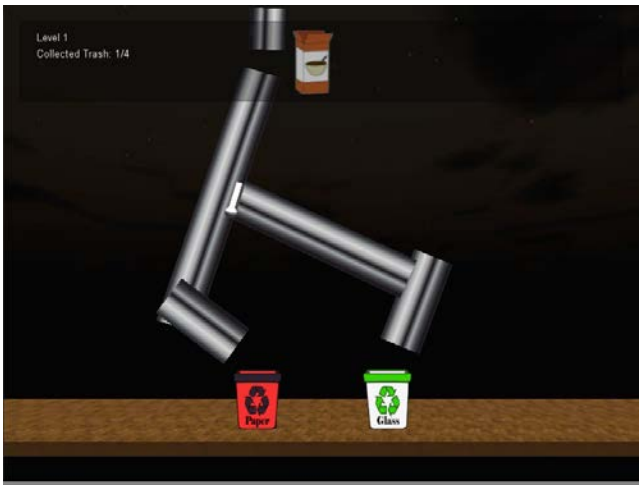

Figure 4. The Recycling game in which the trash is sorted incorrectly and the bin lights up red

Figure 5. Statistics on what has been sorted correctly and incorrectly (everything is sorted correctly here)

4.2 The Papers

In this paragraph we discuss the CHI-papers written by both groups.

4.2.1 Group 1: The Food Game

According to the paper the purpose of the game on nutrition was twofold:

1. To show what types of nutrient each type of food contains
2. To convey the message that nutritional balance is something to look for and actively pursue through a person's dietary habits.

The group explicitly noted that the game does not make any assumptions and offers no recommendations about what to consume or not, or what constitutes a "good diet". They classified the game under the behavioristic perspective but with elements of a cognitive/rationalist approach if the player would experience the "balancing of the meters as a quizzical challenge of which the solution is the right combination of foods."

The target group for the game was children and young adults between 12 and 20.

They found two other games on the same topic:

- The Nutrient Machine Madness Game[1]
- The Food Groups Game[2].

In a short comparison between these two games and their own game they stated that "The NMM [Nutrient Machine Madness] game is more focused on learning what nutrients certain food contains specializing on one nutrient at the time. The food game however is more focus on learning to have a balance between the macronutrients and connecting this to what would happen to a human if one of the ingredient groups would be out of balance. The FG [Food Groups] game focuses on teaching what group a food belongs to but no information about what effects these food groups have."

The group used the Magic Bullet model [4] to analyze their game. For an analysis with the SGDA framework they felt they had to have a more complete version of the game.

In their evaluation plan they reasoned about where the game should be evaluated, at home or in school. Although they envisioned the game to be used at home they suggested that the game should be evaluated in schools in order to make it feasible to do a naturalistic comparison with an alternative curriculum on nutrition. They would test the game using two school classes; one as the experimental group and one as a control group. Their setup for the test was described as follows: "Pre-tests should be run where a subject's knowledge about different nutrients is tested by asking what the dominant nutrient is in different ingredients and what other nutrients it contains. One can also test if a subject can put together meals containing different percentages of the nutrients from a set of choices. Similar post-tests should be held both immediately after the tests and two weeks later but with a different set of items used during the tests."

They did not have a concrete set of test items for the evaluation yet so it is debatable whether they would have succeeded in creating a realistic pre-, post-, and delayed post-test. The test mainly covers the first purpose of the game and not such much the second purpose.

4.2.2 Group 2: The Recycling Game

According to the paper the learning goals for the target group to achieve should be:

1. Learn what types of trash are recyclable
2. Learn the importance of recycling
3. Learn how recycling can be used to use waste to make new products.

They argued that the target group for the game should be children between 8 to 18 year olds who are starting to get responsibilities in the household, such as throwing away the garbage or are moving away from home.

Their learning rationale for the game was that "it could be an opportunity for people who do not have an experience in sorting, to practice without risking more serious consequences when placing trash in the wrong container (which might ruin its contents), or spending too much time at the recycling stations (which does not motivate them to do it). The game's safe environment with minimal consequences and possibility of repetition can act as a stepping stone for trash sorting [and] initiates to feel more confident when they have to exercise what they know in real life."

They found three other games on similar topics:

- Michael, Michael go recycle![3]
- Recycle roundup[4]
- The recycling game[5]

In their analysis of these games they stated that "Some of them do manage to teach which kind of garbage exists and where it should go, but the gameplay is detracted from it because of repetition or lack of levels. On the other hand, games with more levels end up losing the learning part."

The group also chose to use the Magic Bullet model [4] for their internal evaluation, although they did not make explicit how they had used it.

They evaluated they game with several class mates, although they were aware that those were not part of the target group. For a more thorough evaluation they proposed to have two tests; one for the gameplay and one for the learning effects. To evaluate the learning effects they suggested the following:

"We could take two groups of inexperienced people and monitor their trash sorting activities during a time span of perhaps a few weeks. One group would be playing the game, and the other

[1] http://www.nourishinteractive.com/kids/flash/games/nutrient-machine/en/22-nutrient-machine-vitamins-minerals-game-children

[2] http://www.sheppardsoftware.com/nutritionforkids/games/foodgroupsgame.html

[3] http://www.mp3rocket.me/games/71_16588/Michael-Michael-go-recycle/Michael-Michael-go-recycle.htm

[4] http://kids.nationalgeographic.com/kids/games/actiongames/recycle-roundup/

[5] http://www.bbc.co.uk/schools/barnabybear/games/recycle.shtml

would not (control group). Then the evolution of their knowledge would be monitored along the way. Would both groups learn by experience? Would the group playing the game learn faster than the control group since they can practice beforehand and remember the game feedback? It should be very important to record how the testers perform the sorting, and perhaps compare the time they take to do it. During the analysis of the results we should have in mind that there could be other factors which could influence the outcome. For example, maybe a curious child would start researching about recycling by their own initiative, and that would give him/her an advantage. The studies should be carried out more than once and its results should be both qualitative and quantitative before reaching a definite conclusion about how to transfer the learning into real life."

Their evaluation approach was very ambitious, but focused mainly on the first learning goal. If they would have had to perform the evaluation during the course they would probably have chosen a much more modest setup for the evaluation.

4.2.3 Overall Judgment of the Papers

None of the papers was completely ready to be sent to the CHI Student Competition, mainly because the students had not had the time to perform any evaluations. The writing style could also be improved, but since the course was not meant as a writing course we did not want to judge them on this. Another problem was that both papers were much longer than the four pages required for a CHI paper in the extended abstract format. We discussed this with them before the deadline and decided that we would allow them to write a maximum of six pages, since the papers probably would not be submitted anyway. However, both groups' papers demonstrated the students' understanding of how to present research methods, to cite relevant literature, and describe their games and evaluation plan.

A common problem for both groups was that they had chosen a very large target group (12-20 and 8-18), not only for their own game but also for the games to compare with. This makes it hard to design a game that fulfills the expectations on game play from the target group. It also makes it difficult to ground design decisions in the target application area and existing game-based efforts in the domain.

Another problem was that they focused mainly on testing the procedural knowledge in their evaluations. The overall messages that 'nutritional balance is something to look for and actively pursue' and 'learn the importance of recycling' were not explicitly targeted in their evaluation plans. It can be argued that these purposes are no specific measurable objects as meant in [2], and are therefore hard to evaluate.

4.3 Final Exam

The final exam was a take-home exam. Since we only had 8 students in the course we could create it in a way that was rather intensive work for the examiners. It contained three assignments and students were required to write 3000 to 4000 words. The three assignments built on each other, leading logically from one question to the other. However, an inferior quality on one assignment would not necessarily lead to a failure on the next assignment. The assignments and our judgment of the results are given below.

4.3.1 Assignment 1

Evaluate the game [game name] with the two models used in class: The Magic Bullet Model and the Serious Game Design Assessment Framework. Describe also what pedagogical perspective the developers of the game seem to have by describing

-What is the view on knowledge?

-What is the view on learning?

-What is the view on transfer?

The slot [game name] was replaced by one of four different existing games (*Knee Replacement Surgery*, *The Great Flu*, *PowerUp*, and *Equalize* or *Dependency*). With this assignment we aimed for the students to show their understanding of the models discussed in the course for a new game. We also wanted to force them to work more independently of their project group by giving them different games to evaluate.

4.3.2 Assignment 2

Propose several improvements/changes to the game based on your evaluation in the previous assignment. Describe what the effects of these changes could be and why you would propose them. Refer to the literature.

With this assignment we aimed for the students to show an understanding of the literature in order to suggest concrete improvements and reflect on their effects.

Most students were able to use the provided literature in order to suggest reasonable changes to the games that they had analyzed.

4.3.3 Assignment 3

Read the paper 'Taking educational games seriously: using the RETAIN model to design endogenous fantasy into standalone educational games' by Gunter, Kenny & Vick [16].

Perform an evaluation of the assigned game with this new model.

Use your evaluations of the game to compare the three models with each other (so there is one comparison for each set of models: RETAIN-Magic Bullet, RETAIN-Serious Game Design Assessment Framework, Magic Bullet-Serious Game Design Assessment Framework). Describe in what ways the models are similar or dissimilar, taking also into account how they can be used and by whom.

With this assignment we wanted the students to show a deeper understanding of the evaluation models and their similarities and differences. We also conjectured that the literature they had read during the course should have made them able to quickly grasp and use a new evaluation model.

4.3.4 Exam results

Most students were able to apply the given models to a new game, although those who described the models before using them were somewhat more successful in applying them thoroughly. Their description of the developers' views on knowledge, learning, and transfer were less well developed, so this aspect certainly needs some more attention in future versions of the course.

All students described reasonable changes based on their evaluations of the game, but not all of them explicitly based their recommendations on the literature (by citing it) as we had asked them to. In understanding a completely new (and rather complex) evaluation model the students clearly showed their understanding of all models, their applicability, and their pros and cons.

A general comment is that, similar to the reports, almost all students wrote much longer texts than recommended. However, all together we were rather pleased with the students'

understanding of the complexity of serious game design and the finesses of the different assessment models.

5. LESSONS LEARNED

Our recommendations for those teaching similar short courses on Serious Game Design are:

1. Have a thorough introduction of and recurring attention to pedagogical perspectives. We felt that our students' understanding of pedagogical perspectives, and especially the different takes on knowledge, learning and transfer, was lacking. Students probably need to be reminded of these concepts at several occasions during the course.
2. Require students to make a decision on their concept fairly early during the course. We allowed the teams to present several ideas during the pitch. One of the teams had too many ideas and could not make a decision. They therefore lost valuable time, which could have been used for more thorough design decisions. Furthermore, it is essential in a realistic project setting to balance between the brainstorm and design/development phases.
3. Make students decide on a rather small target group for their game. Even though the game could possibly be played by older and younger players, it makes the analysis of similar games more focused and therefore more valuable. The decisions on content and game play can also more easily be based on knowledge about the target group.
4. Use non-digital (board) games to explain the importance of rules for learning. Although we had a lecture on game rules and learning it would probably have had more impact if we had played more non-digital games in order to focus solely on how rules can affect learning.
5. Provide the students with information on how to evaluate changes of attitude. Our focus during the lecture on evaluation was probably too much on measuring learning and less on how to evaluate changes of attitude.
6. Underline your expectations about the students using previous knowledge. For example, since our students are interaction designers, we did have an implicit expectation that they would use their knowledge about attention, information visualization etc. when designing their game. It was interesting to notice how they sometimes approached the serious game design without using this knowledge.
7. If possible, have a complete course on evaluation. Evaluation of the effectiveness of a serious game requires much more time than is available within a single design course. Other university programs already offer such dedicated courses and we think that is a good way to improve the quality of the evaluations.
8. Be very clear about the maximum number of words or pages both in the report and the exam. Students have a tendency to write many pages, while it is actually a sign of thorough understanding to be able to write within certain limits.
9. Involve serious game design practitioners in the course. We have found the lectures and the feedback of the practitioners very useful since they can convey certain messages, for example about the feasibility of a design and how hard it is to create a serious game under real project constraints, with more authority and from another point of view than the university teachers.

6. CONCLUSIONS AND FUTURE WORK

As a first attempt to develop a short course on Interaction, Games and Learning we think the course was rather successful, even though there are certainly some points for improvement. The students were able to design and develop a serious game and write a balanced paper about it, and they were able to apply and reflect on the various assessment models. We have found the Magic Bullet model especially useful to give the students a rather fast and intuitive understanding of the educational aspects of serious game design. We might consider using an article by O'Neil, Wainess and Baker [17] recommended by one of the reviewers as an additional resource.

During the project work some friction within team 2 occurred. It seemed that this was mainly caused by different foci of the team members. We think it is actually enlightening for the students to experience this friction in a team working on serious games because it reflects reality. Creating serious games is no easy task and team members can come from many different backgrounds. Our teams were still quite technical and we would have welcomed students with an educational background to stir things up even more. At the university there is actually a parallel master's course on games and simulations as environments for learning. Students in this course often have a background in education. We think it would be very beneficial for the students in both courses to work more closely together in order to combine their knowledge but also experience the different perspectives and how they can clash during the design of a serious game. For next year's course we therefore plan to create some more synergy effects between the two courses. We also plan to combine the lecture on pedagogical perspectives with the lecture on ecological psychology so that these different takes on learning are presented at the same time, and do not confuse the students too much.

We are aware that the actual concepting, design and production of games are under-represented in the course. This was partly because the students in this course already had a background in game design and development but little exposure to serious games, and partly because of time limits. However, this could be a hinder for integrating the two courses previously mentioned since the students in the other course would probably lack the required programming experience completely. On the other hand, the development of serious games is typically done in multidisciplinary teams, thus being able to communicate with each other over disciplinary boundaries is a requirement for a successful project.

We completely agree with Chaffin and Barnes [2] that teaching a serious games course requires the teachers to become coaches and critics instead of the source of knowledge. As researchers within this field we ourselves still feel that there is so much to be learned, so we can impossibly have all the answers. There is no easy way to designing a successful serious game (leaving alone what 'successful' in this context even means). Giving students a glimpse of the dilemmas and complexity of the field is our contribution to their education.

7. ACKNOWLEDGMENTS

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