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Sandbox games: a way to promote deeper learning in cross-curricular teaching?

Example scenarios for classroom implementation

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Writing this thesis has at times felt like dreaming. I have found myself moving from familiar contexts and seeing places and objects which I thought I knew in new and at times curious situations. Sometimes dreaming is fun, it is exciting and I wonder where they will take me next, at other times dreaming makes me wake up in the middle of the night in cold sweat. At the end of a night I am slowly waking from the dream and try to piece together every piece of information to make some sense of what I have just been experiencing. For me waking up always invokes mixed feeling, on one hand I want to keep on dreaming and see where I am taken next, yet on the other hand I really want to quit dreaming and finally start my day.

I would like to thank those who have helped me make it through the night.

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Abstract

Deeper learning is a term that gained a lot of attention lately. Deeper learning involves pupils spending more time on subjects by using their knowledge and competences to solve authentic problems in order to make learning last. New and interesting opportunities have presented themselves with the introduction of ICTs in schools, and in particular with *game-based learning* (GBL). Within game-based learning, a particular sub-genre is learning through sandboxes. Sandboxes offer much in terms of adaptability and possible approaches to English teaching, and seem to be compatible with *problem-based learning* (PBL) and with CLIL: *content and language integrated learning*. However, there are few examples on how deeper learning could be realized in the classroom, and as yet no studies have been published on the use of sandbox games to facilitate for deeper learning.

This thesis explores some of the theoretical framework for deeper learning and how it connects to PBL, CLIL, and GBL. Three different scenarios are presented, with suggestions for how these can be implemented in classrooms in ways that also develop English skills. Although these scenarios are imagined, they are also concrete and developed to fit different levels of competence within the structure of a typical Norwegian classroom. The following discussion argues that sandbox games can be used as a method for facilitating deeper learning in subjects such as English in ways that are both relevant and feasible within contemporary Norwegian school structure.

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1 Introduction

In this thesis, I explore how principles of *deeper learning* can be realized through the principles of sandbox games, and argue that this also may be a fertile ground for the subject of English. Deeper learning[1] is a term that has gained momentum in later years and is slowly working its way into the school system. Deeper learning is a way to learn that focuses on working with a specific theme or topic for a prolonged period of time, intended to give the pupil a life-lasting understanding of this theme or topic, and how it connects to other topics. In this process pupils are intended to see the bigger picture and be able to use skills acquired in one subject to work on problems from another subject, to reflect on their own learning and to be the active participants in the process. Deeper learning for every pupil is no small feat to implement into the classroom. Interestingly, although there have been several studies and articles published about deeper learning, most of these are theoretical in nature and offer little as to how deeper learning could be worked with in the classroom (Landfald, 2016).

At present, there may be a mismatch between what is required in order to implement deeper learning in schools and what the current practice in our school system allows for. The way classes are structured, planned and executed - everything from time-tables to how we design task for our students – all to some extent undermine fundamental mindsets needed to work with deeper learning. Problem/project-based learning (PBL) is a method of teaching which includes many of the essential elements needed for deeper learning. Research shows deeper learning is often a result of teaching through a PBL method (Bell, 2010). At the same time, researchers point to information and communication technology (ICT) to be a component in order to efficiently teach with the PBL method (Dede, 2014). Computers, software, and the general adaptation of ICTs could drastically change the way we operate in the classroom(Drange, 2014). Indeed, ICTs have proven to be an enabler for deeper learning and cross-curricular work, and should be actively explored. Yet, change is slow and education still

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[1] I have chosen to use the term *deeper learning* rather than *deep learning*. 'Deeper learning' is used in much scientific literature relating to human learning, whereas 'deep learning' is commonly used in computer science.

follows much the same formula, technology is used little in subjects like English. (Center for ICT in Education, 2013)

The use of ICTs in school has been a major area of interest for well over a decade, still expanding rapidly and taking new interesting directions. One of these directions is *game-based learning* (GBL). At present, there is no available literature that explores the connection between deeper learning and the use of games. Deeper learning is not mentioned once in any of the meta-analyses reviewed here (All, Castellar, & Van Looy, 2016; Egenfeldt-Nielsen, 2007; Perrotta, Featherstone, Aston, & Houghton, 2013; Qian & Clark, 2016).

In this thesis, I explore a particular genre of games - the so-called *sandboxes*. Sandboxes are virtual environments that offer a large variety ways to experiment. Crucially, sandboxes offer *scalability*, enabling the world to scale in coordination with the needs of the user. Need a building? Create a building. Need a village? Create a village. Dust plains, mountains or lakes? Create it. Need a small or large rainforest to work on biology, deforestation, or sustainability? The possibilities are endless, and in theory thousands of players could all inhabit the same world and all contribute to shaping that world. As learning space, sandboxes offer endless opportunities for learning and for PBL especially. The scalability enables us as teachers to expand or shrink the world as desired.; to focus on certain elements, acting as boundaries for pupils, but also directional guides.

The theoretical framework for deeper learning is already formed, but the bridge between theory and practice is still a work in progress. As teachers, we know that to suit the needs of every student we must be inventive, creative, and open-minded. These traits are increasingly important if we are to incorporate deeper learning into our daily classrooms. Yet, planning for deeper learning requires us to adapt a new mindset and rethink our roles in the classroom and how teachers cooperate between subjects through cross-curricular work. Coming up with new ideas is also a time-consuming process and hectic time-tables do not always allow for much experimentation. In my research, I considered conducting a classroom study that tried out the scenarios presented in chapter 3. However, due to practical limitations (such as collaboration with other teachers and number of lessons required to perform a thorough study) I dismissed the idea: it would run counter to the core of deeper learning itself and would not produce relevant data. Instead, I have chosen to explore this subject through creating hands-on models

of sandbox teaching as preparation for future classroom implementation that in principle could work within the current educational system. As history can attest humans are creatures of habit, yet find inspiration in the ideas of others. Quite possibly, the more teachers are exposed to ideas of working with deeper learning, the easier it will be to adapt a new mindset and try these methods for themselves.

1.1 Outline

Chapter Two introduces theory and research from relevant fields related to deeper learning, problem-based learning, game-based learning and content and language integrated learning. Chapter Three presents the three scenarios and explains the various aspects that were taken into consideration when designing them. Chapter Four discusses how the scenarios and the principles behind virtual sandboxes represent approaches to teaching that may create environments for deeper learning in subjects such as English in contemporary classrooms.

2 Thematic fields and research status

This review chapter gives an overview of relevant fields related to the present thesis. Deeper learning is an emerging concept which has seen a sharp rise in both research and official white paper for the last couple of years. The field of game-based learning, an area of much contemporary interest, with a wide range of options for implementation has recently seen the rise of sandbox games. The sandbox genre offers new ways to engage pupils, through a virtual world. While deeper learning and game-based learning are not new concepts in a historical perspective there are indications that the understanding of these concepts is not uniformly established yet. Within the field of game-based learning, sandboxes are given little attention and there is no current connection between the use of sandboxes and deeper learning.

2.1 Deeper learning

Deeper learning is a term that has seen an increase in popularity in Norway since the beginning of 2014[2] and 2015, with the reports for *The school of the future* (my transl.) by Ludvigsenutvalget (NOU2014:7, 2014; NOU2015:8, 2015) on request from the Norwegian Department of Education. Since then, the term has been widely used in both media and published research. However, deeper learning is still a 'vague concept' (Blikstad-Balas, 2014), surrounded by different interpretations and meanings.(Landfald, 2016)

2.1.1 Deeper learning in official documents.

The use of the term deeper learning in official documents is broad, but seemingly consistent. Most official documents published after 2014 seem to follow the first definition presented by Ludvigsenutvalget in NOU 2014:7 *Pupils' learning in the school of the future* (my transl.) which was the first investigative document to put deeper learning on the agenda:

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[2] A-tekst search for «Dybdelæring» https://web.retriever-info.com/services/archive HERE YOU MUST SHOW WHAT YOU FOUND (how many hits) , OTHERWISE DELETE

Deeper learning is about the pupil gradually developing their understanding of terminology and context within a subject field. It is also about understanding themes and issues which are interdisciplinary or across areas of knowledge. Deeper learning implies that the pupils use their abilities to analyze, solve problems and reflect on their own learning in order to construct a complete and lasting understanding. (NOU2014:7, 2014 my translation)

The investigative document that followed, *School of the Future* (Norw. 'Fremtidens skole'*)*, published in 2015, elaborates on this definition of deeper learning, adding to its complexity. Some of these elaborations include "active participation in one's own learning processes, use of learning strategies and the ability to evaluate one's own mastery and progress." (NOU2015:8, 2015, p. 10) The NOU committee points out that pupils' interests also play a major role when working with deeper learning:

Choice is a prerequisite in order for pupils to go deeper in certain themes. To learn something thoroughly and not superficially requires active involvement from the pupil, but it is the school's responsibility to facilitate for good learning (NOU2015:8, 2015, pp. 10-11 my translation).

Choice, student involvement and the use of students' own skills are mentioned as important principles in deeper learning. The use of skills is often translated into *competence* in the current K06 curriculum, what is known as competence aims is the operationalization of the main subject areas (NOU2015:8, 2015, p. 64). Given a pupil masters all the competence aims, this should directly translate into a high degree of *competence* as competence and deeper learning are tightly connected. The committee claims that "Knowledge of when to use what one has learned, and the skills to know how it is done, is a result of deeper learning. In this way, deeper learning and the development of competence are closely related to each other. In many cases, achievement of competence requires deeper learning." (NOU2015:8, 2015, p. 41) This is claimed to be true for theoretical as well as practical subjects as both require real life implementation, whether they are knowledge based or skill based (NOU2015:8, 2015, p. 10). The NOU states that there is a need to redesign final exams and rethink how competence is measured so it correlates with the new curricula and new methods of working with subjects. There is a clear focus on "assessing relevant competences in subjects", moving away from reciting facts and towards designing an authentic testing environment where pupils have the

tools they have in their daily lives at their disposal when competence is assessed. In order to implement this, exam questions would need to be redesigned away from all factual questions to competence based questions (NOU2015:8, 2015, pp. 82-84)

Implementing deeper learning is said to yield lasting understanding, improve the pupils learning outcome and serve as a requirement for competence. The arguments from the committee for wishing to implement more opportunities for deeper learning read as follows:

> The committee thinks that additional deeper learning in schools will contribute to pupils mastering central elements in subjects better and easier transfer learning within one subject to another. Understanding of what the pupil has learned, is a precondition for and a consequence of deeper learning (NOU2015:8, 2015, p. 11 my translation).

This "mastering of central elements", must also be seen in light of the committee suggesting that the curriculum is too wide, and recommends that it be narrowed in order to give room for deeper learning. However, it also claims that there is a need for breadth, not only depth, when facilitating for deeper learning. Their suggestion to secure breadth while still narrowing the curriculum is to ensure that the new curriculums for the individual subjects overlap in form of cross-disciplinary competences (NOU2015:8, 2015). This could in turn make it easier for teachers who want to work towards deeper learning as subjects will share competences, which not only encourages cross-disciplinary work, but could also give pupils more time for deeper learning by allowing the continuation of their work from subject to subject. The committee argues that the K06 also encourages this form of work with its overlapping competences, yet has proven to lead to an unintended breadth, which could be removed by systematically ensuring the new curriculum is clear where it overlaps (NOU2015:8, 2015, p. 63).

Following these investigative documents, the White Paper "Subject, immersion, understanding" (Meld. St. 28 - Fag – Fordypning – Forståelse) was released with a small revision on the use of deeper learning: "Deeper learning involves that the pupils gradually develop their understanding of terminology and context within a subject or cross-disciplinary." (Department of Education, 2015-2016, p. 33 my translation) The White Paper has a stronger emphasis on actual *learning outcome* compared to the aforementioned investigative documents: "complete and lasting understanding of content"; "be able to use what they have learned and transfer those skills from one situation to another", "to use their skills and

knowledge to solve problems in known, new or unknown contexts." (Department of Department of Education, 2015-2016, p. 33 my translation) While White Papers rarely offer any examples as to how teachers can implement deeper learning into their lessons, quite a few principles are still mentioned which could help facilitate this process:

> Learning processes which promote deeper learning are characterized by pupils being allowed to immerse themselves in, and work with, study material over time and get feedback and challenges which are in line with their academic development (Department of Department of Education, 2015-2016, p. 33 my translation))

Throughout these documents, the expectations towards the role of the teacher are mentioned on several occasions. With regard to deeper learning, "…teachers must facilitate for pupils' deeper learning, progression and active role in lessons. " (NOU2015:8, 2015, p. 85) The teacher is expected to accommodate for deeper learning using "varied work methods" (NOU2015:8, 2015, p. 11), while always implementing formative assessment in order to track and plan the pupils' progress.

In sum, suggested principles in these documents for how deeper learning could be facilitated are more time on a given task in order for pupils to truly immerse themselves in a subject; interdisciplinary or cross-curricular knowledge, and that pupils should be given the opportunity to use what they have learned to solve authentic problems. Furthermore, their competence should be tested in both familiar, new, and unfamiliar contexts. It is important that the pupils are actively involved in their own learning process and are able to reflect on their own learning. Pupils need to be able to choose which areas they wish to explore further, and the tasks given should be in line with the pupil's academic development and be implemented through a variety of work methods. The teacher is expected to facilitate for and encourage the pupil to pursue deeper learning.

2.1.2 Deeper learning in practice
There have been relatively few studies conducted that discuss how deeper learning should be implemented in practice. This is supported by Landfald (2016) who argues that theorists like Ohlsson (2011) approach deeper learning from a learning psychologist's point of view, where the importance is the psychological processes that take place within a pupil's mind, yet offer

little for classroom implementation. The white papers on the other hand are designed as first steps towards classroom implementation (Landfald, 2016, pp. 69-70).

There are some studies that describe their approach to working with deeper learning. Fisher and Fray (2016) argue that in order for pupils to be able to dive deeper, they must first grasp the surface. Deeper learning requires pupils to use their knowledge and abilities to both ask questions and embrace new ideas. Fisher and Fray's approach to deeper learning is to implement certain "transfer goals" which would be incorporated into every subject, these goals "are the intellectual habits that make skills meaningful." (Fisher & Frey, 2016, p. 81) An example of this is "in 9th grade, we focus on knowing how to listen to someone who knows something you don't know and to ask clarifying questions." While in "11th and 12th grades, students learn to ask questions about widespread assumptions or confusions." (Fisher & Frey, 2016, p. 80) These goals are examples from the "speaking and listening" competences and show a clear progression in difficulty. These goals are set in a manner which ensures progression throughout the pupil's education (year 9-12), and every subject on that year will be working towards these goals. This practice ensures that the pupils have both the time and the continuity needed in order for these habits to become a natural part of their approach to working with a problem, a transfer of competence that in essence translates into deeper learning.

Several researchers argue that ICTs are particularly suited to facilitate for deeper learning. Dede (2014) argues in his study on the role of ICTs in education that "while it is possible to teach for deeper learning without technology, it is hard to imagine how our schools will scale up such instruction without support from digital tools and media" (Dede, 2014, p. 4). Dede's study focuses on digital teaching platforms (DTP), which divide the role of giving instructions between the teacher and the implemented DTPs. This in turn leads to a more blended or hybrid form of learning, where material is taught through a mix of face-to-face interactions and digital teaching material (Dede, 2014, p. 7). Through the use of DTPs the teacher could distribute alternative learning material and tasks; assess pupils work more easily and through this facilitate for deeper learning. Three examples of DTPs are covered in Dede's study, which mainly focuses on teaching STEM (Science, technology, engineering, mathematics) subjects. While DTPs designed for language arts and literature did exist, Dede

claims that at the time the study was conducted social sciences and humanities were not covered yet (Dede, 2014, p. 12).

2.2 Problem/Project-based Learning

Project-based and Problem-based learning (PBL) is a cover term for approaches to teaching that follow an inductive method in which pupils themselves construct their own knowledge. These approaches connect to constructivism and often contain the collaboration aspect which make sociocultural learning theory relevant in PBL as well. PBL is designed to teach in several steps, and requires the use of different skills and competences to solve the problem or design a product. Project-based and Problem-based learning can be distinguished from each other in terms of the end product. In project-based learning, the end result takes shape of a physical product or artefact, while problem-based learning often results in a theoretical solution, although there are exceptions (Larmer, 2014). In the following, I use the term PBL to cover for both these variants.

NOU 2015:8 used an example of PBL in schools as an effective way to implement deeper learning in schools (NOU2015:8, 2015, p. 51). Bell (2010) conducted a study on project-based learning in the 21th century and claims it to be a "key strategy for creating independent thinkers and learners", and that is not "a supplementary activity to support learning" but rather "…the basis of the curriculum", and which implementation leads to "greater understanding of a topic, deeper learning, higher-level reading, and increased motivation to learn" (Bell, 2010, p. 39). Bell (2010) argues "Real-world tasks run the gamut in terms of necessary skills. It is important to remember that even though a project may be based in one curricular area, it crosses over into all areas of traditional academic studies» (p.5). This is due to the nature of PBL, as solving a real-world task often requires the use of many tools and methods.

In their study on PBL, Graaff and Colmos (2003) claim that working with PBL leads pupils to spend much more time on their work, due to it being designed around their interests, background and expectations. Furthermore, they claim that since PBL tasks often reflect reality, pupils feel more motivated to solve the tasks. This authenticity, combined with collaboration and mandatory pupil involvement leads to assignments which truly challenge

the pupil (De Graaf & Kolmos, 2003, pp. 3-7). Worth noting is the claim that "the extent of the students' involvement will determine the project's broadness and complexity" (De Graaf & Kolmos, 2003, p. 5). Other factors in high pupil involvement requires the freedom to make choices, like selecting method, but also provide "alternative solutions". These factors were important in order to maintain pupils "ownership of the project", as motivation was mentioned as an important factor in self-directed learning.

2.2.1 Incorporation of ICTs through PBL

Since the introduction of the National Curriculum *"The Knowledge Promotion"* in 2006, *digital skills* involving the use of information and communication technology (ICT), has been one of the five basic skills to be practiced in every subject and ICT and digital skills have been major focus areas for both researchers, developers, teachers, policy makers and politicians. When, how and why to use ICTs has been much-debated issues in media and research, both nationally and internationally. Statistics by the Norwegian Centre for ICT in Education through their *Monitor* study conducted every second year since 2003, offer an impression of the implementation and use of ICTs in Norwegian schools. Before teachers are able to start implementing ICTs into their lessons, they need to have access to hardware. While Norwegian schools on average have good access to hardware, in 2013 2,2 computers per pupil (Center for ICT in Education, 2013, p. 55) there is still room for improvement. *Monitor 2013* shows that in the English subject only 10% of pupils use ICTs daily, and 60% once a month or less. Combined with the fact that the study reports under 5% increase in use of ICTs in English from *Monitor 2011* to *Monitor 2013,* this paints a bleak picture of the implementation of ICTs in English lessons (Center for ICT in Education, 2013, pp. 89-90). This information correlates with data gathered through the *International Computer and Information Literacy Study* in 2013, which uncovers that almost ¼ of the surveyed Norwegian teachers do not possess required ICTs skills (Ottestad, Throndsen, Hatlevik, & Rohatgi, 2014, pp. 37-38). Before teachers are able to start implementing ICTs into their lessons, they need to have access to hardware.

While the use of ICTs in English lessons currently are at a seemingly low level, there are ways to incorporate them into lessons. Incorporating various forms of ICT into English lessons could take many forms: directly or indirectly; through inductive or deductive

approaches. Bell (2010) argues that "technology as a means, not an end, enables students to experiment with different technologies for all aspects of PBL (Bell, 2010, p. 42). Due to the nature of PBL, pupils will have to make use of a variety of digital tools: "students use a range of tools and resources to conduct their research. They also choose individual ways to demonstrate their learning in their final product."(Bell, 2010, p. 41).

Interestingly, Uusi-Mäkelä (2015) did a study on using Minecraft for teaching English and discovered that when playing the game, the use of language without direction often became superficial and that players did not engage in more complex use of language. However he claimed that " there are other ways to approach language learning in the game (using gameplay for inspiration for creative writing, embedding target-language material in the game etc.) but if the focus is on leveraging the game as a communication environment it is important to provide an authentic motivation for using the target language" (Uusi-Mäkelä, 2015, p. 80). Here the implementation of ICTs could enhance the "authentic motivation" provided in the virtual learning environment. Such an integration of ICTs would support the direction ICTs in school is taking internationally, seen in NOU:2015:8:

> In international curriculum development, more emphasis has been placed on students to master more advanced ICT skills, and more emphasis has been placed on problem solving and that students understand and produce ICT rather than being consumers of ICT (Department of Education, 2015-2016, p. 32).

2.3   The future of English

English has been a subject in Norwegian schools for many years (Simensen, 2014). Ever since its introduction, its place, content and methodologies have been constant topics for discussion. How is the English subject expected to change in the years to come? Should there be more focus on form? On concrete use? Should content or language come first? In her article on the future of the English subject, Vold (2014) explains how the English subject has always been divided into two interconnected aspects: "an expression part which contains communicative skills, such as reading, listening, speaking and writing, and a content part which covers knowledge about cultures, literature and societies" (Vold, 2014, p. 3 my translation). During recent years the expression part has become dominant, and focus on the content part has declined, despite its imperative role for the development of intercultural competence. According to Vold, it is precisely the competence to understand other cultures

and accept differences between them that will become increasingly important in the future, and hence should be strengthened rather than neglected. As both the expression and content part are equally important in order to achieve intercultural competence, neither should take precedence. The argument is to be using English as a tool to work on intercultural issues, as a means to an end, and not the end itself (Vold, 2014, pp. 15-16).

Drange (2014) imagines that the massive progression in the field of ICTs will bring about a change in how English is being taught in the future. Here change is not about using new tools to do the same old tasks, like she claims it is used today (p.5). Drange argues that in order "for technology to create new methods for teaching and learning, it has to be reoriented and used in new processes and new contexts" (Drange, 2014, p. 5 my translation). What innovative teachers are doing today is what latecomers will be doing in 2030, says Drange. "Blended learning", focus on collaboration and producing authentic content that is read and used by others and not just by the teacher could be something the future holds (p.6-10). Changes in *how* and *what* teachers teach is not the only area Drange explores, *where* is also discussed: "A possible way to organize a school is a middle ground between today's model with classroom lessons and a flexible virtual classroom." (Drange, 2014, p. 11) New methods for teaching and new locations also redefine the teacher's role in education:

> The teacher's role in an organization like this will be very important, but instead of being an instructor, the teacher will be a facilitator and administrator who gives pupils tasks they must solve individually and in groups, and be present as required both physically in the classroom and virtually on an internet based learning system (Drange, 2014, p. 11).

This change in the teacher's role was recently studied by Rasmussen and Lund (2015) who offer valuable insights to the changing landscape. In their study, English and History are two of the subjects which show the biggest opportunity for change, due to access to vast amounts of relevant material online (p.4). "Hybrid practices", where analog and digital modalities and resources intertwine, is an area that is slowly expanding. According to Rasmussen and Lund, teachers seem to be entering roles as "designers", mixing and matching different resources in order to create a lesson for the pupils. This practice leads to a higher degree of focus on material rather than the oral transfer of knowledge from the teacher to the pupils. "This is however practices which at the moment are described to a little degree in research literature and therefore under-theorized" (Rasmussen & Lund, 2015, p. 17). The study concludes by

claiming that this form of teaching requires much of the teacher's competence and "a higher complexity in learning environments and available resources seems to lead to an increase in the importance of the teacher's professionalism"(Rasmussen & Lund, 2015, p. 18).

2.3.1 Cross-curricular English and CLIL

Cross-curricular teaching involves two or more subjects working together on a project. This can span from shorter 2-hour sessions to great wide school collaborations carried out across several weeks. A more mundane example of cross-curricular work is the combination of PE and nature sciences, where teachers collaborate to enable longer excursions and field work. Cross-curricular work is also known to rise from the need of longer uninterrupted working sessions. Cross-curricular work requires a great deal of planning and collaboration from the teachers' side. As pointed out by Hunsbedt (2015) "it was found that all kinds of content and language integrated approaches necessarily demanded (or encouraged) more cross-curricular cooperation, especially when planning and assessing " (Hunsbedt, 2015, p. 108). Some language teachers incorporate cross-curricular work in the form of CLIL method.

Gradually, CLIL, short for *Content and language integrated learning*, is gaining ground in several countries. In the CLIL approach, English or other foreign languages are used as tools to work with other subjects such as science or social studies. There are indications that Norway should as well. Hellekjær (2005) studied Norwegian students' comprehension when working with English texts, and found that only one third of the students surveyed were able to understand the English texts on the syllabi without any major problems (p.149). The study also indicated that CLIL introduced to students in upper secondary could possibly have a positive effect on their ability to comprehend English text at university level (Hellekjær, 2005, pp. 206-207).

Brevik and Moe (2012) conducted a study on the effect of CLIL teaching on language outcomes. While their findings did show a significant correlation between CLIL and listening and reading skills, the pupil perspective offers valuable data as well. The pupils in their study had interesting input on their experiences of being taught through the CLIL method. Not only did they claim that "it is fun learning vocabulary in two languages", and "I really like that we

can use English without being assessed on our language use", but also that "using English in social science is just… normal" (Brevik & Moe, 2012, pp. 8-9).

Requirements for successful CLIL teaching have been explored by Navès (2009) and De Graaf et al. (2007). Navès (2009) suggests 10 characteristics for success, summarized and simplified these can be divided into *teacher*, *task* and *pupil*. According to his study most of these characteristics revolve around the teacher being clear, thorough, and well prepared. The teacher should scaffold and build upon pupils' already existing culture and knowledge, as well as continuous assessment and guidance. The task design is based around diverse tasks, often problem based or experiential in nature. Frequent communication between teacher-pupil and pupil-pupil were also identified as positive characteristics. The last characteristics relate to the pupil and involves "collaborative learning, autonomous learning and self-directed learning" (Navés, 2009, p. 34). De Graaf et al. (2007) explore the same area, but focus on how the teacher facilitates for CLIL to be successful. De Graaf et al. argue that providing authentic material and adapting content to fit the pupils' current level form the basis for success. There is a stronger focus on tasks and output, like "encouraging learners' reactions, working in different interactive formats and practising creative forms of oral (presentations, round tables, debates) and written (letters, surveys, articles, manuals) output production, suggesting communicatively feasible tasks, giving the learners enough time for task completion, encouraging learners to speak only in English" (De Graaff, Jan Koopman, Anikina, & Westhoff, 2007, p. 620). Feedback on output (productions) were important and often peer feedback proved to be beneficial. This must be seen in relation to De Graaf's et al. findings that form-focused processing and not form-focused instruction (explaining rules) formed a basis in successful CLIL classes (p.620).

Gjendemsjø (2013) offers insights into some of the potential challenges in teaching a CLIL class through her study. While some pupils loved the challenge offered though the CLIL method, others found the English to be too hard. Time to plan and facilitate for CLIL in lessons was one of the areas teachers interviewed found lacking. Finding and adapting good content for CLIL lessons does not come with extra resources which places a lot of extra work on the individual teacher (Gjendemsjø, 2013, p. 100). This is supported by Navès (2009) who claims that access to "appropriate material" is a stepping stone in succeeding with CLIL (p.33). While finding appropriate material often is a challenge, and very time-consuming,

there are new interesting areas which remove much of this work, one of these areas are video games. Luckily for English learners, games often use English as a standard language of communication.

2.4 Game-based learning

With the introduction of ICTs in schools new opportunities for teaching emerged. One such opportunity is digital, game-based learning (GBL). Game-based learning can either be to use a certain game to teach by designing a lesson around it, or used in a manner where the game itself is intended to teach the pupil certain skills or convey information. There are plenty of meta-analyses on the use of game-based learning (Li & Tsai, 2013; Mitchell & Savill-Smith, 2004; Perrotta et al., 2013; Tobias, Fletcher, & Wind, 2014). While they all agree on the positive potential and the fact that there is no longer any question - *we can learn from games* - many point in the direction that it is the *game* which is supposed to teach. Tobias et al. (2014) argue that there is yet no general way to measure the effectiveness of different games and that "what we need is a way to design games so that people learn what they need to learn" (p. 500). This attitude towards the game itself being the most important element is found in much of GBL research.

According to Egenfeldt-Nilsen (2007), however, there are inherent weaknesses in much research on game-based learning. The fact that we learn from video games is hardly surprising, as we learn from everything we do. "Most studies are one-shot studies with a lack of knowledge of the characteristics of computer games and with weak connections to earlier research" (Egenfeldt-Nielsen, 2007, p. 272). These claims are backed up by one of the leading independent providers of education research, The National Foundation for Educational Research (NFER). NFER published a detailed review of available evidence on game-based learning from the period 2006 to 2013 in the study *Game-based learning: latest evidence and future directions.* This review also concludes that the benefits of GBL are by no means established:

> Despite some promising results, the current literature does not evidence adequately the
> presumed link between motivation, attitudes to learning and learning outcomes. Overall,
> the strength of the evidence has been affected by the research design or lack of
> information about the research design (Perrotta et al., 2013, p. 6).

This might be an indication that there is no common way to assess the way games are used in the classroom. However, All et al. (2016) claim in their study "Assessing the effectiveness of digital game-based learning: Best practices" that "… it is clear that a more standardized approach is not only possible but required in order to be able to improve rigorousness of DGBL effectiveness research and define guidelines" (All et al., 2016, p. 13). Many different views and methods for implementing games into lessons make meta-analysis difficult.

Egenfeldt-Nielsen (2007) argues that teachers need to see computer games as more than just supplement, and would like to see how it compares to existing educational practices (p.271-272) This is backed up by the findings from the NFER study which states that it is not the game in itself which determines the potential learning effect, but how the teacher makes use of the game and what it has to offer (Perrotta et al., 2013, pp. 5-7). The study also reminds us that implementing games into the classroom can be an arduous process:

> While teachers are generally positive about the use of video games in the classroom, they would require very strong evidence of their impact before they replaced more traditional learning styles. Until this time, they are more likely to use video games to supplement existing practice (Perrotta et al., 2013, p. 18).

Supplementing existing practices often means using educational games, or something to do once the required work in that lesson is done. The current practice of analyzing game-based learning puts educational games, which are designed to teach a specific element and non-educational games, which often are designed to tell a story or offer an experience in the same data pool, even if the approaches to teaching with the respective options are vastly different. This can be hurtful to the "evidence" that Perrotta claims teachers require in order to replace more traditional teaching with game-based learning. If the terminology is unclear, and researchers themselves are not competent enough to differentiate between the different approaches to games in the classroom, any research reviews like the NFER study will have a hard time identifying the positive and negative aspects as they state:

> .. it was often difficult to determine if the game had been built with the express intention of meeting educational outcomes, or whether researchers were appropriating existing games to test their possible educational impact (Perrotta et al., 2013, p. 21).

The NFER study further states that the way forward in terms of game-based learning research is that "..it is important we develop a more analytic approach that considers how the different elements that operate within video games impact in an educational setting"(Perrotta et al., 2013, p. 7). However, a recent study by Qian and Clark: "Game-based Learning and 21st century skills: A review of recent research" (2016) did exactly this and tried to identify the different genres and how they were used in the classroom. Qian and Clark (2016) report from their review of 137 studies that the game genres used in research dispersed themselves like this:

> Most of the papers (50%) used an educational game, and the rest used entertainment games (25%), mobile augmented reality or mobile games (15%), design-based games/tools (7%), and intelligent tutoring systems, gamification or other digital technologies (4%).(Qian & Clark, 2016, p. 54)

Interestingly, "design-based games seemed to be more effective than educational or entertainment games as 17 out of 28 results were practically significant " (Qian & Clark, 2016, p. 57). "Design-based-learning" focuses on using the game as a tool for learning, rather than something pupils play to learn. "These studies may have students designing a digital product such as digital storytelling or using visual coding tools to design games" (Qian & Clark, 2016, p. 53). This directly correlates to findings from other studies which emphasize the importance of designing around the use of a game, and that the teacher should still do considerable planning, and not expect the game to teach on its own (All et al., 2016; Egenfeldt-Nielsen, 2007; Perrotta et al., 2013). Considering the unstandardized way to collecting reliable data on which games teach, it might prove more fruitful to look closer at some of the reported benefits of game-based learning in order to unveil how games teach.

According to the NFER study pure academic achievement has been hard to measure, due to the lack of a dependable way of doing meta-analysis of GBL research. Yet, while academic achievement varies there is a clear consensus that the use of GBL reflects "positively on problem solving skills and knowledge acquisition " (Perrotta et al., 2013, p. 18). As such, games might be better at teaching skills that ordinary teaching struggles to implement in an authentic fashion. Interestingly, the areas which had a positive impact was problem solving and knowledge acquisition - both core elements in deeper learning. While the literature indicates that there might be a connection in terms of these benefits and games, the

implementation of them still holds many questions; what did the pupils' lessons look like before games were introduced? Are games in themselves responsible or is it in fact student activity which is decisive? Is there a change in how the teacher taught, from teacher focused to pupil focused? Considering that the same review found evidence that "..significantly better attitudes towards learning were yielded for subjects using interactive games or simulations, compared to those using traditional methods for instruction" (Perrotta et al., 2013, p. 6) one could argue that the implementation of games in the classroom leads to new teaching practices. Interestingly, Qian & Clark also conducted a meta-analysis of GBL, and claim there is reason to be optimistic about the future of game-based learning. While only one third of the studies they reviewed concluded game-based learning to have a medium to high effect, very few of the studies targeted 21th century skills like creativity, communication, and collaboration. Interestingly, 22 out of 29 studies done on 21th century skills used learning theories like constructivism and constructionism as a theoretical framework, which is to be expected as "Both merge nicely with naturalistic game play as learning takes place when it is social, active, and situated" (Qian & Clark, 2016, p. 57).

Considering that the "traditional" methods used in the classroom often require a low degree of problem solving and acquisition of knowledge, but rather reproducing and replicating, teachers should not shy away from the idea that these benefits could be produced simply by more pupil focused work and better task design. With the introduction of new tools and technologies, new methods or approaches to teaching often emerge, game-based virtual learning environments is one such approach.

2.4.1 Sandbox game genre

Thorsteinsson & Niculescu (2016) operate with the acronym GBVLE (Game-based virtual learning environment) to describe education which takes place in a virtual world. However, this thesis does not specifically address GBVLE or game-based learning as such, but rather a niche within this broader definition: a virtual in-game world containing game-mechanics that make it qualify as a *virtual sandbox.*

During the past few years there has been an increasing trend of implementing so-called "player shapeable elements" into new video games. The relevant games in the genre will

change with time, however, it is the gameplay mechanics in the game that form a foundation for the player to shape their own experience that is important. It is this degree of autonomy to utilize the game's mechanics and elements to create content within a game that will be referred to from this point as the term *sandbox*.

To explain what defines the sandbox genre, Minecraft is often a good place to start. Minecraft is an open-ended video game which means there is no clear ending or major goals that must be achieved. This means that the player creates his or her own purpose in the game. The game provides the player with certain tools or mechanics which sets the parameters for what the player can do. The core gameplay mechanics in Minecraft and other sandboxes is the ability to collect resources from the environment and use them to create new elements. In Minecraft these elements often take the shape of blocks which can be placed or removed in order to create a representation or reenactment of the "real" world; buildings, bridges, boats, castles, planes, streets, planets, art - basically anything the player imagines they can create.

Minecraft can be viewed as "the mother of all sandboxes", and still defines the genre even today. This thesis is looking at the sandbox genre in general, not Minecraft exclusively. However, due to Minecraft's huge popularity both in education and in educational research, most examples and available research on teaching in virtual worlds revolve around Minecraft. That said, the pedagogical principles and methods explored in this thesis are transferrable to other sandbox games. It is the approach and task design that bridge the gap between deeper learning and sandbox games, not the game itself. Minecraft is a sandbox, but not all sandboxes are Minecraft, and this enables the generalization and transferability from experiences related to Minecraft on to the sandbox genre.

The sandbox game genre is often combined with other video game genres as extra features for the player to explore. There is a variety of different implementations of the genre, and some games embrace this as their main feature; focusing on giving the player tools to create their own experience, rather than shaping the content for them.

> A sandbox is a style of game in which minimal character limitations are placed on the gamer, allowing the gamer to roam and change a virtual world at will. In contrast to a progression-style game, a sandbox game emphasizes roaming and allows a gamer to select tasks. Instead of featuring segmented areas or numbered levels, a sandbox game

usually occurs in a "world" to which the gamer has full access from start to finish (Divestopedia & Institute, 2017).

Different sandboxes offer different possibilities and degrees of freedom. Some will let the user shape every element in a world, whereas others might only allow for the addition of elements on top of the existing world. A good analogy for the virtual sandbox is the physical sandbox: what can be made will depend on the tools and materials available in that sandbox. While in a physical sandbox, a child might bring their own toys, a virtual sandbox allows bringing in 'outside toys' in the form of modifications or add-ons is referred to as *modding*.

2.4.2 Modifications

The existence of modifications allows the player to bring new elements to the game. These elements come in many different forms; cosmetic changes, change mechanics, add elements, remove elements, reshape element, the choices are almost limitless. It is important to realize that the player can contribute and shape the sandbox both internally and externally, with this understanding one can grasp the autonomy a sandbox game can provide the player.

Modding can be defined as "the act of rewriting programming code in a video game in order to change the appearance or performance of the software[3]". Yet, modding is not limited to rewriting existing code, it can also add additional code:"The borders of transformational processes are only limited by the Java-based framework as players can even crate modifications themselves" (Nebel, Schneider, & Rey, 2016, p. 359). Players might see something missing from their sandbox, create it on their computers and import it into their worlds. This could be adding additional items; how they look, behave or operate; add additional characters who offer new stories, adventures or tasks, or change the games laws of nature or expand them.[45]

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[3] http://www.dictionary.com/browse/modding?s=t

[4] https://www.planetminecraft.com/resources/mods/any/?time_machine=all_time

[5]

http://steamcommunity.com/workshop/browse/?appid=346110&browsesort=trend&section=readytouse items

While not all sandboxes allow the player to add more elements, a closer look at a selection of sandbox games currently available it will yield an impression of the current trend relating to modifications. Per 2017 some known examples of sandbox games are *Minecraft, Kerbal Space program, Scrap Mechanic, Ark: Survival Evolved, Osiris: New dawn and Avorion.*

Table 1

Minecraft	Modding allowed
Kerbal Space program	Modding Allowed
Scrap Mechanic	Modding Allowed
Ark: Survival evolved	Modding Allowed
Osiris: New dawn	Maybe at a later date
Avorion	At a later date

As shown above, five of these six games support modding, while the last one might implement it at a later date. While this selection is too small to generalize, there is a trend in sandbox games to allow for the addition of externally made features in the form of modding.

How widespread is modding? There is little research available. A survey done in USA(2007-2008) reported that "fully 99% of boys and 94% of girls play video games" (Lenhart et al., 2008, p. 2). Furthermore, "80% of teens play five or more different game genres, and 40% play eight or more types of games " (Lenhart et al., 2008, p. 3). Interestingly, since this survey was carried out before Minecraft revolutionized and to a large degree defined the sandbox genre (in 2008), there is no mention of *open world/environment* or *sandbox*. What is mentioned however is mods: "*..more than a third of boys 36% use mods, while one in five girls (20%) employ them to change the games they play*" (Lenhart et al., 2008, p. 27).

Considering that Minecraft has sold over 122 million copies[6] since its release in 2009 and part of its success is reported to be due to the huge modding community, the number is expected to be much higher today.

2.4.3 Virtual sandboxes for game-based learning

Sandboxes, and especially Minecraft have been tried out in various subjects and have proven to provide pupils with new forms of expression and ways to learn. It has been used as means to teach characterization (Schifter & Cipollone, 2015), work on collaboration (Wendel et al., 2013), learn English (Uusi-Mäkelä, 2015), implement common core activities (Couling, 2016) or as a tool for creativity and social development (Cipollone, Schifter, & Moffat, 2015; Müller et al., 2015; Riordan & Scarf, 2016) As part of their review on the educational uses of Minecraft, Nebel, Schneider, & Rey (2016) looked at some of the current educational practices of Minecraft and found that it was heavily represented in a huge number of subjects and fields (p.357). One of the major points for using virtual sandboxes like Minecraft as a platform for learning is the premise that it "presents a constructivist notion of learning, and has roots in *constructionism*, which is the implementation of constructivist principles into classroom instruction" (Schifter & Cipollone, 2015, p. 215). This principle of designing lessons in a constructivist fashion is not something that is automatically applied whenever a teacher might choose to use a sandbox. Schifter & Cipollone argue that traditional teaching styles which have a high degree of teacher instruction "blocks the diffusion" of the use of games like Minecraft in the classroom, however, the blame is not on the teachers themselves, but "…that there may need to be organizational shifts in the educational system as a whole" (Schifter & Cipollone, 2015, p. 222). Still, a change in the educational system could prove to be hard to implement, according to studies done by Torsteinsson & Niculescu who claim that "teachers considered computer-related work as an extra workload, in addition to their conventional teaching."(Thorsteinsson & Niculescu, 2016, p. 511) Furthermore, they argue that in order for the successful implementation of games like Minecraft into the classroom, teachers need to be skilled in the use of the software in order to facilitate and assist pupils. It could be argued that it is not skills within a certain game that dictates whether it can be

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https://twitter.com/Minecraft/status/836214707602210816?ref_src=twsrc%5Etfw&ref_url=http%3A%2F%2Fwww.businessinsider.com%2Fminecraft-121-million-copies-sold-2017-2

successfully implemented into lessons, but how the teacher constructs tasks, something which directly correlates with the observations made by Schifter & Cipollone from earlier. These claims about task design are supported by the findings of Uusi-Mäkelä (2015) who argues that in order to successfully use Minecraft to learn English, language use has to be a "necessity, not an imposed requirement", and that a balance between structured and open activities could be beneficial in order to succeed with games in the classroom (Uusi-Mäkelä, 2015, p. 85). Therefore, when it comes to what can be thought by using a virtual world, much hinges on the capabilities of the teacher and the possibilities they see. In a study on how Minecraft can be used to teach common core curriculum, there was a clear example that some teachers saw many opportunities while others saw few (Couling, 2016, pp. 14-15).

2.5 Roleplay and storylines in a virtual world

Storyline is a method of teaching which has seen many different adaptations and implementations in recent years, and is especially popular in Scandinavia (Mitchell-Barrett, 2010, pp. 13-14). Traditional storylines set the stage through a key question, then let the pupils respond by reacting to that setting. Along the way the teacher applies key episodes or problems which contribute to driving the story forward or reel pupils back towards the red thread. In this sense, the teacher is very much in control of which direction the pupils are heading to and is therefore well suited to target different competences or themes set forth by the teacher. The pupils add to the immersion by creating characters by means of various craft techniques, and in that sense together with the teacher they create the setting and world in which the story takes place. Storylines might incorporate visual aids like pictures or video, letters or other elements that can contribute to the setting and story. This method of teaching is only limited by how well the teacher can design the setting and apply the key questions or problems along the way. The storyline often concludes by a celebration or event (Mitchell-Barrett, 2010, p. 17). Working within a virtual world gives the user access to both the first person and 3rd person at the same time and lets them move in and out of character. In storyline pupils may adapt a sort of roleplaying: they create roles and try to act according to that role, and everything they do is connected to their role in that certain setting. Acting according to role requires the pupil to know something about the character they are reenacting, the more they know, the better they can play their parts. When principles from

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roleplaying and storyline are introduced into a virtual world, new possibilities present themselves: "Role playing in virtual worlds can give the player a sense of identity within the game and effectively enhance students' real-world competency." (Qian & Clark, 2016, p. 57) By taking advantage of both the first and third person perspective available when working within virtual world, teachers allow pupils to connect with content on a different emotional level, which could in turn offer unique opportunities for learning.

The introduction of ICTs in school give teachers and student access to many digital tools which could help enhance their lessons and practice. The storyline method synergizes well with such tools as it allows for easier creation and several new forms of producing content, be it images, video, audio, wikis, various forms of text or other relevant elements. Creation of content in a storyline could require the use of many different skills and competences, as well as new possibilities. Stories can come in many varieties, and part of a storyline could be videos. The study "Digital Storytelling for 21st-Century Skills in Virtual Learning Environments" by Niemi et al. (2014) followed a project that used a virtual platform for sharing and editing videos for creating digital stories. The study found that both pupils and teachers agreed that working with this method required the use of skills like "planning, inquiring, seeking and pondering new solutions, thinking critically, and giving reasons to their choices.» (Niemi et al., 2014, p. 663) The open structure of the project led to the individual schools and teachers to choose the topics for their videos, and the results showed that it had been implemented in a huge variety of subjects, including cross-disciplinary. Due to this nature, pupils projects showed that both formal and informal learning had occurred (Niemi et al., 2014, pp. 661-662). Interestingly, evaluations from the pupils showed that they had used digital tools and worked on their digital literacy, not only by making videos, but by searching for information and helping each other solve computer or software related problems (p.665). The study concludes that while pupils find it fun and motivating to work in this manner "they still need more skills in collaboration, opportunities for networking, and teachers' guidance in knowledge creation and digital competencies" (Niemi et al., 2014, p. 668). Interestingly, these are skills which the study showed pupils practiced during their project. Zolyomi and Schmalz (2017) make a similar discovery: "The benefits of gameplay were apparent as children made meaningful connections, formed positive identities as gamers, and built competency, even to the extent of being the technology expert for their families and peers" (Zolyomi & Schmalz,

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2017, p. 3399). This shows some of the potential for informal learning which lie in making use of technology in the classroom. The integration of digital tools even in well-established teaching methods offer new exiting possibilities.

One of these possibilities is introducing storylines into virtual worlds. In a virtual world, the key principles of storylines remain, with quite a few added benefits. In a virtual world, pictures and videos are replaced with inhabiting that world, yet do not exclude these elements from being implemented in the classroom environment. In addition, storylines in a virtual world could apply other elements from both CLIL and PBL approaches to create a unique experience with a range of opportunities for engaging deeper learning. Using a PBL approach in storyline driven virtual world has been tried out on pupils earlier. One of these projects was reported by Kynan Robinson (2014) who applied a story driven narrative with PBL elements in order to teach science in Minecraft. The project followed a "driving question" which was open enough to facilitate flexibility and choice of direction, but strict enough so that pupils and teacher always could get back on track if the wandered too far from the "driving question" (Robinson, 2014, p. 34). Robinson (2014) reported that "one of the initial discoveries we can observe when reviewing this project was in regards to the intended learning outcomes, based on Victorian Essential Learning Standards. These were covered in approximately two weeks. From that moment on the project was almost entirely driven by the students. The learning became much more 'personalised' and self-directed (existentially realized by the participants)" (Robinson, 2014, p. 40). PBL seems to have a way of promoting pupil autonomy and ownership as projects that follow this approach often reports concurring results. Thorsteinsson & Niculescu (2016) reported in their study on Minecraft that "Many (pupils) finished learning tasks at home and, once they learned to create a local server, they could show their family their work" (Thorsteinsson & Niculescu, 2016, p. 512).

Although both deeper learning and sandbox games are emerging concepts, their roots can be traced further back in pedagogical and methodological literature. Deeper learning mainly builds upon principles found in constructivism. Constructivism can be traced back to the early 20th century and originate from theorists like John Dewey (1933/1998), Bruner (1990), Piaget (1972), and Vygotsky (1978), who all had different perspectives, but agreed that at the basis learning was all about by doing rather than observing. Dewey put it well:

Give the pupils something to do, not something to learn; and the doing is of such a nature as to demand thinking; learning naturally results.

— John Dewey

In practice, this translates into giving pupils access to authentic and relevant material; often problems or tasks that need to be solved and by attempting to solve these problems pupils would learn. The pupils construct their own knowledge based on new information and experiences in light of their previous knowledge. When this knowledge is used in context and reevaluated, be it through internal processes or social collaboration, learning may take place. Through this process both pupils' peers and teacher play an important role, both in creating the context, but also by providing the scaffolding needed to overcome harder tasks.

3 Sandbox Scenarios

This chapter describes three imagined scenarios with different approaches to working with deeper learning and the sandbox genre. First, I will outline the considerations I have made creating the scenarios. Depending on time available, subjects working together and the teacher's competence, what is possible and practical will vary accordingly. Then, I present the scenarios: the first, "City gone green" is a teacher created setting. The second is "Lets settle an island" is a student created setting. The final scenario is "Anything goes" which has no single setting. Together, these show some of the possibilities, opportunities and approaches teachers and pupils could take to deeper learning in a sandbox environment. While there are many ways to work on deeper learning, these scenarios are built on a combination of PBL and CLIL elements; they all implement ICTs, and two of the three will follow a storyline-like narrative. Most importantly, they all use a sandbox game as the virtual learning environment.

3.1 How the scenarios were created

In creating the following scenarios, I wanted to use the highly moldable environment offered in sandbox games and apply PBL methods to it in order to create a learning environment that could facilitate for deeper learning. My thoughts were always to design around the game, rather than expecting the game to teach on its own, as Qian & Clarks (2016) remark. Design-based-learning held the most promise for learning outcome. The scenarios I created had to fit into the current curriculum and be suitable for a somewhat rigid school structure that varies greatly in terms of available equipment and the teachers' digital competence. This meant that I had to create scenarios that could fit into various levels of competence, not only a teacher's digital competence or pupils' general level of competence, but how much experience the pupils and teachers have in working with a sandbox game. This resulted in the choice of dividing how teachers plan teaching with a sandbox world into three different levels of competence: *Teacher created setting, Pupil created setting,* and *No single setting.* This layout will provide a model for which the example scenarios follow. Since they are designed towards different levels of competence the first level offers the most detailed scenario in order to help classes new to teaching in a sandbox. The second level is designed for those who have some experience with teaching in sandbox games and want a framework for experimentation rather than complete layout. The third model is adapted towards classes who have gained experience

teaching in the virtual learning environment provided by the sandbox, but want a functioning model that allows for creativity and autonomy, while conserving general competences.

For classes at the first level of competence it would be beneficial with a *Teacher created setting*, which allows the teacher to select the themes and competences that should be given attention. The "City gone green" example scenario follows the *teacher created setting* model through a storyline narrative, and it is designed to introduce both teachers and pupils to working within a Sandbox world. This means that the tasks designed for this scenario had to take into account that the teacher should be able to decide the general themes of interest, but also had to include elements which enabled the pupils to engage in deeper learning. To solve this problem, I decided to split task design into two different types: *Starter tasks*, and *adapted tasks*. Both task designs follow a PBL method which has been proven to promote deeper learning. I designed the *starter tasks* as a means to give the pupils insight into the field decided by the teacher, to work on digital skills and function as a pathway to new tasks and springboard for the *adapted tasks*. The *adapted tasks* were designed as a way to offer pupils time to engage in deeper learning. These tasks would be given to pupils who show a special interest in certain areas in the theme they are working on. This combination of starter and adapted tasks facilitates for deeper learning as most tasks cover several areas of knowledge, require different skills and maintains a balance between virtual and "real" world tasks. English is also a major part of this scenario; however, the focus is not on curricula of the English subject, but rather using the language as a tool for solving and working with tasks. In this scenario, I follow a CLIL approach to English and require the pupils to work and communicate in English. While I think this is the scenario which is easiest to implement for unexperienced teacher, this does not mean that this model of designing scenarios is the most limited. The idea is to set the stage and pique the interest of the pupils so they are driven by their individual curiosity and creativity. This establishes the premise that not every pupil will have to do the same assignment or work on the same problem. For meaningful learning opportunities to arise along the way, the pupil must start exploring the road ahead. This means that while every pupil might start off on the same ground, but their fields of interest and related exercises will diverge more and more the longer the duration.

The second level of competence is where I place the *pupil created setting*. This is designed to be very pupil driven and requires the teacher to react to situations created by the pupils and

use these situations as an opportunity for teaching. While the teacher is supposed to use situations that arise to teach, I believe it is fruitful to design tasks that facilitate for events to happen. The "let us settle an island" example scenario follows this *pupil created setting* approach and I intended this to offer classes a way to engage in authentic problem-solving on a social level. The intention is to have pupils engage in discussions, practice democracy and develop their 21th century citizen competences. The scenario is built to create friction and opportunities at inciting pupils' emotions. I believe pupils have to care about something before meaningful discussions and reflections can happen. Problem-based learning is said to deal with real-life problems, yet today our problems are not necessarily physical in nature. A virtual world to which the user identifies and feels a connection could potentially hold problems that feel just as relevant as "real-life" problems. In a virtual world, lines between "real" and virtual world become blurred and events that take place feel authentic. These problems hit very close to "home" and the pupils are the ones who must solve them with the tools they have at their disposal. Solving the events that arise is not limited to the virtual space, a classroom debate or discussion; other tools or methods may also solve their problem, yet their virtual world creates a common ground and a point of reference around which the events may revolve. I trust that these events will feel meaningful to the pupils as their choices will directly affect their virtual world, which in turn might help mold the world and create opportunities for new approaches and events. I intended the scenario to be used by several teachers with different classes at the same time, if they are from a different country or culture the result could be even greater. Pupils would then have to use their English to communicate in an authentic way, where the important issue becomes whether they manage to get their ideas and arguments across rather than perfect pronunciation or form. I imagine this to be an arena for understanding both one's own culture and others as well; to foster understanding and develop respectful and reflected individuals.

The third level of competence is intended as an advanced user level. *No single setting* is meant to be a way for pupils to work on self-directed learning, meta-cognition and peer-to-peer task creation and feedback. While methods for teaching may differ, the ways that pupils are assessed still remains the same. The NFER study suggests that "Game-based learning offers the possibility of moving beyond traditional forms of standards based assessment, to consider alternative dimensions of performance and achievement " (Perrotta et al., 2013, p. 32). Pupil to pupil assignment is an interesting topic; with the teacher offering a guiding hand,

pupils could offer valuable feedback to their peers. I think that a game-based learning environment like sandboxes could be an interesting arena for developing pupils' ability to give feedback. The third scenario was designed with this information in mind. I wanted to create an arena where the pupils inhabited a large degree of freedom to create, but which would require them to reflect on their own choices and process along the way. The addition of modifications allows the sandbox to be shaped according to the needs of the user. This allows for exploration of new fields and themes without the need of purchasing new equipment.

Considering all the possibilities, a sandbox appears as a fitting environment to facilitate for deeper learning. However, in order to avoid pupils focusing too much on building and ensure they practice necessary competences I made the choice of splitting tasks related to this scenario into two different categories; *Continuous tasks* and *waypoint tasks*. For the *continuous tasks,* I wanted to ensure that pupils gave the teacher constant information about their processes so they could use this information as formative assessment to plan for future tasks and gain an understanding of where the pupils wanted to go with their projects. Secondly, I saw the need for pupils to do self-evaluation, to reflect on where they are and where they are going in order to activate their meta-cognition. This resulted in the *continuous tasks* which are used in scenario three. I decided to create the *Waypoint tasks* as a means to implement the information gained from the continuous tasks, to help pupils who were stuck in their process and to target specific competences which evaluation of the continuous tasks indicated a need to practice. I wanted *waypoint tasks* to be a meaningful incident which could mark the end of or turning point in a pupil's project. This design facilitates for deeper learning while it enables teachers to enable peer-to-peer assessments and collaboration without having to design storyline events, but rather focus on a pupil's competences and the cognitive processes connected to it.

For every scenario that is created, the teacher will always have the ability to implement what I call *Global events*. Even if pupils are working on their own little projects within the world, there is nothing stopping the teachers from implementing *global* or *semi-global events* from time to time which may encourage collaboration or nudge their world into a certain direction. I imagine these global events to be problems that have arisen in the pupils' worlds, new collective tasks or dilemmas. Anything that requires collaboration and problem solving; this mimics the real world where other things must be put aside to work on a bigger problem. I see

several uses for this method as it can be used to focus on certain competences which pupils collectively have a need for. It may also teach democracy, diplomacy, task distribution, ethics, resource management, and collaboration, only limited by the teachers' action space and creativity. It may also be implemented in order to bring new elements into a storyline as a way to shape the direction or ensure that vital information related to a theme is preserved. "Real"-life incidents in media or new emerging research could be implemented into their virtual worlds through such *global events*. I think this flexibility reflects the moldable environment of the sandbox, and is part of what truly makes sandboxes a living and exciting environment for learning.

These were some of the considerations I made when designing the example scenarios that I describe in detail in the following section.

3.2 *City gone green* – teacher created the setting.

3.2.1 The scenario

In this scenario pupils will create an environmentally friendly city in a cross-curricular work between English, nature sciences and social studies. The example tasks below are comprehensive; they follow a PBL approach and involve several tasks in the process. The comprehensiveness of the tasks means that pupil will have to spend several lessons to complete the tasks. The way tasks are designed will enable pupils to work on them coherently through the weeks. These 3 subjects will be taught by a single teacher and the allotted time will add up to about 6-8 hours a week.

Explaining and presenting the setting to the pupils can be done in many different ways. This should depend on the class and what the teacher thinks will excite the pupils the most; maybe a "mission briefing" fashion, stating problems with many cities today, or have them discuss why they think we are creating a green city? When pupils will start off on their tasks, I imagine that there will be a "fanning effect" where pupils start off on the same tasks, but as time progresses begin to explore and move towards more diverse tasks.

3.2.2 Starter tasks

These tasks are designed to start the pupils off; to make sure pupils have a product that the teacher can use to adapt tasks. The tasks also act as a general introduction and for practicing the use of digital tools, since it is designed to include a CLIL approach English will be the main language for communication and available information. The digital tools available and themes selected from the subject curricula will be an element that is subject to change, but the general idea of tasks building upon each other and incorporating the use of digital tools remains the same.

Below are a few examples of the first available starter tasks:

- **Discuss in your groups** what it means for a city to be "green", **create a new notebook** in OneNote, **invite your group** and **add your answer** to a new page. (This will be your city's *ideology*)

- **What would the city need to support its ideology?** Use a mind map resource or other tools you see fit for your planning.

- You need to **survey the area in Minecraft where you are to build your city**! Make sure to **take screenshots** for later planning of your city, **save and share them with the group**. (Paste them in your collaborative notebook, cloud storage or another way you can all access them.)

- **What would your city look like?** Look at the map and area your groups were provided with. **Plan and make an outline for what it would look like.** (Example of tools you can use: PPT's storyboard, SketchUp, draw it on paper and upload it to your collaborative notebook?)

- **Start building your city in Minecraft**, my advice is to **work together** to finish on one part at a time.

- Building requirements states that **you need to give *a short* explanation** of each part you implement into your city. **Present** what it does, how it works and why you want in your city! (Choose your own way to present this in a multimodal text. Sway, Mix, video, animation, or any other way you see fit.)

Figure 1

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3.2.3 Adapted tasks

When the pupils have begun creating their cities and the framework is in place, the teacher can begin giving more specialized tasks, based on the formative assessment that is done while working with the pupils. Keep in mind that these tasks have to be based upon the work of the pupils, which means that pupils will experience a high degree of differentiation. A side effect of this could be that some pupils would like to do the same tasks that other pupils were given, however, this can only be described as a positive request. Below are a few examples of tasks that could be given to pupils based on their interests or elements in their cities (note that some tasks could be implemented as events by the teacher for this theme such as water runoff, sinkholes, traffic jams, no wind or nuclear meltdown).

Below are a few examples of adapted tasks

- The effect of your solar panels has steadily dropped for the past years, leading to the city having to import electricity. Governor Sump is threatening to ban solar power from your city, and ***needs an explanation of how solar energy really works*** and *what advances are being made in solar energy field?* Present the findings as you see fit.

- A recent event at the nuclear power plant required the fire department to respond. This has interested local news agencies. They are encouraging freelancers to send them articles, with interviews and information regarding the event. Make a news article, make interview questions and publish it where others can read it.

- Demographics state that your city is struggling with attracting new citizens. The city advisor suggests you construct a survey to find out which aspects and implementations could help improve the city and make people move here. ***Make a survey, gather responses, analyze the data you collect and make a short report of your findings***. (Google/Microsoft forms, sway, word and excel are tools that might be helpful, but you are free to choose your own).

- During heavy rain and spring melting the streets are often filled with water. The department of public transportation has asked for solutions to this problem! ***Identify the possible sources of the problems, weigh possible countermeasures and implement them***. The department has asked to be included on a tour and debriefed once the problems are taken care of. This requires you to make a log of the process.

- Household power consumption in your city is through the roof! To reduce the consumption, the Department for Nature Management has asked everyone interested to create a media campaign with suggestions and household implementations that informs the public on how they can help reduce the consumption. ***Research different measures*** that people can implement in their daily lives and ***make a media campaign*** to ***inform the public*** on what they can do to help.

Figure 2

3.2.4 Reasoning

The intentions behind this scenario is to address themes like sustainability, resource management, animal habitat and collective planning. The benefits for both the teacher and pupils can be divided into 4 main areas.

- Pupils will explore the themes and gain an impression of these which will be useful later on, if/when the teacher decides to work more closely on certain aspects within the theme, say renewable energy.
- Just by doing the assigned "starter" tasks pupils will be exploring these areas in a cross-curricular way which will help with their ability to see connections and problems in light of each other. This could form a foundation for deeper learning.
- Starter tasks are designed to introduce the pupils into the theme. The teacher will be free to roam and do formative assessment of the class and evaluate which skills are lacking.
- Pupils might take interest in certain elements within a theme and activate their self-driven learning.

By reflecting on the possible benefits from a scenario, even before designing the starter tasks, the teacher can strengthen the foundation for future lessons. Earlier in this thesis task design, and how sandboxes could facilitate for deeper learning were topics, indicating that teachers cannot expect deeper learning to happen, but the tasks teachers design *must facilitate and allow for it.* That is not only important to keep in mind when it comes to the task design, but also when it comes to pupils who derail and want to chase in a different direction. If it connects to the themes they are working on, derailment should be allowed, and even encouraged. This means that something has caught the pupils' attention and they want to explore this further and use it. The teacher can always bring the pupil back on track later, through implementing tasks to connect their newfound knowledge into the world they are creating. The creation process is where the learning happens, not once the product is done, according to information uncovered in chapter 2.2. Teachers should want these derailments to happen, so there is a need to set aside time for them to happen. However, teachers cannot expect derailing to happen to all pupils at the same time, so there is a need to plan for when this does not happen as well.

Since this example only has one teacher available, making sure to have planned far enough ahead will give teachers the time to facilitate and guide while pupils are working in the lessons. This means that the tasks that are prepared need to take into consideration that pupils will most certainly be working on different task at various times. If one group of pupils sees the need for a solar plant in the city, researches and builds it, there would be no point in giving another group of students the same task, as the "problem" has already been solved! If the teacher must plan for so many diverse tasks, not only will she spend an enormous amount of time planning, but pupils might also miss many elements which they might take a special interest in. To solve this problem, the teacher could divide the class into 4 separate groups, that all work on their own separate cities. This would not only solve the above-mentioned problems, but also form a basis for class discussions on design and peer-to-peer feedback as well.

3.3 Let us settle an island - pupil created setting.

For this scenario, the intention is for the students to focus on areas revolving around collaboration, democracy, ethics, and delegation, in large; topics from Social Studies as well as English. This will be a collaboration between several teachers and classes. While the teachers decide the theme through the tasks they give or the events they implement, the students choose the setting and create the story. The teachers will help push them forward where needed, and supply tasks and guidance along the way. This scenario will be heavily influenced by a storyline-like narrative, where pupils create the story. They will have to create a wiki site where they record their history, culture, and other information about their society as they progress their story.

The idea is to have students spawn on a beach: how they got there and what they are doing there is unknown. They will have to explore the island, and try to establish a working society. No rules are presented by the teacher: stealing, killing, destroying other peoples' stuff are all allowed. In time this may or may not become a problem for the pupils and turn into a conflict. The idea is to let this happen in order for them to see the need for establishing rules and guidelines for their new society. Hopefully there will be a natural progression, where they start out in smaller groups and in time learn that they can accomplish more by working together. This might seem like a gamble, but there is a twist: the different classes participating are separated from each other by a huge mountain chain with a blocked cave that connects them. At one point this path will be opened and pupils will explore this new area only to discover that they were not alone on the island.

How will they treat their new cohabitants? Will they trade, fight or try to coexist? Remember that the pupils had to create their own story and culture, which means that there will almost certainly be conflicts in the narrative. One group might have said that they crash landed on a plane, while the other came by ship. They might originate from different time periods, have different gods and names for the plants in their environment, rules, and social structures. The only thing they know they have in common is the language in which to communicate – which is English. The potential for debate and negotiation is huge in a scenario like this, and it hinges on the teachers' ability to identify events created by the pupils in-game that could serve as openings for learning. I imagine that classroom democracy, managing pupil

autonomy on the wiki site will form a majority of the methods which will be implemented on the class as a collective.

Attaching relevant task to the projects students are working on along the way still applies, yet this is something that can be worked on between these collective engagements. There is nothing stopping a teacher from using this island model in a similar fashion to the "green city" example with starter tasks and many preplanned tasks, yet it is important to keep a certain thematic focus for each scenario. In this scenario, too much input from the teacher could hinder many of the conflicts of interest and tensions which could create meaningful learning situations.

One could argue that there is a certain unethical element to this scenario, like designing a scenario that requires the pupils to be engaged emotionally in order to maximize learning potential. I would argue that possible learning outcomes are far greater. In a sense school already makes use of pupils' negative emotions connected to assignments. How many pupils do an assignment only because of the fear of failing, and not because they are eager to explore a subject deeper? Learning how to deal with conflicts and finding solutions to problems is something pupils will have to deal with throughout their whole lives. Giving them the competence needed through a controlled setting should not pose an ethical problem. As the current general part of the K06 states, pupils are to learn how to respect other people's opinions, while still being able to argue their own.[7] However, some things are very hard to teach following a standard classroom lesson, and pupils need to really care and feel in order to understand empathy and ethical dilemmas. Knowing when to interrupt and when to let it boil for a bit, is an important factor in this scenario. While pupil engagements on an emotional level is a necessity in order to work on pupils' social and emotional education, teachers need to make sure they are in control and prepared to interrupt before conflicts escalate into being harmful to the pupils' psychosocial environment.

Daring to venture into this form of scenario also provides the teacher with valuable information from observing these social interactions and small conflicts of interest. How pupils deal with them and how they react to each other's actions will say something about the

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[7] https://www.udir.no/laring-og-trivsel/lareplanverket/generell-del-av-lareplanen/

socio-emotional environment. Intrigues and unrest within the group is something pupils can hide well and may pass unnoticed by the teachers. Establishing a safe environment for learning should be a priority for any teacher, and scenarios like this *could* provide a safe and more manageable environment in which the psychosocial environment of the class can be monitored and improved. Should there prove to be no tension or conflicts, the scenario still provides a platform for the subject themes. Again, the teachers can scale the scenario as they see fit, and accommodate it to their schedule as well as to the proficiency and needs of their pupils.

3.4 No single setting – anything goes.

In this scenario, pupils will lead the way, with a focus on the use of English and on peer feedback. There will not be a common setting imposed on the pupils, as they are free to create whatever they want. While English will be the main focus, pupils are not discouraged from pursuing or diving deeper into themes which interest them. This scenario will require a high degree of autonomy, but offer adaptability and reusability.

First, each pupil will have to choose whether they create a world only for themselves or if they would like to collaborate with others. Both have their pros and cons, and offer the teacher and pupils a diverse set of competences and methods to learn from based on their choice. They will then begin to build and develop their ideas. The tasks the teacher provide will be split into two different categories: *Continuous* tasks and *Waypoint* tasks.

Continuous tasks are tasks that pupils will carry out for each session, like keeping a multimodal log of their choosing. This could contain *what they have done*, *what they are planning to do* and *why*, supported by media in the form of screenshots, audio, video etc.

Waypoint tasks are bigger projects which are set into motion when pupils reach certain crossroads: when a building or area is finished; when they are stuck and at a loss for ideas, or when the teacher sees the need for a pupil practicing certain competences. The waypoint tasks could be adapted to fit the needs of the pupil or their interests. I say 'or' because while trying to promote pupil autonomy, this cannot happen on behalf of pupils neglecting competences they need to practice. A bad writer would be in dire need of writing practice, yet given the choice of making a video, they probably would choose the easier way out. Waypoint tasks are designed to require a lot of reflection and self-awareness, as well as an understanding on how to give and receive feedback.

Here is an example of what a waypoint task could look like. It requires two groups of pupils who have finished a building or an area.

Explain what you have created, why you created it and how it fits into your world. Present your answers as you see fit (alternatively, state specific modalities: "in writing" "in audio" "make a video"…)

The task requires the pupils to collectively come up with an answer and reflect on their own process.

Once the pupils are done they will give their part about "what they created" to the other group. Then they have to try to figure out why the other group created what they did and how it fits into their world (afterwards they will give their reasons)

This is meant to force the pupils to apply their broader knowledge and put it into context in order to deduce the other groups' reasoning. This will practice their ability to see connections and learn how others might think differently.

Figure 3

4 Discussion

One of the biggest advantages by using a virtual world as a learning space could be reusability and adaptability. From my experience teachers rarely reuse content pupils have created earlier, and even less the work from other subjects. This is unfortunate, both because it contributes to undermine the idea that lifelong learning is a cumulative process, but also in the way it devalues the pupils' products and the work they put into them. Reusing and building on pupils' earlier work should be the norm, but it may seem hard to put into practice. However, it may be harder to implement on a "micro" level (in terms of individual pupil assignments, or tasks) than on a "macro" level; in this case the virtual world the pupils have created. If different subject teachers use the same virtual world as a reference point and learning space to which they connect pupils' micro level tasks, then they are already beginning to explore some fundamental aspects of deeper learning.

Having problems revolve around the same world enables the pupils to see their problems in a familiar context and requires them to take this into consideration when solving these tasks. Any new events that happen in one subject contributes to adding content to the virtual world of the pupils, continuously creating new opportunities for learning and creating a cumulative learning space. One could argue that this can become chaotic and would require the teacher to always adapt to the new environment, however, with to the ability to create as many worlds as needed, subjects could collaborate in worlds they see fit, or create their own. An infinite number of worlds means infinite possibilities. Maybe will certain subjects want to work on the same world as it provides a learning environment and theme that benefits those subjects, and maybe is it in a subject's interest to revisit or reuse a world created earlier by another subject? There are many ways to enable continuity, yet there is no point in enforcing continuity for continuity's sake, this is a cumulative process and so are teachers' ability to teach and manage a virtual world.

Sandboxes allow the users to scale the world up or down in size depending on their needs. This allows the complexity of a world to grow with the teacher and pupils, rather than away from them. Sometimes, small scenarios restricted towards certain competences could be needed, at other times pupils will need little or no confinement. The need for space to develop their ideas should increase the more self-directed their learning becomes. This scalability is not only limited to size or theme, but also to detail. A village created by the pupils has

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enormous potential to scale in terms of detail and depth. To a large degree, tasks created for the pupils will not focus on building their world, but rather enhancing and adding content to that world, shaping and refining the world, creating background stories, encyclopedias, and history for their worlds. As Perrotta et al. (2013) have observed, "..content-specific tasks work better when embedded in the fictional context and rules ('mechanics') of the game." (Perrotta et al., 2013, p. 7). Every event and every task may in some way add to the richness of the pupils' worlds, scaling both on a macro and micro level while always creating new possibilities to drive their learning forward - making the academic content integral to the game rather than simply an add-on.

Considering that the task and problems also scale, this method of teaching allows for education to be adapted to the individual pupil. The teacher could facilitate more complex tasks as the pupil creates the next step of their own learning. Scaling tasks and doing formative assessment of each pupil as a single teacher require the use of ICTs and pupils-pupil task and assessment are important gears in this process. The way ICTs and "classroom" tasks work together to contribute to the development of their worlds while building competence is a crucial factor here.

Sandbox games often allow for players from all corners of the world to join together. Teachers who have gained experience and confidence in working with virtual worlds could expand their own practice to form collaborations with other classes in foreign countries. There is much to be learned from trying to coexist on an island with limited resources, and even more if they are sharing that island with a group of pupils who speak another language and inhabit another culture. Research has already shown that playing together in virtual worlds encourages and promotes collaboration. Müller et al. (2015) did a study which collected 3451 hours of active gameplay by 908 different players on 43 servers over a period of 65 days. This amount of data resulted in the conclusion that "players increase their amount of collaboration not by collaborating with the same player more often, but by collaborating longer and with more different players". The study also found " ..collaborative players to be more socially responsible by giving more to shared resources than they take"(Müller et al., 2015, p. 7). Whether teachers try a "put them together and see what happens"-approach or plan a chain of events and encounters for the pupils, opportunities for learning and applying learned competences will appear. It does not matter if pupils are prepared for their encounter with the

alien group of pupils or have to find out about them on their own: they will use different competences and have to apply them accordingly. Using skills acquired earlier to both communicate, solve problems and coexist. These competences used in a collaboration like this all work towards a pupils deeper learning. Teachers should not limit collaboration across boarders by thinking that tasks need to be highly complex. Consider all the skills required in order to make a representation of one's own country, and teach others about the culture. The task sounds easy, but in a sandbox setting a myriad of different solutions and options become available to the pupils. What is more, pupils get the chance to truly practice their English in authentic situations, as active participants in a global society.

Several projects involving Minecraft have already been tried out in schools. In order to have pupils speaking, writing and reading English, Minecraft combined with CLIL and PBL is a wonderful tool. Pupils build and create, they communicate and give advice to each other in this process, which adds an authentic, but perhaps very focused use of language. When pupil enhance content, they are using English in another manner, while still authentic, it offers a bigger variety in terms of terminology and form, it becomes less spontaneous and more refined. However, what is striking about many of the projects that have used Minecraft is the vast amount of time spent on building. On the one hand, tasks that develop worlds further undoubtedly hold potential for learning. On the other hand, building content takes time. As also Perrotta et al. (2013) have concluded, the key is finding the right balance. Pupils should be spending time enhancing the content they have built, but sometimes they do not have to start building from scratch. Depending on the game there might already be a myriad of available worlds or building to import and reuse. Minecraft as the most successful sandbox, has hundreds of thousands of worlds that pupils can explore and enhance. Most are shared under a Creative Commons license and if not, creators may still grant reuse permissions for educational purposes.

What this means for pupils is that they can explore a vast number of worlds based on themes from different universes like *Harry Potter*, *Game of Thrones*, various computer games, movies, books, real world locations and other imaginary worlds. This allows teachers to focus on using content and teaching competences rather than having pupils spend time on creating all the content themselves. A world built by others does not exclude deeper learning, it just changes the approach. In a sense, pupils deduct instead of construct. Deduction is another

skill vital to mastering deeper learning as pupils need to be able to analyze problems from different angles in order to see possible solutions. Enhancing the content can be done in much the same way as earlier, yet pupils apply a different set of skills and angle of approach. The same principle applies to reusing old content. As education is a cumulative process it may be valuable to rework old content in light of new knowledge and increased understanding. Not only does this allow pupils to see their own progress, but also understand how they can build on earlier work in order to illustrate and work on new problems. This process might open opportunities to reflect on their own learning process: *Why did they do that then, and this now?* This in turn will strengthen their ability to understand their own learning, how the knowledge they now possess reshape and change their previous ideas.

Learning to teach with PBL in a sandbox environment could mean redefining the teacher's job in the classroom. Currently lessons are still following a track which places a lot of emphasis on the teacher. What does this mean for the implementation of sandboxes in education? Research has shown that "there is a tension between the knowledge production that is characteristic of (games), and the instruction-based culture that dominates the contemporary classroom" (Schifter & Cipollone, 2015, p. 225). Deeper learning requires the pupils to be active participants and the driving force behind their own learning; exploring and following their own interest in the search of knowledge, acquiring skills along the way and molding this into competence. Taking the leap into teaching in a sandbox game might seem foreign to many. Nevertheless, if research shows that pupils learn more from spending time and thoroughly working with a theme, as in PBL, and sandbox games offer a perfect platform for the implementation of PBL, then teachers should be eager to explore this field further. When allowed, sandboxes have already proven to encourage and active self-directed learning, as evidenced by Robison (2014, pp. 9)., quoted in 2.5.

What becomes the teacher's job if pupils' learning should be self-directed and partly take place in a virtual learning environment? Their main job will not be to create a set course in which a specific topic can be understood, but rather a setting in which deeper learning can flourish. They must do this in a way that is open to student autonomy and a sense of ownership, building on the idea that pupils will eventually drive their own learning forward. This drive is determined by the pupils own motivation and curiosity, but also depends on the teacher's ability to narrate. Additionally, in order to properly implement CLIL into the

sandbox, the teacher needs to make sure the content is adapted towards the English proficiency of the pupils as seen in 2.1.2. This is where the teacher makes or breaks deeper learning: while their job is not to convey knowledge, it is most certainly to invoke the search for knowledge.

When working with deeper learning in a sandbox, the teacher's job is composed of two major roles; I call these "the relator" and "the task giver". Some of us have met that teacher who is so in love with his subject that he can make any topic seem like the most interesting thing in the world and sparks a yearning to know more! The relator knows the art of sparking an interest in a topic, not by giving the complete and full story, but leaving out just enough parts for the pupils' curiosity to ignite and to start asking questions. The questions pupils ask are then turned into design problems or projects which set them off on a search for knowledge.

The second role teachers inhabit when working in this manner is the "task giver". While one of the fundamentals of deeper learning is that learning should be self-directed and pupils should chase down their own path, there is nothing stopping them from picking up a few skills along the way. This is where the task giver comes in, facilitating relevant and authentic tasks along the way. The idea is to give the students tasks that relate to the topic they are diving deeper into. As seen in 2.2.1, ICTs are enablers, and one of the fundamental game changers when it comes to creating tasks that not only are relevant to the pupils, but also help them practice necessary skills.

There seems to be many interesting approaches for using sandboxes to teach subjects, however there are elements in the current school system which makes exploring new methods of teaching difficult. The current model for education is present with minor variations in almost every country. While not every school follows the exact same model, certain elements can be expected to be found, such as schedules, curriculum, subjects and "one teacher – many pupils", usually contained within a square room with a board and desks.

Time is a crucial factor for deeper learning; to be able to delve deeper into content and to work on the same theme for a prolonged period of time. Yet, the common timetable works against that.

Also, projects are often restrained within their school subject. Typically, when the lesson comes to an end, pupils must abandon their engagement, even when absorbed in what they do. At worst, students will have to wait one whole week until the next lesson. Occasionally, two subjects may collaborate on a project to enable the students to have more coherent time available, yet in a best-case scenario this yields 4 coherent hours of work each week. This work will then be interrupted by other school subjects and new information until they after a week pick up where they left off. Any train of thought must be reconnected and workflow reestablished before pupils can continue their learning. Most will know of examples or projects that span a longer period, but implementing cross-curricular work and project based learning to enable deeper learning should be incorporated every day, every week, not just a few times a year.

One of the main reasons for these interruptions is how subjects are scattered in the timetable, a practice which seems to be based in pure tradition. Consider a study done on interruptions in the workspace by Mark, Gudith, and Klocke (2008) which indicated that any interruption in the workspace whatsoever, when working on a specific task, would cause 23 minute recovery time back to peak efficiency. In addition, "..after only 20 minutes of interrupted performance people reported significantly higher stress, frustration, workload, effort, and pressure." (Mark, Gudith, & Klocke, 2008). Considering how many times a pupil is interrupted during the average 60-minute lesson, they may never experience being in a state of heightened attention, or what is popularly known as "the flow zone". These interruptions also influenced the work that was carried out: "When people are constantly interrupted, they develop a mode of working faster (and writing less) to compensate for the time they know they will lose by being interrupted.*" (Mark et al., 2008) This is transferable to pupil work, where both writing, discussions and other methods stand the risk of constant interruptions from many sources. As each interruption requires time to get back on task this will effect both their product (which many teachers use for assessment) and their actual learning outcome.

Time and curriculum seem to go hand in hand: the more curricular goals within a subject, the less time available for each element of that curriculum. Interestingly there seems to be a common misconception that such a huge curriculum exists for schools today. Based on experiences from practice, and according to studies on Norwegian teaching practice after the LK06, textbooks are to a large degree used as curriculum, both in planning and in execution

of lessons (Juuhl, Hontvedt, & Skjelbred, 2010, pp. 18-20) This practice might have roots in tradition or simply be the path of least resistance. It does, nevertheless, lead to several unfortunate effects, like experiencing too many tasks and too little time. Studies have indicated that teachers do not have enough time to prepare for their lessons, and that is not limited to the preparation of lessons but also time to learn and explore new digital tools (Thorsteinsson & Niculescu, 2016, p. 511).

The common misconception that 'teachers must do all chapters in a textbook for pupils to learn what they are supposed to' is highly unfortunate. It leads teachers into a position in which autonomy and status is transferred from the teacher to the textbook publishers. It makes teachers feel as if they are constantly lacking time to do the projects they would like to, and it does not foster their creativity. Resting on someone else to plan and structure pupils' learning might degrade the skills acquired through their teacher education. In the process, teachers might lose the opportunity to adapt lessons to the preferences of the students, both in terms of interest and abilities. With only a textbook as the available resource, pupils are much less able to direct their own learning, seek out the parts that they find interesting and dive deeper into topics which intrigue them: all crucial foundations of deeper learning.

If teachers are to give students the opportunity to experience and embrace deeper learning, teachers must be willing and able to facilitate *for* and not *against* deeper learning. A strict focus on the curriculum, on 60-minute lessons in each subject and topic, and a mindset set for control and uniform tasks seem to work against the core principles of deeper learning. This thesis has shown that there are numerous of ways of working with deeper learning, yet to facilitate for it, it is not enough to change timetables and combine subjects. Teachers must also dare to change some of the basic structures of today's school practices.

Conclusion

Considering how much research is available relating to classroom practices involving deeper learning, PBL, CLIL, and game-based learning, it is strange that no one has made the connection of using sandboxes as a platform with the intent to facilitate for deeper learning. The example scenarios offer a suggestion for how using a PBL method in a sandbox would allow teachers to create a collaborative learning environment that builds upon the work of the pupils. While implementing such a method of teaching into today's school structure seems possible, it would require both hardware and teachers who are willing to try this model of teaching. Moreover, it would require the teacher to rethink the structure of both tasks and lessons. This might be the biggest obstacle to overcome, but an increase in PBL popularity could potentially make the leap a little easier. I think that a well thought-through model lays a foundation for future classroom implementation. This should be an interest for future research as well. The present lack of research between sandboxes and deeper learning is certainly a field that should be explored further and in greater detail. This is the direction game-based learning really should be heading: not in the direction of designing games that teach lessons, but by designing lessons which use games to teach. A focus on learning how to learn with games in school could also affect how the pupils view games and think about them in their spare time. This transferability is after all what deeper learning is all about: teaching pupils the tools needed to handle whatever the future requires from them. I will end this thesis with a quote which I feel summarizes it well:

"I never teach my pupils, I only attempt to provide the conditions in which they can learn."

— **Albert Einstein**

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