PREFACE

This section is a reader guide and contains a short overview of the purpose of each chapter.

Chapter 1: Through an introduction, the area of the report will be presented. Furthermore I will present the initial problem formulation which will frame the work that will be done to reach a final problem formulation.

Chapter 2: Through a study on previous work done in the problem field of the initial problem formulation, I will gain knowledge that will be used to formulate a final problem formulation.

Chapter 3: In this chapter, the final problem formulation will be formulated followed by a hypothesis. The final problem formulation and the hypothesis will form a foundation for the rest of the work in the report.

Chapter 4: This chapter outlines the method used to submit interviewees and how to collect empirical data. Furthermore, the chapter outlines the method used to test the present product, which will be used later in the report.

Chapter 5: The empirical data will be analyzes and discussed in this chapter. The empirical data will be used to build a foundation of the design of the present product.

Chapter 6: The design and implementation chapter will outline the reflections and design choices done in the perspective of the gained empirical data from the preview chapter, chapter 5. The designed solution, in form of an educational game will be implemented and shortly described.

Chapter 7: This chapter contains a verification of the designed solution. The results will be listed in this chapter.

Chapter 8: The questionnaire and interviewed results from the test will be analysed and discussed.

Chapter 9: The conclusion will end the report by outlining the notable issues observed through the study of the present report.

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1. Introduction

Since the early 60'es, where the very first computer game was developed, we have seen the technology and development of computer games evolve. Generation after generation, people have become more familiar with the use of computer technology, some more than others. An interesting observation is children's ability to adapt the computer technology. The majority of children born since the 90'es have grown up with consoles, handheld consoles and PCs. The computer technology has become a part of the children's existence and they have a natural approach to the use of computers (Prensky, 2001a). Prensky (2001b) defines these children's as the *digital natives*; children born into the time of digital technology. Additionally, when children play computer games, they absorb themselves into the game world with an intensity and enthusiasm that would envy any teacher (Egenfeldt-Nielsen & Smith, 2004; Prensky, 2001). Some computer games have an effect of absorbing and entertaining children for several hours. For that reason game developers have tried to design computer games for educational purposes (Prensky, 2003). However, it has shown not to be a straightforward assignment to produce successful educational games (Annetta, 2008). The majority of educational games typically consist of simple applications, for instance multiple-choice applications, that do not have the engaging or committing entertaining elements as some computer games possess (Jessen, 2007). Other types of games are controlled of behaviourism principles[1]; one solves an assignment and gets a reward, such as playing a computer game.

Game developers have become more conscious about the individual pupil's needs for an optimal learning and educational game has become a known term[2]. Game developers have become conscious of how pupils are motivated to learn and the entertaining elements from games are in focus. It is not just a question to make the pupils play a computer game; it is about taking advantage of the medium as a learning tool, by letting the pupil investigate and form hypothesis while experiencing a new unknown

[1] Behaviourism is a direction within the psychology that deals with the animal behaviour of the human being and leaves out the subjective state of mind (Skinner, 1953). In this context the behaviourism is built on stimulus and response, where play and learning is incoherent. The given assignment solved does not have any connection to the reward given afterwards.

[2] In a broad definition, the term educational games is most commonly used for computer games with a educational purpose that is computer games used for other purposes than only pure entertainment. The purposes for educational games can be simulations e.g. for military, health care or educations but can as well be used where the entertainment is used to control, e.g. the learning as we see it in some educational games (Purdy, 2007).

world. When the pupils investigate on their own, it corresponds more to how we learn in practise than by traditional learning with blackboards and books (Jessen, 2007; Annetta, 2008).

Despite the large number of produced educational games and the positive effects of learning through computer games, educational games are still not used sufficiently for educational purposes (Egenfeldt-Nielsen, 2005).
Nevertheless, it is not the case that nothing is done to improve the conditions in school, on the contrary. Portals and branch organisations like "Elektronisk Mødested for Undervisningsverdenen" (EMU), "Medierådet for Børn og Unge" and "Spilundervisning.dk" just to mention a few, shows that there is made a great effort in providing information about the involvement of computer games for educational purposes. Furthermore, in 2001-2004 the Danish government started the nationwide project "IT, medier og folkeskolen" (ITMF) (Rambøll, 2005). The purpose with the project was to strengthening the educational use of IT and other media, and to make IT and media a part of the daily use in the lessons. The evaluation of the project showed that the teachers had increased the IT and media use. Though this increase was mostly seen at the teachers who already used some IT and media in the lessons. Furthermore, the evaluation showed that the lack of use of IT and media in teaching often was reasoned by the missing user-competences. All things considered, the project showed that the use of IT and media was increased caused of the effort that was done during the period from 2001-2004, but also confirmed that there is still some distance compared with the user-qualification (Rambøll, 2005).

However, there might be more into it than only the lack of user-qualifications, such as lack of cooperation between teachers, researchers and developers. The teachers often ask sceptical questions and believe that violence, aggression, social isolation is the consequences of playing computer games (Poulsen, 2008; Prensky, 2003; Squire, 2003). Furthermore, some teachers do not see the advantage of learning through technology. Some teachers have developed a culture where technology, such as computer games are not a part of the culture and believe that games are only used for entertainment. Moreover, when the culture is challenged the teachers feel insecure, because they may not be used to handle such technology (Sprague, 2004; Prensky, 2007). The researchers, on the other hand, are in the possession of various numbers of journals describing experiments that shows the enhancement of pupil involvement, motivation and immersion (Squire, 2003; Annetta, 2008). Finally, the developers are

talking too much with each other, instead of talking with the teachers (Sprague, 2004). This suggests that there are three different perspectives that need to be communicated across in order to develop something useful.

The teachers focus their research on what is working to improve teaching and learning. The researchers focus their research on creating new technologies from knowledge of what has worked before. The developers focus on designing and developing new material by using the latest technologies (Sprague, 2004). Though, they all have one thing in common, and that is the focus on the pupils. The development of new material for educational purposes has been centred on the pupils' needs for achieving an optimal learning situation. However, to comply with the question of why educational games are not used sufficiently for educational purposes I believe the focus needs to be turned in the direction of the teachers. Since the teachers are the mediators between the educational games and the pupils, the focus should be centred on the teachers and their needs for using the educational games in their teaching.

It is my intention with the thesis to address the problem of the low use of computer games by turning the attention toward the teachers. I will explore, from the teacher's perspective, the cause of why computer technology is not being used more often by teachers. Furthermore I will address the problem of the communication between the game developers and the teachers to develop a viable product.

1.1. Initial problem statement

As a result of the lack of focus on the teachers needs for integrating educational games into the classroom, I will with the present report answer the following question:

How to design a computer game for pupils in the elementary school where the teachers are in focus of the development?

The initial problem statement will work as the framework of the following research. Along the progress of the present report the initial problem statement will continually be revaluated, and after an examination of the problem field, in chapter 2, there will be formulated a final problem statement.

1.1.1. Methodology of the empirical study

To follow up the problem statement, I will take a position based on communication between teachers and game designers, where the base of the study will be organized according to the teachers' perspective. I am conscious about that it may be the situation that the teachers have some needs that may not be possible to accomplish without ruin the game play. This is why it is important to have a communication between the teachers, the game developers, and I, the researcher. To meet the different requirements, I will therefore take starting point in user-centred innovation.

von Hippel (2005) explains the concept, user-centred innovation, as the innovation that is created by the user - the individual that is expected to use and benefit from the product - in order to create a higher utility value than a commercial innovation which is created by the companies' research teams. User-centred innovation engage the user in the design process in order to innovate something completely new or by combining existing solutions to create new solutions (Steinbach et al, 2009).

However, there are different approaches and opinions of how to perform the user-centred innovation. Steinbach et al (2009) lists three different approaches to user-centred innovation. The first way to perform user-centred innovation is the use of lead users, developed by von Hippel, American professor of economics and director of Innovation and Entrepreneurship Group, MIT. Lead users are users with special needs, i.e. extreme users, who are at the forefront and will be motivated to experiment with solutions to meet their own needs. von Hippel therefore believes that these lead users are the most competent to innovate products, because they know what works and what does not serve the consumer. Together with the producer, the innovative process, then take the form of a tangible solution.

The second presented approach to user-centred innovation is used by the Swedish research group, Future Applications Lab, led by researcher Lars Erik Holmquist. The research group believes that the design process, where the prototype is created, will most effectively be developed by the designers. Afterwards the prototype will be presented to the lead user, whose task is to challenge the design.

The last approach presented takes starting point in an *open design focus*, used by Finnish researchers, Salu Ylirisku and Kirsikka Vaajakallio and the Danish researcher Jacob Buur. The open design focus will be pined down through a dialogue between the designers and the end-users; the users, who the

product is designed for. This means that designers are interpreters and intermediaries while the end-users will help designers in the design process by telling about their needs and what can be improved.

My approach to the user-centred innovation will primarily be based on the approach of the open design focus. Through an analysis of the problem field and through dialogues with the teachers, I will find out what it needed to develop an educational game that will meet the teachers request to increase their use of games in their teaching.
However, since it can be difficult to reflect upon what can be improved if a person does not have any experience within games, I choose to combine the open design focus with an overture of von Hippel's approach to user-centred innovation. I will use lead users in form of experienced teachers. Experienced teachers can be a great help in the dialogue with the designer since they can tell about their experiences when they started using educational games, what obstacles they encountered and what could have worked better.
The game developers' role will be to verify the needs of teachers. Through a dialogue with teachers I will analyse their needs, which I will consult with game designers to find advice for what is possible to execute and what is not. As with the experienced teachers who work as the lead users, it is also my intention that the game developers have some experience with producing learning material for teaching.

1.1.2. Biology as the didactic approach

In my previous study I have, in corporation with the company Mediafarm, www.mediafarm.dk, been involved in designing the concept of a biology game. This means that I hold some theory of the autonomy and function of the inner human body. Furthermore, at my study at Mediafarm, noticed the lack of educational games provided for pupils, in the subject biology in the elementary school. One the Danish teaching portal for pupils and teachers (EMU – Elektronisk Mødested for Undervisningsverdenen, (EMU, 2009)) only offers one biology game; a human anatomic puzzle. Furthermore, a search on the Internet, showed that there is only offered a limited amount of games in Denmark that can be used in a biology class; such as www.mindblow.dk and www.bioweb.dk. Games like quiz, multiple choices and criss-crosses are one's that can be assessed on these two websites. The

games are controlled /forced by learning, meaning that one has tried to add elements from games to learning.

Therefore I am motivated to develop a computer game where biology will be the inspiration when designing the conceptual art. However, it will not have any influence of the final problem formulation neither the solution of the present project regarding which subject will be the overall learning; it is the general use of games in education and not the use of games within a specific subject. With the basis of the game, I can then focus on how to design an accessible educational game for teachers instead of focusing on developing a game from the very beginning.

It is notable that the subject biology is only offered to pupils in 7^{th}-9^{th} grade in Danish pre-schools. The experienced teachers that I will use in the dialogue have to hold experience with integrating educational games for the elder pupils. It is my assumption that the younger pupils often easier stimulated when it come to the skills and challenge in a game and therefore the game may be easier to access and integrate in the classroom. This is in contrast to the more complex games that the elder pupils play.

2. Present work on the problem field

The purpose of this chapter is to gain knowledge of previous work done in the problem field regarding the initial problem statement. The knowledge will be used to formulate a final problem formulation and a hypothesis that will be used to design a product for the present report.

Before continue any conjecture about the use of educational games in classrooms, I will continue my study by investigate the teachers' perception of educational games.
Furthermore, when developing an educational game the focus has often been on the effect of learning in the games and the learning environment. Factors for helping the teachers to use a new tool, in this case computer games, has been ignored (Baek, 2008; Can & Cagiltay, 2006). Even though it is important to fulfil certain requirements in order to give the most effective use for the pupil, a game still needs to be accepted by the teachers, before the game can be used in a lesson (Can & Cagiltay, 2006). Therefore I will examine the teachers' needs for integrating educational games into the classrooms.

2.1. Reliable observations

During my study I noticed an interesting observation. There have been performed some surveys regarding what hinders the teachers in using educational games in their teaching. The notable is that the surveys have been conducted different placed around the world (Denmark, Korea, Turkey and Canada); some of them with different approaches to the survey and it is still possible to draw parallels to the results of each survey.

In Denmark, Egenfeldt-Nielsen (2005) made a survey in his Ph.D research, upon the extent of use of educational games in the classrooms and the teachers' perception of computer games. The survey was performed by a quantitative questionnaire on the internet given to teachers at different elementary and secondary schools in Denmark. The average of the age of the teachers was 45.5 years, they had different backgrounds but in general they all had limited experience with computer games. Only 43 teachers from the Danish educational system participated in the survey, despite the fact that the survey

was sent out by letter and email to 150 schools often containing 20-40 teachers at each school. The same problem occurred in the survey conducted by Becker & Jacobsen (2005).

The study done by Becker and Jacobsen (2005) both from the Educational Techology, Faculty of education in Canada, did a pilot study and the study only meant to be used as a guide to research further. The pilot study was executed to gain knowledge about the attitude among teachers for using games in classrooms.

The test was based on an online questionnaire that was sent out to 400 teachers at schools in four local school districts, however, only one fourth of the surveys were returned filled out. In the questionnaire the teachers had the option of a multiple choices which was supplied with lines for optional comments.

As Becker and Jacobsen (2005) state, it may not be the most optimal solution to make an online questionnaire. When conducting a survey online there may be a risk that teachers with minor or no technical skills will not answer the questionnaire. Consequently, most of the teachers, who responded the questionnaire, could be those of the teachers, who were most familiar with computer technology and perhaps the part that already use games for educational purposes. A paper version or even better, an interview scenario, would have avoided any assumptions concerning the use of computer technology. However, Becker and Jacobsen (2005) mention that an online survey was the only option due to the lack of funding.

Nevertheless, the survey conducted by Egenfeldt-Nielsen showed that there were both positive and negative statements of the teachers' perception of computer games. The primary advantage was the motivation when playing computer games. However, this somehow does not agree with the lack of use of computer games in classrooms, unless the teachers prioritize other factors than only motivation as the impact of learning. Other positive statements from the teachers regarding their perception of computer games is the alternative presentation, greater interest from the pupils view, better learning atmosphere, peer collaboration and student autonomy; the results can be viewed in figure 1.

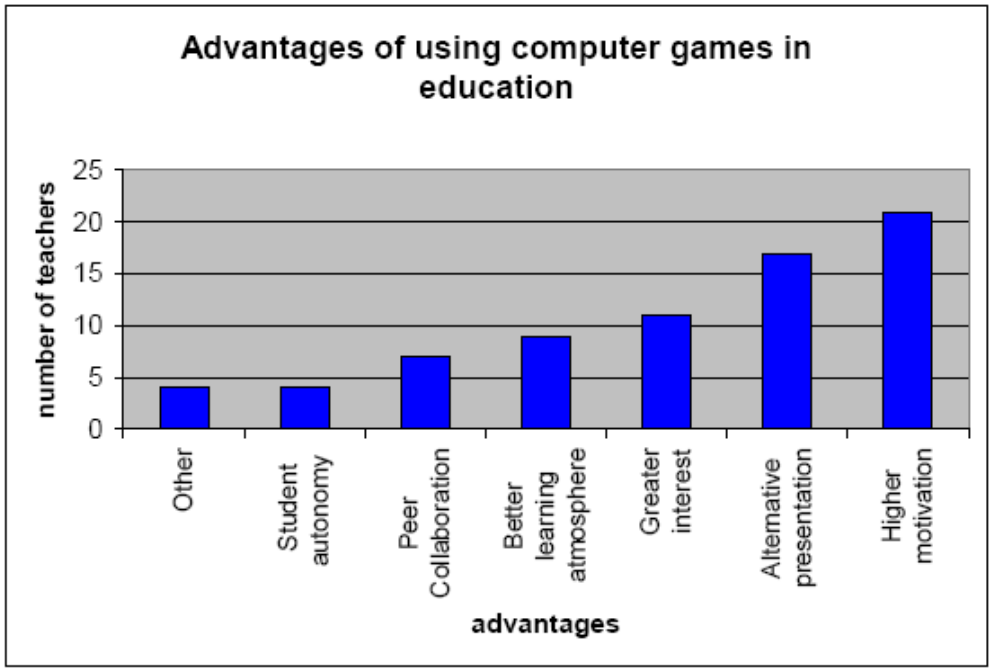


Figure 1 The figure shows the teachers' positive perception of computer games. The results are based on the 43 teachers' who responded the online questionnaire. (Egenfeldt-Nielsen, 2005: 73)

The negative statements of the teachers' perception of the use of educational games in classrooms are mainly the quality of the titles of the games and lack of knowledge of computer games. These two factors, however, do not agree with each other. This may indicate that there is a lack of general information about the advantages and disadvantages about the use of computer games for educational purposes. Other problem, mentioned by the teachers, is access to computers, technical barriers, the problem of covering the curriculum, learning to play game, and more preparation; the results can be viewed in figure 2.

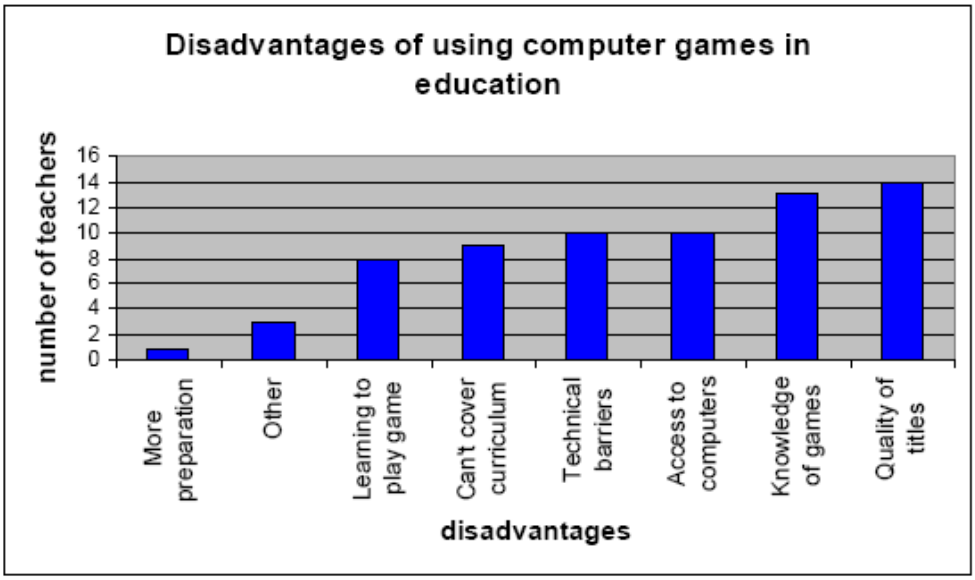


Figure 2 The figure shows the teachers' negative perception of computer games. The results are based on the 43 teachers' who responded the online questionnaire. (Egenfeldt-Nielsen, 2005: 70)

The survey, done by Becker and Jacobsen, indicated that the primary barriers was the missing access to try out educational games, the support and skills to get started and the time that the teachers uses to understand a game and prepare it for a class. Most teachers did not know where or how to find the games, if the games were good enough for the given class or how to incorporate them in a class.
Some teachers had a sceptical view of games and answers that the more the game "sounded" like a game, the less the teachers wanted to try using it. This was the same observation that Egenfeldt-Nielsen did in his survey. Again, this may indicate a lack of information about educational games.
Becker and Jacobsen (2005) believe that the educational games will be used more frequently if the design of the game has a focus on easy use and short preparation time. They also think it would help the teachers if the games are easy to find and navigate through the options.

A notable problem that Becker and Jacobsen noticed was the parents' illusion of how they believe teaching in school should be; i.e. teaching in school and entertaining at home. This is a "culture hindrance" for the teachers because the teachers do not like the idea of having mistrust from the parents about the teachers teaching (Becker & Jacobsen, 2005).

Another survey with the same purpose as the survey done by Egenfeldt-Nielsen and Becker & Jacobsen is done by Baek (2008). Baek holds a Ph.D from Korea, where the survey also was conducted. The purpose of the survey was to find out what hinders teachers in using computer games and how important these obstacles have to the decisions of integrating computer games in the classrooms.

The approach of the research was different than the surveys done by Egenfeldt-Nielsen and Becker and Jacobsen. The procedure of Baeks survey was to extract the hindrance elements directly from teachers to get the most important factors. The procedure of the method was divided in two sessions. In the first session there were used 35 teachers all from elementary or secondary schools (20 females, 15 males). The teachers all had an experience in using computer technology and games in classrooms. The teachers were expected to list all the factors that prevented them from using games for teaching. The factors were compiled to a list, where the factors were analysed and structured by the researchers. The list then built a base for the second session, where a new per of teachers (than from the first session) were answering a quantitative questionnaire based upon the list. The second session participants were 248 teachers from elementary and secondary schools (248 females, 160 males. Baek do not inform whether or not these teachers had earlier experience with computer games.)

The results was categorized under 6 different labels, with the most frequently factor, that inhibit teachers for using games in classrooms, first: "Inflexibility of the curriculum, negative effects of gaming, students' lack of readiness, lack of supporting materials, fixed class schedules and limited budgets." (Baek, 2008)

Under the category of inflexibility of the curriculum, one of the most frequent hindrances among teachers is that it is difficult to find educational computer games with a high level of learning content. If the teacher found a suitable computer game, it still takes too long time and too much effort to prepare the game into the classroom. The second category, “negative effects of gaming” shows that teachers still have a sceptical view of computer game. This is mostly because the teachers believe that a computer game will cause addiction.

The third category, the lack of students’ readiness means that the teachers think that each pupils act differently when incorporating computer games into the classroom. Furthermore, not all pupils have the same computer skills regarding the technology and gaming experiences. The forth category, lack of supporting materials, implies that the teachers are missing the support that can help them about how to teach with games. The second lowest rated hindrance is the category fixed class schedules. The

teachers claim that the games are not designed to a lesson. A lesson has a certain time constrain, and often the games are to demanding compared to the time duration of a lesson. The last category is the limited budget, shows that the teachers think that the cost of teaching with games is expensive and do even think that a successful game belong together with an expensive budget.
Even though the Korean school settings may differ from the Danish and the Canadian school system, the results of the, to some extent, same surveys have showed to have the same outcome.

In Turkey, there have been conducted a survey that are different than the three studies, the Danish, Canadian, and Korean. However, despite some very positive statements compared to other surveys, the outcome is to some degree the same. The study was performed on computer-technical students, unlike the other three studies in which graduate teachers participated in the studies.
The Turkish survey was conducted by Can & Cagiltay (2006), who respectively works in the department of Instructional Technology, Utah state university, and the department of Computer Education and Instructional Technology (CEIT), Middle East technical university Ankara. They did a survey on prospective teachers' perception of the use of games with educational features[3]. The prospective teachers were studying in CEIT; a Turkish university, where students are being qualified to teach K-12[4] in computer and other informational technologies.
These prospective teachers have a high experience with the use of computer technology and some of the prospective teachers had completed a course where there were taught how to integrate computer technology in courses. With this as a basis for the prospective teachers of the test, it can be assumed that the prospective teachers probably have a more positive attitude towards the use of computer games in classrooms than a regular teacher from a collage of education. Can and Cagiltay (2006) therefore states that the doubt found in the test must be focused upon more carefully.
The procedure to conduct the data was a quantitative questionnaire and a qualitative interview.
The questionnaire was given to 116 prospective teachers from four different CEIT departments. The interview was performed on sixteen prospective teachers, four from each of the selected universities,

[3] Computer games with educational features are defined by educational games and other market games that not necessary has been produced for educational purposes but have shown a positive develop and learning effect on pupils (Can & Cagiltay, 2006).
[4] A term for primary and secondary schools. The abbreviation stands for **K**indergarten **- 12**th grade (Wikipedia, 2009).

who had already taken the questionnaire test. The questionnaire was concerning background knowledge of the use of computer in general, demography and use of educational games. The questionnaire consisted of multi choices, short answer and open-ended questions.
Can and Cagiltay encountered somewhat the same issue that Egenfeldt-Nielsen detected with his survey. The results from Can and Cagiltay's survey showed that 77% of the participants thought that games could cause addiction and that games are waste of time (49%). Despite the negative output 79% of the participants still believed that some games could help pupils in developing knowledge and skills.
Nevertheless, the participants from Can and Cagiltay's survey were quite positive, when it came to the use of games with educational features. The major part of the participants agreed that computer games with educational features could easily be used with the curriculum plan. The participant even thought that games with educational features could be more useful than traditional teaching with books, since the use of games would have a more permanent learning (Can & Cagiltay, 2006). However, the participants are studying computer technology and do most likely have a more positive approach toward the use of educational games in classrooms.

Nevertheless, the prospective teachers agreed that it would be useful to integrate educational games into a lesson and that it can help as a useful learning tool if the goals are clear in the game.
The prospective teachers wanted to use games with educational features if:

- the goals of the game are specified and fulfilled the curriculum standards
- the pupils can choose their own goals,
- the games are used in the end of the class, have a short play duration, various levels, and content that is in agreement with the pupils skills (Can & Cagiltay, 2006).

The most frequent concern about the use of computer games with educational features in classrooms were the time duration of the game. Furthermore, Can & Cagiltay comments that one of the biggest factors that teachers are not using games is the technical skills. The participants were sceptical of the time used to incorporate games. They meant that it would take more time to make games a part of the class compared to traditional teaching.

An interesting observation in Can and Cagiltay's survey is that the interviews, conducted as a part of survey, showed that the interviewees did not answer with the same positive enthusiasm regarding the use of computer games with educational features, as they did when they answers the questionnaires. This indicates that Can and Cagiltay's survey conducted through questionnaires has to be considered carefully.

In the following tables, table 1, 2 and 3, I have made a structuralistic approach to the four surveys to make an overview of the discovered perception of computer games. In addition, the advantages and disadvantages will be taking into consideration when investigating the teachers need for increasing their use of computer games in their lessons.

The first table, table 1, outlines a short description of the surveys done, and the approach of the specific survey.

Table 1Surveys conducted

Survey	**Approach**
Egenfeldt-Nielsen	- Online questionnaire, and some by letters - Subjects: Teachers from elementary and secondary schools - Average age: 45.5 - Limited amount of computer knowledge
Becker & Jacobsen	- Online questionnaire - Subjects: Teachers from elementary schools - Relatively experienced with computer technology
Baek	- 2 sessions. First session: Achieved the questions from teachers. Second: Performed the test on a new peer of teachers. - Subjects: All from elementary and secondary schools - First session: Experienced with computer technology. Second session: Not mentioned
Can & Cagiltay	- Questionnaire and some few interviews - Subjects: Students from the department of Computer Education and

	Instructional Technology - High experience with computer technology

The second table, table XXX, outlines the disadvantages detected at the different surveys. Many of the disadvantages were discovered in several surveys.

Table 2Disadvantages from games according to the teachers.

Disadvantages	**Surveys conducted**
Lack of knowledge about games (which games should be used, where can they be found and how to integrating them in a lesson)	- Egenfeldt-Nielsen - Becker & Jacobsen - Baek
Access to computers and computer games	- Egenfeldt-Nielsen - Becker & Jacobsen
Technical barriers	- Egenfeldt-Nielsen - Becker & Jacobsen - Can & Cagiltay
The problem of covering the curriculum	- Egenfeldt-Nielsen - Becker & Jacobsen - Baek
Understanding and learning to play game	- Egenfeldt-Nielsen - Becker & Jacobsen
Take too much time to prepare	- Egenfeldt-Nielsen - Becker & Jacobsen - Baek - Can & Cagiltay
Teacher culture	- Becker & Jacobsen
Sceptical view	- Becker & Jacobsen - Baek - Can & Cagiltay

The pupils lack of readiness, computer literacy	- Baek
The time duration of games. (time constrains of a lesson)	- Becker & Jacobsen - Baek - Can & Cagiltay
Expensive games vs. limited budget	- Egenfeldt-Nielsen - Baek

Most of the advantages were compiled in the surveys done by Egenfeldt-Nielsen and Can and Cagiltay. This does not mean that the two other surveys did not find any advantages, nonetheless, the advantages was not mentioned in the other surveys.

Table 3 The advantages from games according to the teachers

Advantages	**Surveys conducted**
Games motivate	- Egenfeldt-Nielsen - Can & Cagiltay
Different than traditional teaching	- Egenfeldt-Nielsen
The pupils interests	- Egenfeldt-Nielsen
Better learning atmosphere	- Egenfeldt-Nielsen
Peer collaboration	- Egenfeldt-Nielsen
The pupils can control the learning, and develop knowledge and skills	- Egenfeldt-Nielsen - Can & Cagiltay
Games can easily be used in curriculum	- Can & Cagiltay
More permanent learning with games	- Egenfeldt-Nielsen - Can & Cagiltay

Both the disadvantages and the advantages will be used to conduct the interview that I will perform on the experienced teachers, according to the approach of the user-centred innovation, as mentions in the introduction.

As mentions in the introduction, there have been done an effort in complying the issue of the lack of use of computer games in the classrooms. ITMF performed a larger project to make awareness in the Danish school system about integrating IT and media into the classroom. The result was only limited and there still needs to be done an effort to comply the problem of using computer games in the school system.

Katrin Becker, who also performed a survey with Jacobsen (Becker & Jacobsen, 2005) has also tried to do an effort in educating teachers to increase the use of computer games in their lessons.

Katrin Becker (2007) is a doctoral candidate in educational technology studying instructional design of video games. She has established courses to help teachers to understand the advantages and use of computer games for educational purposes. Becker (2007) states that teachers do want to use new technology, such as games, in their teaching. Nevertheless only a little amount of teachers are using games for other purpose than a "reward", which is often given when the real teaching is done. As she found out in her survey with Jacobsen, some of the reasons, for why teachers are not using games as an educational tool for learning, are the lack of resources, like time and equipment, and missing understanding for incorporating games in the teaching. Furthermore there is an uncertainty about the use of games among the teachers, whether it is beneficial for the pupils to use games or if it is a disadvantage. Becker (2007) knows that it can be difficult to find learning games on the internet. When an appropriate game for the given topic is found, there is still a doubt if the game is good enough to use in a lesson, and the teacher instruction is often missing. If games shall be used in educational purposes they need to be available and comprehensible (Becker, 2007). The teacher needs to know how, to use a game, both technically and educationally.

Consequently, Becker (2007) has designed a course for teaching teachers how to use games for educational purposes. The course is designed to teach teachers about advantages and disadvantages of educational games, and how to use games in their teaching. The assignment for the teachers was to analyse and think of how to integrate a game in their own teaching.

During the course, Becker (2007) let the teachers play the games themselves; the teachers need to get familiar with how computer games work in action. If they should make use of computer games in classroom, then they need to play the game themselves before letting the pupils play (Becker, 2007).

An evaluation of the course showed that the teachers were surprised of computer games ability to be used in education. Though, the majority of the participating teachers realized a lack of curriculum in

the games (Becker, 2007). Therefore many of the course participants did not continue the use of educational games. This is, however, the same result as from the ITMF project (Rambøll, 2005). Becker (2007) thinks that a solution to solve the problem is to let the teachers design and produce their own games, even though she mention that this may not be possible since it is a complete different position for the teachers if they should develop a game. I agree to some extent that to solve the problem will be to design a game according to the wishes of the teacher. However, a more realistic solution to the problem would instead be to establish a better communication between teachers and game developers to meet the teachers' wishes for a perfect game, according to the teacher view.

2.2. Pedagogical and didactic approach

As Can & Cagiltay (2006) mention that the prospective teachers find games appropriate and useful when the goals of the learning content fulfil the curriculum requests of the given subject. Furthermore, the pupils level of knowledge and skills have to be in agreement with the goal of the computer game. This means that a computer game should be designed so it can bring the pupil in a state of *flow* when playing the game.

Professor Csikszentmihalyi (1991) has through several years of research investigated the mental state where a participator gets totally absorbed in a substance; he defines the state as *flow*. Professor Csikszentmihalyi (1991) is a positive psychologist[5], has a Ph. D. in management and studies creativity and innovation. He defines flow as an optimal experience, which occurs under a high performance of the human mind in an endeavour of performing a complicated task. When an individual has the feeling of having control of ones own actions, the individual will be affected of joy and enthusiasm (Csikszentmihalyi, 1991).

Csikszentmihalyi did an extensive research on different people's optimal experience. Even though the participants had cultural, social and origin differences, they all explained the optimal experience identical. The research showed that the optimal experience, flow, is build up by eight elements. In order to experience flow the individual will have to (1) perform an assignment that from the individual point

[5] Positive psychology is science about the optimal human function that promotes the well-being in each individual.

of view has a possibility to be completed and (2) have a concentration when performing the assignment, (3) the assignment needs to contain clear goals and (4) give immediately feedback to achieve and maintain the concentration, (5) and the individual must invest mental energy and involve one self in the assignment. Furthermore, flow will give the individual (6) a pleasure experience of having control over ones own destiny, (7) the individual will forget about the daily worries and frustrations and (8) the time, when having the flow experience (Csikszentmihalyi, 1991).

If flow is missing it is often a sign of boredom, stress or caused of an overwhelming assignment. Flow is obtainable, when there exist a balance between the individual's competence level and the difficultness of the challenge given to the individual (Andersen, 2002). Figure 1 shows the zone between competences and challenge where flow can arise.

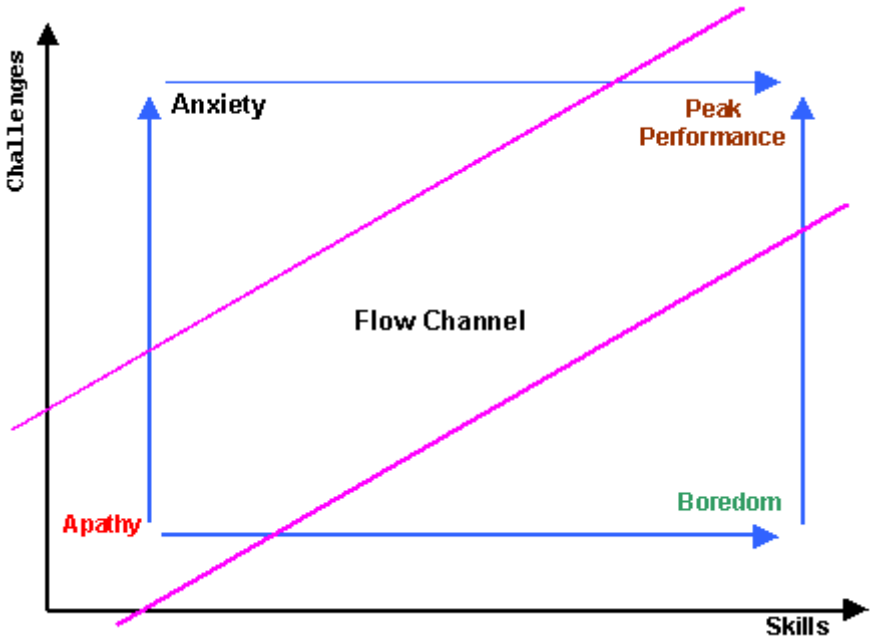


Figure 3 Flow model. (Csikszentmihalyi, 1991)

On the Y-axis is the given challenge and the X-axis is the individual's skills, figure 3. The individual will start in the area of "Apathy". Under normal circumstances, the individual will have a need to renew the learning that has been taught the individual. From the flow model approach, the individual has to move; A difficult challenge will lead to "Anxiety" (vertical movement) and an effortless

challenge will result in “Boredom” (horizontal movement). If the challenge and skills are adjusted the individual’s personal needs, then flow will appear proportionally, within the pink lines (cf. Figure 3)

Even though Csikszentmihalyi did not intended to design the state of flow in combination to game theory, it is still uncomplicated to draw parallels between flow and learning in games (Poulsen, 2008). However, there needs to be made a critic of the flow model developed by Csikszentmihalyi. According to the flow model at figure 3, the flow experience is illustrated as an undisturbed experience. When learning in computer games, or just in general, one can be faced by an obstacle or a dilemma that needs to be solved in order to continue. In this situation the person will loose the state of flow, even if the challenge and skills is still within the frames of the flow statement (cf. figure 3). This means that the flow experience can not constantly be undisturbed, but that one only can try to obtain a floating flow experience. Additionally, the different factors in the flow model, apathy, anxiety, boredom and peak performance, can not be defined since it is an individual judgement and can not be generalized to a specific computer game. However, considering the design of an educational game I can still take advantages of some of the aspects of flow. It is ideal to use the knowledge of flow to improve the conditions for teaching and learning.
Frans Ørsted Andersen (Jensen & Fugl, 2009), DPU (Danmarks Pædagogiske Universitet) has a long research experience with flow and learning environments. Andersen sets up a structuralistic approach of flow, for the use in educational purposes (Jensen & Fugl, 2009):

1. **Clear goal.** Set up a clear set of goals of what wants to be obtained. The goal has to be realistic in accordance with the participator.
2. **Clear settings.** Manageable and understandable rules, materials, frames, etc. has to be informed in advance. The engagement is considerable higher when the settings is determined from start.
3. **Match challenge with ability.** The given challenge has to be consistent with the participators competences. If the challenge is too extensive, then the participator will stress. Contrary, if the participators competences are not completely challenged, then he or she will loose interest. An appropriate balance between challenge and the participators ability will lead to flow.
4. **Feedback system.** A constant flow requires continuous relevant feedback. The participant needs to know how he or she is doing.

5. **Undisturbed.** It is important that the participator is not interrupted by unnecessary factors.

Despite the organized list of ways to get in flow, Andersen emphasizes that flow can not be put into a frame, but more specified flow is a tool that can be used as a pedagogical guideline. Flow is a condition, which has to be generated by activity from the participator to appear (Jensen & Fugl, 2009). However, it is interesting how to incorporate the elements of flow into the context of game play. A pedagogical ideal must be, when one is totally focused in the substance, which stems from being optimal challenged. Then there is a high probability of a good learning environment.

Therefore it will be an advantage to use these flow elements to give both the teacher and the pupil a good experience of the educational game.

However, when developing a computer game with learning, there often occur problems about the lack of learning content or the lack of game content. Kickmeier-Rust et al (2007) state in a journal that many existing educational games fail, when it comes to competing with commercial[6] computer games. Existing educational games are missing the link between game play and learning; either it is a simple application, where the learning is dominant and elements from a game play is applied to the application (such as multiple chooses applications), or one have tried unsuccessfully to add some learning to the digital game (Kickmeier-Rust et al., 2007). Other disadvantages of existing educational games are the difficulty to provide a continuously balance between challenge and the pupils' skill to control and solve the given task. Furthermore it is often difficult for the developers to hold a national curriculum (Kickmeier-Rust et al., 2007).
Commercial computer games attract players because the games can provide the player an experience of immersion, engagement and a virtual environment to explore. These attractions are also the reason for why it is essential to use computer games for learning. However, it can be a difficult task to incorporate learning in computer games and still maintain a high quality of game play (Kickmeier-Rust et al., 2007).

[6] In the present report commercial games is defined as computer games which have been produced with the only purpose of entertaining.

An educational game is a digital learning game where modern game techniques are used, and a synergy of learning methodology and game techniques. (Purdy, 2007) During my examination of the previous study regarding the teachers' perception of computer games, it is clear that teachers have a sceptical view on computer games in general. Furthermore they claim that computer games often lacks from having a high quality of curriculum content. I have chosen to have my attention on educational games instead of other computer games which can be used for educational purposes. This is owing to the extra dimension that educational games provide to the game play, which is the pedagogical approach (Zyda, 2005). Knowing that some teachers have a sceptical impression of the influence that games have on the player, it is important to think of, which type of game will be appropriate for the teachers. It is my assumption that sceptical teachers will have a more positive and motivating approach to the use of a game if they are told that the game has been produced with an educational purposes compared to a commercial game; it is a psychological attitude to comply the before mentioned teacher culture. Furthermore, the foundation of the design of an educational game is build upon the entertaining element from games, which can benefit the pupils' motivation. By designing an educational game it will both benefit the teachers and the pupils.

With the gained knowledge about the teachers' perception of computer games, and knowing what is hindering the teachers in using computer games in their lessons I will now formulate a final problem that will be shape the frame of the following work of the present project.

3. Final problem formulation and hypothesis

Through my investigation of the problem field, I have achieved knowledge about the factors for why the teachers are not using computer games sufficiently in their lessons. Furthermore, I have found out how important the educational and didactic aspects of a game are to achieve optimum learning through computer games. This is both a benefit for pupils' learning abilities, but can be a great advantage when a game shall be designed to be more accessible for teachers with no experience in computer technology.

Consequently, the final problem formulation is:

> *How to design an educational game with a didactic approach for pupils in elementary school, where the teachers are in focus of the development?*

I have experienced through the study of the present report that there is not enough focus on teachers when an educational game have been designed. There is focused on the obstacles that exist, when a teacher tries to integrating a computer game in the lesson. There have been several attempts to comply the problem, but without a greater influence. Therefore I can come up with the hypotheses:

It is possible to develop an educational game that will be accessible for the teachers, and increase their motivation for using computer games in classrooms. The design of the educational game will be based on a user-centred innovation process where empirical data will be conducted from teachers who are experienced with the use of educational games.

4. Method

This chapter described the methods that are used to perform the empirical data, and the method for testing the design, that will be produced according to the empirical data.

4.1. Method of the dialogue

The purpose with this methodology is to gain an insight into the teachers' needs and how the needs are communicated to the developers. The gained insight will be achieved by performing interviews on teachers teaching in elementary school and game experts. When interviewing a person, the interviewer can through questions lead a conversation where opinions, attitudes and experiences from the person's Lebenswelt[7] are revealed (Kvale & Brinkmann, 2009). Nevertheless, the intention with the interview is to identify the needs by obtaining empirical data, which will be used to benefit the design of an educational game and thereby attempting to fulfil the final problem formulation.

When conducting an interview there are many factors to take into consideration. The approach of the interview is conducted according to Kvale and Brinkmanns (2009) method of a qualitative interview process. The process of the qualitative interview is listed as followed (Kvale & Brinkmann, 2009; p. 122):

1. *Thematize*. Formulating the purpose of the research study and make limitation of the theme.
2. *Design.* The design of the research study is planed; the 7 phases is considered in a holistic approach, before the interview is started.
3. *Interview.* An interview guide is formulated in accordance to the theme and the interview is conducted with a reflected approach.
4. *Transcription.* Transcription of the recorded interview.
5. *Analyze.* The method for analyzing the transcribed interview is chosen according to the theme.

[7] Lebenswelt is the everyday life of an individual, and how the every day life appears to the individual in the present time independent of explanations and other opinions (Kvale & Brinkmann, 2009, p. 47).

6. *Verification.* Distinction of the reliability of the results and the validity of the gained information.
7. *Reporting.* Reporting the new knowledge in a scientific matter.

It is important that the *theme* of the research study is properly investigated before starting an interview. A qualitative interview seeks to gain descriptive information about the interviewed person's statements. To start and guide an interview about a person's Lebenswelt, the interviewer has to hold knowledge within the theme. Nonetheless, it is required to thematize the problem field by formulating a research question and a clarification of the theory within the theme. The planning of the theme has a *why* and a *what* (Kvale & Brinkmann, 2009); w*hy*: clarification of the purpose with the research study, and w*hat*: acquisition of previous knowledge of the investigated study. These two questions needs to be answered before the question h*ow*, which is a part of the *design*; *how*: acquisition of knowledge of different kinds of interviews and analyze methods and decide which to use to gain the wanted knowledge from the interviews. In the decision making of the *design* of the interview study, every seven phases have to be considered as a whole.

4.1.1. Acquisition of interviewees

The rapid progress of the appearance of multi media has caused a cognitive change in the pupils mind, which have caused new methods for learning (Prensky, 2001). Nevertheless, games provide pupils-activating teaching in the classroom. The pupils are interactive, accommodating, and attentive when playing educational games (Smitherman, Ring, Jones & Nasseh, 2007). As stated in chapter 2, there are many factors that hinder educational games for being used in classrooms. One of the notable problems is the lack of focus on the teachers when developing educational games. The teacher is the promoter for bringing an educational game to the pupils. For that reason, an educational game needs to be designed in cooperation with the teachers. An advantageous educational game for teachers is customized with a user-friendly aspect, from the teachers' point of view. To be able to conduct information of how to design the customization, there will be performed an empirical study based on qualitative interviews.

Some of the barriers for incorporating games in classrooms among others are lack of technical skills, no experience with computer games in general and uninformed knowledge of the advantages of games. Therefore I find it sufficient to collect empirical data from teachers having experience with the use of educational games in classrooms. Moreover, there will be collected empirical data from game developers. The game developers need to have experience with developing educational games for pupils. The reason for drawing the game developers into the empirical study is to comply the teachers' needs in a design. The teachers possibly have some demands to a design of an educational game. However, it is demands that have to be compromised with the game design. By bringing the game developers into the study, they can support the design of an educational game with their earlier experience.

The empirical study is being used as fundamental ideas of the design for the product of the present report. In addition, the empirical data received from the teachers' will be used to formulate questions to interview the game developers. In this manner, I can collect new empirical data on the basis of the knowledge from the teachers. The final goal is to design a product that puts the teachers' needs in focus, while still considering all view points; the teacher, the pupil and the game developer.

The questions for the interview with a teacher are formulated according to the state of the art performed in the chapter 2. The approach to the interviews on both the teachers and the game developers will be semi-structured (Kvale & Brinkmann, 2009). A semi-structured interview covers an everyday conversation with a structured starting point, which seeks to obtain knowledge about a certain theme. The questions are therefore only working as guidelines. The questions for the different interviews and a description of why the question is asked can be viewed in appendix I.

The interviews will be recorded and transcribed afterwards. Therefore the interviewee is being informed about these conditions. Furthermore, before and after each interview there will be a short "briefing" of the intentions of the interview, and a "debriefing" give the interviewee an opportunity to ask questions about the interview if there are any doubts (Kvale & Brinkmann, 2009).

Interview with Britta Hansen

The intention of the interview with teachers was to perform two or three interviews on teachers who have experience with educational games in the elder grades; 7th-9th grade. Interviewing two or three interviewers will give experience from more than one perspective.

During my research I got a hint about that the majority of teachers from Avedøre School have many years of experience within using educational games in classroom. I got in contact with a teacher from Avedøre School who are teaching in the subject biology and are using educational games when teaching the pupils. Unfortunately, the present time of the school year is occupying most teachers with exams, planning of next school year and schedule planning, and therefore the arranged meeting was cancelled. It was only possible for me to arrange and perform one interview with a teacher.

Britta Hansen from Avedøre School approved to participate in an interview. Britta Hansen is mainly teaching the younger classes, 1st-3rd grade, in respectively mathematics and Danish, though she have taught some elder grades in mathematics and German. The experience with the use of educational games in the classroom is mostly from teaching younger pupils, and her answers will therefore be affected of this. The games offered for young pupils are often easier to handle than games for the elder pupils. The answers from Britta Hansen may not be reliable according to the intention of the interviews, since her experience is conducted from educational games that may not require the same skills as the educational games for the elder pupils.

Interview with Ella Myhring

Since Britta Hansen was the only teacher from Avedøre School, who had time to participate in an interview I continued my searching for at least one teacher more to collect empirical data from more than one perspective. The searching for a supplementary interview led me in contact with Learning Lab Denmark, which is a laboratory, where there is researched in innovative solutions of learning methods. Learning Lab Denmark is in a close cooperation with schools in Denmark, when they are developing and testing new innovative solutions for learning methods and materials, such as educational games. The idea by contacting Learning Lab Denmark was to establish acquaintance with schools, which have a focus and great experience within the use of educational games as teaching material. Despite a great attention and helpfulness from Learning Lab Denmark, I did not succeed in acquire more teachers for my interviews.

In the early phase of the present research I got familiar with Ella Myhring's work by reading some of her articles. Eager to get empirical knowledge from different perspectives, lead me in contact with Ella Myhring. Ella Myhring is a librarian at Højby school in Odense, in a so called "Combi"-library, which is an integrated public and school library. Ella Myhring has about eight years of experience with helping teachers in incorporating computer games into the classroom. Children often play computer games in the library, where she works, which was the reason for, why Ella Myhring got the interest in incorporating computer games into the classroom. What differs from my research and Ella Myhring's experience is that Ella Myhring uses commercial computer games to integrate in the classes, in difference to my focus on educational games. Ella Myhring started out with a focus on educational games, but shortly after she realised the economical importance by developing an educational game. Instead she turned the focus on existing commercial computer games. However, the difference does not have greater influence on the information I intend to obtain, since my focus is on the teachers need to use computer games in class. Ella Myhring agreed to participate in an interview over the telephone. Since she is not a teacher, the questions in the semi-structured interview had to be changed according to Ella Myhring's situation (Appendix I).
Ella Myhring's wide experience will hopefully profit the present research.

Interview with Niels Østergaard and Dan Funder Christoffersen

Previous study has brought me in contact with the company Mediafarm. Mediafarm is communicating visual solutions for customers and has a speciality within 3D-visualitation, animation and interactive design. Despite that game development is not the main purpose at Mediafarm I still choose to perform interviews with the employees at Mediafarm. The reason for this is that I know that the employees hold a great experience within developing educational games for the elder pupils in pre-school.
Niels Østergaard is the creative director and founder of Mediafarm. He has earlier worked together with Dan Christoffersen, who is now an employee at Mediafarm. Dan Christoffersen is technical responsible, a programmer, and dealing with interactive media. Both Niels Østergaard and Dan Christoffersen have approved to participate in an interview which will be transcribed. Since Niels Østergaard and Dan Christoffersen have shared experience with developing educational games I will make advantage of this by making a focus group interview. My idea by performing a focus group interview is to create a dynamic conversation, where Niels Østergaard and Dan Christoffersen supply

each others ideas and experiences. Furthermore they have different competences which may benefit in the interview to get different perspectives of the case.
The questions in the semi-structured interview guide are formulated accordingly to the knowledge gained in chapter 2 [Pre-analysis] and the empirical data received from Britta Hansen and Ella Myhring.

Interview mistakes

It takes an experienced interviewer to perform an interview, which is being conducted after the intentions. Using a semi-structured interview guide, allows the interviewer to control the conversation to a specific topic. However, during the interviews, I often asked the interviewee a leading question. This resulted in that the interviewee just answered with the same words that I just used. Instead I should have letting the interviewee reflect upon the question and answer the question with own words. This can have an influence on the reliability of the answers.
Even though the interviews did not go as intended I still got valuable empirical knowledge which I can use as a reflection in my design.

Transcription guidelines

The purpose with the recorded interviews is to analyse the opinions and experiences from the interviewees. Therefore the transcription of the interviews will not include any sounds, tone of voice or breaks from the interviewer or interviewee, which do not influence the general interview; sounds like “øhh”, “hmm” or the like. A transcription is an interpretation process where the empirical data is found (Kvale & Brinkmann, 2009). An interpretation process demands a resolute estimation in order to turn into a script. During the interviews it happened that one interviewee answered in incoherent sentences. In such cases I reformulated the incoherent sentences to a coherent unit, without ruin the meaning of what was said and still containing the essence of the words spoken. In addition, the interviews are transcribed literally correct.
The transcriptions can be views in the appendix III.

4.2. Method of testing

This section reports why it is important to think about how to test and which test I will use to achieve the data of the usability of the product designed from the analysed interviews.

4.2.1. Approach of the testing

When the product of the present report is designed accordingly to the analysis done upon the interviews with the teacher, librarian, and game developers, I need to test the usability of the product in order to verify the problem formulation. When testing the usability value of a product, there are often used a questionnaire to perform such test. However, according to David Travis (2008), giving the test subject a 5 or 7 point scale to choose from, places the test subject in a situation, where he or she is forced to have a critical view of the product. This type of scale is called the Likert scale, after the American sociologist Rensis Likert (Allen & Seaman, 2007). A Likert scale can measure the degree of a person's statement. Furthermore, usability testing can not only be measured on the test subject's satisfaction but values like effectiveness (the difficulty when completing the task) and efficiency (the time of completing the task) also need to be taken into consideration. In order to obtain an optimal measurement of the usability of a product, these three values need to be measured when testing. To get authentic answers from the test subject it is therefore a good idea to supply a questionnaire with a guided interview afterwards or during the test subject's answering of the questionnaire (Travis, 2008). Consequently, when the product of the present report is being tested of its usability, I will be using a questionnaire as the guide for the interview. The questionnaire will not be an independent sheet, but will be used as a part of the interview.

When testing, the test subject has a tendency to agree with a statement than disagree. Therefore, when making a questionnaire it is important to have a balance between negative and positive statements to get the most reliable answers (Travis, 2008). With this approach I will hopefully get a more in-depth understanding of the test subjects satisfaction, effectiveness and efficiency.

4.2.2. Procedure of the testing

The empirical data was acquired from a teacher and a librarian, both with many years of experience within using games in classrooms, and game developers with experience on developing educational games for pupils. The empirical data will be used to design a product which needs to be tested to verify the usability. Since the focus of the present report is to find a solution to increase the teachers' use of educational games in classrooms, the test will be performed on teachers who have no skills or experience regarding the use of educational games in classrooms. Using inexperienced teachers will give a reliable result, since the product of the present report needs to be accessible for experienced as well as inexperienced teachers. Furthermore, do avoid the issue of testing on teachers who understand computer technology well, the test subjects could not be a part of the digital natives; I will eliminate people from the 80'es and up. When designing an educational game with a biological aspect, I will use teachers who teach in biology. This I will do to examine if the learning content is integrated understandable in the game story, if the knowledge is perceived correctly, and if the level of knowledge is sufficient.

The testing will be performed by letting the test subject try out the product. During the test of the product I will be observing the test subject in order to conduct the effectiveness and the efficiency of the test. The test subject will not get any help or for that matter any opportunity of asking questions, since the test is to verify whether or not the test subject is able to master the product of the present report on his or her own. Subsequently, I will perform an interview with the test subject. I will use a questionnaire with a five point scale to guide the interview. The test subject will be asked a question from the questionnaire, which he or she has to make a personal judge on a quantitative scale; the questionnaire can be viewed in the appendix I. The judgement will be followed up by an in-depth interview to get a deeper understanding of the test subject's judgement.

The interview will be recorded and transcribed under same conditions as the interview conducted on the teacher, the librarian and the game developers. Furthermore, there will be used a meaning condensation on the transcription, in order to analyse the answers from the test subject and the results will afterward be discussed.

5. The empirical data

The objective of the interviews is to collect empiric data in form of opinions and statements from the three interviews. To analyze the obtained data I will make a hermeneutic interpretation, therefore I have used a "meaning condensation"[8] to arrange the notable observations (Kvale & Brinkmann, 2009). The analysis is performed in the following manner: First there will be done a thoroughly reading of the interview transcription. Subsequently, I will find the notable opinion units as they are described by the interviewer, and formulate these to simple formulations in accordance with the theme of the interview. Afterward, the process continues by making questions to the formulations from the point of view of the research specific objective. At last all the significant opinion units will be gathered as a whole descriptive statement.

The following section is the analysis of the three interviews.

5.1. The interviewees' perspectives

After performing the interviews I noticed a difference in how the interviewees directed their focused of their answers. Britta Hansen's point of view was directed on the pupils needs. When I asked a question, Britta Hansen often replied with an answer, where she mentioned the pupils' needs. This can be interpreted as the teacher's and the pupils' needs are in symbiosis; by fulfilling the pupils' requirements, the teacher's needs are fulfilled too. Yet, this does not mean that the teacher's needs are fulfilled, if the pupils needs are considered, but that the teacher's needs often are met by fulfilling some of the pupils demands for playing educational games.

Ella Myhring puts an effort in letting teachers know, how to use computer games in their teaching, which her perspective is reflected upon. In Ella Myhring's interview, she focused on the lack of information about the use of computer games among the teachers, and that this is a problem that has to be solved.

Niels Østergaard and Dan Christoffersen from Mediafarm have a third perspective in the interview. Their attention was on the quality of the design, which is influenced by the economy, politic, and

[8] Translated from the Danish word "Meningskondensering" (Kvale & Brinkmann, 2009)

special wishes from companies who arrange the order. They tell that these three factors have a larger influence of the result of final product and therefore it is not always possible to develop an educational game after the original intentions.

5.2. Motivation and quality

In the Danish preschool, educational games are most frequently used in the introductory period, where after the use of educational games decreases to about 50% in 4th-6th grade and to hardly any use in 7th-9th grade. The reason for the decrease in the use in the elder grades is that it is difficult to find educational games for the elder pupils (Britta Hansen, line 3-6). An educational game both has to motivate the pupil and deliver a high quality of academic level, and according to Britta Hansen, these games are very difficult to find (Line 129-131).

However, the educational games, which Britta Hansen uses in her present classes, are not problematic to integrate into the classroom (Line 74-76). This is due to the levels of the grade that are being taught; 1st and 3rd grade. The younger audience is not as demanding as the elder, when it comes to a challenging game play. Britta Hansen claims as well that educational games for the elder grades, 7th-9th grade, often gets too complicated to investigate, which results in a motivation loss and therefore she gives up working on the new material (Line 5-9). Niels Østergaard and Dan Christoffersen was a part of the production team that produced the educational game Landbrug Online. Landbrug Online was changed to a completely new educational game called Bedriften, because the first game was not accessible for teachers (Line 68-71). If this case is one of many, then it is understandable that Britta Hansen looses motivation, if the educational game gets to complicated or time demanding. It seems that there are a need for a better communication among teachers and developers, when producing new educational games.

Furthermore, Britta Hansen mentions that educational games are often missing different academic levels of difficulties.

> *"…jeg har én nede i min 1. klasse som bare er super super dygtig, og det kan godt være svært faktisk at finde nogle spil, som til hans aldersgruppe, alligevel er stimulerende nok. Fordi så finder man nogle spil, som han slet*

> *ikke er moden til. Men fordi fagligheden er lidt hurtigere end så meget andet."* Britta Hansen. (Line 133-136)

Britta Hansen suggests that an educational game is divided in 5-7 levels of difficulties to choose from. This is to reach the majority of the pupils' abilities. There are perhaps one problem with the level of divisions, since this puts the individual pupil in a situation, where he or she has to judge his or hers own level of competences. Moreover, the pupil first know his or hers own level when the educational game has been played. Instead of choosing a level, I think the game should contain different depths of learning. Thus, all the pupils will achieve from the educational game; poor pupils will perceive the superficial knowledge, and the competent pupils will submerge in the depth of the game and perceive the underlying knowledge. Solving the level of knowledge by using depths will avoid any rising problems about the administration of choosing an academic level.
In the present report I will not design a game, where the learning can be perceived in different depth. It will require more focus on the actual learning instead of designing a user-friendly product, which is the goal of the research study.

5.3. Accessibility and learning in games

As mentioned, Niels Østergaard and Dan Christoffersen have earlier had experience with developing the educational game Landbrug Online. Niels Østergaard and Dan Christoffersen developed the educational game for a company, and had in that case a co-operation with teachers. The work took place in the early 90'ies, where educational games were still a relatively new phenomenon. Therefore the teachers that Niels Østergaard and Dan Christoffersen co-operated with perhaps did not know which requirements were needed for them to easily access the educational game. This resulted in a production of an educational game that took the teachers nearly a week to understand and use (Line 49-54). Consequently, a new version was made, where the pupil could investigate the world on their own, while solving puzzles; in difference to the first version, where the pupils had to follow one road from start to end (Line 72-76). The other educational games, where Niels Østergaard and Dan Christoffersen as well were a part of the production team, were roughly structured the same way; investigate the game world on one's own initiative (Line 161-163). In many of the popular games, it is possible to

investigate the game world on one's own; such as World of Warcraft, Second Life and The Sims. Accordingly, by giving the pupils something they know from home, they find it more logical. I asked Britta Hansen, what she thought of the idea of having a mixture of game elements and learning content; Britta Hansen responded:

> *" Det ville minde meget om det de spiller derhjemme og jo større logik børnene ser i spillet jo mere motiverede er de. Jeg kan give et eksempel på en leg jeg selv har opfundet i matematik til de mindre elever. Her opfatter børnene det udelukkende som en leg, mens jeg jo godt ved at der egentlig foregår en stor indlæring samtidig, fordi legen går ud på at regne på livet løs. Børnene er bare ikke klare over det. Så hvis man har et strategi spil, hvor man har følelsen af at sidde og spille computer men samtidig har en ubevidst indlæring, er dét det optimale."* Britta Hansen. (Line 285-291)

That is to say, the pupils find the game more logic, if they can compare it, with something they are familiar with from their everyday life. It is therefore important that I try to design the educational game with as much game content as possible without compromising the learning content. Motivating the pupils is one of the requirements for teachers to use educational games in the classrooms.
Furthermore, the educational game as well needs to be easily understood by the teachers. Ella Myhring says:

> *"..computerspil har jo forskellige indlæringskurver, og det er da klart, at jo mere simple indlæringskurven er, jo nemmere kan læreren jo sætte sig ind i, hvad kan det her bruges til […] jo mere komplekst et spil er, jo vanskeligere er det jo selvfølgeligt for læreren at overskue, hvad handler det her lige om."*
> Ella Myhring (Line 121-127)

The game content of the present product should therefore not be designed like a game similar to World of Warcraft, since it is a very complex game for beginners. Though, the idea is to maintain as much game content as possible, and still keep the educational game simple to interact with.

Britta Hansen informs that an educational game in her opinion is accessible, when it is installed and straightforward when loading and starting it, and when the starting menu is well-arranged e.g. a list with an explanation of the choices that can bring one further in the educational game. In addition, the educational game should have a continually increase in the difficulty level and all the pupils should be active participating.
The accessibility regarding the installing and loading of the educational game I will not get further into, since I am focusing on the design of the game's accessibility. The same counts for the need of an increase in the difficulty, since due to the time limitation, I will not make several levels.
However, Britta Hansen suggests an educational game should have a well-arranged overview in the start;

> *"Jeg synes egentlig at det har virket godt, at der i mange spil, er sådan en oversigt, altså ligesom en forside hvor der er sådan en oversigt. Her, hvis du klikker her, så kommer du ind og arbejder med det, og hvis du klikker her, kommer du ind og arbejder med det! Og så videre. Så det synes jeg virkede godt, fordi det er igen med til at gøre at det virker let at arbejde med."* Britta Hansen. (Line 112-115)

Making an overview of the content of the educational game will ease the general view for the teachers and motivate them to continue to explore the possibilities of the educational game. It is important to design something that is familiar to the teachers.

> *"..det er tilgængeligt når det er kendt og man kender det"*. Britta Hansen. (Line 102)

I will attempt to design a product that consists of an overview that will seem familiar to most teachers.
Concerning the control of a game, there are often tutorials available in the game option. However, this is not the most accessible approach when learning how to control a game. Dan Christoffersen comments that developers have improved the use of tutorials (Line 260-269). A classic tutorial are often given the player a lot of information at one time, while leading the player through a level that are

not an integrated part of the game. Instead the developers have started making the tutorials as a part of the game narrative. Dan Christoffersen gives an example of how to integrate a tutorial in the game:

> *"Så skulle første mission være at man bare skulle komme fremad og nå frem til et eller andet. Så har du lært det første. Og så har du ikke engang fået at vide at nu har du lært det, det skete bare helt naturligt. Og den karakter du skulle nå hen til kunne sige "kan du ikke prøve at samle det der op, hvilket du gør ved at trykke på den tast". Så samler man det op og så får man en ny besked og på den måde bliver du underholdt samtidigt med at du bliver undervist. Det er hele konceptet bag, at man ikke bare skal opnå viden uden at gøre noget. Det hele skal være oplevelses baseret, således det hele hænger bedre fast og er sjovere og det er det som computerspil kan. Man skal være aktiv og have oplevelser og man skal mærke det på egen krop."* Dan Christoffersen. (Line 283-290)

To gain most advantage of the medium, I think it is ideal to integrate the learning of the navigation and controlling of the computer into the game narrative. Dan Christoffersen mentions the game Little Big Planet as an example, where the learning of the navigation is integrated into the game play (Line 272-278). Every time the player gets a new tool or have to learn how to master the game in a new way, then a small video sequence with a little guy pops up letting you know how to handle it. Designing the educational game with this approach will not require any earlier use of games, in order to master the educational game. The teacher can avoid using precious time on explaining the pupils how to play the game. In addition, Britta Hansen suggests that the educational game is executed within one or two lessons; that is 45-90 min.

Britta Hansen recommends that all the pupils to be active involved in the educational game. Often there are only one computer for two or three pupils, which imply that the educational game needs to be designed so one pupil is not just leaning back in the chair while the other one is working. In traditional class discussions it is often the teacher who does the talking; only few pupils are participating in the discussion (Line 293-297).

> *"Men det skulle dog være sådan, at den ene elev ikke bare skulle kunne læne sig tilbage, mens den anden knokler. Det ser man desværre alt for tit. Så det skulle være sådan, at for at komme videre i spillet så kræver det at begge elever er aktive. "* Britta Hansen. (Line 259-261)

Niels Østergaard's and Dan Christoffersen's solution to Britta Hansen's citation is to place dilemmas in the educational game (Line 195-205). Again they give an example from Little Big Planet, where the players have to co-operate, in order to complete the level. The pupils need to be put in a situation, where they are actively wondering and discussing what to do, to get further in the game.

A notation to make is that Britta Hansen like the idea of an educational game that can be used on every grade in the pre-school, where the pupil will be challenged according to the grade the pupil chooses (Line 209-220). I see the advantage in having one educational game for all grades, if the teacher teaches mathematic in both 1st and 3rd grade, since the teacher only have to master one educational game instead of two. However, since my focus is on the subject Biology, which is only offered in 7th-9th grade in the Danish preschool, it will not work in my case. In addition, the educational game suddenly becomes a larger production, and then there is the economy aspect of it.
Another idea that Britta Hansen suggests, is to give the pupil a printable visual proof of what they have accomplished in the educational game. The proof should work as a motivation for the pupils to compete among each other (Line 269-273). Firstly, games are often made with visual proofs of improvements to motivate the player to continue. Secondly, printable proofs will not be taken into account when designing the educational game from the present report. After my opinion, the printable proof does neither have any influence on the educational game's accessibility nor a factor which will have a major importance for increasing the game use among teachers.

5.4. Teacher guide

Educational games are often followed by a teacher guide, describing how the game works, and how the pupils can learn from it. In some cases, like Niels Østergaard's and Dan Christoffersen's experience, the teacher guide is too comprehensive and complicated that it will take the teacher more time to

familiarize with, than the time the pupils spent on it. Britta Hansen states that she prefers a guide that can tell her step by step how to understand and control the educational game (Line 179-184). As I mentioned earlier, I will try to solve this problem by integrating the guidance in the game narrative; letting the tutorial be a part of the game.

However, Niels Østergaard mentions that if a game has curriculum content, than there have to be a teacher guide (Line 250-252). The present research will only concern the development of an educational game, therefore I will not develop a teacher guide. Though, the design of the educational game will consider as many requirements as possible.

5.5. Teacher culture and authority

A common reflection from all three interviews was about the teachers' culture and authority towards the pupils. Educational games may be difficult for teachers to master completely, which often results in a lack of use of the educational games. Nonetheless, it is not a necessity to master a game 100%, in contrast to literature where the teacher would read the material several of times before giving a lesson (Ella Myhring, line 85-90). The issue is to change the teacher culture and the authority that exists between the teacher and the pupil. It is important to know that games are a medium that not always can be mastered completely, and because of the progression of digital media it may happen that a pupil know more than the teacher.

> *"Computerspil er et helt andet medie og skal forstås i en helt anden sammenhæng og her skal vi nok vænne os til at trække på det som eleverne kan."* Ella Myhring. (Line 91-92)

In the classroom the teacher has an authority in form of his or hers knowledge of the given subject and the ability to communicate the knowledge. The authority disappear in a certain extend, when entering a computer room, where many of the pupils are at least as good as the teachers to play the games. In addition to this it can be difficult to control the learning that the teacher has intended and the teachers are afraid that the pupils do not perceive the knowledge.

Nonetheless, it is not only the authority towards the pupil's but the parent's of the pupils' as well. Britta Hansen tells:

> *"Altså, man skal gøre op med sig selv hvad for nogle spil. Der er jo rigtig meget læring gennem leg, men stadig så leger man ikke for at lege men leger for at lære. Og det er rigtig rigtig vigtigt at gøre sig op fordi forældrene…altså børnene vil gå hjem og når mor og far siger, "hvad har i lavet i dag", så vil børnene sige "vi har spillet computer", eller "vi har leget". Og så tænker mor og far "nåh, har de nu gjort det igen". Så derfor er man nødt til på forhånd at gøre op med sig selv, hvorfor er det vi skal spille på computer og hvorfor er det vi skal lege den her leg."* Britta Hansen. (Line 160-165)

Britta Hansen refers to the pupils' parents, when she talks about incorporating educational games into the classroom. This demonstrate what Ella Myhring, Niels Østergaard and Dan Christoffersen mention that the teachers need to change their attitude toward the new way of learning instead of thinking about the parents, the school committee or for that matter a specific curriculum (Ella Myhring, line 95-101; Mediafarm, line 166-180).

When playing an educational game the pupil has, to a considerable extend, the influence of, which assignments he or she wants to accomplish. The pupil has the possibility to construct own learning, and that is what is important, when playing an educational game. I believe that one can never know if the knowledge communicated actually corresponds the learning that is taking action in the pupils' head. Furthermore, pupils have another approach to learning than the previous generations, and therefore the teachers need to rethink the learning process. Ella Myhring expresses how to look at the learning process:

> *"vi gør læring til elevens projekt, og ikke lærerens projekt."* Ella Myhring. (Line 107)

The paradox is that teachers do not even think that they can learn something from playing games; what they learn, they need to have on paper. Instead the teachers should try to play a game and see what

actually can be learned. On the other hand, games are on equal terms with other educational material; every new educational material needs to be investigated and prepared for a class, whether it is a new literature or an educational game. It is the teacher culture which needs to be changed, and this is where the information takes an important part. I believe the problem is that the teachers must be equipped with the knowledge about educational games from day one off, when the teachers finish the collage of education; if one is not informed about something, then how should one know about it unless the person is getting a tip from e.g. a colleague or a scientific journal, like Britta Hansen mentions (Line 29-34).

Ella Myhring is doing a remarkable effort in making awareness about computer games advantages in teaching by informing teachers and arranging lectures for teachers at different schools in Denmark (Line 51-60). Even though Britta Hansen as well think this is the way to comply the problem of the lacking use of educational games in classroom (Line 241-244), I think the most effective solution is to improve the curriculum of the college of education. It is a question of making educational games a part of the material that will be introduced during the teacher education. Lectures and courses, which are being offered at schools, are not progressive enough to reach all Danish teachers. Educational games have existed for many years, yet many teachers are still not aware of computer games profitable use as education material.

5.6. An empirical overview

The empiric research have given me knowledge from three perspectives; the teacher, the promoter and the developers. I have analysed the empiric data and from all three interviews, I have gathers the empiric information that consider all perspectives as a unified whole.

As Niels Østergaard and Dan Christoffersen inform, there are many obstacles that prevents game developers to design a product as they intended. Furthermore, due to the goal of the present report and the time limitation, there are requirements, wishes from the interviewees that will not be taking into consideration.

To make an educational game manageable for teachers, the overview of the educational game has to seem familiar to the teachers, to give them motivation to continue. Furthermore, an educational game

needs to be designed with as much game content as possible without compromising the learning content. To motivate the pupils, the game play needs to be recognizable; reminding of commercial games. However, to motivate the teachers to use educational games, the learning content needs to have a high quality of academic level.

Tutorials are useful when learning how to master a new educational game. The educational game will be designed with an integrated tutorial into the game narrative. Integrating a tutorial into the game narrative will result in an immediately learning situation, instead of losing time on learning how to control the game. This will benefit both teacher and pupil.

The educational game of the present report needs to be designed so all pupils are actively having a dialog in order to play the game. The structure of the educational game should give the pupil the opportunity to explore the game world on their own and create their own path of knowledge. In this way it will be the pupils' project instead of the teachers, as Ella mention.

It is notable that in all three interviews there were referred to the missing information to teachers about the use of educational games in classrooms. Better communication among developers and teachers may not be the only issue, when comply the lack of use of educational games in classrooms. As all four interviewees state it is important to inform the teachers about the use and advantages of educational games. Informing the teachers may solve the problem of the teachers' authority among the pupils, parents, and the scepticism of educational games that are found among the teachers. However, the report from ITMF (Rambøll, 2005) shows that informing teachers at the schools does not have an influence compared to the effort used to solve the problem. Therefore I believe that this information must be communicated in an earlier state that is before the teacher students finish their education. In the present report there will not be focused on informing teachers.

6. Designing and implementation of product

With a holistic approach of the achieved empirical data, there will be designed an educational game. The chapter outlines the reflections of the design choices. The implementation of the educational game will be explained short in the subchapter, implementing the product.

6.1. Designing from empirical data

The empirical data showed that there are many needs from the teachers that can be useful when developing an educational game with the purpose of making a user-friendly design for the teachers. In the present study I will only focus on a minor part of the teachers needs, in order to get more in depth with the reflections and the design.
The needs that I will consider in my design are:

- Providing an accessible overview
- Integrate a high level of learning, and
- Contain a suitable balance between game play and learning

I do know that a suitable balance is an individual judgement. The purpose is however, to integrate the learning into the game play without ruin the game play. From another angle, the game play should not be disturbed by the learning, but on the other hand the game play and learning should be designed as a unity together.
I have chosen to focus on the accessible overview, since I believe that it is important to have a positive first hand impression for further investigation of the game. My choice for focusing on the high level of learning content is that many teachers do not use games in classrooms because the teachers are afraid that the pupil will not gain enough knowledge. By focusing on a high level of learning content can increase the motivation for using the present educational game. When designing an educational game it is important to think of the target group. Even though the teachers are the once who have to present the educational game to the pupils, the game still needs to be attractive to the pupils, in order to provide

optimal learning. Therefore I have chosen the last focus should be to design an educational game where the game and learning comply each other in a unity.
The following subchapters describe the design choices.

6.1.1. Providing an accessible overview

Many teachers are teaching the same grade with the same subject, and therefore they do not have to investigate new curriculum. It is often easiest to teach with the material that one have used for many years in preference to prepare new material for each year. Therefore, when the teachers are presented to a new material, the material has to be attractive and motivate the teacher to investigate the material. Ella Myhring states that teachers have difficulties by mastering complex games. Therefore when designing an educational game that is new for many teachers, it is important that the game is accessible and motivates the teachers to continue focus on the material. Britta Hansen claims that teachers need to be presented to something familiar. Consequently, I will use the design of a book as inspiration for the overview of the educational game that I will develop.
It is an individual judgement what is accessible and what is not. By using a book as inspiration, every teacher will know the structure of the educational game. The purpose of using a book as inspiration is to give the teachers an easy approach to the game, and hopefully motivate the teachers to continue the investigation of the educational game. Figure 4 illustrates my idea of using the content of a book.

Figure 4 The figure shows the design solution when using a book as inspiration.

6.1.2. Integrate a high level of learning

Some of the hindrances of why the teachers avoid the use of computer games in their lessons are reasoned by the lacking curriculum content in the games. Furthermore, there is a lack of support when the teachers want to know, which knowledge can be achieved by a specific educational game. By using the content of a book, I can list the knowledge that can be achieved in the educational game. My intention is that the teachers, by them selves, can form an overview of the knowledge in the educational game.

As stated in the 1st chapter, the introduction, I will make a biological educational game. Each chapter of the content is a superior topic of what can be learned in the chapter, see figure 4. The chapter then has subchapters which is where the gaming will be played. Figure 5 illustrates an example of how it looks like when the player wants to learn about arteriosclerosis.

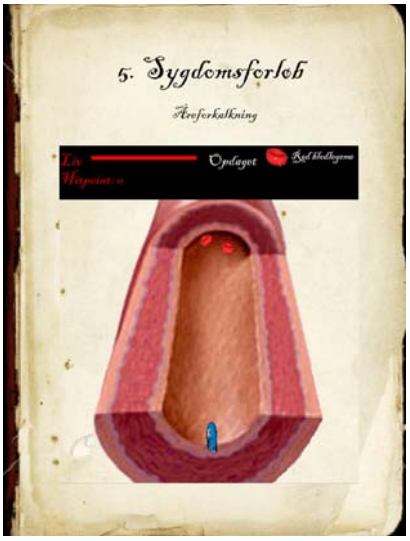


Figure 5 The figure illustrates the interface of the game, when the player have clicked on the subchapter "Åreforkalkning" in the content.

6.1.3. Contain a suitable balance between game play and learning

Both Britta Hansen and Ella Myhring state in the empirical interviews that the educational game has to look like the commercial computer games that the pupils are playing in everyday life. The reason for

this is that the pupils understand the game if they find the game logical; a recognizable game logic. The game theory is designed according to Salen & Zimmerman's (2004) rules of game play.

A genre that is well known by most pupils is first person shooter games. By using this genre, I can integrate the biological aspect into the game story, by letting the player investigate the game world, and solve quests, e.g. find, diagnose, or treat a disease. To give the educational game a didactic approach I will use the elements from the flow theory.

Using the structuralistic approach from the book also benefit this focus. The purpose is to let the pupils explore the game world on their own. Having the learning listed in the content, the pupils can easily explore the knowledge of biology. With the content overview, the pupils to not have a specific road to follow, but instead the pupil can individually choose the path to explore. From Mediafarms experience, this is the most immersive and motivating way to structure an educational game for pupils.

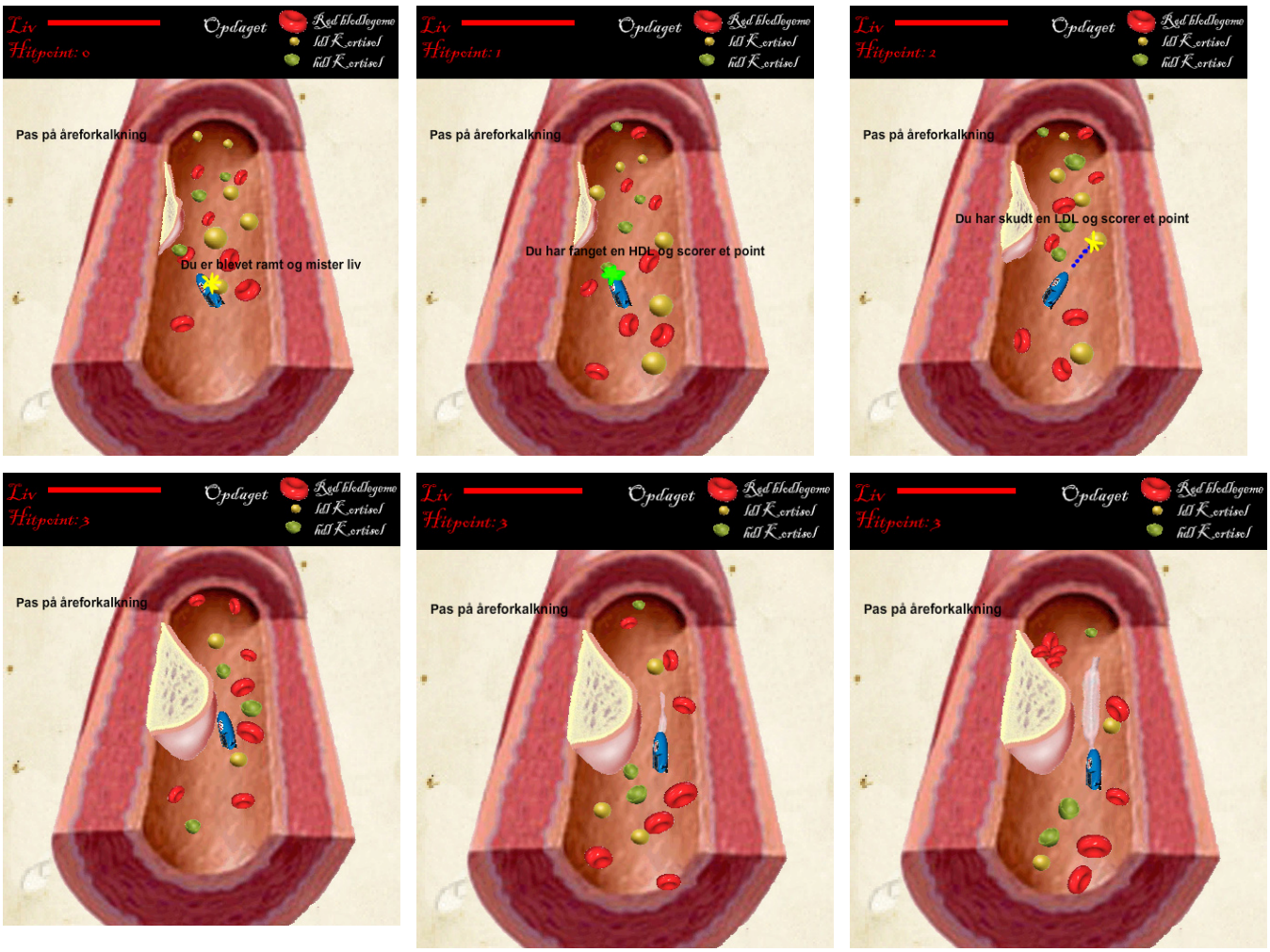
6.2. Implementing the product

To implement the design choices I have used the program Flash. The structure of the interactive application is showed in figure 6. The front side of the book is an interactive link that will bring the player further into the content when clicking. Then the first page of the content is shows; "Indholdsfortegnelse". Here there are two options; either the player can click on the 1st chapter, "Biologiens evolution", or he or she can click on "Næste side" which will bring the player to the second page of the content. The page that is linked to "Biologiens evolution" only explains the meaning of each chapter. From this page, it is possible to navigate back to the first content page. The second content page only has one link, which is "Åreforkalkning". Clicking on the link will bring the player to chapter 5, where he or she can play a game about arteriosclerosis. The game is not interactive. However, the player will be presented to a video which plays a scenario of how to play a game about arteriosclerosis. The Flash product can be viewed on the enclosed CD.


Biologiens Verden
spil
Indholdsfortegnelse
af spillets univers
1. Biologiens evolution
5. Bygdemsforløb

Figure 6 The figure illustrates an outline of the interactive overview.

Figure 7 shows screen shots from the game.



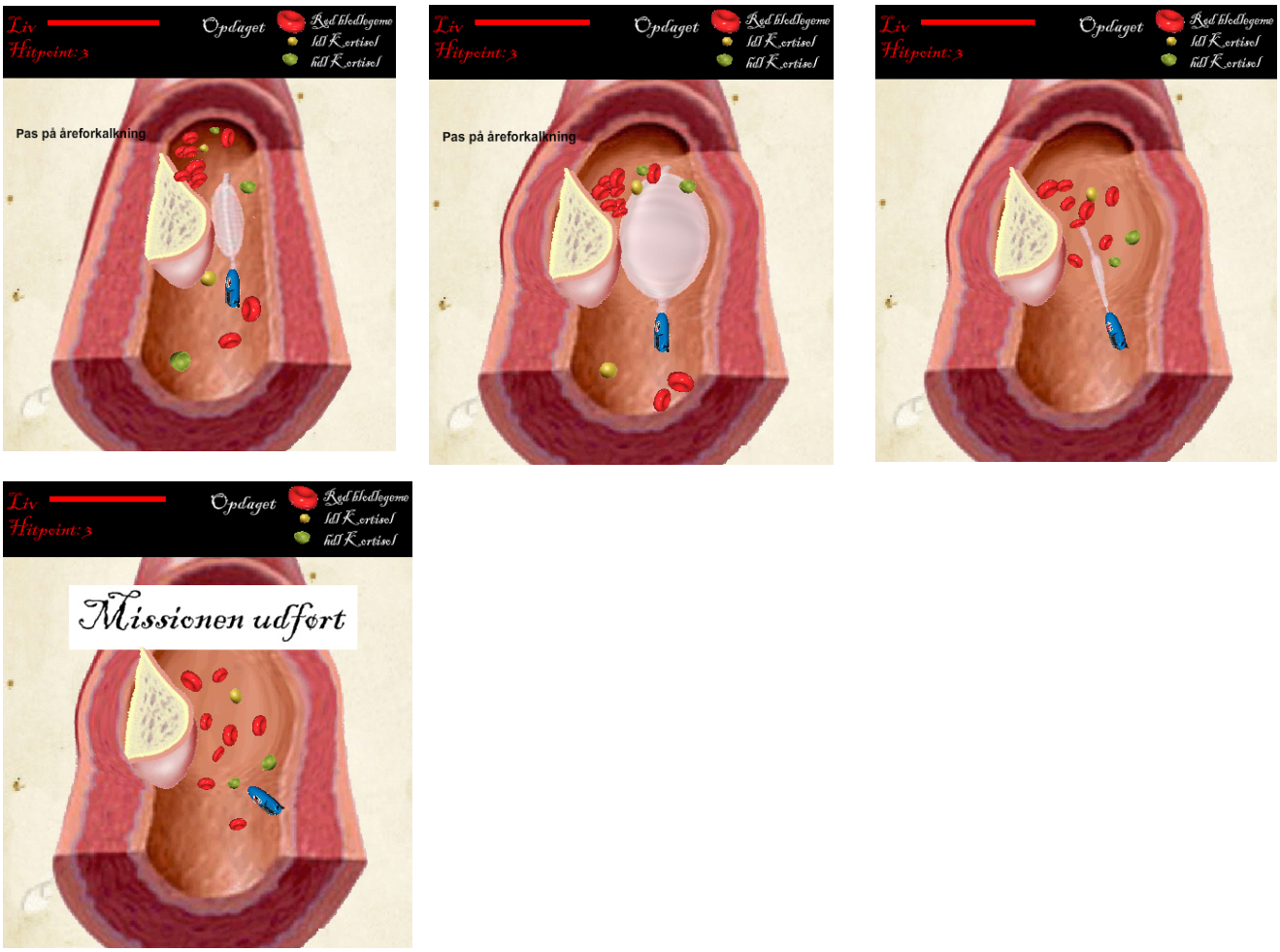


Figure 7 An outline of 9 screen shots from the video of a game scenario.

7. Verification of the product

The chapter contains a verification of the product that has been designed and implemented in the present report.

The product is tested in order to verify whether or not the present product is accessible and understandable for teachers. The intention when testing the present product was to use test subjects with the following conditions: Working as a biology teacher, never used educational games in classrooms and not a part of the digital natives.

Due to the period of the school year, it was not possible for me to perform the testing on the intended test subjects. The test subjects that I was able to reach, was all studying on the collage of education. The disadvantage by having test subjects that are still studying, is that they often are young and consequently a part of the digital natives. According to my earlier stated conditions for the test subjects, this can influence the results of the testing. This can increase the risk that test subjects are familiar with computer technique. On the other hand, an interesting perspective by having prospective teachers as test subjects is that they are the new generation of teachers to teach in the school. It can be interesting to see if they understand the present product since these test subjects may be a part of the digital native and therefore assumed to have a better understanding of computer technology.

Three test subjects agreed to perform a test on the present report and they all agreed to be interviewed. Table 4 shows an overview of the conditions of the test subjects.

Table 4The table is an overview of the test subjects and their conditions according to the test.

Test subject	**Conditions**
Anna Nielsen, student	• 23 years old • 4rd semester • Primary subjects: Danish and History • Only use computers for writing and searching on the internet. • Private computer use: Searching on the

	internet. But not often.
Signe Jeppesen, student	• 26 years old • 4rd semester • Primary subjects: Danish and Biology • Private computer use: Searching on the internet in general.
Lars Jensen, student	• 27 years old • 6th semester • Primary subjects: Danish and English • Private computer use: Play some games once in a while, or else just for searching on the internet.

7.1. Overview of the questionnaire results

The section contains an explanation of the observations and gives a short overview of the three interviewees' responses to the questionnaires. The transcribed interview can be viewed in appendix IV.

The observations showed that Anna Nielsen and Signe Jeppesen had some problems with interacting with the product. It took a while for both of them to understand how to get further into the game. On the first "content page" of the present product Signe Jeppesen and Anna Nielsen had no problem with understanding that "næste side" would bring them further in the content. On the last "content page" they both tried to mouse-click on all the signs trying to get action out of it. After a while they pressed the right sign, which brought them further to the game. On the other hand, it did not seem to be a problem for Lars Jensen to interact with the product. It did not take Lars Jensen much time to understand, how to get further into the game.

The following is a short overview of the results from the questionnaire:

1. Jeg blev, ved første indtryk, motiveret til at fortsætte med at interagere med spillet.

Meget enig	Enig	Ved ikke	Uenig	Meget uenig
Signe, Lars	Anna			

2. Det er svært at finde et overblik over spillets indhold og formål.

Meget enig	Enig	Ved ikke	Uenig	Meget uenig
	Anna			Signe, Lars

3. At oversigten er designet som en bog, gør at jeg har lettere ved at genkende det og få et overblik.

Meget enig	Enig	Ved ikke	Uenig	Meget uenig
Anna, Signe, Lars				

4. Der var et tidspunkt hvor jeg blev forvirret og havde lyst til at stoppe.

Meget enig	Enig	Ved ikke	Uenig	Meget uenig
Anna	Signe		Lars	

5. Der er ikke så meget læringsindhold i spillet.

Meget enig	Enig	Ved ikke	Uenig	Meget uenig
			Anna, Signe, Lars	

6. Læringen skal integreres anderledes i spillet.

Meget enig	Enig	Ved ikke	Uenig	Meget uenig
		Signe	Anna, Lars	

7. Det er let at danne sig et overblik over læringen i spillet.

Meget enig	Enig	Ved ikke	Uenig	Meget uenig
Signe	Anna, Lars			

8. Spil og læring er integreret godt sammen.

Meget enig	Enig	Ved ikke	Uenig	Meget uenig
Signe, Lars	Anna			

9. Det er et spil jeg godt ville udforske på egen hånd, for til sidst at bruge det i undervisningssammenhænge.

Meget enig	Enig	Ved ikke	Uenig	Meget uenig
Signe	Anna, Lars			

The results of the questionnaires and the transcribed interviews will be analysed and discussed in the following chapter.

8. Discussion of results

This chapter contains an analysis and discussion of the results from the questionnaire and interviews of the testing.

8.1. Accessibility of the present game

Signe Jeppesen and Anna Nielsen had a limited experience with computer technology, opposite to Lars Jensen, who uses the computer more frequently. All the test subjects' experiences with educational games are very limited. According to the interviews performed on the test subjects, the knowledge about the educational games is simple applications that contain limited game content (such as multiple choices with some game content added). This was also clear to see in the observations and by viewing the questionnaire and interview answers. Test subjects skills gave a clear view that it is more difficult to interact with the product if one do not have computer technical skills compared to one who have the skills.

During my observation of the testing by Anna Nielsen and Signe Jeppesen, I noticed that they both had difficulties by interacting with the game. This was a correct observation, since both Anna Nielsen and Signe Jeppesen agreed in having difficulties in providing an overview, and that they at one point lost their motivation to continue (Anna Nielsen, line 25-28; Signe Jeppesen, line 47). Even though Anna Nielsen and Signe Jeppesen give a negative answer, it actually shows that the negative answer is owing to that the product is only limited developed. In my observation I noticed that both Anna Nielsen tried to press all the textures without any luck. It took them a while before they understood that it was only few places that was interactive. Therefore, the reason for why
Signe Jeppesen states that the reason for why she wanted to stop was because she did not understand why she could only click on one link. This confused her, and therefore she agreed with the statement that she lost her motivation to continue the interaction.

> *Ja, fordi der var kun et emne jeg kunne sætte markøren på så den viste en hånd, og den kørte jeg så hurtig forbi det ene sted, fordi jeg ikke opfattede med det*

> *samme, at jeg kunne trykke på det emne. Den var lidt svær at 'poppe' op, så jeg vidste ikke det var den jeg skulle trykke på, men jeg fandt da ud af det.. Men det var også fordi de andre emner ikke viste en hånd som indikerer man kan trykke sig videre, så ja jeg var da lidt i tvivl et kort øjeblik om man kunne trykke sig videre på skærmen, så skulle lige finde den først. (Signe Jeppesen, line 49-54)*

I assume that if the game was developed with the entire links active, then it would have been easier for both Anna Nielsen and Signe Jeppesen to understand and to easily access the structure of the game. With only one link working, Anna Nielsen and Signe Jeppesen did not understand the purpose of the game. Both Anna Nielsen and Signe Jeppesen had a positive approach to the game, which contradicts the statements of loosing motivation. Therefore to make further assumptions regarding the accessibility the product needs to be developed more, and retested.

Lars Jensen, on the other hand, did not seem to have any problems with interacting with the game. Under the observations, it took him short time to interact with the game and understand it. This is reflected in his answers:

> *Jeg syntes det hele virkede som man bare skulle gå i gang og bare komme der ud af. Jeg havde faktisk ikke lyst til at stoppe.(Lars Jensen, line 28-29)*

Knowing that Lars Jensen has more experience with computer technology than Anna Nielsen and Signe Jeppesen, is it difficult to conclude upon. However, more tests are needed to make further notices.

8.2. Recognizable design

Regarding the statement about the difficulty of obtaining an overview, Signe Jeppesen first had to think about it or a while, where after she very much disagree with the statement (line 22-26). The reason for why she was in doubt could be that she had difficulties during the testing by interacting with the game. However, she very much disagreed with the statement which most likely because she liked the way the content was listed.

> *Ja, jeg synes bestemt ikke det var svært at finde overblik. Øhm.. det stod meget, det var meget godt sat op i en indholdsfortegnelse der viste, hvad der var under de forskellige hovedemner, der viste hvor henne du kunne få viden omkring spillet og hvordan du kan bruge det til dine elever. Øhm..ja det var ret godt stillet op, sådan med underpunkter.(Signe Jeppesen, line 24-31)*

Lars Jensen and Anna Nielsen replied with the same opinion. Lars Jensen found it very easy to navigate through since:

> *Fordi det hele stå jo så man fuldstændigt kan gå ind og se hvad man skal have. Og hvilke ting man skal ned under og så klikke sig ind der og gå videre til det næste. (Lars Jensen, line 16-17)*

Additionally, all three test subjects had positive reactions to the use of a book as a design solution; it influences the accessibility of the game. They agreed that it was good that the interface was recognizable since it made it easier to form an overview of the content. Signe Jeppesen compared it with the situation where one has a regular physical book. Here you just look at the content if you want to get an overview of what knowledge the book contains

> *Ja, helt klart. Jeg er jo også vandt til…altså hver gang du skal have en faglig viden, så læser du ofte i en bog, og her har du den skematiske oversigt, hvor man har nogle emner og nogle under emner, og det ser du hver gang man åbner en bog i indholdsfortegnelsen. Det er jo typisk det man er vant til at se, når man åbner en ny bog, så danner man sig hurtigt et overblik ud fra indholdsfortegnelsen. (Signe Jeppesen, line 40-44)*

8.3. Pupils accessibility

In chapter 2, I examined some surveys about the use of games among teachers. However, one of the hindrances was that the teachers meant the pupils had different game and technical skills. Anna Nielsen states that one does not need much background knowledge to understand this game. Therefore the teachers can easily integrate the game into the class without worrying about that some pupils do not understand the educational game.
Signe Jeppesen as well thinks it is a game that can easily be given to the pupils.

> *Jeg fik lyst til at lære noget og give det videre til mine elever. (Signe Jeppesen, line 18)*

8.4. A holistic design of game and learning content

Signe Jeppesen was the only student studying biology. Nevertheless, all three test subjects understood the knowledge in the game. Signe Jeppesen and Anne Nielsen could even refer to the knowledge learned by viewing the game.

> *Jeg syntes det er godt at man ser den her blodåre og man kan vælge sig ind på forskellige ting. Hvad sker der når der er en blodprop. Der er det gode og det onde kolesterol. Hvad gør jeg ved det. Hvordan skal jeg forholde mig til det. Det syntes jeg var godt. (Anna Nielsen, line 36-39)*

> *Man kan sige, de ting som er onde for kredsløbet, der mister man liv hvis man rammer dem, og omvendt de ting der er gode og som gavner kredsløbet, der får man rent faktisk point. Også det der med at man skal samle nogle egenskaber som er gode for kroppen og som så giver point, altså det synes jeg giver et rigtig godt indblik i, hvad det er der er sundt for kroppen. (Signe Jeppesen, line 56-60)*

That Anna Nielsen and Signe Jeppesen can refer to the learning exactly as I intended the game to signal means that the learning have been integrated successfully. However, Lars could not refer to the specific learning, but mentioned the idea about obtaining knowledge about the health. Knowing that Signe Jeppesen is studying as a biology teacher, and that she is positive about the learning in the present game, it approves that the learning content is successfully integrated.
However, as Signe Jeppesen states, she does not know if she think the learning should be integrated in another way (line 64-67). This she substantiate with the reason that she have not tried educational games before. Therefore she can not tell if there are other ways that are more appropriate than this. Consequently, there needs to be done further testing on biology teachers in order to make a reliable conclusion.

However, Signe Jeppesen thinks that the learning and gaming is integrated in a good way.

> *Lige præcis i det lille udsnit du viste mig, der synes jeg egentlig at både spillet og læringen var utrolig godt integreret, altså, det havde et godt samspil synes jeg. Øhh..men det er selvfølgelig svært at sige ud fra en så lille en del, øh.. fordi når spillet er meget større kan det jo give et helt andet billede af samspillet der er mellem indlæring og selve spillet. Men ud fra det lille indblik, der synes jeg egentlig det var rigtig godt. (Signe Jeppesen, line 80-84)*

She claims that seen in a perspective of a complete game, then the answer may be different. Again, the conceptual art of the complete game needs to be developed to see more clear lines of whether the present game is successful or not.

8.5. More games like this

The test has shown both positive and negative statements. The negative statements are often reasoned by the limited development of the present game. Despite the limited edition, all three test subjects liked the concept of the game and wanted to try and experience more. They all felt like investigating the

present game on their own. The confidence about investigating a computer game on their own is probably because:

> *Det virker som om at det er let at gå til og man skal ikke bruge alt for mange kræfter på det. Forstået på den måde at alle kan være med både dem der er fremme i skoene mht. sådan noget spil, og dem der ikke er så meget på med computere. De kan også bruge spillet. Så jeg syntes det er et spil der er godt at bruge i undervisnings sammenhæng. (Lars Jensen, line 55-59)*

Signe Jeppesen wants to examine more about the level of learning that can be provided to the pupils by letting them play the game. Furthermore she likes the fact that you can learn from games.

> *Jamen helt klart, det er da et spil jeg vil gå igennem og se hvor meget det er man kan lære, og på hvilket fagligt niveau det ligger på. Bare det at lære fra et spil synes jeg er en rigtig spændende indgangsvinkel, og da jeg aldrig selv har prøvet det før, vil jeg gerne være åben for nye muligheder til læring. (Signe Jeppesen, line 92-95)*

That a teacher student studying biology is more interested in seeing more of the game is a positive perspective regarding the success of the present game. I do believe that further development and more tests are needed in order to know if the present game can increase the teachers' use of games in the classroom. However, according to the conducted test, the future perspectives are positive.

9. Conclusion

Educational games are far from a used phenomenon in the elementary schools in Denmark. There have been done a large effort in influencing the teachers' awareness about the use of educational games in lessons, and to give them more confidence to start investigating games on their own. With the present project I wanted to make a different approach to comply the problem, than what earlier have been done. I formulated the following final problem formulation:

> *How to design an educational game with a didactic approach for pupils in elementary school, where the teachers are in focus of the development?*

From an open design focus I compiled empirical data from experienced teachers, which was analysed with a hermeneutic approach. A design and a limited pilot project were produced in form of an educational game from the perspective of the gained empirical knowledge.
By designing the educational game with a structuralistic approach like a book, I could comply several issues' about the lack of use of educational games in the elementary school.

A test upon the present educational game showed a positive response. The design of the present educational game showed to be a success among the test subjects. Designing the content of the game and learning as a book, influenced the accessibility of the game. As experienced through the empirical data, making a design recognizable for the teachers, it will comply some of the hindrances that are preventing teachers for increasing the use of educational games in classrooms.

The test subjects were able to refer to the learning that was integrated in the game movie. When they referred to the learning they mentioned the learning in a connection to the game. This means that the learning and the game content are working as a unity. However, it was not possible to implement an interactive game that the test subjects could try. To make any conclusions upon the harmony of learning and gaming, the present educational game needs to be developed further and be tested again.
Nevertheless, the test subjects were exited about the approach of the present educational game and they all stated that they wanted to investigate the game and eventually give it to the pupils.

The test shows that the approach of compiling empirical data from the teachers' experiences has been a success. However, to make a conclusion upon a larger influence of increasing the use of educational games at elementary schools in Denmark, there is a need for further tests. The negative outcome from the test was mostly reasoned the limited edition of the present educational game. However, the prospective for using this approach for comply the lack of use of educational games are positive.

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